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Sebastian Schmidt

Musical Extrapolations

Creative Processes Involved While Music is Being Listened to and Composed

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Sebastian Schmidt
Karlsruhe, Germany

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For my beloved daughter Sontje and my wonderful wife Nadja.

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Sebastian Schmidt, Karlsruhe

Abstract

It is well known that human creativity influences the organization of music, and that individual differences of creative behavior in music exist. Numerous studies have been carried out to investigate aspects of creativity, such as the link between creativity and cognition, developmental aspects of creativity, creative personalities, creative production abilities, definitions of musical creativity, educational strategies for musical creativity, etc. However, most of these studies only deal with particular aspects, and relatively little work has been carried out to assess creativity in music in a systematic way.

The present study proposes such a systematic understanding about the conditions, mechanisms, influences, and processes evolving into a creative behavior in music, based on interdisciplinary perspectives of the cognitive sciences: developmental psychology, neuroscience, music psychology, emotions research, and creativity research in general and in music. For instance, our findings suggest that general creative processes are involved while music is perceived, learned, and practiced. But also that, similarly to activities involved in composing music, creative processes are active while listening to music. We thus assume parallels in developmental aspects between listening and composing competences, and, furthermore, argue for possible developments of musical creativity or creative thinking in music consisting roughly of three steps. These and other findings establish the foundation for an extended systematic, proposed as an original model of creativity in music.

The focus is on so-called musical extrapolations processes which bring the elusive quality of music into mental existence by creating extrapolations about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations. These processes, involved while music is being listened to and composed, are defined as the result of implicit and explicit problem-solving processes which are guided in tangible ways by factors of intrinsic activities and motivation, pre-disposed and experience-based structures, and environmental pressure.

This so-called Model of Musical Extrapolations structures a new perspective in research, and furthermore, provides an enormous potential for future extensions, not least because an enhanced perspective is opened about the complexity of highly creative and parallel processes organizing sounds while listening to what is called music, as well as musical ideas while composing.

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Introduction

What is Music?

People experience music everyday, and most of them would indeed have an idea of *what* music is. In fact, the problem is to communicate and describe one's own idea, because music does not have any existence independently of its human perception. A frequently admitted answer communicates musical ideas by describing music, is called music theory. While learning to play an instrument, and consequently to read and understand music semiotics – such as notations, concepts of scales, rhythm, etc., but also cultural-historical concepts of music – people acquire a terminology, by which it is possible to understand aspects of musical ideas and to communicate aspects of one's own ideas about music to another person. Musicology investigates this cycle, going from music practice and music communication, from different perspectives leading to several findings which can outline aspects of what music is. For instance, a socio-cultural perspective outlines answers about what music is *for,* and *why* individuals listen and practice music. Philosophical perspectives reflect upon the nature of music, such as embodiment, aesthetics, expression, and ethics. Neuro-physiological and psychological perspectives investigate what is going on inside the human brain when we develop musical ideas, leading to definitions of the mechanisms and processes of human perception.

The present work opens an additional perspective on the question what music is, namely: the result of ongoing creative processes. Indeed, music is at first a mental construct. For instance, at every instant, exclusively one sound is audible, which in itself is quite meaningless. It is only through creative processes that the physical concatenation of sounds – which is certainly not music itself – can be modelized into certain musical concepts, such as a melody, rhythms, or a musical piece, and ideas about what music is *for,* and *why* individuals listen to and practice music, etc.

For humans, in fact, the world is a mental model, or an integrated set of hypotheses, created by the interaction of the human nervous system, its current activity, past experiences, and the perceivable environment stimuli. If one realizes that this complex, which creates one's own reality, has also created a wonderful rich musical society, with its genres, discourses, and developments, it becomes clear that more investigations into these factors and processes would really help to better understand the basis of the evolution of this marvelous diversity of musical ideas and musics, all contributing to answers the question about what music actually is.

Consequently, the goal of the present work is to modelize a perspective on the question: what are the basic factors and creative processes, which creates first, one's own reality while music is being listened to and composed; and second, individuals' psychological developments in general and especially in musical matters?

For this purpose we divide the thesis in two parts.

The first presents interdisciplinary perspectives of cognitive sciences related to music, which frames specific topics, such as fetuses' musically relevant abilities, infants' general musical organization, and the ways in which these structures can develop through musical experience itself. Further objectives should define creativity and its relation to musical processes. This includes the characterization of creativity from the perspectives of cognitive science, social psychology, personality research, as well as emotions research, but also an overview about definitions of musical creativity, developmental aspects of musical creativity, and creative processes involved while music is being listened to and composed.

The second part of this thesis structures an original proposal of creativity in music based on this foundation, namely: *The Model of Musical Extrapolations*. It defines the activities of listening to music as well as composing of music, as consistently creative, or, that is to say, as ongoing explicit and implicit problem-solving processes, which are tangibly guided by factors of: intrinsic activities and motivations, pre-disposed structures, experience-based structures, as well as environmental pressures.

Chapter 1 begins the overview of research in developmental psychology, with a close look at individuals' music-relevant predispositions, their biological maturation, and the influence of the social-cultural environment on these structures, assuming that cultural conditions cause the psychological development (starting in the prenatal period). This means that each individual initially matures in the uterus with a comprehensive set of pre-disposed structures, by which musical experiences and learning processes take place during the prenatal period. In order to get a closer insight on these possible experiences, we characterize fetuses' sound environment in terms of the frequency-range, pressure levels of sounds, intonation, prosody, and variations in loudness, as well as their auditory competencies and memory structures. Subsequently, we sketch the auditory developmental process of infants, by reviewing investigations of aspects of auditory sensitivity: auditory threshold, frequency, pitch, and timbre discrimination. Because detected and discriminated sounds taking place at different times need to be organized into meaningful segments into hearable phrases, words, melodies, etc., we review investigations outlining infants' perceptual abilities in grouping and segregation processes organizing auditory stimuli into a 'something whole'. A sensorimotor perspective on music follows, assuming that infants' recognition of acoustic patterns already depend on time intervals between stimuli. We present findings on when and how temporal skills develop in infants, based on motor rhythms and temporal regulations of behavior, and, second, when infants are able to anticipate temporally predictable events, and also their abilities to process musical sequences.

The second part of chapter 1 outlines the influence of the social-cultural environment on the musical-artistic competence from infancy to adulthood. Because such competences are primarily cultural phenomena, social and educational contexts have to be taken into account in individual psychological developments. We thus discuss the contributions of JEAN PIAGET as one of the founding fathers of the developmental and educational psychology, as well as NEO-PIAGETIAN's researches. Finally, we review and compare three theoretical models explaining musical development, for the purpose of presenting slightly different perspectives on children's evolving musical-artistic competence.

Chapter 2, which focuses on conceptual models, theories, and empirical investigations concerning creativity, opens a second perspective on music. The goal is to describe behaviors in general, and in music, as the result of activities trying to create something new, and, trying to solve founded, presented, and self-imposed problems. This perspective is very insightful, because it implicitly highlights a constructivist perspective, whereby explanation can be suggested for the phenomenon that 'different, even contradictory, levels of interpretations, emotions and other meaningful experiences [can arise] on the basis of the same physical sound' – which also applies to music. Furthermore, this perspective extends the discussion of the first chapter about psychological development, with the effect that further factors causing psychological development opportunities are presented.

In the first part of Chapter 2, we begin with an overview of various prominent theories related to the connection between creativity and cognition. This includes, among others, the discussion about the relation between creative potential and humans intelligence, creative thinking applied to solve problems, and unconscious processes of creative cognition. In connection to this, we observe developmental and social influences on human creativity. For instance, we show that creativity research and developmental psychology share many concepts and theoretical frameworks. A further important point discusses social factors: adaptation, adversity, family depended variables, which are proposed as decisive 'external' influences on children's creative potential. Because it is assumed that creativity also depends on individual's personality, motivation, and emotions, we first review empirical investigations and theories describing individual traits and characteristics in relation to creativity. In a second step, personality and creative activity is considered from the point of view of intrinsic and extrinsic motivation. Finally, since emotions have a strong impact on creative motivation, we discuss the role of emotion underlying creative behavior in general, as well as emotions in relations to certain personality traits and their impact on creative behavior, such as divergent thinking and creative problem-solving.

The second part of this Chapter 2 presents theories and empirical investigations in order to characterize the facets of the concept of musical creativity. This begins with an overview of various definitions and usages of the term musical creativity, describing behaviors in music, such as musical divergent thinking, musical problem solving, flow, etc. We also present proposals which suggest differences in underlying structures of behaviors related with musical creativity (e.g. listening, improvisation, composition). In a second step, we discuss in detail two original proposals on musical creativity. The first conceptualizes 'that creative thinking is a dynamic process of alternation between convergent and divergent thinking, moving in stages over time, enabled by certain skills (both innate and learned), and by certain conditions, all resulting in a final product.' The second highlights the perspective that creative thinking 'is only part of the story'. Indeed, products of musical creativity are in practice build on a history, and are determined in a social-cultural environment. Based on this, we open an extended perspective on musical creativity. This means that, in a person-centered perspective, the creation of something *new* also points at the developmental conception of creativity and musical creativity in particular. In this way, we propose possible developments of musical creativity or creative thinking in sound/music consisting roughly of three steps: P-musical-creativity, P-culturalized-musical-creativity, and H-musical-creativity. Subsequently, we briefly survey the historical development of the psychometric approach – measuring creativity – and its characteristics, strengths, and weaknesses. Based on this, we discuss and compare process- and product-centered measurements in general, and in terms of music, in order to validate, first, that measured musical creativity or creative thinking in sound/music depends on developmental factors in general, as well as specifically musical; second, that the level of expertise is significantly related to creative behavior in music; and third, that there are differences concerning the validity in assessing H-musical-creativity between process- and product-centered measurements.

Because the goal of the present work is to modelize creative processes involved while music is being listened to and composed, the following two subsections discuss the creativity involved in listening to music as well as while composing music. This includes, first, arguments which, opposed to a traditional understanding of listening to music ('merely receptive'), conceive listening as an activity which 'makes' the music. In addition, we discuss proposals outlining meaning-creation of

Western music (not only) as elaborated on various ways of listening, among those which can be chosen when listeners are intended to ’create’ music. Finally, we relate these characterizations of creativity in listening to music to various proposals contouring listening to music from the perspective of creativity research.

Next follows the characterization of creativity while composing music. In the beginning, we present indications for the thesis that imagery and imagination are supporting processes present in composers’ mind while doing their work. Second, we open a perspective which suggests that compositional activities and processes work in a tension field between problem-finding and problem-solving processes. For this purpose, we first characterize the act of composing music as creation, exploration and solving of self-imposed ill- and well-defined problems, by which it is possible to embed various perspectives into compositional processes, such as the role of personality, motivation, and emotion, etc. Third, we discuss relevant influences on composers’ inspirations to find interesting problems, its structuring, the evaluation of possible compositional solutions, etc. In the last step of our observation on creativity while composing music, we present and discuss three different proposals which structure composing processes, in order to offer an extended picture about composition of music conceptualized as creative problem-solving processes.

Chapter 3 intends to introduce our original proposal of creativity in music, namely: *The Model of Musical Extrapolations.* We first start with the definition of the expression musical extrapolations. Subsequently, we try to sketch how extrapolation processes comprehensively influence the generation of meanings, in general and in musical contexts. Based on several examples, we furthermore advocate an universally understandable reasoning, starting that processes leading to musical extrapolations, consistently present a creative character, and, moreover, are responsible for the generation of music (as a mental construct) while listening as well as composing.

Chapter 4 consists in the core subject of this work. Based on the question: what bring the elusive qualities of sounds or chords – occurring at different time – into mental existence while music is being listened to and composed? We modelize basic factors and their inter-dependencies which are proposed as the so-called *Model of Musical Extrapolations.* It suggests that, based on interacting factors – instrinsic activities and motivations, pre-disposed and experience-based structures, and environmental pressures, – perceptual and conceptual problems are constantly constructed and found, ideas are generated to solve these problems, and approaches to a solution are evaluated. This means that the musical meanings of elusive qualities of sounds and chords occurring while listening, and while composing, are created and organized in form of mental models or integrated sets hypotheses, which perpetually needed to be modified, extended and combined. Based on this perspective, we also formulate arguments for the thesis that psychological developments concerning the handling of music consists in far more than enculturalization and acculturalization processes. Indeed, we discuss a complex of creative processes which cause psychological developments while individuals' are engaged with music.

The final Chapter 5 outlines perspectives of investigation offered through the *Model of Musical Extrapolations*. This includes questions, first, about how music analysts could be supported when they try to reconstruct compositional problem solutions, based on composers' notational sketches, preparative works, fragments, and early versions. Second, if explicitly presented knowledge from creativity research, e.g. models, strategies, have positive effects on composers' development, and, if so, how these pedagogical concepts and knowledge could be implemented in secondary education. Third, we moreover propose a research topic which focuses on composers' creative interaction with computers, supposing a survey of composers and their strategies in using computers while composing in computer-aided environments. Fourth, we finally suggest a perspective of investigation which would specify and extend the outlined *Model of Musical Extrapolations* regarding individuals' differences in pre-disposed structures.

Part I
Interdisciplinary Perspectives of Cognitive Sciences in Terms of Music

Chapter 1
Perspectives of Developmental Psychology: Between Pre-disposed Structures and Musical Experience

1.1 Ontogeny of Musical Abilities during the Prenatal Period

Infants already seem to have perceptual capacities for musical expertise in terms of differentiating and processing fundamental musical features, such as sound discrimination, harmonic spectrum, sound duration, pause length, and tempo. Looking for the origin of these capacities, it does not seem plausible that such sensory functions suddenly begin at birth. On the contrary, a current perspective proposes that these abilities have their origin in the early functioning of auditory grouping and segregation processes during the prenatal period. Indications for this thesis can be seen in a newborn's preference for mother's voice (DeCasper/Fifer, 1980), for mother's language (Mehler et al., 1988), for familiar melodies (Panneton, 1985), and for the prosody of a familiar spoken text (DeCasper/Spence, 1986). This section intends to review a selected corpus of research, which proposes various aspects of the prenatal auditory experience, as a starting point for the development process of ontogenetic musical abilities.

1.1.1 The Fetal Sound Environment

The findings of studies on the fetal sound environment are characterized by technical constraints and their solutions.

> "The first series of human intra-abdominal recordings was obtained with microphones covered with rubber membranes that were inserted into the vagina or the cervix nearest to the uterus [...]. In contrast to the findings from the initial studies, more recent ones using hydrophones adapted to fluid impedance and narrow band analysis, have indicated that the womb is a relatively quiet place." (Lecanuet, 1996, p.4)

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All sounds the fetus can perceive, whether from inside (mother's voice, her heartbeat, her movements, her breathing, and her digestion) or outside of mother's body, are muffled, because high frequencies are attenuated by the amniotic fluid and mothers body, which acts as a low-pass filter (see Richards et al., 1992; Parncutt, 2006). That is to say, sound pressure levels at low frequencies (< 300 Hz), measured outside of the ewe[1], are generally comparable with the pressure levels of sounds within the uterus (see Lecanuet, 1996).

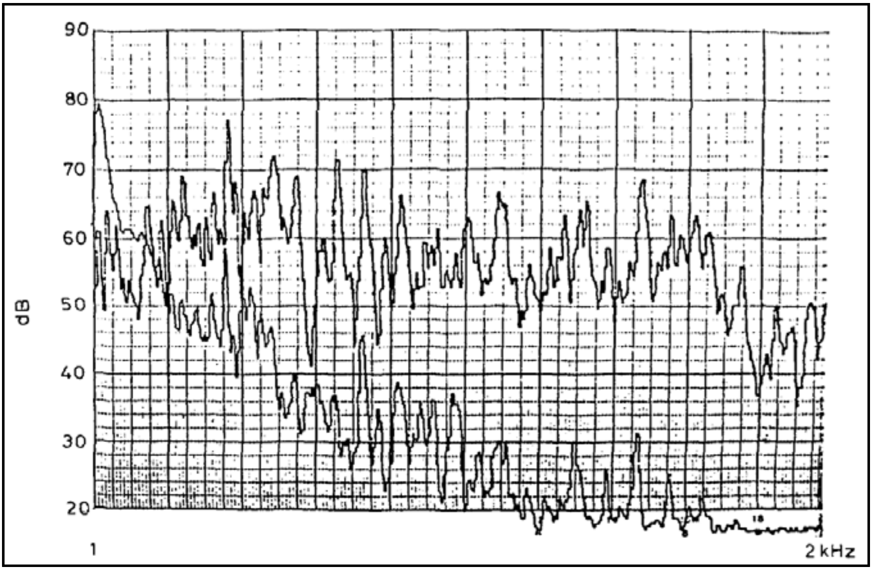

Fig. 1.1 "Musical recording ranging from 0 to 2000 Hz. Upper curve: ex utero recording. Lower curve: in utero recording; intra-uterine basal noise synchronic to the attenuated transmitted sound" (Querleu et al., 1988, p. 200)

> "Between 315 and 2500 Hz, the attenuation increases at a rate of 5 dB per octave. [...] Therefore, it is likely that the fetus will not be privy to overtones of traditional musical timbres at relatively high frequencies (1000-2000 Hz)." (Abrams et al., 1998, p.314)

Within previous studies concerning the human womb, similar observations were also made.

[1] "Because only a limited amount of information can be gleaned from human experimentation, investigators have started to work with sheep. Because of similarities in body weight and abdominal dimensions during pregnancy, sheep and humans have similar acoustic transmission characteristics." (Abrams et al., 1998, p.308)

As shown in Figure 1.1, QUERLEU et al. (1988) have measured that the degree of attenuation in utero increases with the rise of frequency: 2 dB at 250 Hz, 14 dB at 500 Hz, 20 dB at 1000 Hz, 26 dB at 2000 Hz. They conclude that external conversations are audible, because, although only 30% of the phonetic information is available to the fetus, the intonation is almost perfectly transmitted to the amniotic sac.

This implies, if any prenatal musical experience may be proved, it will mainly be based on prosody, intonation, timing, variations in loudness, or variations in pitch register, rather than single sounds and their overtones. Indications for this thesis can also be seen in tests made by VERSYP (1985). Recordings were made in utero and ex utero: first; the mother sang a French lullaby and in a second try a recording of the singing the same musical piece was played (at 60 dB via an external loudspeaker). The measurements have shown that equivalent fundamental frequency-patterns were recorded in utero and ex utero (see Figure 1.2).

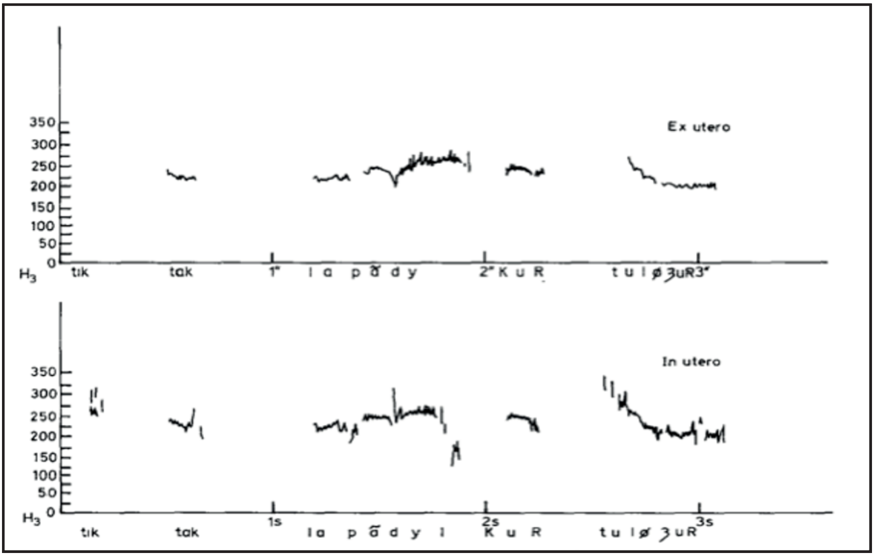

Fig. 1.2 "Pitch curve of a French nursery rhyme ('La pendule') recorded by a Mingograph ex utero (upper curve) and in utero (lower curve)." (Querleu et al., 1988, p. 205)

In conclusion, the characterization of the fetal sound environment as sketched above could give a better insight of the reason why newborns prefer their mother's voice, mother's tongue, mother's language, familiar melodies, and the prosody of a familiar spoken text. First: the intonation, prosody, variations in loudness, etc. of mother's voice constitute a permanent acoustic information in the fetal sound environment. Second: in terms of music, intra-abdominal recordings have revealed that frequencies higher than 1000 Hz play no noticeable part in fetal sound environment (under normal sound pressure levels), which implies that important features of music, such as "[...] the timbral features, by which we identify instruments [and a rich musical voice], could be obscured by the filtering of higher order partials by the abdominal content." (Abrams et al., 1998, p.309) Therefore, because of the similar sound pressure level in utero and ex utero for frequencies below 300 Hz and, in addition, the exact rendering of intonation of speech or music in the uterus for similar frequencies, an accepted perspective supposes that a possible fetal music perception is mainly stimulated by low frequencies and durational features (global prosody) of speech and music.

1.1.2 Fetal Auditory Competencies

> "Before birth, different brain regions develop at different rates, and sensory organs initially develop independently of the brain regions to which they will later be connected. Connections between periphery sense organs and the central nervous system start to mature in about the 25th week [gestational age], after which sensory learning can begin in earnest (Oerter and Montada, 1995)." (Parncutt, 2006, p.2)

The morphological development of the cochlea, considered as the most essential part of the ear for processing auditory stimuli in utero[2], starts to curl by the 6th week and attains its full size by the 20th week. Already at about 11 weeks, the first auditory cells (hair cells) begin to develop on the basilar membrane. At 14 weeks, rows of inner and outer hair cells can be observed, but none of them are functional at this stage (Arabin/van Straaten/van Eyck, 1998). Until about the 20th week, the human cochlea morphology seems to be functional, although it is not anatomically complete (Pujol/Lavigne-Rebillard/Uziel, 1991).

The maturation of the inner ear probably ends during the 8th month with the organization of afferent and efferent synaptic connections (Lecanuet, 1996).

Research results collected over the past 50 years demonstrated that the fetal auditory system becomes more sensitive with its maturation (see Lecanuet, 1996, pp. 10-17 for a comprehensive account in different domains). For instance, HEPPER and SHAHIDULLAH (1994) have uncovered, in a study concerning 450 human fe-

[2] "[...] it can be assumed that the middle ear is not necessary for fetal audition since it is adapted to the amplification of acoustic stimuli in aerial life. Without this amplification, clinical studies show that there is an average loss of 30 dB from the aerial environment of the outer ear to the liquid environment of the cochlea. In utero, since, the outer and middle ear are filled with amniotic fluid, and since liquids, tissues and bones have close conducting properties, the acoustic energy inside the uterine cavity can reach the cochlear receptors with negligible energy loss, thus, suppressing the need for an amplifying system." (Lecanuet, 1996, pp. 9-10)

tuses, that the range of frequencies which leads to a behavioral response, is initially small at the 19th week (see Figure 1.3).

> “The first response was observed at 19 weeks of gestational age by a single fetus who responded to the 500 Hz tone. The number of fetuses responding to each frequency increased with gestational stage. Fetuses responded first to the low frequency tones 500 Hz, 250 Hz, and 100 Hz, with 96 % responding by 27 weeks of gestational age to the 500 Hz and 250 Hz tones. At this age non responded to the 1000 Hz or 3000 Hz tone. Fetuses first responded to the 1000 Hz and 3000 Hz tones at 29 and 31 weeks of gestational age respectively. One hundred per cent of the fetuses responded to the 1000 Hz tone at 33 weeks of gestational age and to the 3000 Hz tone at 35 weeks of gestation. [...] Furthermore, the intensity level required to elicit a response decreases for all frequencies as gestation increases, this may suggest that fetal hearing becomes more sensitive during gestation. The lines [the right side of Figure 1.3] for each gestational age represent the mean intensity level required to elicit a response for the fetus and may be considered as equal loudness contours.” (Hepper/Shahidullah, 1994, pp. 82-83)

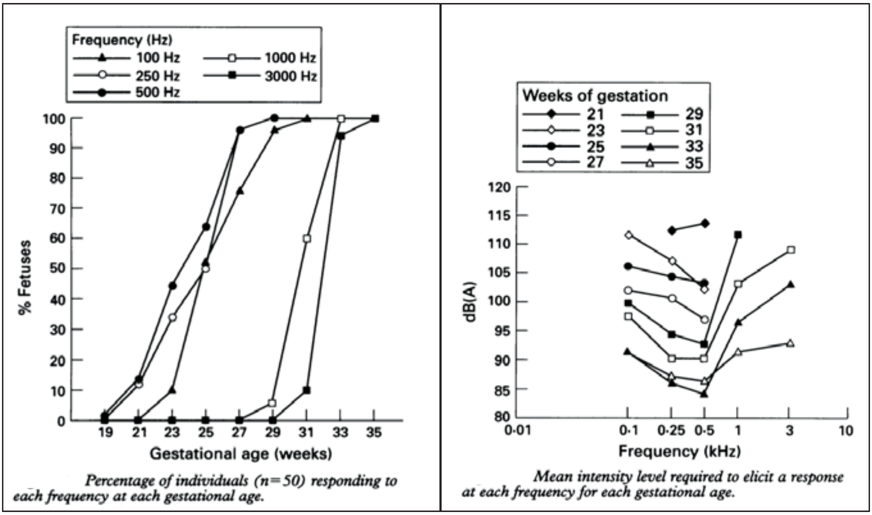

Fig. 1.3 Sensitivity for frequencies, depending on fetal age and sound pressure levels (Hepper and Shahidullah, 1994, p.83)

In terms of perception and discrimination of segmented speech sounds, the perfect conditions for the perception of this frequency range in the uterus (see 1.1 on page 27), and fetal early response to this range of frequencies (shown in Figure 1.3), DECASPER and SPENCE (1986) support the hypothesis that fetuses are indeed able to remember and recognize human voices (the in utero-speech-experience hypothesis). In addition, KISILEVSKY et al. (2003) have revealed that fetuses at about 38 weeks of gestational age discriminate between their mother's and a stranger's voice[3], which "[...] suggests that fetuses indeed are capable of remembering and recognizing characteristics of their mother's voice." (Kisilevsky et al., 2003, p.222) Also GROOME et al. (1999) demonstrated that by 36 to 40 weeks, fetuses respond to speech stimuli (83-95 dB sound pressure levels) by displaying heart rate decelerations to vowel sounds (/i/ and /â/). An other indication for a certain speech experience of fetuses are babies which are born three to six weeks early, or between 34 and 36 completed weeks of gestation. They can also discriminate the reversal of pairs of consonant-vowel sounds, /babi/ to /biba/ or /biba/ to /babi/ (Lecanuet et al., 1987).

If one asks about fetal perception of music, it is admitted that fetuses can response to music-relevant information at certain gestational ages, such as changing of musical notes (Lecanuet et al., 2000), melodic contour (Granier-Deferre et al., 1998), or variation of tempo (Kisilevsky et al., 2004). Observations of changing fetal heart rate or behavioral responses after onset of music reveal that fetuses are able, first: to distinguish between ongoing background uterine sounds and environmental sounds, such as discriminating the music from the maternal heart rate; second, to react differently to changes of certain ex utero stimuli parameters, such as pitch, tempo, or sound pressure levels.

> "To understand fetal responses to music, it is instructive to consider music perception by non-human animals, which—like the fetus—do not contribute actively or directly to human culture and therefore, presumably, do not experience music (or anything else) in the way human children or adults do. Cows, for example, may produce more milk when exposed to slow music and less when exposed to fast music, because a slow beat reduces stress and a faster beat increases it (North and MacKenzie, 2001)." (Parncutt, 2006, p. 13)

Nevertheless, although fetuses are unable to know what music and, moreover, language are, they can distinguish between various acoustical features of music and language, on the basis of the physical degree of change. But to recognize a physical degree of change, other acoustical information had to be saved previously, in such a way that a distinction is possible. Therefore, the discrimination of fetuses between their mother's and a stranger's voice, changes of musical notes or melodic contour, variations of tempo, etc. can only be processed by using a kind of auditory memory structures.

[3] Indications for newborn's preference of mother's voice (DeCasper/Fifer, 1980), and mother's language (Mehler et al., 1988) (see 1.1 on page 27).

1.1.3 Fetal Auditory Learning and Memory Structures

As we have already seen in studies concerning fetal behavioral responses after onset of various stimuli (see 1.1.2 on page 31), prenatal perceptions take place, and probably 'serve as a running-in period for the sensory systems' (see Hepper, 1992, p.145). Just as studies exploring memory in newborns by using learning paradigms, such as associative learning (e.g. Fifer/Moon, 1989; DeCasper/Fifer, 1980), imitation (e.g. Anisfeld, 1991; Field et al., 1982a), classical conditioning (e.g. Crowell et al., 1976), and habituation (e.g. Slater/Murison/Rose, 1984), "[...] similar paradigms have been applied to the fetus to explore its memory. Paradigms of "exposure learning", classical conditioning and habituation have been used to examine fetal learning and fetal memory." (Hepper, 1996, p.16)

In answer to the question on which memory structures are available to the fetus in utero, it seems that no semantic or conceptual memory can be invoked, because fetuses have no explicit language, as a precondition for the content of such memory structures. However, based on various studies (details follow), there are indications of prenatal learning concerning sensory and procedural memory structures affected to limited long-term memory structures.

By using current Magnetoencephalography technique (fMEG) (see in this regard Lounasmaa et al., 1996), which detects the magnetic field produced by the active neurons in the fetal brain, a kind of working sensory-memory can be defined. In a test method[4] originally used in Electroencephalographic (EEG) recordings, sound sequences are presented to the fetus, consisting in a standard (frequent) sound, and intermixed with a deviant (infrequent) sound of different frequency, duration, or intensity. Deviations of a standard sound elicit a negativity mismatch (MMN), as a component of the auditory event-related brain potential[5], which evidenced a sound discrimination. In addition, this advocates for the implication of sensory-memory structures, in which "[...] each sound forms a memory trace in the auditory system, if an incoming sound violates the neural memory representation of the recently heard sounds, it elicits an MMN." (see Kujala/Tervaniemi/Schröger, 2007, p.3) The earliest fetal MMN responses were recorded in various studies successfully, between 29 and 33 week of gestational age (e.g. Wakai/Leuthold/Martin, 1996; Lengle/Chen/Wakai, 2001). These results match findings concerning the myelination of the brainstem and central auditory pathways at about the 29th week of gestation age (see Perazzo/Moore/Braun, 1995).

> "Synaptic density of the fetal cortex and auditory pathway myelination are necessary factors for the beginning of simple cognitive function. Hence, cortical response to tone fre-

[4] Oddball paradigm

[5] The event-related potential (ERP) is a measured brain response, that results directly from specific sensory, cognitive, or motor stimuli (see Luck, 2005).

> quency change could be expected at approximately 28—30 weeks GA [gestational age]." (Draganova et al., 2007, p.204)

In terms of fetal learning and memory involving longer time periods in utero, investigations studied the habituation to repeated vibro-acoustic stimulation[6], suggest that fetuses at 30 weeks of gestational age are able to learn, and have, first, a procedural short-term memory of at least 10 min (Granier-Deferre et al., 2011; van Hereren et al., 2000), and, second, a procedural long-term memory of 24 hours (van Hereren et al., 2000). Moreover, it was shown that fetuses at 34 weeks of gestational age have a 4-week memory, because "[...] 34-week-old fetuses are able to store information and retrieve it 4 weeks later." (Dirix et al., 2009, p.1152)

In addition, studies exploring memory by exposure to music in utero and, afterwards, ex utero, revealed that musical stimuli learned during the prenatal period can change behavioral states (e.g. James/Spencer/Stepsis, 2002) and/or trigger specific attentional response (e.g. Panneton, 1985) in newborns. This provides further indication of the starting point of the processing of musically relevant information, and its storage over a certain time period.

Granier-Deferre et al., (2011), for example, demonstrated that the exposure to a descending piano melody twice daily during the 35th and 37th week of gestation (repeated when the infants were one-month old) indicate that, first, near-term fetuses can discriminate acoustic features, such as frequencies, spectra, duration, tempo, rhythm, and process complex auditory streams, and, second, auditory memories can last at least six weeks. They conclude:

> "Our results provide the first direct evidence that melodic contours can be processed before birth and remembered for at least several weeks after birth. They are consistent with recent data showing that the contour characteristics of newborns' crying paralleled the main intonation patterns of their maternal language (Mampe et al., 2009)." (Granier-Deferre et al., 2011, p.5)

In conclusion, let us return to Hepper's (1992) conjecture that prenatal perceptions probably serve as a running-in period for the sensory systems. After birth, memory is essential for normal processing of various stimuli and "[...] it is not too surprising that such an important psychological function is "practiced" before birth in some form." (Hepper, 1996, p.18) Beyond hearing, breathing (Kozuma et al., 1991) and eye movements (Horimoto et al., 1993) also begin in utero, although there is no air, and limited visual stimuli. If one assumes, for example, that breathing coordinations are stored in certain memory structures to ensure they will function efficiently when needed, it suggests that storage and retrieval of information is an essential process for breathing after birth. As we have seen, memory-processed auditory stimuli also prepare for the world ex utero (although not so essential as

[6] Vibro-acoustic stimuli provide auditory, tactile, proprioceptive and vestibular stimulations to the fetus.

respiratory movements), above all as an indirect neonatal bonding between the mother and her baby (DeCasper/Fifer, 1980; Kisilevsky et al., 2003), which promotes the survival of the newborn.

1.2 Infants' Auditory Sensitivity Related to Acoustical Parameters of Music

Early "[...] research [(e.g. Sinnott/Pisoni/Aslin, 1983)] on the development of auditory sensitivity has revealed considerably poorer sensitivity for infants than for adults [or older children]." (Trehub et al., 1988, p.273) This suggests that the perceptual organization of the auditory environment must be different between infants and older children or adults, or, that is to say, auditory sensitivity seems to mature after birth. Therefore, the following section attempts to sketch the auditory developmental process of infants, by reviewing investigations on certain aspects of auditory sensitivity, which are considered from the current perspective as preconditions for infants perceptual organization.

1.2.1 Auditory Threshold Sensitivity

Among others, the results of HEPPER and SHAHIDULLAH (1994) (see 1.1.2 on page 31) have shown that the auditory sensitivity threshold matures during the prenatal period for different frequencies. This process seems not to stop after delivery, but, on the contrary, behavioral and auditory brainstem response (ABR) studies indicate that this threshold matures further in infants. However, there is a large discrepancy in results within the behavior studies, and furthermore, compared to and within ABR studies.

For example, TREHUB et al.(1980) investigated the auditory threshold sensitivity of 6, 12, and 18 month old infants by using visual reinforcement audiometry method[7] (see in this regard Moore/Thompson/Thompson, 1975). As shown in Figure 1.4, their results displayed a general decrease in threshold sensitivities

[7] "VRA is essentially an operant conditioning procedure in which the operant response is a head-turn. Head-turns reinforced by presentation of an interesting visual event, usually the activation of a mechanical toy. The acoustic stimulus serves as a discriminative cue: Head-turns in the presence of a specified sound, or set of sounds, are reinforced, whereas head-turns a other times are not. Once the infant has learned the response contingencies, a threshold for the detection of sound can be determined by varying sound intensity to find the level at which the infant stops responding." (Olsho et al., 1987, p.627)

between 200 and 10000 Hz. In addition, infants at 12 and 18 months of age are more sensitive to lower frequencies than infants at 6 months of age. But there were no significant differences to be found at higher frequencies between these three groups. The measured adult sensitivity (displayed by initials M.B. and E.D.) was significantly better at lower frequencies, but similar to those of infants at higher frequencies.

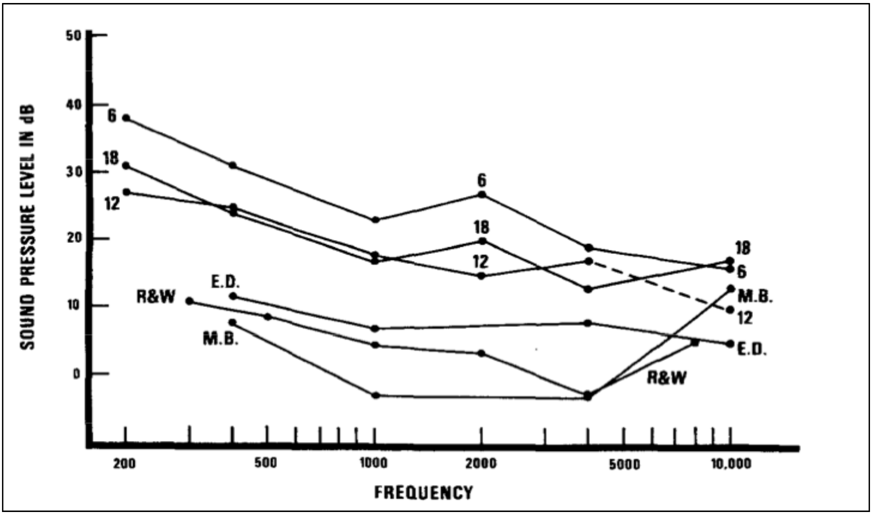

Fig. 1.4 "Thresholds as a function of frequency for infants 6, 12, and 18 months of age and for two adults. Thresholds determined by Robinson and Whittle (1964) are also plotted." (Trehub, 1980, p.280)

In contrast, BERG and SMITH (1983) (see Figure 1.5) reported a smaller difference in sensitivity threshold between infants and adults, because the deviation, measured in a free sound field, was about 6 dB at 500 Hz, 13 dB at 2000 Hz, and 10 dB at 8000 Hz. Noteworthy is the discordance with TREHUB ET AL. who observed a decrease of threshold sensitivity between 200 and 10000 Hz: BERG and SMITH reported similar sensitivities across all frequencies within groups of 10, 14, 18 month old infants.

NOZZA and WILSON (1984) presented results similar to those of BERG and SMITH. They found thresholds for 6 month old infants of 20 dB at 1000 Hz and 16 dB at 4000 Hz. The sensitivity of 12 month old infants were about 2 dB lower than for 6 month old infants. Compared to adults, infants are less sensitive, that is to say, the measured threshold was 14 dB higher at 1000 Hz and 7 dB higher at 4000 Hz.

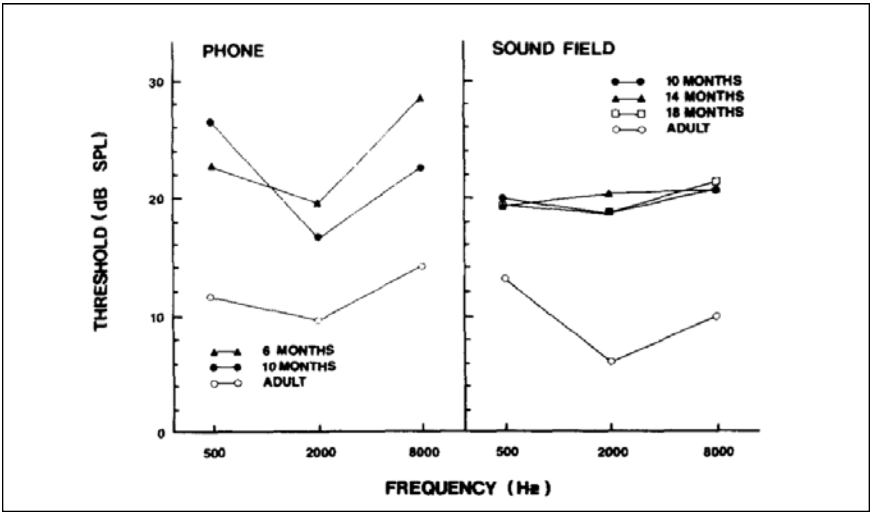

Fig. 1.5 "Mean phone and sound field thresholds for various age groups at each of three frequencies. Only data for counterbalanced groups are illustrated." (Berg and Smith, 1983, p.414)

The auditory threshold sensitivity can also be studied by using physiologic measures such as the auditory brainstem response (ABR), which is an evoked potential of auditory activity in the brainstem. This potential is first recorded in human neonates at the 27th week of gestational age (Starr et al., 1977), and furthermore allowed to determine thresholds in newborns, infants and adults. For example, KLEIN (1984) used tone pips stimuli at 0.5, 4, and 10 kHz to measure auditory evoked potential thresholds in 40 normal infants from 2 to 28 weeks old and 14 normal hearing adults.

As shown in Figure 1.6,

> "The greatest difference between infant and adult thresholds occurred at 4.0 kHz. The magnitude of this difference decreased with age; however, differences were still significant up to 28 weeks of age. No significant differences were seen at 500 Hz. To the 10.0 kHz stimulus only the youngest (2-4 wk) infants had thresholds that were significantly higher than adults." (Klein, 1984, p. 291)

In contrast to KLEIN, WERNER et al. (1993) found that infants at 3 and 6 month possess more similar ABR thresholds at all three frequencies (see Figure 1.7).

WERNER et al. also studied the relationship between behavioral and ABR thresholds (see Figure 1.8), with the result that the thresholds are quite different[8].

[8] This result is consistent previous studies concerning the relationship of ABR and audiometric thresholds in infants.

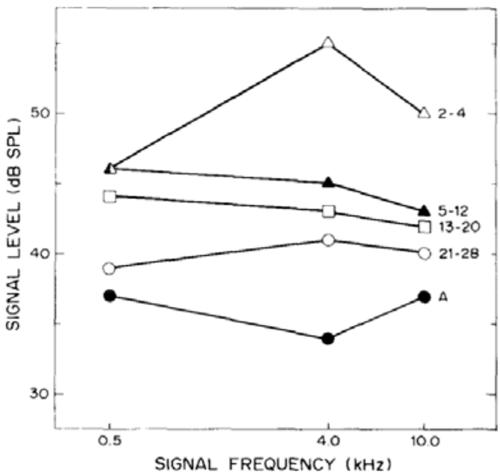

Fig. 1.6 "Mean evoked potential thresholds with age group as the parameter. Thresholds to 500 Hz stimuli are not significantly different between groups." (Klein, 1984, p.293)

They conclude, first, that the "[...] frequency specific auditory brainstem response measures of sensitivity approach maturity by the time an infant is 3 months old. Second, behavioral thresholds for the same stimuli are immature at this age, and thresholds are more immature at high frequencies than they are at low frequencies. Behavioral thresholds improve at the highest frequencies between 3 and 6 months." (Werner/Folsom/Manel, 1993, pp. 138-139)

Particularly interesting is the significant improvement of behavioral thresholds at 8 kHz between the 3rd and 6th month. However, the correlation between behavioral and ABR thresholds is not significant at 8 kHz for infants. Therefore, this improvement seems not the result of the maturation of the primary auditory system at or peripheral to the auditory brainstem, but due to other factors.

One explanation for the different results could be that ABR's are essentially unaffected by attention or state of arousal (see Picton et al., 1974), whereas behavioral studies have to count on the optimal level of arousal, motivation and attentiveness. In addition, attention could also be a factor for different results concerning the sensitivity threshold within behavioral studies themselves, because "[...] data showing that infants' thresholds can be reduced dramatically by procedures that increase motivation (Olsho et al., 1988; Trehub et al., 1981) and to a lesser extent by manipulations of attention (Primus and Thompson, 1985)." (Werner/Folsom/Manel, 1993, p.131)

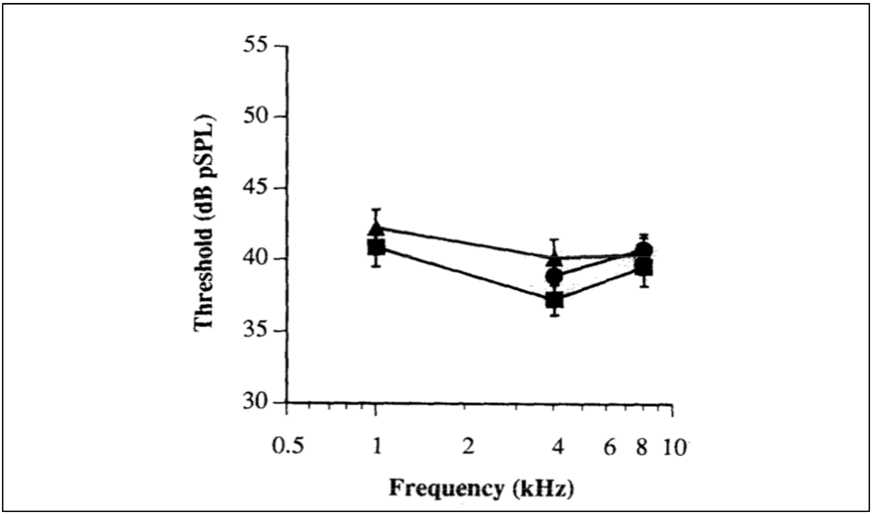

Fig. 1.7 "Average ABR tone pip threshold (± 1 standard error) as a function of frequency. Squares, 3-month-olds; circles, 6-month-olds; triangles, adults." (Werner, 1993, p.136)

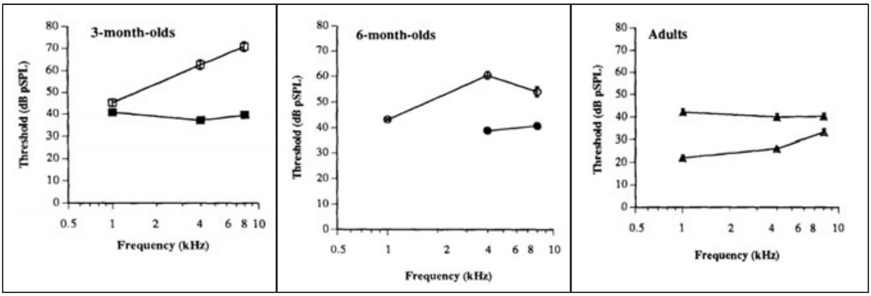

Fig. 1.8 "A comparison between average behavioral and ABR tone pip thresholds as a function of frequency in three age groups. Filled symbols, ABR; open symbols, behavior." (Werner et al., 1993, p.137)

> "In addition, head-turning procedures [used in visual reinforcement audiometry methods] require a split of attention between the simultaneously visual and auditory stimuli. Attentional capacities may be less developed in infants than in adults, which may also contribute to the elevated thresholds of infants." (Fassbender, 1996, p.56)

In conclusion, despite the discrepancies in the results of the above studies, the available data suggests that the threshold sensitivity matures further after birth.

Because, ABR's of very young (2-4 week) infants indicate that thresholds of higher frequencies are higher shortly after birth than in older infants. These auditory sensitivities could be partially caused by the fact that some brainstem structures are probably incompletly myelinated (see Salamy/McKean, 1976), and synapses are incompletely synchronized (see Rorke/Riggs, 1969). At about 3 months after birth, the auditory brainstem seems to have further matured, because it was found that for infants "[...] ABR threshold was adult-like at all frequencies, even among 3-month-olds." (Werner/Folsom/Manel, 1993, p.131) In contrast, behavioral studies concerning the threshold reported lower sensitivities, that is to say, that between 3rd and 6rd month there are significant differences between behavioral thresholds and ABR thresholds. In terms of behavioral thresholds, WERNER et al. reported lower sensitivities in middle frequencies than in lower and higher frequencies. Astonishingly, similar sensitivities are also be found in KLEIN's (1984) study of frequency dependent ABR thresholds during infancy.

Other results concerning infants' sensitivity thresholds between 6th and 18th month (Trehub/Schneider/Endman, 1980; Nozza/Wilson, 1984; Berg/Smith, 1983) also show significant discrepancies in some aspects. While TREHUB et al. displayed a general decrease in threshold sensitivities between 200 and 10000 Hz, BERG and SMITH reported a better threshold sensitivity (see phone presentation tests) at lower frequencies for 6 month than 10 month old infants. Moreover, BERG and SMITH tests in a free sound field showed no significant difference between 10 and 18 month old infants. Factors accounting for these differences may come from the degree of arousal and motivation, in addition to the already above-mentioned problem of attentiveness, or rest on different setups.

Finally, although all auditory threshold experiments are somewhat different in setup, procedure, and stimuli, behavioral and ABR studies presented above confirm that the auditory threshold matures further after birth, because most studies showed a significant difference in frequency specific thresholds between infants and adults.

1.2.2 Auditory Sensitivity for Frequency, Pitch and Timbre Discrimination

This section reviews investigations concerning the ability to distinguish different frequencies, which is considered as the basic property of the auditory system. Complex auditory signals, such as music and speech rely upon frequency discrimination, because, for example, the perception of current timbre in music, or prosody in speech, is based on the distinction of different simultaneous frequencies (overtones). Such discrimination abilities are furthermore important for the perceived pitch of a complex sound, which corresponds to its fundamental frequency, even when the fundamental frequency is not present (virtual pitch, (see Terhardt, 1974)).

Therefore, because of the importance of these preconditions for music perception, and knowing that overtones higher than 1000Hz play no noticeable part in fetal sound environment (which would be an important feature for a prenatal music experience) (see 1.1.1 on page 29), the questions it raises: At which stage of development can infants discriminate frequencies, pitch and timbre?

Frequency Discrimination

Early attempts to determine frequency discrimination in youngest infants have failed (Leventhal/Lipsitt, 1964; Trehub, 1973). TREHUB (1973), for example, studied this ability in 1 to 4 month old infants by using the high amplitude sucking procedure[9] (HAS), with the conclusion that there are no differentiations of frequency shifts from 100 to 200 Hz , 200 to 1000Hz, and 1000 to 2000 Hz, for square-wave and sine-wave tones at this age. However, as we have already seen (see 1.1 on page 27), later investigations indicate, first, that newborns can discriminate human voices (DeCasper/Fifer, 1980; Mehler et al., 1988), and, second, that 3-month-old infants can discriminate frequencies (Werner/Gray, 1998).

In terms of difference of sensitivity for frequency discrimination between infants and adults, OLSHO (1984) (see Figure 1.9) reported that the frequency difference limens[10] (FDL) were significant smaller below 2000 Hz for infants aged 5 to 8 months than for adults.

> "At 4000 and 8000 Hz, there were no significant differences; in fact, the infants performed relatively better than adults. The values of Weber's fraction (ratio of FDL to standard frequency) for infants decreased from approximately 0.038 at 250 Hz to 0.01 at frequencies above 1000 Hz. For adults, Weber's fraction decreased from about 0.02 at 250 Hz to 0.006 at 1000 Hz and then increased to little above 0.01 at 4000 Hz." (Fassbender, 1996, p.65)

Based on indications that frequency discrimination depends on changes in sound pressure level (see Wier/Jesteadt/Green, 1977), OLSHO (1987) (see Figure 1.10) studied the development of discrimination abilities of 3- to 12-month-old infants, compared with those of adults, at two sensation levels[11] for each subject.

> "The FDLs [frequency difference limens] of 3-month-olds were worse than those of adults at all three frequencies, and increased with increasing frequency. The FDLs of 6- and 12-month-olds were worse than those of adults at 500 and 1000 Hz, but not at 4000 Hz.

[9] Sucking is one of the few activities over which infants have good motor control. Therefore, one of the techniques which can measure newborn's perceptual abilities is called high amplitude sucking procedure (see in this regard (Siqueland/DeLucia, 1969)).

[10] The ratio between the minimum distinguishable frequency interval and the frequency.

[11] Sensation level is the difference between the absolute threshold of hearing to a certain acoustic stimulus and the sound pressure level while presenting this stimulus.

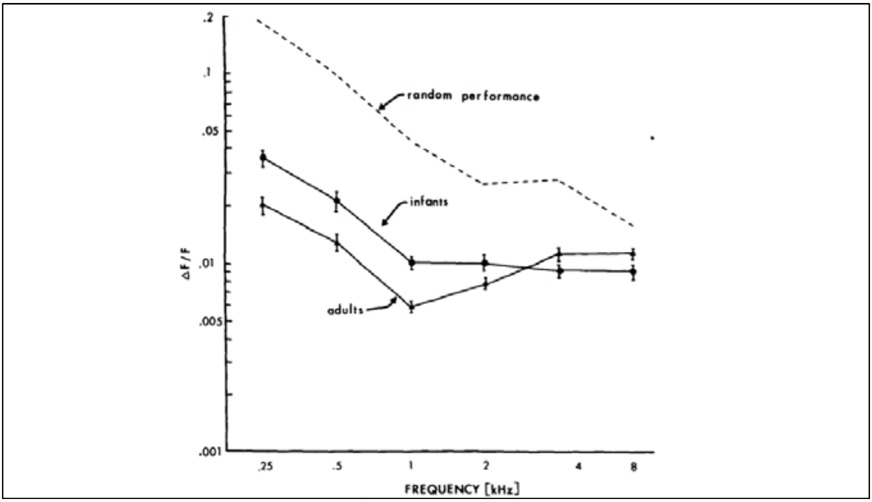

Fig. 1.9 "Mean relative frequency for infants and adult (bars indicate ± 1 standard error). Dashed line shows average thresholds obtained using the same staircase algorithm if the subject responds randomly with a probability of .8 on each trial." (Olsho, 1984, p.32)

> Decreasing the SL [sensation level] led to an increase in the FDL of about the same magnitude at all ages, and the same age differences were found at both SLs. Thus infant-adult differences in FDL are not simple consequence of differences in absolute sensitivity." (Olsho, 1987, p.454)

In conclusion, the presented findings provide important indications: at which frequency ranges infants are more sensitive than others, and how frequency discrimination abilities evolve. Thus, it seems infants *per se* can discriminate better high frequencies, and that this quality develops faster than for low frequencies, because their sensitivity is similar to that of adults at about 6th months. Low frequency difference limens remain immature, and probably stabilize only in the late childhood (see Maxon/Hochberg, 1982).

Pitch Discrimination

Compared to the frequency discrimination (of pure tones), pitch discrimination is more complex, because every perceived pitch combines many sinusoids with different frequencies. As already mentioned, pitch perception is important to follow musical progressions such as melodies, or prosodic information of speech. Hence, two important questions are raised. First: do infants discriminate changes in pitch, as they discriminate frequencies (see 1.2.2 on the preceding page), and, second,

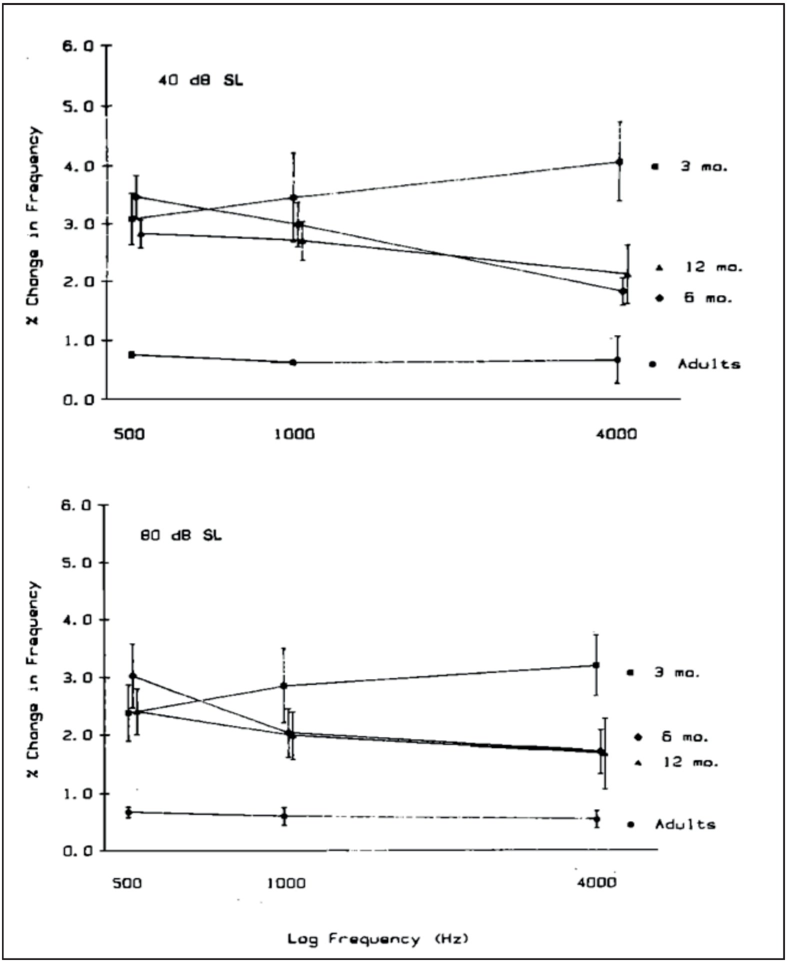

Fig. 1.10 "Average relative frequency difference limen (FDL/frequency) as a function of frequency for infants and adults at 40 dB SL [sensation level] and at 80 dB SL. Error bars represent ± 1 standard error." (Olsho, 1987a, p.459)

do infants perceive changes in pitch of complex tones, even when fundamental frequencies are not present (virtual pitch, (see Terhardt, 1974))?

Results presented in behavioral studies (Clarkson/Clifton, 1985; Trehub, 1987; Montgomery/Clarkson, 1997) concerning pitch discrimination suggest "[...] that infants at 7 months probably already process complex tones in a manner similar to that of adults, that is, by extracting the pitch of complex tones with missing fundamental frequency." (Fassbender, 1996, p.67)[12] That is an amazing feature in this age group. However, more recent mismatch negativity (MMN)[13] studies (He/Hotson/Trainor, 2007; He/Trainor, 2009) have revealed, first, that 2-, 3-, and 4-month-old infants' responses to infrequent pitch changes in piano tones, and second, that

> "Adults and infants 4 months and older showed a mismatch negativity response to these [pitch of the missing fundamental frequency] pitch changes, but 3-month-old infants did not. Thus, cortical representations of the pitch of the missing fundamental emerge between 3 and 4 months of age, indicating that there is a profound change in auditory perception for pitch in early infancy." (He/Trainor, 2009, p.7718)

Finally, the presented results of the behavioral studies suggest that pitch discrimination abilities matures until about 7 months after birth, because at this time, pitches of complex tones are processed similar as for adults. A number of ERP studies (Leppänen/Eklund/Lyytinen, 1997; Kushnerenko et al., 2002; Draganova et al., 2005) showed that infants already respond to changes in pitch during the newborn period. But, HEE and TRAINOR (2009) provide indications that responses to pitch discrimination are based on fundamental frequency rather than pitch, because 3 month old infants can not process the pitch of the missing fundamental. Cortical representations for pitch changes with missing fundamental were recorded only between the 3rd and 4th month after birth.

Timbre Discrimination

Complex tones in music or speech differ in three primary attributes: pitch, loudness, and timbre. As we have seen (see 1.2.2 on page 42), pitch of a sound depends on the fundamental frequency, in addition loudness depends on the sound pressure level, but timbre discrimination is based on multidimensional attributes.

> "Tone onset effects (such as rise time, unequal rise of partials, and noise) and in-harmonic partials, as well as steady-state effects (such as amplitude modulation, vibrato, and pitch instability), contribute to the perception of a certain timbre (Plomp 1970). Timbre is generally defined as that attribute by which the differentiation of two sounds with identical pitch and loudness is possible." (Fassbender, 1996, p.67)

In terms of music, timbre provides those information by which listeners identify instruments, and differentiate a rich texture of musical voices. Therefore, the sensitivity to timbre discrimination for complex sounds is an important basis for a

[12] However, other studies (Chang/Trehub, 1977; Plantinga/Trainor, 2005) show that relative pitch representation in infants differs substantially from that of adults (for more information see 1.3.3 on page 55).

[13] Occasional changes in a sound category elicit a mismatch negativity (MMN), which is a event-related brain potentials (ERP).

differentiated perception of music. Knowing that acoustic information of timbre plays no noticeable part in the fetal sound environment, and therefore, that its experience starts after birth, it is significant to research: How long does the maturing process in infants last to discriminate sounds based on timbre information?

TREHUB ET AL. (1990) found indications that infants already between 7 to 8 months of age classify tonal stimuli on the basis of timbre.

> "Infants 7 to 8.5 months of age were tested for their discrimination of timbre or sound quality differences in the context of variable exemplars. They were familiarized with a set of complex tones with specified spectral structure; members of the set varied in fundamental frequency, intensity, or duration. Infants were then tested for their detection of tones that contrasted in spectral structure but were similar in other respects. They successfully differentiated the two spectral structures in the context of these variations, indicating that they can classify tonal stimuli on the basis of timbre." (Trehub/Endman/Thorpe, 1990, p.300)

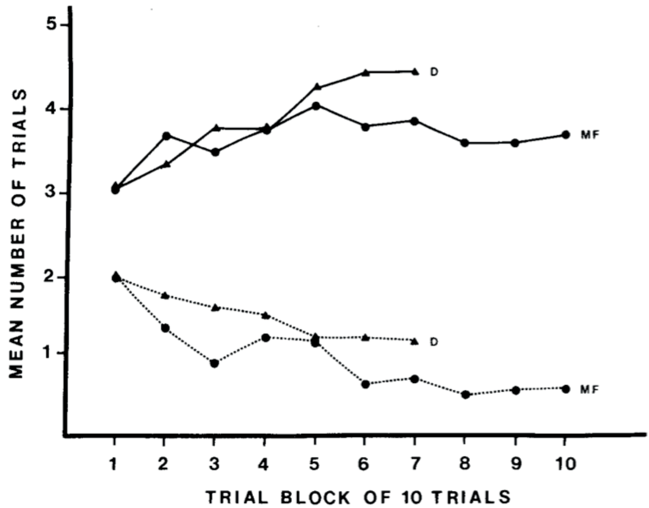

Fig. 1.11 "Mean number of trials on which infants turned for change trials (solid lines) and control trials (dashed lines). Data are plotted for each test stage in blocks of 10 trials containing 5 change and 5 control trials. The curves labeled D represent the discrimination stage (N=22), and those labeled MF depict the missing-fundamental one (N=16)." (Clarkson et al., 1988, p.18)

Furthermore, CLARKSON ET AL. (1988) also test 7-month-old infants' ability to discriminate timbre of sounds with different spectral envelopes. They presented tones which either included fundamental frequencies (see Figure 1.11: labeled as

D), or missed the fundamental frequency (labeled as MF), but otherwise have the same pitch, the same loudness, and the same temporal parameters.

As Trehub et al. (1990), Clarkson et al. (1988) also reported that in just 7 months, infants can distinguish sounds on the basis of their spectral envelopes.

> "The infants performed equally well whether the range of frequencies in the comparison sounds was higher or lower than that of the background. When the fundamental frequency was removed from the sounds, the group evidenced discrimination of the changes in spectral envelope with these less salient stimuli. Nonetheless, fewer individual infants met the performance criterion for the missing-fundamental stimuli than for the discrimination ones. These individual data suggest that the infants may have had more difficulty with the missing-fundamental stimuli [...]." (Clarkson/Clifton/Perris, 1988, p.19)

The results presented above suggest that infants at this early age discriminate acoustic stimuli on the basis of spectral information. However, the results of Clarkson et al. (1988) did not very clearly report the bandwidth of spectral processing in infants. It remains unclear if infants use the full range of six upper harmonics in their test setup, or only one or a few upper harmonics.

However, there are indications that infants detect sound changes on the basis of the overall frequency configuration, such as in the case of melodies (e.g. Trehub, 1987) or running speech (e.g. Femald/Kuhl, 1987). These findings also give some crucial indications that already infants categorize their auditory environment. That is to say, the organization of the spectral information, such as found in a complex tone, creates meaningful segments. Because complex tones can only be differentiated by means of spectral information, when harmonics previous organized in a kind of categories.

1.3 Perspectives of Infants General Musical Organization

Based on the previous section, which has outlined infants' sensitivity to detect and discriminate sounds and complex tones, this section reviews perspectives of infants' organization of sounds, that is, the organization of detected and discriminated sounds and tones in 'meaningful segments'.

> "That is a truly remarkable achievement. We hear many levels of organized patterns in speech, music, and environmental sounds that are not obvious in the physical sound waves themselves (Bregman, 1993: 12-14). Rather than hearing completely isolated sounds or an undifferentiated continuum, we hear phonemes, words, sentences, melodies, rhythms, and phrases, all consisting of parts that seem related despite their taking place at different frequencies and at different times. We can also hear the wind blowing, a bird singing, an automobile engine starting, and someone speaking as four separate sounds, even if they are all occurring simultaneously. If this were not the case, all we would ever hear would

> be a single sound, consisting of the sum of all sounds present at a given moment. These levels of organization are the result of certain aspects of our own perception, cognition, and memory." (Snyder, 2000, p.31)

1.3.1 *Auditory Grouping and Segregation Processes*

So-called auditory grouping and segregation processes are considered as one of the basic mechanisms of the auditory structuring. The human nervous system seems to have an innate tendency (Shepard, 1981; Bregman, 1994) to separate acoustical information out of the ongoing auditory continuum. And those parts which have a kind of similarity, proximity, continuity, etc. to each other are grouped together into a 'something wholes'.[14] In addition, research concerning other species (MacDougall-Shackleton et al., 1998; Hulse/MacDougall-Shackleton/Wisniewski, 1997) have also shown that birds, especially European Starlings, can process acoustical information in this way.

Gestalt psychologists in the 1920s (Wertheimer, 1922; Koffka, 1935) already discovered that human perception is foremost holistic, which seems to be plausible by certain picture puzzles such as KANIZSA-TRIANGLE, RUBIN'S VASE or NECKER CUBE. More recent research suggest two general principles pertaining to the grouping of segments.

> "Primitive grouping factors are primarily determined by the structure of the human nervous system itself, and the ways it has evolved to understand the world around us." (Snyder, 2000, p.32)

> "Learned grouping effects, which are comprehended using long-term memory categories and schemas, always operate within a realm already known to varying degrees. All learned groupings are formed from features that were originally primitively grouped." (Snyder, 2000, p.33)

Early studies (Bower, 1965; Bower, 1967) found indications for a kind of grouping in young infants, because major Gestalt laws, such as the principle of good continuation are effective to organize visual stimuli in 40-day-old infants. In terms of auditory grouping, investigations on auditory stream segregation in infancy (Demany, 1982; Fassbender, 1993; McAdams/Bertoncini, 1997; Winkler et al., 2003; Smith/Trainor, 2011), and the duration illusion (Thorpe/Trehub, 1989), have revealed that principles used by infants to group auditory information are similar to those of adults.

Regarding SHEPARD (1981) and BREGMAN's (1994) suggestion that the human nervous system seems to have an innate tendency to group acoustical information together (see 1.3.1), recent studies support their thesis, because auditory

[14] For a good overview on this topic see (Bregman, 1994; Snyder, 2000).

stream segregation processes were found in infants at birth. WINKLER ET AL. (2003), for example, used event-related potentials[15] to study newborns' (2–5 days of age, gestational age 38–42 weeks) grouping and segregation abilities. They conclude: "[...] we found that, similarly to adults, newborn infants segregate concurrent streams of sound, allowing them to organize the auditory input according to the existing sound source. The segregation of concurrent sound streams is a crucial step in the path leading to the identification of objects in the environment. Its presence in newborn infants shows that the basic abilities required for the development of conceptual objects are available already at the time of birth." (Winkler et al., 2003, p.11812)

These results are also supported by behavioral studies. For instance, MCADAMS and BERTONCINI (1997) tested the auditory perceptual organization in 3 to 4 days old infants compared with those of adults.

> "In a sucking paradigm, infants heard repeating four-note ascending and descending melodic sequences comprised of notes of two different timbres presented from speakers at two different locations. When three of the four notes had the same timbre / location infants could discriminate ascending and descending contours, presumably because infants integrated the tones on the basis of timbral/spatial cues. However, when the same melodic contours were presented using notes that alternated in timbre/location, infants failed to discriminate the rising and falling contours, suggesting that infants segregated the melodies into separate streams." (Smith/Trainor, 2011, p.657)

Another behavioral study (Demany, 1982), comparing older infants' (1,5 to 3,5 month old) abilities of auditory stream segregation with those of adults (16 to 30 years old), has revealed that young infants already group auditory stimuli on the basis of Gestalt laws. FASSBENDER (1993) has come to a related argumentation, after testing Gestalt laws of proximity and similarity on 2 to 5,5 month old infants, based on stimulus attributes of frequency, amplitude, and spectral content. He concluded "[...] that infants 2-5,5 months of age already organize rapid tone sequences perceptually on the basis of the Gestalt principles of proximity and similarity among sequence elements." (Fassbender, 1996, p.73)

> "Similar principles can also explain higher order levels of melodic organization. Narmour (1990) has proposed a theory of melodic structure, the implication-realization model, which begins with elementary Gestalt principles such as similarity, proximity, and good continuation. The responses of listeners in continuity-rating and melody-completion tasks have provided empirical support for some of these principles (Krumhansl, 1995; Cuddy & Lunney, 1995; Thompson et al., 1997; see also Schellenberg, 1996, 1997)." (Justus/Bharucha, 2002, p.13)

Finally, all presented studies observed similar auditory grouping and segregation processes in newborns, young infants, and adults. But there are specific differences between these age stages. Although, DEMANY (1982) found a "[...] close

[15] The event-related potential (ERP) is a measured brain response, that results directly from specific sensory, cognitive, or motor stimuli (see Luck, 2005).

parallelism between the adults' and infants' performances [which] suggests that the temporal determinants of stream segregation do not differ greatly from infancy to adulthood." (Demany, 1982, p.275), McAdams and Bertoncini (1997) (Experiment 1) reported a slower tempo for segregation in infants than in adults. Furthermore, infants cannot distinguish patterns accurately when the tempo is too fast and the inter-stimulus intervals too short (see McAdams/Bertoncini, 1997). Although basic mechanisms of auditory grouping and segregation processes are present from birth, this suggests that perceptual abilities are at first immature, and probably develop further through childhood. Regarding the question of whether learned groupings are active in infants, it can be assumed that, although most of the auditory grouping and segregation processes are primitive groupings at all ages in the studies explained above, acoustical information experienced during the prenatal period could provide important structures for limited learned groupings (see 1.1.3 on page 33). Nevertheless, infants' overall sensitivity to variations in melody and tempo seems at least partially processed by an innate tendency (Shepard, 1981; Bregman, 1994) to group acoustical information on the basis of Gestalt principles, such as proximity, similarity, and continuity.

1.3.2 *Perception of Time and Rhythmical Structures - a Sensorimotor Perspective*

Music is commonly said to be the art which heavily depends on time. However, time and specific rhythms are elemental factors affecting human perception at all, since the prenatal period. For example, fetal and neonatal memory-dependent perceptions (see 1.1.3 on page 33), such as the recognition of structures, already depend on time intervals between presented stimuli. Furthermore, infants (and fetuses 1.1.3 on page 34) probably perceive very early a wide range of their own rhythms, from few milliseconds (sucking rate, respiratory rhythm, etc.) to several hours (sleep-wake rhythms, hunger rhythm, etc.). In addition, these rhythms are very important in neonatal bonding to the mothers.

Starting from the sensorimotor perspective (McGraw, 1943; Piaget, 1952; Bernstein, 1967) (see also 1.4.2.1 on page 66), which proposes that infants' temporal abilities develop from both perceptual and motor skills, it seems that wide-ranged pre- and postnatal perceptions of rhythms, and practiced motor skills such as sucking rate, are essential foundations to process time and rhythmical structures. Indications for this perspective were also found by recent neuropsychological studies of music perception (see Janata/Grafton, 2003), which have shown that the motor regions of the brain contribute to both perception and production of rhythms. In addition, Carroll-Phelan (1996) has analyzed various studies of braindamaged patients, which deal with disorders on rhythmic processing. She found "[...] the close relationship between auditory perception and imagery for rhythmic sequences, timing and motor processes." (Carroll-Phelan/Hampson, 1996, p.517)

In this context, to get a better insight in infants' perception of time and rhythmical structures, it is important to outline first, when and how temporal skills develop in infants, based on motor rhythms and temporal regulations of behavior, and, second, when infants are able to anticipate temporally predictable events.

Rhythmical Stereotypes

It was observed in western cultures that infants perform numerous rhythmical, highly stereotyped behavior, such as kicking, waving, banging, rocking, etc., during the first year of their life. Such rhythmical behaviors are generally believed to play an important role in the early development of motor skills, and are associated with particular stages of neuromuscular maturation. For example, WOLF (1967); (1968) proposed that infants' stereotypical behavior is a manifestation of an 'intrinsic neural clock', which is a precursor for internal triggers of sensorimotor regulation in children and adults. In this way, MCGRAW (1943) interpreted hands-and-knees-rocking as one of the steps for prone progression. According to MCGRAW, such rhythmical movements of the legs are also indispensable for central motor skills when infants later learn to walk.

More precisely, THELEN (1979) studied infants' (2 - 12 month-old) rhythmical behavior, and found that every infant did highly stereotyped movements. Seventy-four distinct rhythmical movements were observed, "[...] and rhythmical kicking was one of the earliest stereotypes observed. It was performed by each of the 20 infants persistently for a number of months, and often with great frequency during the observation." (Thelen, 1979, p.702) As seen in Figure 1.12, THELEN also detected a development of rhythmical, stereotyped behavior within the first year of life.

> "The frequency of these behaviors showed a significant developmental trend with a peak of performance between 24 and 42 weeks of age and a slight but real decline in the last fifth of the year. In contrast, the number of different stereotypies showed a steady and consistent increase over the year. Thus, while the overall frequency of stereotyped behavior is declining, the number of different stereotypes observed rising. Clearly, new stereotypies are being added to the repertoire without the loss of older behaviors. Six or seven months of age is the time when infants show the most rapid increase both in frequency and in numbers of these motor behaviors." (Thelen, 1979, p.711)

Another perspective highlighted infants' stereotypical behavior partly caused by the environment, as transient, developmental phases of well-adjusted infants[16].

[16] For detailed information see 1.4.1 on page 58.

	Weeks					Analysis of variance
	4–12	14–22	24–32	34–42	44–54	Source
Mean bouts of all stereotypies	5·07[d]	27·42[c]	54·17[a]	49·85[a]	38·14[b]	Age blocks, $F = 35{\cdot}22$, $df = 4$, $P = 0{\cdot}0001$
Mean numbers of different stereotypies	1·28[d]	3·80[c]	7·36[b]	8·43[a]	8·77[a]	Age blocks, $F = 171{\cdot}82$, $df = 4$, $P = 0{\cdot}0001$

[a, b, c, d] Results of Duncan's Multiple Range Test. Means with the same letter are not significantly different ($\alpha = 0{\cdot}05$).

Fig. 1.12 "Developmental Changes in Total Bouts and Total Numbers of Rhythmical Stereotypies" (Thelen, 1979, p.711)

> "Piaget (1952), for example, calls kicking, banging, and rubbing movements 'secondary circular reactions', a necessary stage in cognitive development in which the infant repeats activities that have had an interesting effect on the environment." (Thelen, 1979, pp.699-700)

That implies, although stereotypical behaviors are mostly organized without important reference to the environment (see Berkson, 1967), stereotypical behavior may be elicited by extrinsic stimuli, such as finger flexion, if the infant sees his/her mother grabbing an object in her hand. Three-month-old infants are already sensitive to the action goals of others, when supported by previous motor experience (Sommerville/Woodward/Needham, 2005), and 6-month-old infants are sensitive to the action goals of others, when performed by a human agent (Woodward, 1998).

In addition, as we have seen, THELEN (1979) reported 'the number of different stereotypes showed a steady and consistent increase over the year' (see 1.3.2 on the preceding page). This could also be an indication for PIAGET's perspective, if one assumed that infants' increasing sensitivity for action goals of others lead to repeated imitation of these actions.

Generalized imitation serves as a powerful learning paradigm for the acquisition and developing of infants' social and linguistic behavior (Baer/Deguchi, 1985), and has been evoked in infants at 6 and 12 months of age (Kaye/Marcus, 1978; Kaye/Marcus, 1981). Moreover, it seems imitation is partly an innate reaction, when one considers that 3-42-hours-old infants already imitate facial expressions (Field et al., 1982b; Meltzoff/Moore, 1977).

That is what PIAGET pointed out with his term assimilation, 'in which the infant repeats activities that have had an interesting effect on the environment'. From this perspective, it seems that stereotypical behaviors, such as kicking, finger flexion, etc. are at least partly caused by immature sensorimotor patterns of this imitated extrinsic stimuli.

Temporal Patterning

> "Temporal pattern perception, which relates to the perception of rhythmic structure (Cooper & Myer, 1960) or grouping (Fraisse, 1978), involves the perception of absolute timing information, such as element duration and the silence interval between successive elements. It also includes the listener's ability to perceive relative timing information available in the stimulus pattern, that is to say, the position of a sound element relative to all other elements in the sequence (Martin, 1972)." (Morrongiello, 1984, p.441)

It was shown in the previous sections that young infants have the ability to incorporate extrinsic temporal patterns for the development of their own sensorimotor system. Furthermore, investigations on auditory grouping and segregation processes (Demany, 1982; Fassbender, 1993; McAdams/Bertoncini, 1997; Winkler et al., 2003; Smith/Trainor, 2011) and the duration illusion (Thorpe/Trehub, 1989), have revealed that infants group auditory information similary as adults. In terms of processing absolute and relative timing information, it was found that infants can perceive and operate such time-related information very early – between the 2nd month and the 5th month after birth (see Demany/McKenzie/E. Vurpillot. Nature, 1977; Krumhansl/Jusczyk, 1990).

In conclusion, infants' processing of complex auditory pattern seems well enough developed to structure auditory events temporally (see Demany, 1979; Arco, 1981; Arco, 1983), whether speech or music (see Trehub, 1989; Trehub/Trainor, 1993).

Infants' Ability to Temporally Predict Events

Do infants temporally predict extrinsic stimuli?

The ability to anticipate predictable stimuli are fundamental requirements for human survival since the origins of evolution, in order to be prepared to cope with various changes in the environment (see in this regard Roth, 2010). In addition, Lang et al. (1978), p.469 propose that "[...] states of expectation permit us to deal more effectively with subsequent stimuli, facilitating information intake as well as prompting more efficient and appropriate responding." However, to react suitable at extrinsic stimuli is in the most case the result of learning processes. As already discussed above, newborns are very sensitive to learning paradigms, such as associative learning (e.g. Fifer/Moon, 1989; DeCasper/Fifer, 1980), imitation (e.g. Anisfeld, 1991; Field et al., 1982a), classical conditioning (e.g. Crowell et al., 1976), and habituation (e.g. Slater/Murison/Rose, 1984). This section extends this perspective, and reviews investigations concerning newborns' and infants' ability to anticipate the temporal regularity of events and their interruption.

A possible explanation for such processes is based on the analysis of heart rate variations. Namely, it was observed in adults that conditioned anticipation processes can cause changes in the heart rate. But there has been very few experimental attempts to study any type of temporal conditioning in newborns and younger infants.

STAMPS (1977), for instance, tested auditory anticipations of 30 to 80-hours-old newborns in two groups, by repeating 2-sec sounds (90dB Buzzer) within 20-sec. intervals for the experimental group and randomly between 10 and 20-sec. intervals for the control group. In this test setup, it was possible to anticipate sounds for the first group, but not for the second group. In both groups, it was observed that the heart rate accelerate during the 10-sec. after the sound. But in contrast to the response of adults occurring before an anticipated stimulus (Coles/Duncan-Johnson, 1975; Bohlin/Kjellberg, 1979), no deceleration was recorded in the experimental group within the last 10-sec. of the interval. However, when the subsequent acoustic stimulus was omitted, a deceleration of the heart rate takes place in the experimental group. A similar observation was also recorded in CLIFTON's experiment (1974) concerning the auditory anticipation of 27 to 103-hours-old newborns. CLIFTON concluded that the deceleration after the absence of the next stimulus could be an indication for an orienting response to them.

> "Although the newborn infants did not anticipate or "get ready" for the UCS [unconditioned stimulus], they did show a "What happened?" or orienting response when the expected stimulus did not appear." (Clifton, 1974, p.17)

This suggests that newborns react to the omission of temporally predictable events, but cannot anticipate this event. There are some (but inconsistent) indications that such anticipation processes develop somewhat later in the period after the 2nd month of life (see Brooks/Berg, 1979; Davies/Berg, 1983; Haith/Hazan/Goodman, 1988).

Using heart rate responses, DONOHUE and BERG (1991) presented a clear evidence that 7-month-old infants can anticipate temporally predictable events. As seen in Figure 1.13, for all infants a white noise (S 1) was made audible for 15 sec. After S 1 was played 10 sec., a second stimuli S 2 (one of two animated percussive toys illuminated by Christmas tree lights in an enclosed box) occurred for the time of 2 sec. There were 20 trails, segmented in five blocks of four trails. As seen in Figure 1.14, after the third block of training, the heart rate decelerated slowly after the onset of S 1. This suggests that the infants had learned to anticipate the S2 stimuli.

> "[...] the present data provide evidence of [...] anticipatory HR responses in 7-month-old infants and indicate that an S1-S2 paradigm with a fixed ISI [interstimulus interval] is well suited for the study of future-oriented behavior in infants. This paradigm allows the observation of several aspects of future-oriented behavior in a manner that can provide converging measures of this type of cognitive activity." (Donohue/Berg, 1991, p.65)

In conclusion, it was tried to show that rhythmical structures are omnipresent for infants, and serve as important corner marks for the development of their own

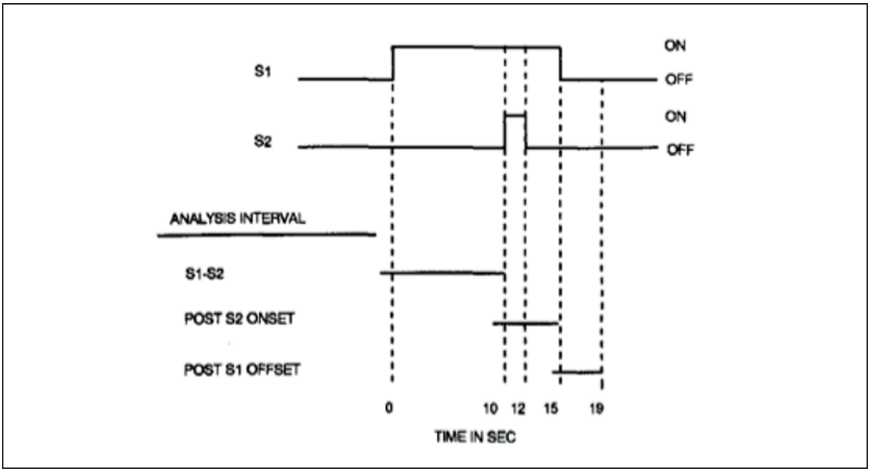

Fig. 1.13 "Stimulus timing sequence of a paired trial and heart rate analysis intervals. (S = stimulus.)" (Donohue and Berg, 1991, p. 61)

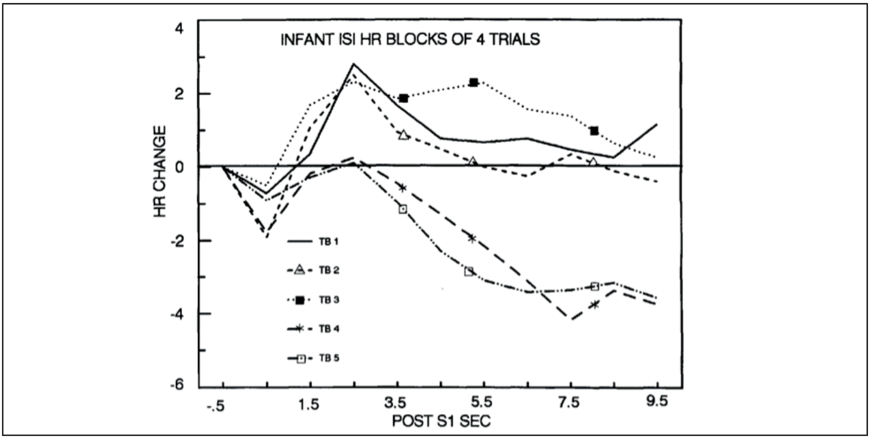

Fig. 1.14 "Infant heart-rate (HR) change over the S1-S2 interval for Trial Blocks 1-5." (Donohue and Berg, 1991, p. 62)

sensorimotor system. The ability to process such time-related information is moreover significant to "assimilate" extrinsic stimuli (such as imitation) from the environment. Besides grouping and segregation processes, the experience and practice of rhythmical structures, such as stereotypical behavior, seems to be a prerequisite for the development of temporal pattering. Noteworthy is that already between the 2nd and 7th month after birth, infants are able to anticipate auditory events temporally. All capabilities together provide the basis of infants rhythmic and/or temporal structuring of auditory events, as it is required for the processing of musical sequences (see 1.3.3).

1.3.3 *Processing of 'Musical' Sequences*

What is a musical sequence? From the physical perspective, it is a structured succession of individual tones. However, from the perceptual and cognitive perspective it is much more. As mentioned earlier (see 1.3 on page 46), it consists in the organization of detected and discriminated sounds and tones in 'meaningful segments', particularly guided by grouping processes, as an innate preference of the human mind (Shepard, 1981; Bregman, 1994), but also in the learned capability to handle time-related information, such as rhythmical patterns (see 1.3.2 on page 50).

However, segmentation of musical sequences is furthermore based on the perception of changes in pitch information, because "Pitch contour and temporal pattering [...] provide reasonable means for parsing the speech or musical stream into chunks appropriate for further processing." (Trehub/Trainor/Unyk, 1993, p.20) As we have seen, such 'chunks' are based on the perception and processing of rhythmic structures. Concerning 'pitch chunks', this section discusses when and how infants are able to perceive and recognize musical pattern based on the variation in pitch (e.g. changes in pitch contour, pitch contour in transposition to different pitch levels).

Pitch is one of the fundamental perceptual attributes of a musical sound, and is therefore also fundamental for perception and processing of melodies in music, or prosody in speech. As stated in the previous section (see 1.1 on page 27), neonates already can use prosodic information (characteristic pitch and rhythm patterns) to recognize their mother's voice (DeCasper/Fifer, 1980), mother's tongue, familiar melodies (Panneton, 1985), prosody of a familiar spoken text (DeCasper/Spence, 1986), and are sensitive to pitch contours in speech, and process contour information to categorize words (see Nazzi/Floccia/Bertoncini, 1998). It is also assumed that the processing of relative pitch information starts (and develops further) with exposure to speech and music, whereas processing of absolute pitch is available very early (Sergeant/Roche, 1973; Saffran/Loman/Robertson, 2000). However, infants younger than 4 months cannot process the pitch of complex tones if the fundamental frequency is missing (see 1.2.2 on page 42).

PLANTINGA and TRAINOR (2005) found indications that 6-month-old infants primarily use relative pitch information when they store melodic sequences in their long-term memory.

> "The results of this study suggest that by 6 months of age infants, like adults, store melodic information primarily according to a relative and not an absolute pitch code in long-term memory. After a delay of 1 day, infants at 6 months recognized a familiar melody although it was presented at a new pitch, and recognition was as good for transpositions to related as to unrelated keys. [...] infants showed no preference for listening to a transposed compared to a non-transposed version of a familiar melody." (Plantinga/Trainor, 2005, p.8)

A more recent study (Tew et al., 2009) explores whether 6-month-old infants really store melodic information in the same way as adults. By using the electroencephalography technique (EEG), the study concerns melodic encoding in the auditory cortex between infants and adults. The scientific background for this comparison was the observation that "[...] in adults, MMN responses are also elicited by occasional changes in a melody, even when the melody is presented in transposition to different pitch levels from trial to trial (Trainor/McDonald/Alain, 2002; Fujioka et al., 2004)." (Tew et al., 2009, p.287)

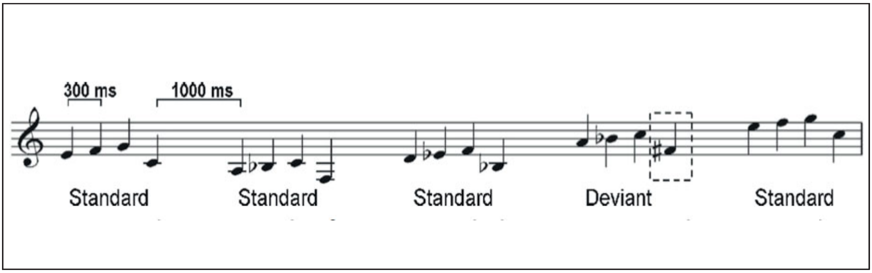

Fig. 1.15 "Stimulus: 600 trials of a 4-note melody were presented, transposed to one of 20 different starting notes between G3 and D5, such that successive transpositions were to related keys (up or down by a Perfect 5th, 7/12 octave, or Perfect 4th, 5/12 octave). On deviant trials (20% of trials, separated by at least two standard trials) the fourth note was raised by a semitone." (Tew et al., 2009, p.288)

In this test setup, infants (6-month-old) and non-musician adults (21-29-years-olds) listened 600 times a 4-note melody, in 20 different random transpositions with successive melodies in related keys (as seen in Figure 1.15). It was detected that "[...] 6-month-old infants, like adults, encode melodic information in terms of relative pitch distances, but that the underlying cortical activity differs significantly from that of adults. [...] adults show a right, frontally negative MMN similar to that of previous studies (Trainor/McDonald/Alain, 2002; Fujioka et al., 2004), whereas 6-month-old showed an extended right frontally positive response. A similar slow positive wave has been reported previously in younger infants for simple pitch changes (He/Hotson/Trainor, 2007; He/Hotson/Trainor, 2009) [see also 1.2.2 on page 42]. The present results indicate that this immature response persists for longer in the case of more complex melody processing. The results corroborate previous behavioral studies showing relative pitch representation in infants (Chang/Trehub, 1977; Plantinga/Trainor, 2005; Trainor, 2005; Trainor/Trehub, 1992), but show that this representation differs substantially from that of adults. Pitch representation in the auditory pathway is not achieved until auditory cortex, and processing relative pitch involves further interactions with parietal and frontal areas (Itoh et al., 2004; Warrier/Zatorre, 2004). These connections may remain immature at 6 months." (Tew et al., 2009, p.289)

Finally, we can summarized that 6-month-old infants process musical sequences, but not at the adult level. Although infants at this age have the ability for 'temporal pattering' (see 1.3.2 on page 52) and to 'predict events temporally' (see 1.3.2 on page 52), the 'measured cortical activity to encode melodic information in terms of relative pitch information, differs significantly from that of adults'. However, infants are very sensitive in perceiving various pitch information, such as pitch contour, prosody, virtual pitches (see Terhardt, 1974), etc., and use relative pitch information, 'when they store melodic sequences in the long-term memory'.

1.4 The Evolving Musical-Artistic Competence From Infancy to Adulthood

The aim of the last sections (2.1 - 2.3) is to tackle important questions concerning: first, are there music-relevant predispositions in fetuses; second, are infants sensitive to acoustic parameters of music; and third, do infants possess capabilities to segment acoustic parameters mentally.

The present section falls more into the second part of the subtitle 'Between Predisposed Structures and Musical Experience', in that it intends to outline the development of musical-artistic competence[17] caused by experience and practice. Because, such competences are at first cultural phenomenona, social and educational contexts have to take into account individual psychological developments. Social and educational contexts are a-priori bound up with the preceding. An indication for a very early influence of social contexts in humans psychological development seems to be that already infants are already attracted to and 'learn' products of culture, such as the preference for their mother's voice (DeCasper/Fifer, 1980), and for their mother's tongue (Mehler et al., 1988). Moreover, infants' sensitivity for various learning paradigms (see 1.1.3 on page 33), suggest that cultural conditions already characterize the psychological development in the infancy.

[17] Musical-artistic comptences include for example, singing, symbolic representation of music, understanding of stylistic variations, composition of music, or perception of emotion in music.

This section follows this line of thought, and starts with a child in a social-cultural environment perspective, reviewing the contribution of PIAGET, as one of the founding fathers of the developmental and educational psychology, as well as NEO-PIAGETIAN researches. Subsequently, we have reviewed and compared three theoretical models involved in explaining musical development, to gain more insight in different perspectives of children's evolving musical-artistic competence.

1.4.1 *Child Development in a Social-Cultural Environment - the perspective of Piaget and Neo-Piagetian*

Recent investigations concerning infants' socialization (Papousek, 1996; Trehub, 2001; Trehub, 2003), suggest that musical competences result from the interaction between infants' biological predispositions (see sections 2.1 - 2.3), and the social environment. In this way, the social-cultural environment (e.g. parents, family member, teacher, etc.) seems to form a basis for children's psychological development, such as musical-artistic competences. This perspective has a long tradition in developmental psychology. PIAGET already highlighted the social-cultural environment[18], as an important factor for infants during their psychological development.

> "The human being is immersed right from birth in a social environment which affects him just as much as his physical environment. Society, even more, in a sense, than the physical environment, changes the very structure of the individual." (Piaget, 1973, p.156)

To be more precise, PIAGET suggested a model of cognitive development from infancy to childhood, which tried to explain the development of interactions between biological predispositions and the social environment, including gradual 'stages' of psychological development. To sketch such a developmental process, PIAGET (1970) proposed three factors (biological maturation, activity, social experiences), and three basic tendencies of thinking (organization and adaptation, and equilibration) which influence changes in children's thinking.

- *Biological Maturation:* Innate sensory structures and motor responses are the first tools to interact with the environment. As we have seen in previous sections, there are behavioral changes during the infancy, which are based on biological changes of the nervous system. In addition, HUDSPETH and PRIBRAM (1990) measured children's direct brain activity, and found indications for regional development changes that are consistent with PIAGET's perspective.

[18] However, VYGOTSKY is considered as the main initiator of the socio-cultural perspective (see in this regard Woolfolk/Hughes/Walkup, 2008).

> "Those areas of the brain most associated with perceptual input and physical control, for instance, showed their greatest development during the first few years, whereas those most associated with higher-level processes showed a major increase in late adolescence." (Long et al., 2011, p.37)

- *Activity:* A fundamental assumption of PIAGET's theory is an *intrinsic activity* of infants and children. That means, they are not "[...] passive creatures waiting to be stimulated by external forces before they respond, but are themselves the prime movers and shakers of their world. They actively seek stimulation, initiating action on objects and people who come in contact with them. Thus, the motivation to learn and to develop is within the child." (Pellegrini/Bjorklund, 2009, p.125)

> "With physical maturation comes the increasing ability to act in the environment and learn from it. When a young child's coordination is reasonably developed, for example, the child can discover principles about balance by experiencing with a seesaw." (Woolfolk/Hughes/Walkup, 2008, p38.)

- *Social Experiences:* Children's individual development is highly influenced by social experiences, or learning from the environment.

> "The speed of development, however, can vary from one individual to another and also from one social environment to another; consequently, we may find some children who advance quickly or others who are backward, but this does not change the order of succession of the stages through which they pass." (Piaget, 2008, p.41)

Founded on his research in biology, PIAGET suggested three basic tendencies (organization, adaptation, and equilibration) or 'invariant functions' of thinking, which are innate to all species (see Piaget, 1975 (1959)).

- *Organization:* This principle states that all perceptions, thoughts, and behaviors are grouped, combined, arranged, etc. into coherent 'schema' systems.

> "People are born with a tendency to organize their thinking processes into psychological structures. These psychological structures are our systems of understanding and interacting with the world. Simple structures are continually combined and coordinated to become more sophisticated and thus more effective. Very young infants, for example, can either look at an object or grasp it when it comes in contact with their hands. They cannot coordinate looking and grasping at the same time. As they develop, however, infants organize these two separate behavioral structures into a coordinated higher-level structure of looking at, reaching for and grasping the object. They can, of course, still use each structure separately (Flavell, Miller and Miller, 2002; Miller, 2002)." (Woolfolk/Hughes/Walkup, 2008, p.39)

> PIAGET understands schema as basic sets of experiences and knowledge, which result from acting in the environment and grow through individuals' lifespan. These schemes can be modified, if it makes sense in a new experience. Indeed, this constructivist perspective of psychological development is similar to later approaches (called schema-theories) to study adult cognition, although subsequent schema theorists consider themselves in the

> tradition with the work of BARTLETT (1932). He described schema as "[...] unconscious mental structures and processes that underlie the modular aspects of human knowledge and skill. They contain abstract generic knowledge that has been organized to form qualitative new structures. Schemas are modular-different cognitive domains have schemas with different structural characteristics." (Bartlett, 1932, p.141) Both, subsequent schema theorists[19] and PIAGET consider schema as an important organizing function, which reduce environmental complexities to make thinking and action efficient (see in this regard Taylor/Crocker, 1981).

- *Adaptation:* PIAGET suggested that children constantly modify their existing 'schemes' into more adaptive structures. That is to say: the purpose of *Organization* is *Adaptation,* which means to adapt the current environmental conditions, or/and to respond appropriately. He divided adaptation in two processes called assimilation and accommodation. The first can be described as transforming new information in a certain manner, whereby it is compatible with existing ways of thinking. In the second process, accommodation, preexisting structures are changed or reorganized to integrate new experiences[20].
- *Equilibration:* Assimilation and accommodation are complementary processes of cognition, aiming at a cognitive balance, or *equilibration* with the environment.

> "Piaget assumed that people continually test the adequacy of their thinking processes in order to achieve that balance. Briefly, the process of equilibration works like this: if we apply a particular scheme to an event or situation and the scheme works, then equilibration exists. If the scheme does not produce a satisfying result, the disequilibrium exists, and we become uncomfortable. This motivates us to keep searching for a solution through assimilation and accommodation, and thus our thinking changes and moves ahead." (Woolfolk/Hughes/Walkup, 2008, p.40)

Piaget's Stages of Cognitive Development

PIAGET concluded from his observations that the cognitive development of children takes place in four qualitatively different stages. As seen in Figure 1.16, these are *sensorimotor*, *pre-operational*, *concrete operational*, and *formal operational*. As already stated earlier (see 1.4.1 on the previous page), he argued that every child passes through these stages in a fixed sequence. The time which a child takes to pass stages can vary in duration, because of dependence on most influential factors: *social environment*, *activity*, and *biological maturation* (see 1.4.1 on page 58). In the following discussion, these four stages will be outlined briefly[21].

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[19] For example, ROSCH and MERVIS (1975), MINSKY (1975), SCHANK and ABELSON (1977), and ANDERSON (1983)

[20] For detailed information about assimilation and accommodation see (Piaget, 1952).

[21] For more information see (Piaget, 1950; Piaget, 1952; Piaget, 1954/1981)

Stage	Approximate age	Characteristics
Sensorimotor	0–2 years	Begins to make use of imitation, memory and thought. Begins to recognise that objects do not cease to exist when they are hidden. Moves from reflex actions to goal-directed activity.
Preoperational	2–7 years	Gradually develops use of language and ability to think in symbolic form. Able to think operations through logically in one direction. Has difficulties seeing another person's point of view.
Concrete operational	7–11 years	Able to solve concrete (hands-on) problems in logical fashion. Understands laws of conservation and is able to classify and seriate. Understands reversibility.
Formal operational	11–adult	Able to solve abstract problems in logical fashion. Becomes more scientific in thinking. Develops concerns about social issues, identity.

Fig. 1.16 "Source: From *Piaget's Theory of Cognitive and Affective Development* (5th ed.) by B. Wadsworth. Published by Allyn and Bacon, Boston, MA: 1996 by Pearson Education" (Woolfolk et al., 2008, p.40)

- *Sensorimotor*: PIAGET assumed that children's cognitive development starts from basic reflexive actions, such as sucking. Sensory inputs and primitive motor abilities are coordinated to organize sensorimotor pattern, such as stereotypical rhythmical behaviors (see 1.3.2 on page 50). From these primitive sensorimotor 'schemes', [...] basic programs of intelligent behaviour develop, called *circular responses* [highlighted by the author], which eventually give rise to verbal intelligence and thought (Piaget, 1952)." (Cockcroft, 2009, p.328) Circular responses are divided in six sub stages: *simple reflexes*, *primary circular responses*, *secondary circular responses*, *coordinated secondary circular responses*, *tertiary circular responses*[22]. At the end of the sensorimotor period, children develop, first, an action-goal activity, and, second, an 'object-permanence'. According to PIAGET, the latter is considered as one of the most important accomplishments in this stage of development, because children can understand that objects continue to exist even when they are not audible, visible, or touchable.
- *Pre-Operational*: In this stage, children are most ego-centric, which means they can only see things from their own point of view. In addition, animalism is characteristic in this stage. They believe that everything that exists has a kind

[22] For detailed information about these sub-stages see (Cockcroft, 2009, pp. 328-332).

of consciousness, of soul, or can feel. Pre-operational also means that, although thinking skills develop, children at this stage do not understand concrete logic, but can think in symbolic forms. At around 5 years of age, “[...] the child is less egocentric and much better at classifying objects on the basis of perceptual categories such as size, shape and color. Piaget called the child’s thinking at this stage *intuitive* because his understanding of objects and events still centres on their single most important characteristic, rather than on logical or rational thinking.” (Cockcroft, 2009, p.333)

- *Concrete Operational*: According to PIAGET, children between 7 - 11 years old can think more rationally and ’adult-like’, such as in ’reversible mental actions’ on concrete objects, but not on abstract objects. In addition to reversibility, important skills acquired during this stage are: de-centering; seriation; class inclusion; transitivity; invariance, and conservation (see in this regard Piaget, 1973).
- *Formal Operational*: At around 11 - 16 years of age, children develop the ability to logically handle with abstract concepts. A keyword is deductive reasoning: PIAGET believed that hypothetical and deductive reasoning develop through this stage of cognitive development. This is important to think more scientifically, but also to consider possible consequences of their own actions on the environment.

Finally, although PIAGET’s theory existed over half a century, and still influences the developmental psychology, some of its central tenets are criticized, or nowadays rejected.

For example, the question whether the cognitive development proceeds in stages is still controversial. Some researcher agree with PIAGET’s perspective that cognitive development is coherent and progresses through ’stages’ (see Hudspeth/Pribram, 1990; Flavell/Miller/Miller, 2001). Other scientists disagree, and do not believe that children’s intellectual development proceeds in holistic structures, but argue “[...] that cognitive development is a complex, multifaceted process in which children gradually acquire skills in a wide range of areas such as visual spatial ability, mathematical reasoning, verbal reasoning, and so on (Bjorklund, 2005).” (Cockcroft, 2009, p.341)

> “Perhaps the clearest consensus is that very few contemporary psychologists place the same emphasis as Piaget on the role of logical operations – the notion that thinking strives towards higher levels of logic, or scientific analysis – and this is particularly true for the explanation of development in an artistic domain such as music.” (North/Hargreaves, 2008, p.318)

In recent decades, various subsequent theorists – known as NEO-PIAGETIAN – have studied PIAGET’s theory and the criticism it raises, with the purpose of developing alternative mechanisms and models in order to explain changes in children’s cognitive development.

Neo-Piagetian Approaches of Cognitive Development

NEO-PIAGETIANS kept certain of PIAGET's concepts and conclusions – such as that children's cognitive development progress in a series of stages or levels –, but they also disagree with some of his suggestions, and have developed slightly different perspectives of cognitive development. This section will give a brief overview which principles of PIAGET are preserved, and which are altered or newly developed.

Virtually all NEO-PIAGETIANS have respected five basic concepts of PIAGET (Case, 1992a). First, they focused on children's cognitive structures; second, they assume that "[...] cognitive structures are actively created by learners who construct and build knowledge rather than merely store verbatim information as if one were an audio or video recorder." (Knight/Sutton, 2004, p.49); third, four different structural development levels of children are distinguished; fourth, "[...] hierarchical inclusion of earlier structures in later ones [...]. Thus, for any given achievement at on stage (e.g. imitating the line drawn by an adult), it is always possible to indicate two precursor insights at the previous stage from which this achievement has been constructed (e.g. understanding how to make a mark with a pencil or crayon, and understanding the spatial relationship between a straight line and edge of a paper." (Case, 1992a, p.183); and fifth, development and changes of children's cognitive structures are related to their ages.

NEO-PIAGETIANS extend PIAGET's theory in some other aspects (Case, 1992b; Case, 1992a). For example, PIAGET suggested earlier (Piaget, 1950; Piaget, 1952) that changes of cognitive structures take place as 'structures d' ensemble', or as whole. In his later work (Piaget, 1985), he proposed that developmental processes take place in a more domain-specific manner. Most of NEO-PIAGETIANS (FISCHER, 1980; PASCUAL-LEONE, 1987; FISCHER/KENNY/PIPP, 1990; CASE, 1992B; DEMETRIOU/EFKLIDES/PLATSIDOU, 1993; FELDMAN, 1994) used this foundation, but focused more than PIAGET on characteristics of domain-specific changes of cognitive processes. They assume that variability in the development of children across cognitive domains and environmental contexts is the rule, rather than the exception (see Fischer/Farrar, 1987). In contrast to PIAGET, NEO-PIAGETIANS (see in this regard Commens/Richards/Armon, 1989; Labouvie-Vief, 1992; Case, 1992b; Kitchener et al., 1993) also studied adolescents and adults, and have noticed the same variability in the development of cognitive domains, and have defined further levels of abstract thinking[23].

In addition to specific knowledge domains, the environment in which the learning takes place is also important for individual development. NEO-PIAGETIANS

[23] For detailed information (seeFischer/Yan/Stewart, 2002).

believe that learning[24] and development[25] takes place in different tempi across cognitive domains, caused by the influence of the environment (see Labouvie-Vief, 1992).

> "Moreover, neo-Piagetians typically consider co-constructive processes involving the collaborative efforts of two or more learners to be vital to complex, integrated learning and development, and as central to the development of new learning in adults as it is in children. Moreover, these learning processes are contextually sensitive in that new learning is most robust in the context in which it was constructed. Conversely, as learning context and processes vary from the original one, new learning becomes increasingly fragile and potentially difficult to access at all at times." (Knight/Sutton, 2004, p.51)

Besides 'co-constructive processes' also other contextual influences (e.g. family, teacher, opportunities for practice, etc.) also support the development of cognitive domains, and probably lead to faster cognitive development: assuming that the best environmental conditions are given for learning processes[26], a learner can perform at the 'optimal level of learning'.

It can be summarized that Neo-Piagetians accept concepts of PIAGET's theory of cognitive development, and incorporate different theoretical approaches from their own researches, such as CASE (1985), who "[...] emphasizes that both working memory capacity and information processing efficiency play a major role in cognitive processing." (Chen/Hancock, 2011, no page numbers) Furthermore, they focus directly on the improvement of educational techniques (see Demetriou/Shayer/Efklides, 1992), presuming that cognitive development progresses in form of changes in cognitive structures, which are highly influenced by, first, domain-specific processes, and second, environmental contexts.

1.4.2 Three Models of Musical-Artistic Development

We now explore the perspective that, first, children's abilities and behaviors are the result of their own 'biological maturation' in relation with an expanding capacity to interact with their environment, and, second, that this progress makes it possible to speculate about further developmental processes[27]. This section concerns, first,

[24] In the original theory of PIAGET, learning is considered as assimilation.

[25] In the original theory of PIAGET, development is considered as accommodation.

[26] See in this regard the concept 'zone of proximal development' (Vygotsky, 1978).

[27] "We learn to walk before we can run, to stand up before we can do either, to imitate before we utter original statements, to become capable of sexual reproduction only when adolescence is reached. Of course, each person imposes his or her own style on these developmental processes, but that there is development and that there are at least broad patterns of development are facts beyond dispute. Furthermore, it seems important, especially for teachers and parents, to have

a review of three major theories of musical development, and second, discusses relationships and distinctions amongst these theories, with the purpose of presenting slightly different perspectives of children's evolving musical-artistic competence.

1.4.2.1 Hargreaves 'Five Age-Related Phases in Musical-Artistic Development'

A model originally proposed by HARGREAVES and GALTON (1992), and revised by HARGREAVES (1996), described five age related phases in musical-artistic development[28] of children, namely: *sensorimotor*, *figural*, *schematic*, *rule systems*, and *professional*. This work is often linked to aspects of PIAGET's theory of cognitive development explained above. For example, as PIAGET, HARGREAVES also proposes that musical development starts from sensory-motor schema. Another link is the focus on cognitive mechanisms:

> "Cognitive schemes are one way of describing the thinking processes that underlie different aspects of musical behaviour – perception, performance, literacy, and production – and they enable explanatory links to be made between these different aspects." (Hargreaves, 1996, p.154)

But on the other hand, HARGREAVES does not understand cognitive schemes primarily as logical operations, because 'this may be very inappropriate in the arts'. Furthermore, he points at an important terminological problem concerning 'stages of development', as used by PIAGET, because the term 'stages' expresses a certain functional coherence. In contrast, HARGREAVES describes musical development in 'phases' as "[...] a rough and ready map, drawn at a very broad level of generality, of development in these areas. It is 'rough and ready' in the sense that there is huge scope for individual variation within each developmental phase." (North/Hargreaves, 2008, p.335)

Specifically, HARGREAVES focuses on the development of musical-artistic competences – *singing*, *musical representation*, *melodic perception*, and *composition* – in relation to his proposed phases – *sensorimotor*, *figural*, *rule systems*, and *professional*.

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some understanding, of this, a set of expectations that corresponds to the maturation of children in their care." (Swanwick/Tillman, 1986, p.305)

[28] Development of competences: singing, musical representation, melodic perception, and composition.

Phase	Age (years)	Singing	Graphic representation	Melodic perception	Composition
Professional	15+				Enactive and reflective strategies
Rule systems	8–15	Intervals, scales	Formal-metric	Analytic recognition of intervals, key stability	'Idiomatic' conventions
Schematic	5–8	'First draft' songs	Figural-metric: more than one dimension	Conservation of melodic properties	'Vernacular' conventions
Figural	2–5	'Outline' songs; coalescences between spontaneous and cultural songs	Figural: single dimension	Global features: pitch, contour	Assimilation of cultural music
Sensorimotor	0–2	Babbling, rhythmic dancing	Scribbling: 'action equivalents'	Recognition of melodic contours	Sensory, manipulative

Fig. 1.17 "Five phases of musical development (adapted from Hargreaves and Galton 1992)" (Hargreaves, 1996, p.156)

The Sensorimotor Phase

He suggested that "[...] the most of the major developments in the first 2 years of life involve the practice and development of physical skills and co-ordinations, and these are largely 'presymbolic' in the sense that abstract symbolism – the capacity to mentally conceive of or represent an object in its physical absence – is not present." (Hargreaves, 1996, p.157) In this way, it seems unlikely that infants have musical representations in this phase, but musical representations are later rooted in sensorimotor developments. HARGREAVES presented indications for this perspective, namely *scribbling: 'action equivalents'*[29]. Based on GOODNOW's (1971) observation that scribbling on a paper matches the timing of sounds being heard currently, HARGREAVES conceptualizes these movements as beginning attempts to represent musical stimuli.

Another competence, *musical composition,* refers to infants' increasing control about musical instruments if they produce sounds. He observes that interaction with musical instruments 'shift from sensory to manipulative behaviour' in the sensorimotor phase, [...] from exploration of the means of producing sounds towards an increasing control of the techniques of doing so. Infants' early fascination with variation of dynamic levels, as shown in 'strumming' on different instruments, gradually gives way to a more organized exploration of pitch, rhythm, and timbre." (Hargreaves, 1996, pp.157-158) In terms of the *singing* competence, he suggests that infants develop an increasing activity of 'vocal play and babbling', as well as 'rhythmic dancing' within the first 2 years of life. As mentioned earlier (see 1.3.2 on page 50), stereo-rhythmical behaviors, as well as perceptions of self

[29] See Figure 1.17 at 'Graphic representation'.

produced rhythms (sucking, respiratory, etc.), and environmental rhythms, seem to be prerequisites for the development of temporal patterning, as it is used for singing competences. Finally, HARGREAVES highlights the perception of changes in melodic contour as an important ability for *melodic perception*:

> "First, contour is a critical feature of early musical perception; infants seem to use a 'global' processing strategy in which the broad shapes of melodies are extracted from their local details. Second and third, this contour information seems to be extracted from melodies regardless of variations in intervals and extract pitches, respectively; these do not yet appear to be critical in defining melodies. Fourth, however, interval changes can be detected in transposed sequences under certain conditions: and when this does occur, performance is best in sequences that conform to Western diatonic structure. Fifth, as with melodic memory, infants also seem to be able to recognize basic similarities between rhythmic sequences, and to do so irrespective of changes in the tempo of those sequences." (Hargreaves, 1996, .158)[30]

The Figural Phase

In this phase, children acquire abilities to represent objects, people or symbolic situations, which have implications to their graphic representations of these stimuli, "[...] they depict the overall shapes or outlines of the subjects or the drawings, but the detail within them are not yet accurate." (Hargreaves, 1996, p.159) Following this perspective, HARGREAVES uses BAMBERGER's (Bamberger, 1982; Bamberger, 1991; Bamberger, 1994) distinction between 'figural' and 'metric' representations of music[31], and proposes that "[...] 2–5-year-olds are more likely to make 'figural' than metrically accurate representations simply because of their level of development, and that these may well incorporate some metrical inaccuracy." (Hargreaves, 1996, p.161) Based on studies on the development of singing (Dowling, 1984; Davies, 1992; Davidson, 1994), HARGREAVES proposes that a development towards 'articulate and recognizable songs' is performed in this period. This implies, first, that children spontaneously mix together elements from different familiar songs (see Moog, 1976). Second, that 3-years-old children can produce different pitches, but without stability and coherence as adults do. And third, "[...] by the age of 5 years or so, individual contours and intervals are reproduced accurately, but it is not until the schematic and rule systems phases that the parts of a song are organized into coherent wholes." (Hargreaves, 1996, p.162)

[30] For detailed information about infants' melodic perception see 1.2.2 on page 40; 1.3.3 on page 55.

[31] "A figural drawing was described as one that conveyed the overall two-part shape or 'figure' of the sequence, which was seen as demonstrating an appreciation of musical expressiveness and a *metric* drawing as one that accurately conveyed the number of claps, but that did not convey its musical sense to the same way." (Hargreaves, 1996, p.159)

The Schematic Phase

At about the age of 5 years, children are able to schematically recognize and use artistic conventions. This means, first, that they use artistic conventions as adults do, and, second, a set of self-invented conventions, "[...] but these are not yet integrated into a coherent sense of style. In their musical compositions, correspondingly, Swanwick and Tillman (1986) suggest that children develop 'vernacular conventions', such as the use of simple melodic and rhythmic ostinati, in striving towards a coherent idiom." (Hargreaves, 1996, p.162) Concerning *musical representation*, HARGREAVES refers to results of DAVIDSON and SCRIPP (1988), which have revealed that between 5 and 7 years old, one observes a development from representing a 'single dimension' of music[32] towards 'figural-metric' dimension of music. This increasing competence called 'relation of systems' was also observed in other studies. For example, TREHUB ET AL. (1985) observed that children can also identify the song 'Happy birthday to you' even if pitch intervals and melodic contour were changed. Probably the most meaningful indication for growing schematic thinking during this period can be seen in children's recognition of tonality and harmony (see in this regard Imberty, 1969), "[...] which has investigated phenomena such as children's preference for consonant chords and intervals over dissonant ones, and their ability to recognize musically appropriate modulations and key changes." (Hargreaves, 1996, p.163)

The Rule System Phase

In this phase "[...] approximately between the ages of 8 and 15 years, the accurate use of artistic conventions becomes established: works can be produced and perceived with full adherence to adult conventions of style and idiom in literacy, graphic, musical, and other domains." (Hargreaves, 1996, p.164)

The Professional Phase

HARGREAVES refers to individuals which have fully acquired musical conventions, and are able "[...] to transcend them, producing works that display independence from conventional styles, and the capacity of self-reflection in relation to them. This advanced position, [...] acknowledges that there are no absolute standards in art – that there is a sense in which rules exist in order to be broken." (Hargreaves, 1996, p.165) Such individuals are, for example, composers, such as Stravinsky, Debussy, and Coltrane, etc, who have created new genres through their

[32] Usually, the rhythm dimension.

’important part of real-life creativity’ (see in this regard Sloboda, 1988). Based on findings of DAVIDSON and WELSH’s study (1988), they suggest that important features for music composition in this phase are ’enactive and reflective strategies’.

1.4.2.2 Swanwick and Tillman’s Model of ’Developmental Spiral’

SWANWICK’s and TILLMAN’s model of musical development “[...] centers on the idea that play, a very important human activity, is intrinsically bound up with all artistic activity, the early and obviously playful activities of children being sublimated into activities such as painting pictures, playing music and reading novels.” (Swanwick/Tillman, 1986, p.306) This constitutes the most important background for their theory, based on 745 musical compositions of 48 children, collected over a period of four years.

> “We define ’composition’ very broadly and include the briefest utterances as well as more worked out and sustained invention. Composition takes place when there is freedom to choose the ordering of music, without notational or other forms of detailed performance instruction. Others may prefer to use the terms improvisation, invention or ’creative music’. All of these fall within our definition of ’composition’. The advantage of this approach is that we are observing relatively undirected musical processes rather than the products of polished performances, directly influenced by teachers and peers.” (Swanwick/Tillman, 1986, p.311)

As seen in Figure 1.18, compositions having similar properties were grouped together in four layers of musical thinking: *materials*, *expression*, *form*, and *value*.

> “Further evaluation of the compositions led to seeing that on each of four levels there was a transformation from assimilatory, personal response to music (the left side) to accommodatory ‘social sharing’ (the right side). [...] The developmental spiral thus consists of eight ‘modes’ of musical functioning, two on each layer or level.” (Swanwick, 2001, p.235)

In order to get an overview of SWANWICK’s and TILLMAN’s conception of children’s musical-artistic development, let us summarize the eight developmental modes appearing on their spiral[33].

Sensory

In this mode, children are fascinated with the ’impressiveness of sounds’. They experiment with all kinds of sound sources, such as the unusual use of conventional instruments. But their actions “[...] are fairly unorganised, pulse is unsteady and

[33] For detailed information see (Swanwick/Tillman, 1986).

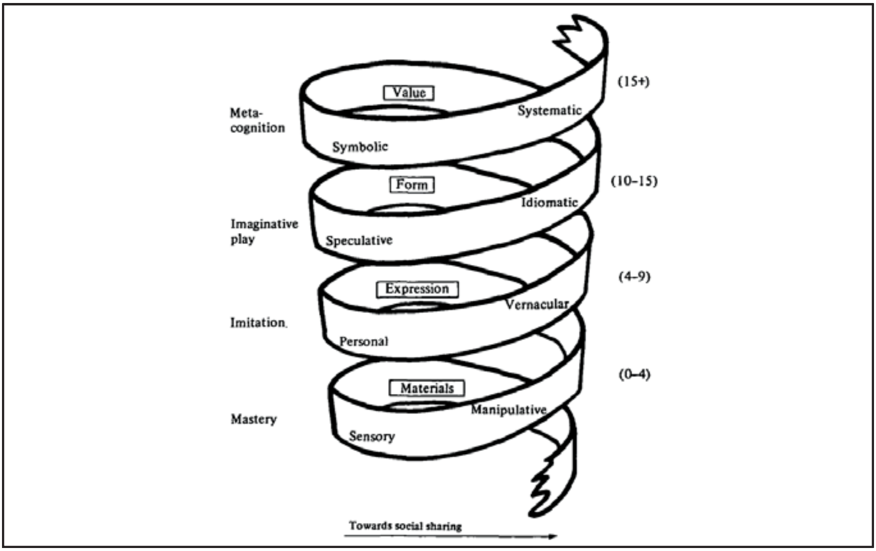

Fig. 1.18 Spiral sequence of musical development (from Swanwick and Tillman, 1986, p.331)

variations of tone colour appear to have no structural or expressive significance. The activities of children up to about 3 years have this character of unpredictable sound exploration." (Swanwick/Tillman, 1986, p.332)

Manipulative

Children acquire an increasing control about techniques in using musical instruments and sound sources. Furthermore, there is a development towards the control of a steady pulse, as well as a growing interest to timbre "[...] and the other surface effects of sound shifts towards the control of particular devices, such as glissandi, scalic and intervallic patterns, trills and tremolos." (Swanwick/Tillman, 1986, p.332) But, compositions are mostly long and 'rambling' in this mode.

Personal

'Personal expressiveness' is mostly determined "[...] through the exploitation of changes of speed and dynamic level, climaxes being created by getting faster and louder. Signs of elementary phrases (musical gestures) appear." (Swanwick/

Tillman, 1986, p.332) But a tendency exists that such musical gestures are routed from 'immediate feeling experience of the child', with 'little structural control'.

Vernacular

In the *vernacular* mode "[...] children seem to have entered the first stage of conventional music-making." (Swanwick/Tillman, 1986, p.332) This is because, first, children compose more melodic and rhythmic patterns including repetitions; second, musical conventions appear, such as musical phrases; and, third, metre gets more significant in 'little sequences of melody and rhythm'. Thus, one can often predict what the child will compose.

Speculative

At about 10-years-old, children have control about musical pulses and phrases and start using 'imaginative deviation' or variation of repeated patterns. This "[...] points to much greater experimentation, a willingness to explore the structural possibilities of music and to contrast with and vary an established motif or melody." (Swanwick/Tillman, 1986, p.333) Surprising structural moments also occur in this period, but without coherent meaning, such as a given musical style.

Idiomatic

In children's further development, surprising moments get to be more integrated into a 'particular style'.

> "Technical, expressive and structural control begins to be established reliably over longer periods of time. There is a strong tendency to move towards what children regard as a 'grown-up' musical style or idiom. The world of popular music is especially influential here. Previous tendencies to work in a speculative way outside the conventions of metre and melody can be suppressed." (Swanwick/Tillman, 1986, p.333)

Symbolic

> "The Symbolic mode of experience is distinguished from previous levels by the capacity to reflect upon the experience and to relate it to growing self-awareness and developing value-systems." (Swanwick/Tillman, 1986, p.333)

A foundation for this are children who seek to enter idiomatic musical communities. Hence, "[...] a strong personal identification with particular pieces of music, even turns of phrase and harmonic progressions. [...] At the Symbolic level there is a growing sense of music's affective power and a tendency to become articulate about this experience. Musical values become more idiosyncratic and commitment to music is frequently based on an intensity of experience that is felt as unique and highly significant." (Swanwick/Tillman, 1986, p.333)

Systematic

Finally at the systematic level, SWANWICK and TILLMAN propose that musical novices have evolved into a 'fully fledged musical person[s]'.

> "There is consciousness of the stylistic principles underlying the chosen idiom(s). There is the beginning of aesthetic speculation and the possibility of creating new 'systems'. Musical composition may be based on general principles of consciously organised groups of musical materials (such as the use of the whole-tone scale, serialism, electronically generated music and so on). Musicians and others often feel the need to write and talk about these processes, often in a philosophical way. Even if they do not, we can still find evidence of a strong value commitment to music which involves expanding musical possibilities in a systematic way." (Swanwick/Tillman, 1986, p.334)

1.4.2.3 Schubert and McPherson's Model of Emotion Perception in Music

SCHUBERT and MCPHERSON's proposal (2006) observes another important dimension of development: how perception of emotion in music evolves from infancy to late childhood.

That emotions and musical structures will be connected while listening to music is common sense, since MEYER's (1956) landmark. This evidence was expanded by various later perspectives (e.g. Juslin/Sloboda, 2001; Huron, 2006). Therefore, it can be assumed that perception of emotional information is an important factor for the development of musical-artistic competences, because it appears likely that emotion and cognition are two sides of the same coin of elaboration (see **?**,). In this way, SCHUBERT and MCPHERSON outline a development of emotion-related processes during the childhood, which are involved in processes of children's acquiring music-knowledge in a given culture.

> "The theoretical position we propose is that throughout childhood different forces work parallel in a spiral manner and that decoding emotional information from music is a dynamic combination of one-to-one (veridical) connections and general (schematic) associations." (Schubert/McPherson, 2006, p.194)

Their perspective assumed some implicit definitions about emotions in general, and are furthermore based on definitions of emotions connected with music, which must first be explained briefly.

> "Emotions are often connected with other actions, associations, behaviours, and environmental stimuli. For example, Lang (1979) demonstrated how emotions can be triggered through a network of interacting nodes representing the emotion inducing stimulus (such as seeing a snake), the representations of physiological states (increased heart rate) and the associated thought patterns that occur as a result (such as running away). Bower (1981) further developed this way of understanding emotion by suggesting that emotion nodes (one representing happiness, another sadness, another anger, and so on) are able to activate memory structures (e.g., the memory of a snake, or even a piece of music), and vice versa." (Schubert/McPherson, 2006, p.194)

To connect such definitions of emotions with music, SCHUBERT and MCPHERSON mainly use BHARUCHA's (1987); (1994) and MEYER's (1956) concepts as foundation for their own developmental model of emotion perception in music.

BHARUCHA defines "[...] two mechanisms through which musical information is primed during the listening process: when listening to a melody, what do we expect the next note to be?" (Schubert/McPherson, 2006, p.194)

> "One process is the *veridical* (one to one) expectation: so a node, which in this case represents a single note of a melody, then activates a node representing the next node of that melody. [...] Another mechanism is referred to as *schematic* expectancy. Here, the listener has acquired (without any necessary conscious attention) the rules of music in a particular style, and can therefore predict the next note of a melody of that style when the melody is unfamiliar. A typical example is the leading tone toward the end of a musical phrase." (Schubert/McPherson, 2006, p.194)

MEYER "[...] describes two broad ways in which emotions and music can be connected by listeners: *referentialism* – where the meaning in music comes from direct associations made with the situations, mood, and so forth and the music: Something outside the music is connected and associated with the music. *Absolutism* suggests that meaning in music comes from within the structure of the music itself, without any need to make reference to something outside the music." (Schubert/McPherson, 2006, p.194)

Furthermore, SCHUBERT and MCPHERSON propose that BHARUCHA's notion of *veridical* and *schematic* expectations shares 'remarkable similarities' with MEYER's concepts of *referentialism* and *absolutism.*

> "The veridical connection is that which occurs between a specific event and a specific piece of music (that special song on a first date), as an example of Meyer's referentialism. And when many exemplars of a particular mood are connected with similar musical structures (e.g., music in the minor key representing a general sadness or negative emotions) we can say that there is a general, or schematic representation of emotion and music, as might be the case for absolutism. In this way, absolutism (and therefore schema) may be understood here as a subconscious abstraction of musical and extramusical rules, so that the listener *thinks* that the connection with emotions is part of the musical structure, but it has actually been built up from numerous exemplars of different veridical connections." (Schubert/McPherson, 2006, p.195)

As explained below, and schematically seen in Figure 1.19, SCHUBERT's and MCPHERSON's spiral model is based on this distinction and subdivides explicitly all development phases of emotion perception in music in 'veridical dominant connections' and 'schematic dominant connections'.

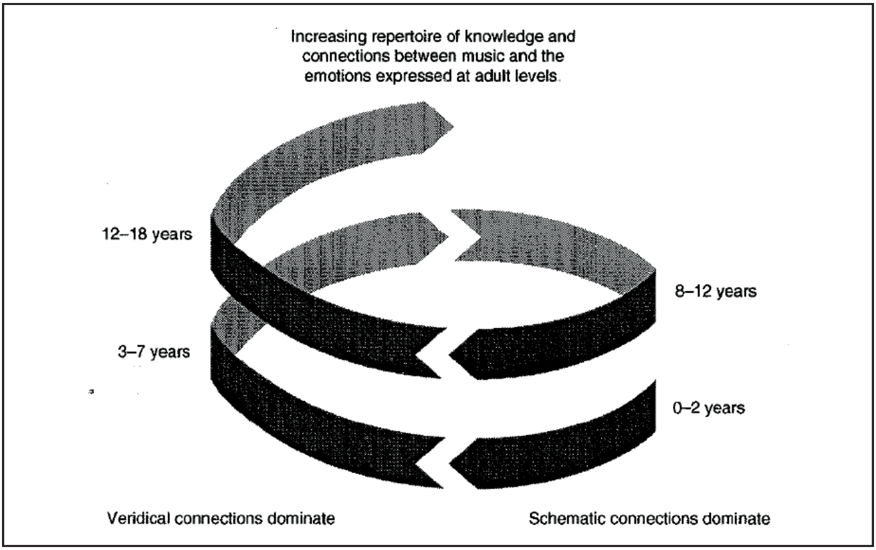

Fig. 1.19 "Spiral model of development of emotion perception in music. [...]" (Schubert and McPherson, 2006, p.202)

Infancy to 2 years

In this first period of development, emotions and music are mostly schematically connected, because "[...] infants are born with basic kinds of mechanisms that enable them to interpret the emotional meaning of sounds in the environment and, in particular, from their caregiver. This suggests the presence of a strong schematic, hard-wired mechanism that may well provide the young infant with an evolutionary advantage." (Schubert/McPherson, 2006, p.199) SCHUBERT and MCPHERSON present various indications which can support their thesis. Right after birth, newborns and their parents already initiate a kind of 'musical' interaction, which can be seen as biologically programmed bonding between the mother and her baby, which promotes survival of the newborn (see Dissanayake, 2000).

> "The slow high-pitched utterances involved in infant-directed speech help them attend to and grasp messages in their parents' tone of voice long before they are capable of understanding what is actually being said (Fernald, 1992, 1993; Trehub & Nakata, 2001), and the pitch variations associated with infant-directed speech facilitate the communication of emotional messages (Slaney & McRoberts, 2003)."[34] (Schubert/McPherson, 2006, p.198)

Concerning the perception of emotional meaning in music, SCHUBERT and MCPHERSON also refer to studies which suggest that infants can extract emotional information from lullabies, and therefore put up the question whether this is caused by processing various acoustic features [as explained in 1.2 on page 35], "[...] or whether emotional perception is hard-wired and automated as though the auditory signal is processed as an emotional whole (or 'gestalt'), without the need for prior processing of the auditory parameters." (Schubert/McPherson, 2006, p.199)

As already cited, SCHUBERT and MCPHERSON rather follow the second perspective of emotion perception[35]. In this they also refer to studies of Levi (1978), Zajonc (1984), and Gentile (1998).

In summary, they propose [...] that it is likely that some acoustic signals will also signal emotional meaning to the infant. That is, the mechanism for emotional detection by the infant is primarily, though not exclusively, schematic." (Schubert/McPherson, 2006, p.199)

Three to 7 years

> "One of the fascinating changes in children's perception of emotion in music in Western culture from ages of 3 to 7 is the gradual development of the major-*happy*, minor-*sad* connection. [...] With few exceptions (Dolgin & Adelson, 1990) the literature suggests that the major-happy minor-sad relationship is only beginning to be made at 4 years of age, even though it has become firmly established by the age of 7 or 8 (Trunk, 1981; Kratus, 1993; Gerardi & Gerken, 1995; Dalla Bella et al., 2001)." (Schubert/McPherson, 2006, p.200)

Based on this 'enhanced ability to perceive emotional connotations of major and minor modes', SCHUBERT and MCPHERSON propose that by exposure of major

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[34] FERNALD (1992), p.148 suggest for example: "The communicative force of the mother's vocalizations derive not from their arbitrary meanings in a linguistic code, but more from their immediate musical power to arouse and alert, to calm and to delight. Through this distinctive form of vocal communication the infant begins to experience emotional communication with others, months before communication through symbols is possible."

[35] But, they note in this context that "[...] emotion perception occurs as soon as the child learns to attend to the relevant stimulus cues and to decode the specified emotion. Emotion cognition is thought to develop later, as the child gains more sophisticated cognitive skills, has more experience in social interactions, and begins to acquire culture-specific display rules." (Boone/Cunningham, 1998, p.1008)

and minor modes, veridical dominant connections help to "[...] develop increasingly stronger associations over the period from 3 to 7 years of age." (Schubert/McPherson, 2006, p.201). Furthermore, children in this period develop a growing ability to interpret emotion in human voices, and "[...] can achieve consistent interpretation of emotion in melodies presented on musical instruments (Dolgin & Adelson, 1990)." (Schubert/McPherson, 2006, p.201)

With respect to biological predispositions in relations to the cultural environment, from which children learn major-happy, minor-sad connections, they write: "[...] that during infancy absolutist (schematic) processes are at work in determining the emotional content of musical and auditory signals. We therefore speculate that loudness, tempo, and pitch may be connected with emotion in a schematic, possibly hard-wired (innate) way. By the same token, the infant is slowly developing new ways of connecting emotional information through exposure to and participation in cultural norms, such as by the age of 7 years we see the major-*happy* minor-*sad* connotations of Western culture becoming firmly established." (Schubert/McPherson, 2006, p.201)

Eight to 12 years

In this second schematic dominated period, children have acquired a great musical repertoire and connected musical structures and emotional identification. An indication for this can be displayed by "[...] their ability to detect correctly different musical and other artistic styles (Walk et al., 1971; Silverman et al., 1975; Hasenfus et al., 1983)." (Schubert/McPherson, 2006, p.202), and their openness towards different styles between 6 to 9 years of age, 'without showing a strong bias towards, or rejection of, a particular style'. (Schubert/McPherson, 2006, p.202) This increasing repertoire (veridical connections) builds the foundation for schematic transfer of emotional connotations and associations within and between different musical styles.

> "This suggests an absolutist value in music because referentialism (veridical connection) is closely connected with specific exemplars of emotion-music connections." (Schubert/McPherson, 2006, p.202)

Adolescence (12–18 years)

SCHUBERT and MCPHERSON propose that "[...] the connection between emotion and music is an inextricable element in the relationship between teenage development and music." (Schubert/McPherson, 2006, p.203) Based on the assumption that "[...] in Western culture the idea of 'over-identifying' is characterized by the increasing tendency to idolize an individual, such as a sporting champion, movie celebrity or rock star [...].” (Schubert/McPherson, 2006, p.203), both authors present indications (see Raviv et al., 1996) that such behaviors play an important role in adolescence’s personal development between 10 and 17 years.

> “While the music of the idolized rock star is a prime candidate for a veridical connection between the emotions associated with the individual, any piece of music can be connected with any idol.”(Schubert/McPherson, 2006, p.204)

Another argument points at some more ability to made veridical associations between emotion and music itself during adolescence. Based on HALL’s (1998) study of associations with rap music, it is suggested that “[...] by the age of 12, the ability to extract general information about music is superimposed with a new dimension and ability (and perhaps even a need) to form specific, veridical links with music and its meaning. In doing so, adolescents use music for the purpose of identifying with others, in developing their own sense of identity and in managing the emotions. Connections are being formed between pieces of music and the new, complex emotional changes the adolescents experiences.” (Schubert/McPherson, 2006, p.204)

1.4.2.4 Conclusion – Relationships and Distinctions Amongst the Three Theories

There are a number of possible connections amongst the three theories reviewed above. For example, most striking is the common fact that all three theories define phases of development, in which qualitative changes take place. Another relationship exists in the way they build on and further develop basic concepts of Piaget (1950); (1951); (1952), outlined earlier (see 1.4.1 on page 58).

First, PIAGET (1951) defined that *assimilation* primarily takes place during children’s ’imaginative play’.

> “Play also, especially from the point of view of “meanings” can be considered as leading from activity to representation, in so far as it evolves from initial stage of sensory-motor activity to its second stage of symbolic or imaginative play.” (Piaget, 1951, p.2)

SWANWICK and TILLMAN’s proposal (1986) shares this perspectives with PIAGET, because in the theoretical basis of his detailed developmental theory, SWANWICK (1983) proposes that “[...] mastery, imitation and imaginative play are essential psychological elements in all artistic engagement (Swanwick, 1983, 1988). In specifically musical terms these are identified with perceiving and controlling sound materials, projecting and locating expressive character, and awareness of interrelationships between expressive gestures, i.e. dynamic structure.” (Swanwick, 2001, p.234)

As already noted earlier (see 1.4.2.1 on page 65), HARGREAVES (1996) proposes that musical development starts from sensory-motor schema, and therefore designates developmental phases – partly by PIAGET's terms.

> "I have reverted to Piaget's original term for the developments that occur in the first 2 years of life since it provides a more direct description than the earlier term 'presymbolic' [used in (Hargreaves/Galton, 1992)], which in a sense defines the stage in terms of what is absent rather than what is present. A second, pragmatic reason is simply that many people are familiar with Piaget's term." (Hargreaves, 1996, p.157)

The second link to PIAGET is that all three theories explicitly or implicitly implement PIAGET's concepts of assimilation and accommodation. SWANWICK (2001) proposes for example " [...] that on each of four levels [*materials*, *expression*, *form*, and *value*] there was a transformation from assimilatory, personal response to music (the left side) to accommodatory 'social sharing' (the right side)." (Swanwick, 2001, p.235) HARGREAVES (1996) did not explicitly use these two terms, but his notion of the development within the 4 phases is characterized by assimilation and accommodation processes.

SCHUBERT and MCPHERSON (2006) also use both concepts implicitly: veridical connections can be assimilated by exposure, because they are founded on innate schematic connections between emotion and music. This unanimity builds the foundation for accommodation processes of emotional connotations and associations within and between different musical styles.

On the other hand, differences between the three theories are more obvious than their relationships, and often give rise to a scientific discourse based on individual positions[36]. But more important is that such slightly different perspectives offer the opportunity to get an extended picture of the evolving musical-artistic competence between infancy and adulthood, better than one theory could display alone. This is evident for example in the question: what are the predispositions for the musical development within the infancy period? While SWANWICK and TILLMANN (1986) generally refer to a 'genetic inheritance of each individual', HARGREAVES (1996) used PIAGET's designation of a sensorimotor phase, and refers therefore directly to PIAGET's notion that development starts from innate sensory structures, basic reflexive actions, and primitive motor abilities, which are

[36] "Hargreaves and Zimmerman, however, asserted that conceptual labeling, categorising and organising musical 'perceptions' provides 'the key for later study and enjoyment of the complexities of music'. Musical development thus proceeds from sensory-motor schema, though representation in musical images to 'the ability to handle an increasing number of concepts' (Ibid., p. 386). Is musical development really an increase of labelling and categorising? I doubt it." (Swanwick, 2001, p.233)

"Questions have been raised as to whether the initial assessment or 'coding' of the compositions was sufficiently objective (Hargreaves & Zimmerman, 1992). There are also issues concerning the sample of children: for instance, could these findings be repeated in another cultural setting?" (Swanwick, 2001, p.235) coordinated to organize sensorimotor pattern[37]. SCHUBERT's and MCPHERSON's proposal (2006) extended these perspectives in that explanations of early auditory perception mechanisms must also incorporate the detection of emotion information, because it seems that musical structures are inextricably connected with emotions. Hence, they propose that "[...] connecting emotional meaning to music or musical information is schematic (that is, more or less, innate)." (Schubert/ McPherson, 2006, p.207)

These perspectives together suggest that infants' predispositions for the first assimilation processes are, on the one hand, innate sensory structures, basic reflexive actions, and primitive motor abilities. And that they are, on the other hand, innate evaluation mechanisms, such as in decoding emotional information from the mother's voice, as well as infants' interpretation of the emotional meaning of other sounds/sound sources in the environment.

Another, more complete picture is visible if one relates the various musical behaviors or/and secondary functions, which are assessed in the course of musical development. SWANWICK and TILLMAN (1986) develop their model through "[...] observing the compositional processes of children. [...] without notational or other forms of detailed performance instruction." (Swanwick/Tillman, 1986, p.311) Furthermore, SWANWICK (2001) believes that developmental theories "[...] which depend on analysis of secondary symbol systems (notations) or on separated observations of melodic, rhythmic, harmonic and other behaviours, or rely on testing only aural perception may have attractive possibilities in terms of control and reliability. However, the issue of musical validity is a real one for such methodologies." (Swanwick, 2001, pp.233-234) In contrast, HARGREAVES (1996) used 'secondary functions', such as graphic representation, and suggests "[...] that although medium-specific aspects of musical development clearly do exist, it is nevertheless possible to delineate general features of the course of artistic development that do exist across domains and that display regular changes with age. This has been done by specifying aspects of thinking that underlie developments in each art form by identifying the cognitive rules and strategies which are present in artistic and musical development" (Hargreaves, 1996, pp.153-154) SCHUBERT and MCPHERSON (2006) observe still another dimension of musical development: how processes connecting emotions[38] with music have implications for the development of the perception of musical structures, and thus produce effects on the individual musical-artistic development, such as the favored musical style, which are listened and played.

Finally, if one follows the perspective that the musical-artistic development takes place across domains outlined above – but certainly not completely –, then

[37] This perspective is coherent with current research results, presented in the chapters 1.1 on page 27 – 1.3 on page 46.

[38] including the complex emotional changes which children experience during childhood

it is also obvious that, first, the proposed time spans – in which changes take place –, suggest parallel developments of individual competencies; and, second, that the development of certain competencies effects in their turn the development of other competencies, such as melodic perception for composition abilities. Therefore, it can be concluded from section 1.4 that musical-artistic development is a multi-faceted and heterogeneous process, in which takes place qualitative, subsequent, and hierarchical changes of single competencies take place, often in a parallel manner. This progress can proceed at different speeds, and can lead to various endpoints for different music learners. Such discrepancies are caused by, first, individual predispositions, and, second, the influence from and the interaction with social and educational contexts.

1.5 Summary

In this chapter, using concepts from various disciplines, our focus was initially to outline perspectives concerning the following questions: first, are there music-relevant predispositions in fetuses; second, are infants sensitive to acoustic parameters of music; and third, do infants possess capabilities to segment acoustic parameters mentally. In a second step, infants' abilities to process acoustic stimuli were associated to a social-cultural environment perspective, assuming that cultural conditions cause the psychological development during infancy (and in the prenatal period as well). Hence, based on empirical data and models we outlined which physiological and psychological structures foster musical behavior, and how these structures can develop through musical experience itself.

Starting with the 'Ontogeny of Musical Abilities during the Prenatal Period' (see 1.1 on page 27), we have seen that intonation, prosody, variations in loudness, etc. of the mother's voice constitute a permanent acoustic information in the fetal sound environment. Furthermore, intra-abdominal recordings have revealed that frequencies higher than 1000 Hz play no noticeable part, which implies that important features of music, such as timbral features, can not be perceived by fetuses. In this way, an accepted perspective supposes that a possible fetal music perception is mainly stimulated by low frequencies and chronological features (global prosody) of speech and music.

Concerning the music-relevant predispositions in fetuses, various findings suggested that the fetal auditory system becomes more sensitive with its maturation: Fetuses can thus process music-relevant information at certain gestational ages, such as a range of frequencies, changing of musical notes, melodic contour, variation of tempo, or discrimination of human voices, etc. Furthermore, we presented indications of prenatal learning concerning acoustic stimuli. This means that fetuses, at 30 weeks of gestational age, are able to learn, and have, first, a procedural short-term memory of at least 10 minutes, and, second, a procedural long-term memory of 24 hours. In addition, it was shown that fetuses at 34 weeks of gestational age have a 4-week memory. Between the 35th and 37th week of gestation, fetuses can discriminate acoustic features, such as frequencies, spectra, duration, tempo, rhythm, and process complex auditory streams; moreover, their auditory memories can last at least six weeks.

Subsequently, we have discussed ’Infants’ Auditory Sensitivity Related to Acoustical Parameters of Music’ (see 1.2 on page 35). Generally, various studies detected that auditory sensitivities, which are considered from the current perspective as preconditions for infants’ perceptual organization, seems to mature further after birth. This was evidenced in the case of threshold sensitivity, but also for frequency, pitch and timbre discrimination.

The next section ’Perspectives of Infants General Musical Organization’ (see 1.3 on page 46) reviewed perspectives of infants’ organization of sounds, that is, the organization of detected and discriminated sounds and tones in ’meaningful segments’. Interestingly, all presented studies observed similar auditory grouping and segregation processes in newborns, young infants, and adults. But specific differences between these age stages could also be detected. For instance, although infants possess an innate tendency to group acoustical information on the basis of Gestalt principles, such as proximity, similarity, and continuity, they need a slower tempo than adults for segregation. Moreover, infants cannot distinguish patterns accurately when the tempo is too fast and the inter-stimulus intervals too short. This suggests that perceptual abilities are at first immature, and probably develop further throughout childhood.

Thereafter, investigations were reviewed focusing on infants’ early development of motor skills; their ability of temporal pattering; their ability to temporally predict events; and their processing of ’musical’ sequences. First of all, it seems infants are born with temporal abilities and motor skills, whereby they can process wide ranged pre- and postnatal perceptions of rhythms, and can practice rhythmical and stereotypical behavior, such as sucking rate. We found furthermore that both, frequencies and numbers of motor behaviors, show a steady and consistent increase over the first year after birth. In terms of temporal pattering, defined as the ability to process absolute timing information and relative timing information, we were able to present arguments for the fact that infants can perceive and operate time-related information between the 2nd month and the 5th month after birth. And, after reviewing investigations for the question, whether infants possess the ability to temporally predict events, indications could be found to the effect that newborns react to the omission of temporally predictable events, but cannot anticipate these events[39]. Finally, concerning the question about when infants are be able to perceive and recognize musical patterns based on pitch variation, we presented results that 6-month-old infants primarily use relative pitch information when they store melodic sequences in their long-term memory. However, the 'measured cortical activity to encode melodic information in terms of relative pitch information, differs significantly from that of adults'. This means that the processing of relative pitch involves further interactions with parietal and frontal areas – these connections may remain immature at 6 months.

The following perspective relates more to the second part of the chapter's subtitle 'Between Pre-disposed Structures and Musical Experience', in that it intends to outline the development of musical-artistic competence caused by experience and practice. Because social and educational contexts are a-priori bound up with music defined as a cultural product, the contribution of JEAN PIAGET was first reviewed as one of the founding fathers of the developmental and educational psychology. His model (Piaget, 1973) of cognitive development from infancy to childhood tries to explain the development of interactions between biological predispositions and the social environment, including gradual 'stages' of psychological development. But, more important, PIAGET has proposed a constructivist model of cognition which shows that cognitive structures are actively created by learners who construct and build knowledge! He furthermore argued for the perspective that every child passes through four qualitatively different stages in a fixed sequence – these are sensorimotor, pre-operational, concrete operational, and formal operational.

Because, since he has developed his theory, some of PIAGET's central tenets are criticized, we additionally presented some perspectives of so-called NEO-PIAGETIANS, which have revisited PIAGET's theory for the purpose of developing alternative mechanisms and models in order to explain changes in children's cognitive development. We thus reviewed some extending and improving aspects proposed by NEO-PIAGETIANS. First, they assumed that variability in the development of children across cognitive domains and environmental contexts is the rule, rather than the exception. Second, they also studied adolescents as well as adults and have defined further levels of abstract thinking. Third, NEO-PIAGETIAN believe that learning and development takes place in different tempi across cognitive domains, because of the influence of the environment. For example, co-

[39] However, at about the 29th week of gestational stage, fetuses possess limited memory structures, wherein acoustical information can be saved. Fortunately, it was found that the start of working sensory-memory structures in fetuses is associated with the *intrinsic activity* 'to predict' (see 4.2.1 on page 228), or, that is to say, "[...] each sound forms a memory trace in the auditory system, if an incoming sound violates the neural memory representation of the recently heard sounds, it elicits an MMN [mismatch negatively]." (Kujala/Tervaniemi/Schröger, 2007, p.3) This mechanism is very informative, because it reflects an intrinsic activity "[...] in the auditory system for predicting future sound events on the basis of the recent past, and the brain's reaction when those predictions are not fulifilled." (Trainor/Zatorre, 2009, p.172)

constructive processes caused by collaborative efforts of two or more learners highly effect the cognitive development. This can also be seen in case of contextual influences (e.g. family, teacher, opportunities for practice, etc.). Indeed, if the best environmental conditions are given for learning processes, a learner can perform at the 'optimal level of learning'.

After exploring the initial perspective that all fetuses and children's abilities and behaviors are the result of pre-disposed structures and their 'biological maturation' in relation with an expanding capacity to interact with their environment, we have finally reviewed three major theories of musical development, in order to present slightly different perspectives of children's evolving musical-artistic competence. Accordingly, the first model of HARGREAVES (1996) outlined the development of musical-artistic competences – singing, musical representation, melodic perception, and composition – in relation to his proposed phases – sensorimotor, figural, rule systems, and professional. SWANWICK and TILMAN's theory (1986) about musical composition activities of children between 3 and 15 proposed that there exists a developmental spiral of unfolding musical-artistic competence, defined as levels: sensory, manipulative, personal, vernacular, speculative, ideomatic, symbolic, and systematic. The third proposal of SCHUBERT and MCPHERSON (2006) summarized how the perception of emotion in music evolves from infancy to late childhood. Based on the assumption that cognition and emotion are two sides of the same coin of elaboration, emotion perception in music was defined as an important factor for the development of musical-artistic competences. In this way, both authors have defined that early auditory perception mechanisms must also incorporate the detection of emotion information. Their spiral model of development of emotion perception in music explicitly distinguishes four phases – 0-2 years, 3-7 years, 8-12 years, and 12-18 years –, which include developing competences to perceive and interpret emotional connotations offered by musical structures. Finally, all three theories, outlining an evolving musical-artistic competence between infancy and adulthood, were discussed to show conceptual distinctions and relationships between them, for the purpose of structuring a more complete picture about musical-artistic development.

Chapter 2
Perspectives on Creativity in General and while Music is being Listened to and Composed

2.1 Perspectives on Creativity in General

2.1.1 Cognition and Creativity

Research in cognition can be described as the attempt to capture the functionality of 'homo sapiens'[1] intelligence, particularly in defining mental models, which are founded on basic mental processes underlying human thinking and behavior, such as attention (Shaffer, 1975; Allport, 1980), memory (Atkinson/Shiffrin, 1968; Baddeley, 2003), language (e.g. Chomsky, 1965; Fauconnier/Turner, 2003, learning (e.g. Piaget see 1.4.1 on page 58) , or problem solving (Newell/Simon, 1972; Mayer, 1992). Research in creativity also tries to discover the functionality of certain intelligent processes, such as the emergence of new and unexpected ideas in humans (see in this regard Boden, 1994).

This field has shown an intuitive connection between cognition and creativity, from which scientists start to look at creativity in human cognition by using methods and knowledge from existing cognitive theories, and study it empirically (see Smith/Ward/Finke, 1995). RUNCO (2007), p.2 thus proposes that "[...] bridges [exist] between cognitive processes (e.g. attention, perception, memory, information processing) and creative problem solving, as well as connections with intelligence, problem solving, language, and other indications of individual differences. The basic processes are generally *nomothetic,* meaning that they represent universals. These are things shared by all humans. Individual differences represent the dimensions along people differ. There are both cognitive universals and cognitive individual differences in creativity."

[1] The precise meaning of this denomination is: 'a particularly wise man'.

S. Schmidt, *Musical Extrapolations,* DOI 10.1007/978-3-658-11125-0_2,

This section presents an overview of various prominent theories which are related to creative cognition, in order to get more insight on individual differences of creative behaviors and their relations to cognitive processes.

A persistently controversial debate in creative cognition focused on the question if creativity potential is related to humans intelligence (measured in IQ-tests). Early indications for such a relationship came from SPEARMAN's conception (1927) of 'g', which means general ability (the foundation for IQ). In SPEARMAN's conception, the coping of creative tasks – *inkblot test, free completion test, unfinished pictures, unfinished stories* (see in this regard Spearman, 1927, p.187) – requires a high degree of 'g'. Such a relationship has recently partially been confirmed. However, as certain researchers, such as GARDNER (1993b), define creativity as essential to act intelligently on a high level, other studies have found poor relations between intelligence and creative potential (e.g. Getzels/Jackson, 1958; Torrance, 1975; Furnham/Chamorro-Premuzic, 2006; Furnham/Bachtiar, 2008). Indeed, a highly intellect person is not necessarily creative.

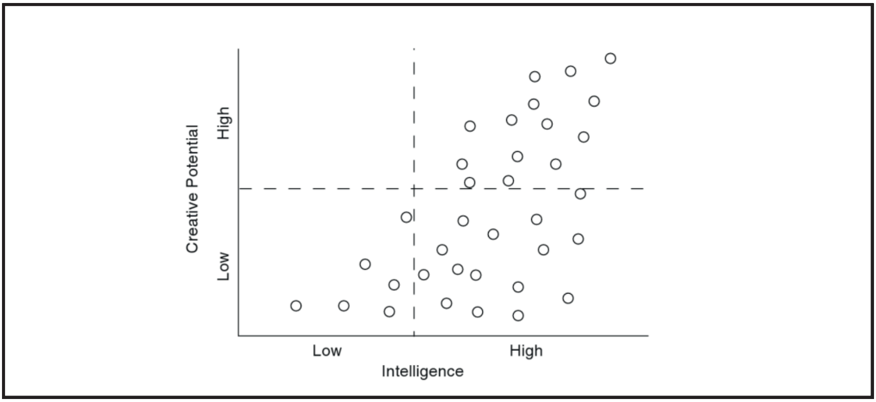

Fig. 2.1 "Scatterplot showing that creative potential is more likely to be high with high intelligence." (Runco, 2007, p. 7)

However, as seen in Figure 2.1, "[...] no one with extremely low IQ does highly creative work (low variation, high correlation), but above a moderate level of IQ some individuals are creative but others are not (high variation, low correlation). This allows for the possibility that at the highest level of IQ, creativity is very difficult or even impossible (low variability, high correlation)." (Runco, 2007, p.8)

WALLACH and KOGAN (1965) contributed an additional perspective to this debate. Based on their study concerning children's divergent thinking[2] abilities, they propose that the intelligence quotient and convergent thinking – which are necessarily related – are independent from divergent (original) thinking. In a later study concerning college students, WALLACH and WING (1969) extended this view, and found that extracurricular activities and accomplishments allow a 'predictive validity' on the output of divergent thinking tests, and therefore, divergent thinking capabilities "[...] were moderately correlated with (i.e., predictive of) the extracurricular activities and achievements of the students, whereas the measures of more traditional intelligence were not. This conclusion has been replicated many times (Kogan & Pankove 1974; Milgram 1978; Runco 1986). It does apply to some domains of accomplishment more than others, but that is as it should be, given domain differences in creativity (Albert 1980; Gardner 1983; Plucker 1998; Runco 1987). This difference is extremely important. It implies that creative thinking, as estimated from tests of divergent thinking, is more important in the natural environment than are tests of the IQ or academic tests." (Runco, 2007, pp.4-5)

Another relation between creativity and cognition is possible, if one evaluates the 'original output' created through analogical thinking, such as RUTHERFORD's atom model, KÉLKULÉ's benzene model, or the more 'ordinary' analogies, produced while/after listening to music (see 2.4 on page 140). The common process acting behind these models can be simplified as information (e.g. concepts) which has been constructed in a certain other context, and which is transferred (used) in a current context showing similarities (Weisberg, 1995; Welling, 2007). In this way, it is a kind of common sense that "[...] on a general level, analogy is at the very basis of any human cognitive activities, from the more automatic, (those that operate implicitly without the person even being aware of it), all the way to very elaborate and explicit forms that are active in scientific research, logical thinking, etc." (Deliège, 2006, p.64)

To define and compare such processes, WELLING (2007) specifies four mental operations from existing theories of creativity: *application*, *analogy*, *combination*, and *abstraction*, which are more or less related with a high degree of creative output. He concludes that "[...] so-called high creativity is more readily associated with combination and abstraction operations, while everyday creativity is derived primarily from application and analogy operations. Some contradictory findings might be explained by the fact that high creativity is often not the result of a single operation but results from a longer period in which several operations are put to use during the discovery process." (Welling, 2007, p.22)

Another important fact about creative thinking is concerned with people's abilities to solve problems. There are many different kinds of problems (see Wakefield,

[2] The distinction between convergent thinking and divergent thinking was first proposed by J. P. Guilford (1950).

1992), such as coping with a situation, reaching a goal, or solving a test, as is often practiced in schools. This suggest solving strategies depend on how ’well-defined or ill-defined’ is the problem itself (see Mumford et al., 1993; Schraw/Dunkle/Bendixen, 1995). In terms of ’ill-defined’ problems, an individual’s ability in problem definition is in itself an important component of creative problem solving (Csikszentmihalyi/Getzels, 1971; Getzels, 1975; Getzels/Smilansky, 1983; Wertheimer, 1945). For example, WERTHEIMER (1945), P.123 proposes that “[...] thinking is not just solving an actual problem but discovering, envisaging, going into deep questions. Often in great discoveries the most important thing is that a certain question is found. Envisaging, putting the productive question is often a more important, often a greater achievement than the solution of a set question.”

In addition, it seems problem formulation and problem solving concern different domains of creativity:

> “A large body of research now indicates that individual differences exist, with some persons exceptionally capable at identifying or defining problems, but perhaps not as good at solving problems. Other people may be very good at solving problems, but the problems need to be given to them in a very unambiguous fashion.” (Runco, 2007, p.16)

A more structured insight on the creative process, such as problem finding, is possible on the basis of the four-stage perspective of WALLAS (1926), who defines an ensemble of stages, called *preparation*, *incubation*, *illumination*, and *verification*, through which the creative process evolves.

As Wallas (1926), a wide range of researchers (Ypma, 1970; Mansfield/Busse, 1981; Hayes, 1985) believe that *preparation* is an important condition for creative processes. This involves problem identification and problem definition, where preparatory work explores the problem’s dimensions. But, to be able to explore relevant knowledge, the creative person “[...] often carried out over long periods of time, to acquire knowledge and skills relevant to the creative act. Hayes (1985) has provided strong evidence that even the most talented composers and painters, e.g. Mozart and Van Gogh, required years of preparation before they began to produce the work for which they are famous.” (Hayes/Mellon, 1990, no page numbers) The stage of *incubation* points at unconscious thinking or processing of information about the problem. These unconscious processes of creative cognition are studied in various perspectives, such as the associative thinking (e.g. Mednick/Mednick/Mednick, 1964; Guilford, 1979), concerning intuition (Bowers et al., 1990; Hasenfus/Martindale/Birnbaum, 1983), or blind variation (Campbell, 1960), and try to explain the progression towards the solution to a problem, even if it is not consciously thought out. *Illumination* can be described as a sudden insight, and leads to a ’eureka’ experience (see Gruber, 1988).

> “Very importantly, most often insights are singular. We may have a problem, and one solution pops into our heads, like bulb being turned on. In that light (another pun!), insightful

> thinking is unlike divergent thinking, where various ideas are generated. Insight leads to one solution." (Runco, 2007, p.20)

But on the other side, WEISBERG (1986), p.50 suggests "[...] there seems very little reason to believe that solutions to novel problems come about in leaps of insight. At every step of the way, the process involves a small movement away from what is known." In a similar direction, SCHILLING (2005), p.134 proposes that the "[...] process of insight incorporate[s] unexpected connections within or across representations as one of the underlying mechanisms: (a) completing a schema, (b) reorganizing visual information, (c) overcoming a mental block, (d) finding a problem analog, and (e) random recombination."

Incidentally, to see insight as a kind of restructuring also points to perceptual processes, which probably also play an important role in creative processes. Regarding 'reorganizing visual information' or reorganized auditory grouping and segregation processes (see 1.3.1 on page 47), "[…] Shepard clearly viewed that mechanisms of perceptual organization that involve spatial relationships in particular as a powerful source of general knowledge about relationships that can be analogically applied to invention and problem solving." (Flowers/Garbin, 1989, p.152)

> "The creative productions of a brain presumably stem from whatever intuitive wisdom, whatever deep organizing principles have been built into that brain as a result of the immense evolutionary journey that has issued in the formation of that brain. If the arguments sketched out in this chapter have any merit, the most basic and powerful innate intuitions and principles underlying verbal and nonverbal thought, alike, may well be those governing the relations, projections, symmetries, and transformations of objects in space." (Shepard, 1981, p.339)

The final stage *verification* "[...] allows the creative individual to test and tinker. With creativity requiring both originality *and* effectiveness, verification is probably vitally important. It may be that problems are made the most effective during some sort of verification. The more recent applications of this stage model have included recursion, the idea being that the individual may revisit early stages and cycle through the process as much as needed. It is not a strictly linear affair." (Runco, 2007, p.19)

Besides theories explaining creative thinking in a kind of step-by-step movement, some recent theories (Amabile, 1990; Mumford et al., 1991; Runco/Chand, 1995; Sternberg/Lubert, 1996; Finke, 1997; Mumford et al., 1997b) define creativity as a process of component mechanisms interact together, without the requirement of a linear progression. RUNCO and CHAND (1995) for example, "[...] presented a two-tiered componential model of the creative process. This differs from the model of Wallas primarily in including a second tier which recognizes the influence of knowledge and information, both procedural and factual, and the influence of motivation, both intrinsic and extrinsic." (Kozbelt/Beghetto/Runco, 2010, p.31)

2.1.2 Developmental and Social Influences on Creativity

As we have seen in the previous section (see 2.1.1 on page 88), creative output depends on various cognitive factors, which interact in a multifaceted process. Moreover, it seems plausible that creative output is also influenced by individuals' development in a given culture.

First of all, a large number of researchers propose that creativity research and developmental psychology share many concepts and theoretical frameworks. Obviously, a persistent prominent conception in developmental psychology is that individuals' development proceeds in a sort of stages or phases (see 1.4.1 on page 58 – 1.4.2 on page 64). As explained above (see 2.1.1 on page 88), creative processes are also partly explained in a kind of passage through stages. However:

> "In developmental theory, the stages proceed over childhood, with each stage lasting several years; in creativity theory, the stages culminate in the production of a single creative work or creative thought. Thus, the latter stages were markedly shorter, lasting only a few months or even, in some cases, a few days." (Sawyer, 2003, p.16)

Nevertheless, Sawyer (2003) points out about Piaget's stage theory of development (see in this regard 1.4.1 on page 58) "[...] that Piaget's constructivist theory of development was fundamentally a theory of creativity. [...] I discovered that Piaget (1971a) himself had noted these parallels: "The reals problem is how to explain novelties. I think that novelties, i.e., creations, constantly intervene in development" (p.192)." (Sawyer, 2003, pp.12-13), hence "[...] the crux of my problem [...] is to try and explain how novelties are possible and how they are formed." (Piaget, 1971a, p.194) Feldman (1974) argued, there are parallels between Piaget's stage-to-stage transitions and creative insight (see 2.1.1 on page 88). Because both are issues of novelty, and furthermore, the creative insight – "aha" experience – emerges from the unconscious incubation. As Piaget already noted (see above), also the transition to a new stage[3] is hardly to explain.

> "Some developmentalists have proposed that there is something like an incubation period between developmental stages, because it takes time for individuals "to appropriate the complex knowledge that they co-construct during social interaction" (Azmitia, 1998, p. 240). Complex ideas must ferment or percolate in our unconscious until they fully develop and begin to influence cognitive performance." (Sawyer, 2003, p.43)

[3] "If there are novelties. Then, of course, there are stages. If there are no novelties, then the concept of stages is artificial." (Piaget, 1971a, p.194)

A most obvious relationship between concepts of creativity research and development psychology is that "[...] development is an active process in which the child *transforms* sense impressions and information from the external world. Transformationist theories view development as a creative process. Almost all twentieth-century theories of development, including behaviorism, psychoanalysis, and socioculturalism, accept some form of transformationist view (Lawrence & Valsiner, 1993), yet this perspective attained its most sophisticated expression in the constructivism of Jean Piaget." (Sawyer, 2003, p.32)

Another perspective, which relates individuals' development with creative output, based on KOHLBERG's (1987) theory of development and changes in conventional behavior. Because a distinction between conventional and unconventional behavior is useful to define creative output (e.g. Rosenblatt/Winner, 1988), and furthermore individuals' development in a given culture (see in this regard 1.4.2 on page 64).

> "Conventions define culture. They also direct thinking toward normative behavior, which means that they constrain thinking and can easily inhibit creativity. Conventions are, after all, indicative of something about which there is a consensus; creativity, on the other hand, requires originality, self-expression (not group expression), and unconventional thought and action." (Runco, 2007, p.41)

KOHLBERG's conception organized the development leading from the child to the adult in three phases of moral reasoning: pre-conventional, conventional, post-conventional. Research in creativity has bought this perspective, and as schematically seen in Figure 2.2, there are indicators for "[...] a U-shaped development that begins with a period of high creativity in early childhood (marked by play and freedom from conformity), is followed by a slump in the middle years, and then reemerges in a more sophisticated form of creativity in one's adulthood (Albert, 1996; Keegan, 1996; Runco & Charles, 1997). Although there is no consensus as to the exact age that a slump occurs, it seems to be prominent either at the start of school or between the ages of 9 and 12 and there are disagreements as to whether creativity is different in degree or in kind once it reemerges in adulthood (cf. Albert, 1996; Keegan,1996)." (Hickey, 2002, p.400)

Concerning social factors, which may fulfill children's creative potential during the childhood, RUNCO (2007) suggests a useful perspective, in which *adaptation, adversity*, and *family depended variables/factors* are decisive 'external' influences on creativity during childhood.

Adaptation plays an important role in DARWIN's theory (1964), and in PIAGET's stage-theory of cognitive development. The latter conceptualizes adaptation as a process, which takes place in terms of assimilation and accommodation (see 1.4.1 on page 58).

> "The first of these can help us to understand the cognitive transformations that sometimes lead to creative ideas (Guilford 1968; Runco 1996d). The latter can explain the sudden

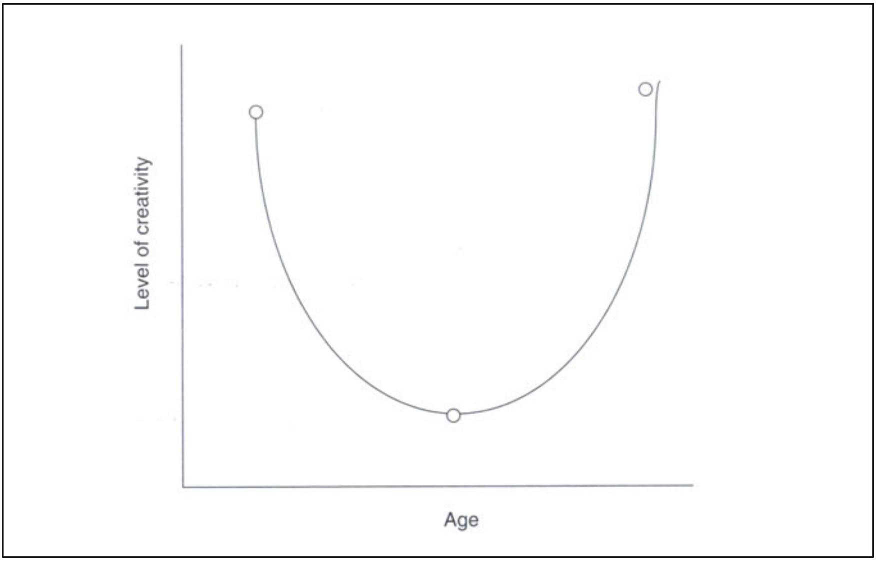

Fig. 2.2 "U-shaped developmental trajectory" (Runco, 2007, p.43)

> insight that characterize many creative "aha" moments (Gruber 1981b). Neither assimilation nor accommodation is considered, however, unless the individual fells the need for adaptation. In Piaget's own terms, adaptation occurs only when the individual experiences a kind of disequilibrium. This may occur when the person does not understand some experience or information (understanding is not in equilibrium with the information), or in the case of adversity." (Runco, 2007, p.44)

Adversity is often considered as a strong motivation for creative efforts to change certain circumstances. Therefore, various investigations (Goetzel/Goetzel, 1962; Goetzel et al., 2004; MacKinnon, 1983 (1960); Albert, 1978) have studied adversity and its impact on creative output. For example, in the very prominent study of GOETZEL and GOETZEL 1962; 2004 autobiographical data of 400 eminent persons were analyzed, with the conclusion that most of them had "[...] in their childhood experienced trauma, deprivations, frustrations, and conflicts of the kind commonly thought to predispose one to mental illness or delinquency." (Goetzel/Goetzel, 1962, p. xii) Moreover, "[...] only fifty-eight can be said to have experienced what is the stereotyped picture of the supportive, warm, relatively untroubled home [...]. The comfortable and contented do not ordinary become creative." (Goetzel/Goetzel, 1962, p.132) ALBERT (1978) extended this perspective after studying gifted children, who lost their parents early, because he concludes that parental loss can be seen as a particular form of adversity. Finally, MACKINNON 1983 (1960) observed that some of his highly creative subjects "[...] endured the most brutal treatment at the hands of sadistic fathers." (MacKinnon, 1983 (1960), p.375)

RUNCO (2007) sees a strong relation between strong creative motivation, caused by adversity, and PIAGET's concept of dis-equilibration, PIAGET "[...] tied adaption to *intrinsic motivation.* Given his biological training and perspective, it is likely that he felt there was a genetic basis for the motivation to adapt. Regardless of the nature and nurture, the assumption is that humans do not like to feel dis-equilibrium and are motivated to avoid it by adapting. Often these adaptions are creative (Cohen 1989; Runco 1994d). Piaget's tying adaptation to intrinsic motivation is significant because it helps us to understand why so many others have found intrinsic motivation to be necessary for creative work [...]."(Runco, 2007, p.49)[4]

Family is one of the most influential factors for individuals' development during childhood, because the characters of family members, and the structure and processes within family life have a tremendous impact on the development of children's creative potential.

> "Whatever levels of [creative] potential are present in a child, the direction in which they are developed (towards convergence or divergence), will be [...] guided by the kinds of interactions the children have with their parents." (Cropley, 1967, p.62)

There is a controversial debate about the relationship between family size, birth order and creativity potential/output (see Kaufman/Sternberg, 2005). Most studies (Csikszentmihalyi, 1965; Jarial, 1979; Dave, 1980; Runco/Bahleda, 1987; Feldman/Goldsmith, 1991); (see in this regard Goetzel/Goetzel, 1962) found indications that birth order validity predicts the creative potential of individuals. For example, in a study of 200 students, JARIAL (1979) noted that the firstborn children have more verbal creativity than children who were born later. RUNCO and BAHLEDA (1987) have measured higher skills in divergent thinking in eldest, followed by the youngest, and lastly middle children. CSIKSZENTMIHALYI (1965), p.87 suggests "[...] that the most original artists were more likely to be firstborns." And FELDMAN (1991) proposes that prodigies are more commonly firstborns. However, there are also investigations (Cicirelli, 1967; Datta, 1968; Albaum, 1977; Wilks/Thompson, 1979), which found no significant differences in creativity between firstborns and later-borns. SAWYER (2012) refers to studies which found no relations.

> "Sulloway (1996) argued that firstborns are less likely to be innovative revolutionary scientists, because firstborns identify more with their parents and with authority, and are more invested in the status quo. There's some evidence that whereas firstborns are more likely to become famous scientific creators, laterborns are more likely to become artistic creators (Clark & Rice, 1982). Simonton (1994, 1999a) likewise argued that creative geniuses were generally not firstborns; he thought that firstborns and only children tend

[4] For detailed information about motivation and creativity see 2.1.3 on page 96.

> to make good leaders in time of crisis, but that middle-borns are better in safe, peaceful times, because they are better listeners and compromisers." (Sawyer, 2012, p.68)

RUNCO and BAHLEDA (1987) have found indications for a relation between family size and creativity, because divergent thinking takes more place in families with numerous children. BEAR ET AL. (2005) studied sibling sex- and age differences in relation to family size, and observe that "[...] growing up with a large group of opposite-sex siblings or with a large group of siblings relatively close in age seems to positively affect the creativity of firstborns." (Bear et al., 2005, p.75) Moreover they suggest that "[...] rather than focusing on the question of whether different birth order positions are associated with relatively high or low levels of creativity, future research should shift its attention to the sibling constellation variables that likely moderate the effects of birth order position on creativity." (Bear et al., 2005, p.75)

Besides sibling influences, various other factors, such as family trees and history (see Kerr/Chopp, 1999), family climate and interaction (Kerr/Chopp, 1999), parents' own creativity (Runco/Albert, 1986; Noble/Runco/Ozkaragoz, 1993), parents' attitude toward education (Runco/Albert, 1985), socio-economic situation (Chaurasia, 1993; Kaur/Kharb, 1993), and peer status (Lau/Li, 1996) can also play a significant role in individuals' creative development.

For example, CHAURASIA (1993) and KAUR (1993) observed correlation between creativity and a high socio-economic situation. However, "[...] creative individuals typically come from more difficult and stressful family environments." (Kerr/Chopp, 1999, p.712). And RUNCO (2007) concludes from his earlier study[5] concerning relationships between children's creativity and parental independence:

> "Parental appreciation for the autonomy of their children is related to the actual independence of the children and to the creative and divergent thinking skills of the children. Parents who allow independence tend to have children who think creatively. The highly original children have parents who allow independence at an early age." (Runco, 2007, p.52)

Similarly, but partly contrasted to RUNCO's (2007) perspective (see 2.1.2 on page 91), SIMONTON (1999) proposes six developmental and social variables, that influence creative individuals during their life span. One notes that "[...] creative individuals tend not to be first-born, that they are intellectually precocious, that they suffer childhood trauma, that their families tend to be economically and socially marginal or both, that they receive special training early in life, and that they benefit from role models and mentors." (Nakamura/Csikszentmihalyi, 2003, p.187)

Returning to KOHLBERG's (1987) concept of post-conventional thinking (see 2.1.2 on page 91), and thus concerning developmental influences on creativity in adult-

[5] (Runco/Albert, 1985)

hood: creative output in this period is often considered as a more sophisticated form of creativity. Indications for such a definition are that most famous discoveries, inventions, or works in art are products of individuals' creative thinking and behavior during adulthood.

> "The crucial element in postconventional creativity is that the individual takes account of external constraints and conventional values, but is able to produce novelty despite this." (Cropley, 1999, p.514)

Such postconventional thinking can be explained in different ways. For example, NEO-PIAGETIAN's (see Arlin, 1984; Koplowith, 1984; Kramer/Woodruff, 1986) developed the concept of 'postformal thinking', which "[...] are most likely during adulthood, characterized by an understanding of relatively (i.e., a recognition of the importance of immediate context and a devaluation of absolutes), dialectical thinking (i.e. the capacity to take on both extreme positions, "thesis" and "antithesis", and integrate them into the meaningful synthesis), and problem finding. The latter of these would be most directly related to creative achievements, given how important it can be to devote one's efforts to meaningful problems." (Runco, 2007, p.64)[6] In addition,

> "In domains that are less logically ordered, such as musical composition, literature, and philosophy, [...] specialized knowledge is not enough; one needs to reflect on a great amount of experience before being able to say something new. Therefore, one would expect important new contributions in these domains to be made late in life." (Nakamura/Csikszentmihalyi, 2003, pp.187-188)

This suggestion of high creative output in later life, and therefore ongoing developmental and social influences on the creative individual, was also found in studies (Lindauer/Orwell/Kelley, 1997; Fisher/Specht, 1999) concerning aging and creativity. Because, LINDAUER ET AL. (1997), P.42 points out that "[...] what can be said with some certainty about the reports of old artists for whom creative work was a life time activity, is that excellence in old age is possible, that continual learning does take place, and that changes with age can be for the better.“ And, in the study of FISHER and SPECHT (1999), "[...] a 76-old-woman captured the essence of creativity and its link to successful aging when she stated: Creativity is important throughout one's whole life. If you're creative, you're able to approach problems that arise with greater success and, as a result, you will be happier. You can solve problems in a non-conventional way. I'm creative in what i see and how i use what i see. That also carries over into other things. I'm not done with life. In some ways, i think i'm just beginning to see what it's all about." (Fisher/Specht, 1999, p.470)

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[6] For detailed information about problem finding see 2.1.1 on page 87.

2.1.3 *Creativity in Dependence on Personality, Motivation, and Emotion*

Processes were observed in the previous sections (2.1.1 - 2.1.2), which contour creativity from the perspective of creative cognition, as well as developmental/social influences on individuals' creative potential.

Both, 'cognitive individual differences in creativity' (see 2.1.1 on page 85) and individuals 'external' influences during their life time, seem to have a decisive impact on personality, and creative motivation, as well as emotions while creating. Therefore, a large number of scientists (e.g. MacKinnon, 1963; MacKinnon, 1965; Dellas/Gaier, 1970; Barron/Harrington, 1981; Mumford/Gustafson, 1988; Feist/Runco, 1993; Eysenck, 1993; Feist, 1998; Runco, 2007) studied creative personality and attempted to define essential characteristics of creative persons.

This section first tries to give more insight in such core traits, by reviewing empirical investigations and theories which describe individual traits and characteristics in relation to creativity.

In a second step, personality and creative activity is considered from the point of view of intrinsic and extrinsic motivation. Finally, since emotions have a strong impact on creative motivation, and moreover because emotion as well as cognition belong to the same coin of elaboration (see LeDoux, 1996), we will discuss the role of emotion underlying creative behavior in general, as well as emotions in relation to certain personality traits and the their impact on creative behavior, such as divergent thinking or creative problem-solving.

What defines a creative personality?

PHARSES (1986), p.4 defined personality as "[...] that pattern of characteristic thoughts, feelings, and behaviors, that distinguishes one person from another and that persists over time and situations."

Maybe the most obvious personality traits of creative individuals are their relatively independence, autonomy, and their non-conventional thinking (see in this regard 2.1.2 on page 94), from which they can create original concepts, such as scientific findings or artistic works. RUNCO (2007) noted in this context:

> "Creative things are always original. There is more to creativity than originality, but originality is absolutely necessary. Moreover, originality may require some sort of autonomy. Originality implies that a person is doing something that is different what others are doing, and that is probably easiest if he or she is independent and autonomous." (Runco, 2007, p.288)

Independence while discovering how something is done, can already be supported by certain family structures and processes (see 2.1.2 on page 93). Because, RUNCO and ALBERT (1985) observed that 'highly original children have parents who allow independence at an early age.'[7] Similarly, MACKINNON (1962) detected "[...] that creative architects more often than their peers report that unusual freedom was granted to them in their early years by their parents." (Rejskind, 1982, p.58)

Independence traits are well marked in artists, and often go hand in hand with rebelliousness, and non-conventional thinking (see Crutchfield, 1962; Griffin/McDermott, 1998), because "[...] empirical literature on personality and artistic creativity supports the nonconforming, rebellious nature of artists." (Feist, 1999b, p.278) In contrast to rebelliousness, creativity is also related with introversion. For example, CHEEK and STAHL (1986) detected correlations between shyness and a higher degree of verbal creativity in children. Similarly, "[...] Roe (1952, 1953) found that creative scientists were more achievement oriented and less affiliative than were less creative scientists." (Feist, 1999b, p.282) Whether creative individuals are more extroverted or introverted probably depends on the area in which they are working. For example, performing artists, such as singers, need through their artistic activity per se a certain degree of extroversion. However, scientists and composers do not necessarily need extraversion, because their creative work will mostly be done away by others. In relation to ROE's (1952); (1953) observation that 'creative scientists were more achievement oriented', "[...] Dudek et al. (1991) reported significantly higher levels of need for achievement in a sample of professional artists compared with almost 400 nonartists adults. " (Feist, 1999b, p.278)

Besides autonomy, independence and non-conventional thinking, several authors suggest that creative persons also possess traits of openness to experience, tolerance of ambiguity, imagination, and playfulness.

Openness to experience is an important topic within personality research itself, because it is a part of a widely studied and cited Five-Factor-Model (see McCrae/John, 1992; Goldberg, 1993). In creativity research, openness is considered as a fundamental factor for creative output in different domains, such as arts and sciences (see Feist, 1998). In this way "[...] McCrae (1987), has argued, openness is closely related to having a flexible cognitive style when approaching problems, that is, being able to "think outside the box" and not being tied to any one perspective (functional fixedness). Openness and flexibility in turn are related to having the imagination to think of how things could be, no just how they are. By being receptive to different perspectives, ideas, people, and situations, open people are able to have at their disposal a wide range of thoughts, feelings, and problem-solving strategies, the combination of which may lead to novel and useful solutions or ideas." (Feist, 1998, p.300) This proposal has been studied in

[7] See previous section.

varies investigations with the conclusion that first, artists are more open to experience than nonartists (e.g. Cross/Cattell/Butcher, 1967; Csikszentmihalyi/Getzels, 1973; Domino, 1974; Alter, 1989) and, second, "[...] that creative and eminent scientists tend to be open to experience and more flexible in thought than are less creative and eminent scientists [...]." (Feist, 1999b, p.280)[8]

In addition to a kind of openness to experience, some individuals have "[...] the tendency to perceive ambiguous situations as desirable." (Budner, 1962, p.28) Tolerance to ambiguity thus seems to be a natural prerequisite for creativity, because it "[...] may allow the person to deal with ill-defined nature of problems that have creative potential." (Runco, 2007, p.297) VERNON (1970) highlighted this trait as an important factor for creative output. And STERNBERG (1995), p.143 suggested, "[...] one must be willing and able to tolerate at least some ambiguity in order to manifest one's creativity." In this way some researchers (Barron/Harrington, 1981; Sternberg/Lubart, 1995; Urban, 2003) concluded that individuals' degree of tolerance to ambiguity correlates with their degree of creativity.

Within perspectives of developmental psychology as well as creativity research, imagination and playfulness are considered to be related. For PIAGET (1951), playfulness is an elemental intrinsically motivated trait/behavior, by which children discover/construct their environment. "[...] play constitutes the extreme pole of assimilation of reality to the ego, while at the same time it has something of the creative imagination which will be the motor of all future thought and even of reason." (Piaget, 1951, p.16) In creativity research, POLICASTRO and GARDNER (1999), p.217, for example, define imagination as "[...] a form of playful analogical thinking that draws on previous experiences, but combines them in unusual ways, generating a new pattern of meaning. Considerable evidence demonstrates that a playful approach to the task at hand increases the likelihood of producing creative results (Amabile, 1983; Bruner, Jolly, & Sylva, 1976)." A similar relation was also observed in children. LIEBERMAN (1965) detected that kindergarteners with higher rates on playfulness receive higher scores on divergent thinking. Moreover, GARDNER (1993a) studied the personality of some famous creators, e.g. EINSTEIN, PICASSO, or STRAWINSKY, and concluded that they had childlike traits, which involves a kind of playfulness.

Furthermore creative individuals show stronger relations with personality traits, such as anxiety, sensitivity, impulsivity, emotional labile, and mental/affective illness (see Rossman/Horn, 1972; Rothenberg, 1990; Feist, 1991; Feist, 1999b). For example, FEIST (1999b), p.278 suggested, "[...] artists are indeed more emotional and sensitive than nonartists [...]. For instance, Marchant-Haycox and Wilson (1992) administered the Eyesenck Personality Profile to 162 performing artists (actors, dancers, musicians, and singers) and found that they scored significantly higher than control subjects on anxiety, guilt, and hypochondriasis. Similarly,

[8] see (Garwood, 1964; Helson, 1971; Albert/Runco, 1987; Roco, 1993)

Hammond and Edelmann (1991), [...] found that professional actors scored significantly higher on the neuroticism scale than nonactor comparism subjects. [...] Ludwig (1995) examined the relative rates of mental and affective illness in 1,005 eminent people of 18 professions. Ludwig's main finding was that all forms of psychopathology (alcohol and drug abuse, psychosis, anxiety disorders, somatic problems, and suicide, among others) were more common in the artistic professions than in all other professions. [...] Walker et al. (1995) found that eminent artists were more depressed but not more anxious than their noncreative eminent peers."

Finally, the research literature on personality offers much more trait differentiations[9], which can depend on researchers' backgrounds, their domain of research, and focuses of the studies. For instance, BARRON and HARRINGTON (1981), p.453, in their study 'Creativity, intelligence and personality', conclude that generally "[...] a fairly stable set of core characteristics (e.g., high valuation of esthetic qualities in experience, broad interests, attraction to complexity, high energy, independence of judgment, autonomy, intuition, self-confidence, ability to resolve antinomies or to accommodate apparently opposite or conflicting traits in one's self-concept, and finally a firm sense of self as "creative") continued to emerge as correlates of creative achievement and activity in many domains." FEIST's (1998) 'A Meta-analysis of personality in scientific and artistic creativity' revealed that "[...] creative people are more autonomous, introverted, open to new experiences, norm-doubting, self-confident, self-accepting, driven, ambitious, dominant, hostile, and impulsive." (Feist, 1998, p.299). RUNCO (2007), P.314, in the chapter 'Personality and motivation', proposed that a creative personality can be described as a "[...] combination of the following traits, tendencies, and characteristics: autonomy, flexibility, preference for complexity, openness to experience, sensitivity, playfulness, tolerance of ambiguity, risk taking or risk tolerance, intrinsic motivation, psychological androgyny, self-efficacy, interests and curiosity."

Personality and Motivation

Aside from definitions of personality traits of creative individuals[10], one must also ask: What motivates personalities to invest in creative efforts?

Although research in motivation benefits of a long tradition, which goes back to Greek hedonism, different psychological and behavioral efforts in the last century led to the most common perspective of motivation in creativity research, composed of intrinsic as well as extrinsic motivation.

[9] For detailed information see (Feist, 1998; Feist, 1999b; Runco, 2007).

[10] See previous section.

> "Intrinsic motivation is defined as the motivation to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving satisfaction, or personally challenging; it is marked by a focus on the challenge and the enjoyment of the work itself. By contrast, extrinsic motivation is defined as the motivation to engage in an activity primarily in order to meet some goal external to the work itself, such as attaining an expected reward, winning a competition, or meeting some requirement; it is marked by a focus on external reward, external recognition, and external direction of one's work (Crutchfield, 1962; Harlow, 1950; Hunt, 1965; Lepper, Greene, & Nissbett, 1973; Taylor, 1960)." (Collins/Amabile, 1999, pp. 299-300)

Hence, different theoretical and empirical investigations conceptualized motivation as an integral part of the creative work performed by individuals. AMABILE (1998), p.78 proposes for example, "[...] creativity is the function of three components: expertise, creative-thinking skills, and [intrinsic] motivation."[11] Several other theories of creativity suggest that intrinsic motivation is being indispensable for the creative process (e.g. Woodman/Schoenfeldt, 1990; Sternberg, 1995; Sternberg/Lubert, 1996; Runco/Chand, 1995), as well as for the development of individuals' creative abilities (e.g. Csikszentmihalyi, 1988; Csikszentmihalyi, 1990; Woodman/Schoenfeldt, 1990; Gardner, 1993a). Moreover, a very large body of empirical work supports the necessity of motivation for creativity. For instance, in a longitudinal study over 22 years, TORRANCE (1980) found out that individuals who made what they most like to do, are more creative in their pursuits. Similarly, HEINZEN ET AL. (1993) compared adolescents talented in math and science with their peers, and observed that intrinsic motivation is one of the first indicators of scientific potential in this population. This suggests that creative people are highly intrinsically motivated to solve challenging problems in their domain (see Albert, 1990; Csikszentmihalyi/Csikszentmihalyi, 1988). In the same manner, HEINZEN (1989) "[...] found that moderate levels of challenge were conducive to generating a large number of possible solutions to a problem. Such ideational fluency has been demonstrated to be related to creativity: The more solutions considered, the more likely some will be creative. The power of intrinsic motivation is so strong that simply thinking about intrinsic reasons for doing a task may be sufficient to boost creativity on that activity (Greer & Levine, 1991; Hennessey & Zbikowski, 1993), especially for those who have an ongoing involvement in the target domain (Amabile, 1996). " (Collins/Amabile, 1999, p.301)

But intrinsic motivation is only one side of the coin of the motivation of individuals, because the personality and its creative motivation is formed through extrinsic socio-cultural constraints and motivators. Therefore, it is common sense that intrinsic and extrinsic motivation are strongly linked. HEINZEN (1994) for example, describes motivation as a continuum consisting of two sides called: proactive as well as reactive creativity.

[11] "The intrinsically motivated state is conducive to creativity, whereas the extrinsically motivated state is detrimental." (Amabile, 1983a, p.91)

> "Proactive creativity [is] personality driven, whereas reactive creativity is situation driven. [...] The mix between proactive and reactive creativity in our own lives describes the creative output that represents our own contribution across the life span." (Heinzen, 1999, p.431)[12]

Similarly, AMABILE's (1993) conception subdivided extrinsic motivation in two types: "[...] synergistic extrinsic motivators, which provide information or enable the person to better complete the task and which can act in concert with intrinsic motives; and nonsynergistic, extrinsic motivators, which lead the person to feel controlled and are incompatible with intrinsic motives. Thus, although intrinsic motivation may be inversely related to some types of extrinsic motivation (nonsynergistic), it may combine additively with other, synergistic, extrinsic motivators." [...] Amabile (1993, 1996) describes two mechanisms by which synergistic extrinsic motivators might make positive contributions to creativity. In the first, *extrinsic in the service of intrinsics* – synergistic extrinsic motivators, which support one's sense of competence or increase involvement in the task – may act in concert with high levels of intrinsic motivation to increase creativity. A second possible mechansism for the positive influence of synergistic extrinsic motivators on creativity is the *motivation-work cycle match*, wherein different types of motivation play roles in different parts of the creative process. For instance, Amabile suggests that high level of intrinsic motivation is particularly important when the emphasis is on novelty. Thus, when individuals are attempting to identify a problem or generate possible solutions, being intrinsically involved in the task and not distracted by extrinsic concerns will help them to produce more original ideas. At other points in the creative process, however, when the greater emphasis is on persistence or evaluation, synergistic extrinsic motivators may keep creators involved in a problem through times when they must acquire the skills and information necessary to solve problems within a domain." (Collins/Amabile, 1999, p.304)

Moreover, motivation through evaluation (see above) is strongly influenced by various other factors. For example, there are individual differences in personality traits (see in this regard 2.1.3 on page 96) that can effect the interpretation of extrinsic constraints and motivators. In this way, CHEEK and STAHL (1986) thus found out that creative thinking of sensitive people is often negatively influenced (demotivated), if they expect an evaluation. In addition, whether evaluation motivates individuals also depends on their level of expertise and situational as well as contextual factors.

> "Less skilled participants were more creative when they expected evaluation, while more skilled participants were more creative under nonevaluation conditions." [...] The impact of expected evaluation on creativity has been found to vary depending on what type of

[12] "Proactive creativity is the process characterized by intrinsic motivation, positive affect, spreading activation, and focused self-discipline that produces new, effective products (broadly defined)." (Heinzen, 1999, p.431)

> activity precedes the creativity task (Conti, Amabile, & Pollak, 1995). Participants who engaged in a creative activity prior to the experimental task were more creative when they were not expecting evaluation." (Collins/Amabile, 1999, pp.307-308)

In conclusion, the investigations described above suggest that intrinsic motivation to make what one likes to do is indispensable for creativity. At the same time, extrinsic constraints can motivate in different ways, but can also boil down the pleasure found in creative work. This is because, perception/construction of extrinsic constraints and motivators are always an expression of personality traits, which, moreover, depend on temporary sensitivities. This leads to a more complicated perspective on creative individuals, namely the relations between creativity and emotions.

Personality and Emotion

In order to outline the personality of creative individuals, it is useful to incorporate the impact of emotional states on the motivation to be creative. Because, as we will later see in more detail, "[...] the affective pleasure in challenge may be related to curiosity and problem-finding ability; openness to emotional states may be linked to transformation ability; and positive or negative mood states may accompany creative work (Feist, 1994; Higgnis, Qualls & Cougar, 1992; Isen, 1987; Russ, 1993; Shaw & Runco, 1994). Concerning functional links, processes such as access to affect-laden thoughts or primary process material may be involved in divergent thinking or free association (Russ, 1993)." (Lubart/Getz, 1997, p.285)

But, what 'is' an emotion (state)?

> "Are emotions to be conceptualized as brain modes, actions or action tendencies, reflexes, instincts, attitudes, cognitive structures, motives, sensations, or feelings? Are they biologically fixed modules (and hence reducible to biology) or socially constructed roles (and reducible to sociology)? discrete categories or bipolar dimensions? cognitive, precognitive, or postcognitive?" (Russell, 2003a, p.145)

RUSSELL's question emphasized the observation that scientists from various theoretical traditions still discuss controversially what defines emotions, and which processes cause emotions[13].

Concerning the present subject, the question could be: How do persistent and temporary emotions contribute to individuals' personality?

First of all, since the theories of JAMES (1884) and LANGE (1885) a frequent perspective is that emotions have rooted in individuals' bodily states (e.g. LeDoux,

[13] For extended information about various perspectives on emotions (see Lewis/Haviland-Jones/Barrett, 2010).

1996; Damasio, 1999; Panksepp, 1998; Russell, 2003a; Niedenthal, 2007; Niedenthal et al., 2009). For instance, LEDOUX (1996) proposed "[...] that human emotional feelings arise when subcortical information about emotional bodily changes reaches higher working memory and cognitive consciousness generators in the dorsolateral frontal cortex." (Panksepp, 2010, p.53) This perspective, however, also implies that there is a kind of intrinsic activity in emotional feelings (see Northoff, 2012), conceptualized, for example, as a "[...] neurophysiological state that is consciously accessible as a simple, nonreflective feeling [...]." (Russell, 2003a, p.147), from which an affect is generated. There are some prominent models which try to describe such assessment processes of individuals' self-states (e.g. Russell, 2003a; Panksepp, 1998; Northoff, 2012), but maybe RUSSELL's model (2003a) of *Core affects* is a useful foundation to outline the contribution of emotions to creativity.

To go more into detail, RUSSELL defines *Core affect* in general as a region situated within two dimensions (see Figure 2.3) of displeasure–pleasure and deactivation–activation, which marks a certain degree of raw emotional feeling (neurophysiological state).

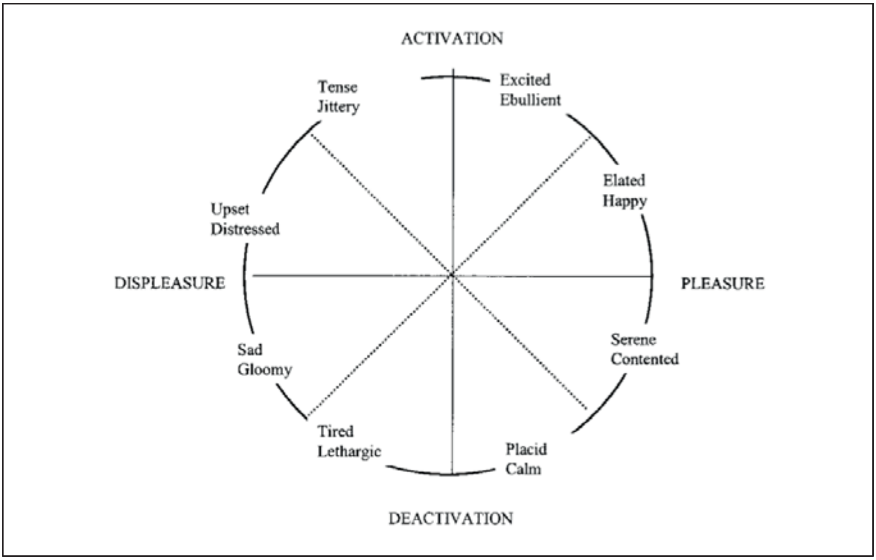

Fig. 2.3 "Core affect" (Russell, 2003, p.148)

> "At a given moment, the conscious experience (the raw feeling) is a single integral blend of two dimensions, hence describable as a single point on [...] [Figure 2.3]. The horizontal

> dimension, pleasure–displeasure, ranges from one extreme (e.g., agony) through a neutral point (adaptation level) to its opposite extreme (e.g., ecstasy). The feeling is an assessment of one's current condition. The vertical dimension, arousal, ranges from sleep, then drowsiness, through various stages of alertness to frenetic excitement. The feeling is one's sense of mobilization and energy. [. . .] As consciously experienced, core affect is mental but not cognitive or reflective (Zajonc, 2000). Cognitive events, such as beliefs or percepts, are intrinsically about something: They have Objects. In contrast, core affect per se is not about anything. That is, core affect can be experienced in relation to no known stimulus – in a free-floating form – as seen in moods. [. . .] A person always has core affect: Picture a single point that moves about in [. . .] [Figure 2.3], responding to events internal and external. Core affect can be neutral (the center point), moderate, or extreme (the periphery). Changes can be short lived or long lasting (as in a clinical depression). Intense core affect can be the focus of consciousness, but milder core affect is typically a part of the background of the person's conscious world. Change in core affect, in proportion to its rapidity and extent, fills consciousness. When the feeling weakens or stabilizes, it recedes into the background. When neutral and stable, perhaps core affect disappears altogether from consciousness. [. . .] As a direct consequence, core affect is implicated in attention, perception, thinking, judgment, mental simulation, and retrieval from memory (e.g., Baron, 1987; Blaney, 1986; Bower, 1992; Eich, 1995; Forgas, 1995; Forgas, Bower, & Krantz, 1984; Izard, Wehmer, Livsey, & Jennings, 1965; Mayer, Gaschke, Braverman, & Evans, 1992; Schiffenbauer, 1974). [. . .] Core affect influences the quality and type of cognitive processing. Much evidence shows that activation influences cognitive performance in a curvilinear manner: Optimal performance occurs at intermediate levels of activation, with the level higher for simpler tasks, lower for more complex tasks (Humphreys & Revelle, 1984). Increased arousal leads to attention selectivity (Easterbrook, 1959; Eysenck, 1982). Negative core affect generally leads to more detailed and critical thinking, whereas positive core affect leads to more heuristic and divergent thinking (Park & Banaji, 2000; Schwarz & Bless, 1991). [. . .] Attributing core affect to an Object is the first step in solving the problem quantified by core affect. [. . .] Simulating the future allows anticipation of various features, including one's core affect in reaction to the imagined scenario: If such and such happens, then I will feel satisfied. These judgments are probably not perfect predictions of actual feelings, but they are far from random. [. . .] In this way, the task of anticipating the future is shared by attributed affect and stored knowledge of affective quality." (Russell, 2003a, pp.148-160)

If one relates RUSSELL's explanations with creative personality, then it seems plausible that the degree of neurophysiological activity, conceptualized as core affect or mood, etc., marks the starting point from which creative processes evolve in individuals. Moreover this implies that various degrees of neurophysiological activities can lead to different creative performances and creative products. Therefore it can be assumed that levels of core affect (emotion state/neurophysiological state) are important factors for processes described in the previous section (see 2.1.3 on page 99) under individuals' motivation.

In addition, to speculate about the impacts of such states to personality traits (see 2.1.3 on page 96), it is useful to look in the direction of longer emotional periods, because a personality trait is considered as "[...] that pattern of characteristic thoughts, feelings, and behaviors, that distinguishes one person from another and that persists over time and situations." (Pharses, 1986, p.4) Research in personality has contoured various traits, such as autonomy, anxiety, playfulness, etc. (see 2.1.3 on page 96), which persist over time, or characterize an individual in certain (recurring) situations. And, as already explained in various sections previously, cognitive processing is also essential for the development of individuals' personality. Therefore, emotional periods, such as a personality trait of anxiety in a particular situation, consist of processes which are conceptualized as related more with cognitive structures in dependence on environmental stimuli[14] as well. RUSSELL (2003a) thus proposed various processes that contribute to an emotional episode, and which effect personality traits. These are: Core Effect, Antecedent Event, Affective Quality, Attribution, Appraisal, Instrumental Action, Physiological and Expressive Changes, Subjective Conscious Experiences, Emotional Meta-Experience, Emotion Regulation (see Russell, 2003a, pp. 150-151).

A more recent model (BARRETT, 2009A) also emphasized neurophysiological states (Core affects) as essential building blocks, although aiming at explaining individuals and cultural variability in emotion perception and experience. BARRETT presupposes that the human brain constantly categorizes sensory patterns in a certain way[15][16], because "[...] internal sensations from the body and external sensations from the world are made meaningful by categorising them. This cat-

[14] For example, "[...] Russell explicitly refers to the assignment of affect to exteroceptive stimuli when he describes the transition from Core Affect to emotional episodes and emotional meta-experience. In the moment when the continuously present Core Affect is related to an episodically occurring exteroceptive stimulus, an emotional episode and meta-experience may occur." (Northoff, 2012, p.9)

[15] See in this regard EDELMAN (1989).

[16] "Categorisation doesn't happen in stages, because a physical or affective state is ambiguous, or because people consciously experience the need or motivation to conceptualise. It happens as a natural consequence of the way the brain works. Human brains categorise continuously, effortlessly, relentlessly. Some of the categories used by the brain are grounded in statistical regularities in the world. From birth, the human brain captures statistical regularities in sensorimotor patterns and stores them as internal representations. Words are then applied to these categories later in development. Other categories have no statistical regularities. For these categories, words act like the glue that holds a category together. Without words, these categories would not exist. According to the conceptual act model, emotion categories are an example of the latter type of category (cf. Barrett, in press [see Barrett, 2009b]). The brain then draws from its vast repository of stored representations in the blink of an eye, to associatively recombine what it has learned in the past. This allows the brain to continuously and unintentionally categorise what sensory stimulation means in the present, to make the present state meaningful. An act of categorisation is the brain's prediction of what sensory stimulation stands for (e.g., Bar, 2007). Via this process of categorisation, the human brain transforms only some sensory stimulation into information. Only some of the wavelengths of light striking our retinas are transformed into seen objects. Only some of the changes in air pressure registered in our ears are heard as words or music. Only some sensations from the body are transformed into emotion." (Barrett, 2009a, pp.1291-1292)

egorisation uses emotion knowledge that has been learned via prior experience." (Barrett, 2009a, p.1292)

Moreover, BARRETT's 'conceptual act model' assumed that "[...] mental events that people refer to as "emotion" are constructed, [...] from three more ingredients that are psychologically primitive (cannot be reduced to anything else psychological), and that are always in play: (1) a mammalian system that represents physical states that are experienced as pleasant or unpleasant with some degree of arousal (called core affect; Barrett & Bliss-Moreau, 2009; Russell & Barrett, 1999); (2) a human conceptual system for emotion (i.e., what people "know" about emotion) that resides in memory (Barrett, 2006b) and that might exist in a more limited form in non-human great apes; and (3) controlled attention that is not necessarily deliberate or intentional but that helps to negotiate which conceptual elements are activated and which are suppressed in a given instance of conceptualisation (see Barrett, Tugade, & Engle, 2004, for a discussion). The conceptual act model hypothesises individual (and perhaps even cultural) differences in each of these three ingredients. People can differ in their affective reactivity, in the size and complexity of their conceptual systems for emotion, and in the controlled attentional capacity that is available to them to build categories and manage the process of categorization. When combined, these psychological primitives produce a powerful and highly flexible system that can account for the full richness and range of experience that characterises human emotional life." (Barrett, 2009a, pp.1294-1295)

It also seems that BARRETT's proposal of 'emotion concepts' does not distinguish between emotional and cognitive processing per se, but conceives emotions as interactions between body, subcortical as well cortical regions of the brain.

> "Furthermore, emotion concepts, in this view, are not amodal (lists of beliefs or propositions), but are themselves embodied (e.g., Barsalou, 2008; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), blurring the boundary between conception and perception. And the conceptualisation of core affect is not something that occurs after the fact, as in the common idea of interpreting or cognising a snapshot of affective change after it has taken place. Instead, an instance of a concept, to the extent that it is expressed as a brain state that includes activity in sensory and motor neurons (some of which may be representing affect), intrinsically shapes the mental event that emerges as an emotion. This suggests, of course, that any particular pattern of physiological or motor activity that is observed in a given instance of "fear" will take its character both from a person's core affective state and from whatever conceptual knowledge is brought to bear during the categorisation process at a given point in time." (Barrett, 2009a, p.1295)

Additionally, BARRETT's suggestion of embodied 'emotion concepts' is similar to other models of the mind, which are labeled under 'theories of embodied cognition'. Because, the "[...] assertion common to recent instantiations of such theories is that high-level cognitive processes (such as thought and language) use partial reactivations of states in sensory, motor, and affective systems to do their jobs (14).[(Wilson, 2002)]." (Niedenthal, 2007, p.1003)

This perspective is also related to previous explanations, such as LAKOFF's proposal (1987), xi "Reason has bodily bias.", and the emphasizing of the sensorimotor phase as initial developmental period, in which bodily experiences are conceptualized as building blocks for individual development (see 1.3.2 on page 49; 1.4.1 on page 60; 1.4.2.1 on page 66). Indeed, and not only during initial stages of development, bodily sensations are the basis on which various kinds of knowledge are produced. Building knowledge always includes modal-specific states (pattern of neural activities in the brain), such as intermodal states (auditory, visual, motor, and affective) while experiencing a 'snarling bear' (see Niedenthal, 2007). If a knowledge is re-activated, relevant modal-specific states which occurred when the knowledge was initially acquired are also re-activated. For example, "[...] retrieving the memory of a specific person involves the reactivation of parts of the visual states that were active while perceiving him or her. In the same way, thinking about an action involves partial activation of the motor states that originally produced it." (Niedenthal et al., 2009, p.1121)

We can finally summarize: all the frameworks explained above lead to the conclusion that neurophysiological states (such as core affect, mood, etc.) generally contribute to personality traits, because certain degrees of core affect significantly influence behaviors in a given situation. Furthermore, neurophysiological states are 'mostly'[17] connected with cognitive processing, because, as already suggested, the "[...] brain captures modality-specific states during perception, action, and interoception and then re-instantiates parts of the same states to represent knowledge when needed." (Niedenthal, 2007, p.1003)

Returning back to the main topic of this section '(creative) personality and emotion', creativity research has also investigated affective processes in relation to: first, personality traits; and second, creative processes, such as creative problem solving and divergent thinking.

Regarding affect and personality, RUSS proposed for example that "[...] in some cases personality traits are behavioral reflections of the underlying affective process." (Russ, 1993, p.8) Furthermore, she refers to conclusions of MCCRAE and COSTA (1987) that "[...] openness to experience is related to access to thoughts, feelings, and impulses. Access to a primary process facilitates openness to experience. Tolerance of ambiguity is also related to these dimensions of affect, in that a variety of disparate thoughts and feelings can be experienced simultaneously. Comfort with affect states and affective fantasy should increase the probability that the openness to experience trait would develop. Affective pleasure in challenge would be important in the well-researched trait of preference for challenge

[17] However, some perspectives doubt that it is always so. For example, Zajonc (1980) proposed "[...] affect could be generated, without a prior cognitive process." (Zajonc, 1984, p.117)

and complexity. Pleasure in challenge would also be consistent with the trait of curiosity and risk taking. Affective pleasure in problem solving is an important component in intrinsic motivation, curiosity, and self-confidence. A self-confident individual anticipates the positive affect involved." (Russ, 1993, p.105)

Moreover, McCrae and Costa's proposal (1987) of affective pleasure in creative efforts leads back to the conclusion above, 'that the degree of neurophysiological activity, conceptualized as core affect or mood, etc., marked the starting point from which creative processes evolve in individuals. [...] various degrees of neurophysiological activities can lead to different creative performances and creative products' (see 2.1.3 on page 104). Both perspectives are related to investigations proposing that mood influences creative problem solving as well as divergent thinking. That is to say, "[...] that positive mood may affect processing during problem-solving towards being more "heuristic", "loose", and "intuitive", whereas people in a negative mood tend to be more adept in critical and analytical thinking (cf. Melton, 1995)." (Kaufmann/Vosburg, 1997, p.152) This position is also related to Russell's (2003a) proposal that 'Core affect influences the quality and type of cognitive processing' (see 2.1.3 on page 103).

However, there are various empirical findings and theoretical interpretations of mood in relation to creative efforts.

The perspective that positive mood facilitates creative problem solving is based on the theoretical assumption that "[...] material associated with positive mood is more richly interconnected in memory relative to other moods (Isen, 1984, 1993; Isen & Daubman, 1984; Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985). Positive mood has the capacity to activate this highly associated material, thereby increasing the likelihood of making novel associations." (Vosburg, 1998, p.315) For example, Isen et al. (1987) have shown that positive mood may contribute to a better performance in the 'candle task' of Duncker (1945)[18] and Mednick's (1962) Remote Associates Test. Mitchell and Madigan (1984) found facilitative effects of positive mood on heuristic problem-solving tasks. Moreover, "[...] Jamison (1993) suggests that a mild hypomanic state is conducive to high levels of ideational fluency, speed of association, combinatorial thinking (including incongruent combinations and metaphors), and loose processing involving irrelevant intrusions in thought (cf. Schuldberg, 1990, 1999; Shapiro & Weisberg, 1999; Shapiro et al., 2000)." (Kaufmann/Vosburg, 2002, p.318) And, in the line with these results, "[...] Russ (1993) proposed that positive mood will stimulate creativity in problem-solving, by way of facilitating divergent thinking and transformation abilities involved in changing existing knowledge into new patterns of configurations. [...] [And] experiments by Greene and Noice (1988) and Abele (1992b) have demonstrated significant positive effects

[18] This is a problem of insight.

of induced positive mood on divergent thinking tasks." (Kaufmann/Vosburg, 1997, p.152)

The idea behind the proposal 'negative mood tend to be more adaptive in critical and analytical thinking' (see above) is that "[...] individuals in a negative mood will consider their task environment as problematical and consequently will employ a "tight," risk aversive, analytic, and systematic processing style."(Vosburg, 1998, p.315) Several studies found indicates for this idea, such as "[...] that positive mood leaves a person more open to biases in thinking and judgments, whereas negative (mildly depressed) mood leads to more realistic perceptions and judgments and decreases the tendency to be subject to biases (Alloy, 1986; Alloy & Abramson, 1979; Alloy, Abramson, & Viscuti, 1981; Forgas, 1998; Tabachnik, Crocker, & Alloy, 1989)." (Kaufmann/Vosburg, 2002, p.318) Similarly, "[...] Martin et al. 1993 demonstrated that subjects stopped searching for task-relevant information sooner under positive as compared with negative mood conditions when asked to stop when they thought they had enough information." (Kaufmann, 2003, p.194)

However, there are also findings which contrast with such a general 'positive mood-creativity hypothesis'. First of all, RUNCO (1994b) presented a variety of ways in which 'tension' and 'dissatisfaction' are prerequisites for creative problem-solving: "[...] a strongly negative mood (frequency of suicidal thoughts) was, indeed, significantly positively related to problem-finding ability, indicative of an ability to imagine new and interesting problems." (Kaufmann/Vosburg, 2002, p.319) Moreover, as already seen previously (see 2.1.1 on page 87), problem finding/identification is an important process for creative problem-solving. The anticipation of resolving this tension can be a motivating force in creative problem-solving. Other proposals (Boden, 1991; Mumford, 2003; Rothenberg, 1990; Weisberg, 1986) again emphasize that high-level creative problem-solving often needs rational and systematic thinking, such as the inclusion of expertise.

A core argument for RUNCO's (1994b) perspective came from LUDWIG's (1995) study of 1005 prominent twentieth century individuals from over 45 different professions. He found a significant correlation between depression and degree of creative achievement (see also 2.1.3 on page 98). This seems also the case for affective disorders in general, because several systematic investigations (Andreason, 1987; Jamison, 1993; Post, 1996; Feist, 1999a) found relationships between creative individuals and variations of affective disorder. Indications for such a kind of 'negative-mood-as-motivator perspective' were also found by GEORGE and ZHOU (2002) that applied MARTIN ET AL. (1993) 'mood-as-input model' to creativity, "[...] proposing that the information provided by affective states can influence an individual's effort and persistence on creative activities at work. They suggested that when people are experiencing positive affect, are aware of that affective state, and are in a situation that clearly calls for creativity, they will interpret their positive mood as an indication that they have met their creative goal and additional effort is not needed. [...] By contrast, when people are experiencing negative affect, are aware of that affective state, and are in a situation that clearly calls for creativity, they will interpret their negative mood as an indication that they must try harder to find a creative solution. The results of a cross-sectional study conducted in a large manufacturing organization supported these hypotheses (George and Zhou, 2002), although an earlier experimental study testing the mood-as-input model found support only on quantitative aspects of performance and not on creativity (Hirt et al., 1997)." (Amabile et al., 2005, pp.370-371)

Beyond a strict positive-mood-creativity as well as negative-mood-creativity hypotheses, some proposals (Canli et al., 2000; Cahill et al., 2004) suggest a curvilinear relation between creativity and affect. For example, CANLI ET AL. (2000) demonstrate in a neuropsychological study that intense emotional experiences per se stimulate the amygdala and later regions associated with memory processing. However, FRIJDA (1986) "[...] asserted that positive and negative emotions are both characterized by "control precedence," such that emotions absorb available cognitive resources because they require direct attention. Building on Frijda's theory, Weiss and Cropanzano (1996: 54) stated that "people in an emotional state tend to be controlled by that state, they tend to be preoccupied by the emotion, and there is a persistence to behaviors designed to deal with the emotion." According to this view, powerful emotions, both negative and positive, may distract from task performance (Amabile et al., 2005, p.372). Other studies (Jamison, 1989; Jamison, 1993; Jamison, 1995; Ludwig, 1992; Ludwig, 1995) again propose that particular changes in affect states contribute to creativity, such as changes from positive to negative emotions. Indications for this can be seen in various studies demonstrating relationships between creativity and bipolar disorder in individuals (e.g. Akiskal/Akiskal, 1988; Shaw et al., 1986; Rothenberg, 2001). Such as AKISKAL and AKISKAL (1988), who "[...] in their study of 750 patients, found that patients with Bipolar II and Bipolar III disorder were more artistically creative. They also noted that creativity was confined to patients with a mild form of bipolar disorder." (Ghadirian/Gregoire/Kosmidis, 2001, p.145)

In conclusion, based on the seemingly controversial discussion about affect states and their contribution to creative efforts, we can summarize that various kinds of affects seem to induce motivating forces (instrinsic-extrinsic perspective (see 2.1.3 on page 99)) and/or to trigger knowledge which was saved with a particular emotion together (see in this regard embodied-cognition perspective (see 2.1.3 on page 106)). Moreover, levels of affect states, conceptualized as core affect, mood, emotional episode, etc. seem to be first, essential building blocks to produce knowledge in general; and second, prerequisites for proposed core characteristics of certain creative personalities, such as openness to experience, sensitivity, impulsivity, emotional labile, and anxiety (see 2.1.3 on page 96). These thoughts, and the most[19] studies exposed above, indicate that kinds of ’affect-laden knowledge’/’affect-laden thoughts’ and ’affect-laden free-floating states’[20] are in general reinforcing factors for creative processes. On the other side, creative work trigger affect states as well, because “[. . .] creative achievement in the arts and sciences suggest that creative insight is often followed by feelings of elation (Gruber, 1995; Feist, 1999; Shaw, 1999).” (Amabile et al., 2005, p.375)

However, good reasons advocate for the perspective that affect and creative work usually take place simultaneously. Indeed, as seen previously, intrinsic motivation to be creative “[. . .] is defined as the motivation to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving satisfying, or personally challenging; it is marked by a focus on the challenge and the enjoyment of the work itself.” (Collins/Amabile, 1999, pp. 299-300) This suggests that kinds of affect-laden states and thoughts are involved in creative activities, leading to a creative behavior, which, for example CSIKSZENTMIHALYI (1975); (1996) designate as ’flow-state’.

2.2 Musical Creativity/Creative Thinking in Sound

What is meant with Musical Creativity?

Probably, proposing a clear definition of this concept is a big challenge because, as pointed in the previous section (see 2.1 on page 85), there are already various ’perspectives on creativity in general’, and each individual point of view emphasizes own processes or factors for creativity, such as cognition (see 2.1.1 on page 85), developmental and social influences (see 2.1.2 on page 90), personality (see 2.1.3 on page 96), motivation (see 2.1.3 on page 99), and emotion (see 2.1.3 on page 102), etc.. Research in music uses some of these aspects to suggest various proposals of musical creativity, like musical divergent thinking (e.g. Gorder, 1980; Webster, 1990; Webster, 2003), musical problem solving (e.g. Feinberg, 1974; Pogonowski, 1987; Elliot, 1995; Burnhard/Younker, 2004), flow and musical processes (e.g. Byrne/MacDonald/Carlton, 2003; MacDonald/Byrne/Carlton, 2006), imagination and musical processes (e.g. Copland, 1952; Thomas, 1987; Reichling, 1990; Hargreaves/Miell/MacDonald, 2012), etc.

This variety of proposals is related to the variety of using the term ’musical creativity’ as well. For example in a study, analyzing papers in the Music Educators Journal from 1914 - 1970, HOUNCHELL (1985) concluded, there were different definitions of creativity in music, but “[. . .] the term ”creativity” was most commonly used in relation to composing and that creativity was often used as a

[19] Some studies present opposite findings (see Weiss/Cropanzano, 1996; Fridja, 1986).

[20] This means a high level of core affect, experienced in relation to no known stimulus.

means of building support for ideas regarding music education." (Brophy, 2000, p.151)[21] LEMAN (1999) defined more generally that musical creativity "[...] is associated with notions such as novelty, originality, and flexibility but also with divine intuition, passion, and the courage to express personal emotions." (Leman, 1999, p.285) From a social-cultural perspective, BURNHARD (2009), P.361 argued, "[...] not only is musical creativity embodied in contextual activity of (and other-than) composing, improvising and arranging but is implicated in constructing the broader realities in which the acts of performing and listening occur." And finally, FRITH (2012) proposed that musical creativity refer in general to different things in relevant music genres, because "[...] classical composers are not more inventive than improvising jazz performers; rather, the musicians in these different musical worlds 'create' according to different principles of collaboration, originality, expressiveness, and so on." (Frith, 2012, p.70)

Additionally to FRITH's point of view, some authors (e.g. Schubert, 2012; Webster, 2003; Cook, 1990) suggest, there are differences in underlying structures of behaviors related with musical creativity (e.g. listening, improvisation, composition).[22] WEBSTER (2002), p.14 for example, proposes that "[...] composition, performance of previously written music, and music analysis resulting from repeated listening are all time-independent. The creative processes have the benefit of "time away." Improvisation and single-time listening unfolds in fixed time and the creative thinking is part of a flow of musical behavior that does not benefit from reflection to the extent that the others do." Also COOK (1990) argued, there are "[...] a fundamental contradiction between the way which the composer conceives music and the way in which the listener experiences it, and the same, of course, applies to the formal level at which a composer sees his piece as a structurally integrated whole – a level of structure which may have little if any reality for the listener." (Cook, 1990, pp.223-224)

Maybe, the linking core of every creative behavior in terms of music is creative thinking in sound, which furthermore seems to be a prerequisite for the development of thinking in general. Remembering, already in the earliest months after birth, infants begin to experiment with pitch, timbre, rhythm, dynamics and expanding upon sounds through manipulations. By that, they interact in a direct manner with their environment aiming to discover or construct meanings from self-created and perceived sounds (see 1.2 on page 35 – 1.4.2 on page 64).

It is not surprising that such a developmental perspective of thinking in sound is related with a popular proposal of the 'creative thinking process in music' (Webster, 1990; Webster, 2002; Webster, 2003) proposing, "[...] what creativity in music really is: *the engagement of the mind in the active, structured process of think-*

[21] See in this regard 1.4.2.2 on page 69.

[22] For detailed information about creativity and listening to music see 2.4 on page 140, as well about creativity and composition music see 2.5 on page 162.

ing in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11)[23]

Building on this definition, WEBSTER's model (2003) itself seems to be a good beginning to outline two slightly different conceptualizations of musical creativity or creative thinking in sound.

To go more into detail, first and foremost it is striking that WEBSTER's comprehensive model is highly influenced by 'perspectives on creativity in general' (see 2.1 on page 85), because he conceptualized "[. . .] that creative thinking is a dynamic process of alternation between convergent and divergent thinking, moving in stages over time, enabled by certain skills (both innate and learned), and by certain conditions, all resulting in a final product." (Webster, 2002, p.11)

Schematically seen in Figure 2.4, WEBSTER placed GUILFORD's concept (1950); (1967) of convergent-divergent thinking[24] as one cornerstone of his model, assuming "[. . .] the [musical] thinking process is a constant interplay between two qualitatively different ways of thinking. Divergent thinking on the part of the music creator involves imaginative thought. Here the creator is exploring the many possibilities of music expression, always cataloging, sifting through, rejecting, accepting only to change yet again. Small kernels of musical thought, which might be a melodic or rhythmic phrase, a harmony, a timbre, or even longer and more complex patterns of music, are all imagined and possibly realized on some musical instrument. These primitive gesturals (PGs) are all part of the exploration process that often characterizes the opening periods of creative thought. Such thinking is largely divergent in nature. Of course, such thinking occurs all through the creative experience as ideas are refined, then rejected, and new periods of divergency occur. All of this is cast against convergent thinking that is more linear and more analytical. Here, the aesthetic decisions are made and the gesturals are turned into entities that are far from primitive. The thinking in this case is more discriminatory and driven by an emerging plan that may be conscious or subconscious. Musical material is rejected or celebrated, manipulated and fine-tuned. This kind of thinking might logically occur closer to the end of the creative process, but not always. The interplay between divergent and convergent thinking is almost magical in scope and is at the center of creative thinking." (Webster, 2002, p.13)

The second cornerstone, and moreover a further influence from the general creativity research can be seen by his partial adoption of WALLAS (1926) 'Stage

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[23] Although, originally WEBSTER (1987B) noted that this model "[. . .] is not designed in developmental terms." (Webster, 1987b, p.167) , BROPHY (2000), pp.153-154 argued "[. . .] that several developmental characteristics are implied. Product intention is doubtless different for the young child, who relies primarily on intuition and chance for performance and improvisation. The enabling skills that are vital to the model are developing in children, implying that creative products may be differently affected by these conditions at different ages. The same is true of the gradual acquisition of conceptual understanding in music, achieved over a period of time."

[24] See also 2.1.1 on page 87.

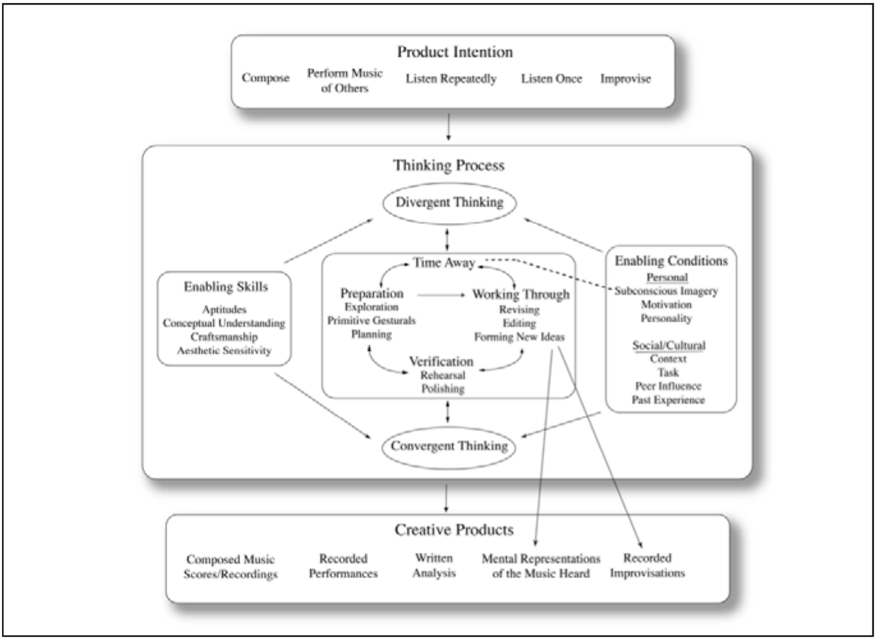

Fig. 2.4 Webster's (2003) model of 'creative thinking process in music' (source Webster, 2003, p.60)

Theory'[25]. WEBSTER is "[...] quite sure that stages operate in the creative process and have retained the notions of preparation, verification, and incubation (though I have renamed this "Time Away" which seems to make more conceptual sense to me). I have come to believe that illumination is not as much a stage as a qualitative event that occurs many times in the creative process. I also feel that the notion of verification is best reserved for the final polishing stage of the creative processes that are more reflective in nature. The idea of "Working Through" is attractive because it functions both in terms of reflective thinking and "in the moment" thinking. It is this stage, too, that likely occupies the greatest percentage of creative time and is the most indicative of convergent and divergent thinking in combination." (Webster, 2002, p.14)

Both, convergent-divergent thinking and stages of creative processes depend furthermore on two factors that influence the thinking process, named 'Enabled Skills' and 'Enabled Conditions'. The first factors are a big topic in the general psychology of music research (see Cambouropouos et al., 2012), and furthermore

[25] For detailed information see 2.1.1 on page 88.

considered as to be acquired in the course of development (see 1.4.2 on page 64), starting from individual predispositions (see 1.1 on page 27 – 1.3 on page 46). The second factors, as it is studied in 'perspectives on creativity in general' (see 2.1 on page 85), influence the development of musical skills as well as the creative work in a certain moment of thinking and doing.

RYAN and BROWN (2012) sum up, in WEBSTER's view, when people start to think in sound or music, they "[...] typically have some intention related to composition, performance and improvisation, or analysis (Product Intention). With the intention established, the creator uses needed skills, which are influenced by conditions, as the thinking process takes place (Enabling Skills and Condition). The creator goes through various stages at the center of the model derived from the Wallas stages, moving between Divergent and Convergent Thinking, and finally reaches the final product (Webster, 1990)." (Ryan/Brown, 2012, p.107)

The second interesting conceptualization of musical creativity came from ELLIOT (1995). At first, he believes that originality, which is often associated with creativity, 'is only part of the story'.

> "That is, originality is a necessary condition for calling something creative, but it is not sufficient. For when we focus exclusively on a product's foreground of unfamiliar features, we overlook the product's background of familiar features, including its links with past achievements. In other words, without some relationship to other accomplishments – without the context or background of past achievements – new productions would merely be bizarre, not original."(Elliot, 1995, pp.216-217)

In this way, it is proposed 'A Head-and-Shoulders View of Musical Creativity' (see Figure 2.5), in which creative musical achievements depend on 'previous achievements in a history of practice'. That means, for example, [. . .] Beethoven's "Eroica" (his third symphony) stands on the shoulders of previous musical works that Beethoven's predecessors and colleagues composed or that Beethoven himself composed. [. . .] compositional practices are ongoing social practices. When a composer begins to compose, he or she is not acting alone. Whatever music gets done is connected to a network of direct and indirect musical, social, and cultural achievements and relationships. People who achieve results inevitably stand on the shoulders of past and present doers and makers in their domain. The "head and shoulders" view of musical creativity [in Figure 2.5] is meant to emphasize the musical interdependence of music makers and creative musical achievements past and present." (Elliot, 1995, p.217)

This precondition is important for Elliot's model of 'Musical Creativity in Context' (see Figure 2.6), because the acquired musical achievements of the past and present (named *as musicianship)* represents the expertise that "[. . .] makes it possible for a person to generate ideas and select ideas that have promise for creative achievement." (Elliot, 1995, p.224) Focused on the creative achievement, and, moreover, referring to BEREITER and SCARDAMALIA's (1993) as well as

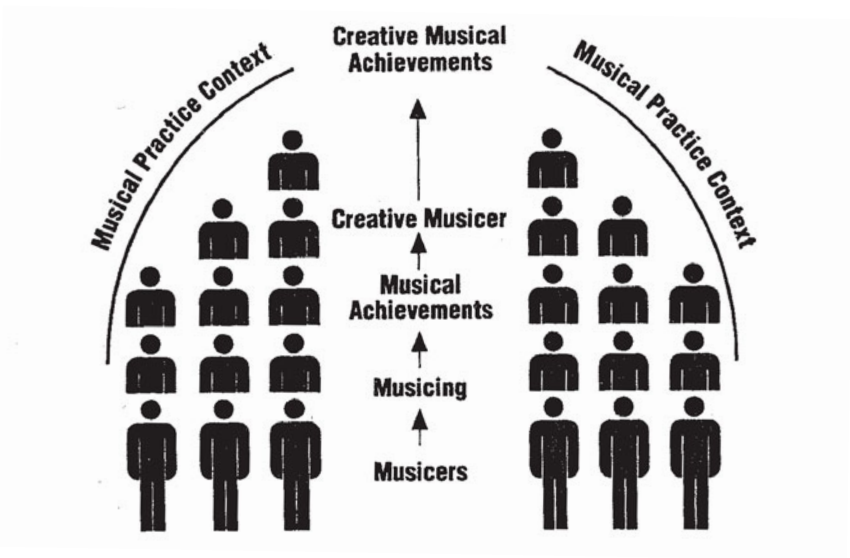

Fig. 2.5 "Musical Creativity: A Head-and-Shoulders View" (Elliot, 1995, p. 218)

PERKINS (1986); (1988) suggestions[26], ELLIOT proposed that creative thinking and doing in music can partly be conceptualized as an ensemble of problem solving and finding strategies (see in this regard 2.1.1 on page 87).

> "Creating is like trying to hit a moving target; new goals and problems are constantly arising in the course of challenging projects. We do not usually know ahead of completion precisely what the intermediate steps or the final outcome of our efforts will be. [. . .] Another key to creative achievement, then, is problem finding. A proficient level of musicianship not only makes it possible to generate and select musical possibilities, it also alerts us to problems and opportunities that hold the promise of musical significance." (Elliot, 1995, p.225)

This also means, creative thinking and doing in sound is guided through predictions or anticipations about the musical potential, which 'arises' after a particular decision. ELLIOT named this ability *promise detector* that is the main motivation for one's development of thinking and doing in sound, because it is supposed that people "[. . .] learn to predict and select for musical promise by attempting to find and solve authentic music-making problems that are just beyond their current lev-

[26] For detailed information see (Elliot, 1995, p.225).

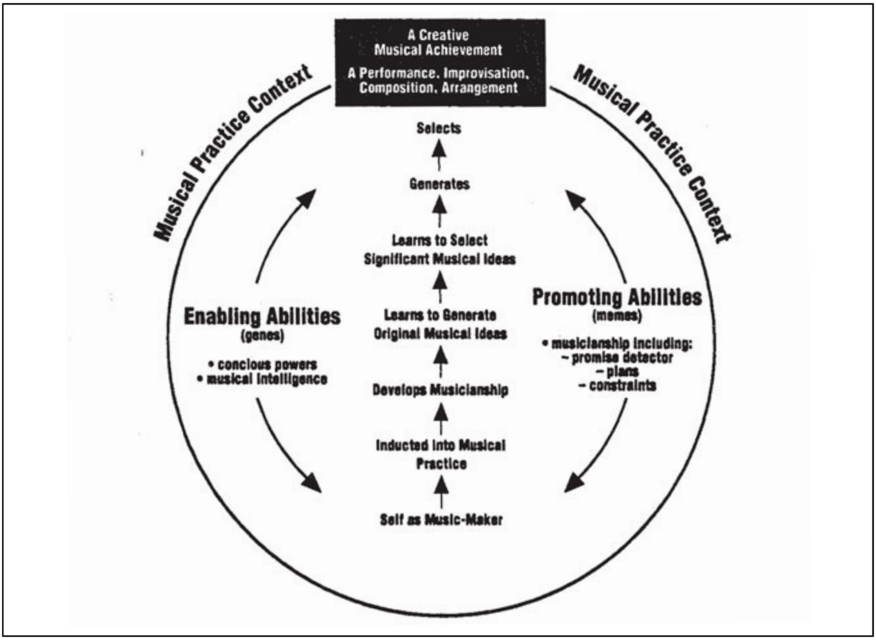

Fig. 2.6 "Musical Creativity in Context" (Elliot, 1995, p. 230)

els of musicianship. In other words, the process involved in developing one's musicianship from a novice to an expert level is the same process required to develop a "creative musical promise detector". The process is motivated and directed by upward spiral of difficulty requires learners to set new goals that, in turn, demand higher levels of musicianship." (Elliot, 1995, p.226)

In summary, ELLIOT's models emphasize that products of musical creativity, such as performance, improvisation, composition, and arrangement build on a history in practice, and are determined in a social-cultural environment. Moreover, he assumed, creative thinking and doing in sound is motivated to expand the own level of musicianship, based on problem finding and solving strategies. Or in Elliot's words, a product of musical creativity, such as a "[. . .] performance, composition, arrangement, or improvisation is the tangible result of effort expended, expertise deployed, promises realized, and enjoyment felt." (Elliot, 1995, p.230)

Finally, although there are various definitions of musical creativity as well as creative thinking in sound or music, it can be stated that the aspect of *creating new* – whether studying the process or the product, is a factor for all of the definitions listed above. Because, for example, WEBSTER (2002) explicitly pointed to the relation between 'process of thinking in sound' and the 'product that is new for the creator' (see 2.2 on page 112); LEMAN (1999) proposed a relation between musical creativity and 'notions such as novelty, originality'; FRITH (2012) emphasized, both classical composers and jazz improvisors are inventive while creating music; and ELLIOT (1995) argued for a perspective of musical creativity, in which strategies are acquired or created to become a higher level of musicianship.

The latter also points to another big topic that will be the subject in next section. There a more developmental perspective of musical creativity or creative thinking in sound is discussed, which supposes that creativity in terms of music can be expanded and stimulated.

2.3 Developmental Aspects of Musical Creativity/Creative Thinking in Sound

2.3.1 Definitions of Musical Creativity in the Course of Development

As presented above in section 'Developmental and Social Influences on Creativity' (see 2.1.2 on page 90), several prominent scientists (e.g. PIAGET, FELDMAN, SAWYER, RUNCO) in the field of creativity research, conceive creativity as a potential all given from birth, basically found when children create or transform new meanings from sensual impressions. That is to say, such a concept of 'everyday creativity' points to an active process during children's intellectual development, significantly caused by an essential capacity of normative human cognition (see 2.1.1 on page 85). The development of that capacity or potential highly depends on social factors and personality variables (see 2.1.2 on page 91; 2.1.3 on page 96).

This perspective is related to WEBSTER's (2002) proposal of creativity in music (see 2.2 on page 112), as an engagement of the mind in thinking in sound to produce something that is new for the author. The term *new*, in a person-centered perspective, also points on the developmental conception of creativity and musical creativity in particular: "[...] novelty could simply mean that it is something produced for the first time by a particular child who is not copying, repeating, or imitating, but is inventing. In synthesis, [...] a product is creative when it is new for its author, not for the society to which the subject belongs, when the process of associating or combining or transforming these concrete materials (sounds, words, images, etc.), rules or concepts happens intentionally in this child for the first time." (Tafuni, 2006, p.135)

In line with this, but more detailed and comprehensive, BODEN (1994) supposed a definition which differentiates between psychological (P-creative) and historical (H-creative) creativity.[27]

> "A valuable idea is P-creative if the person in whose mind it arises could not have had it before; it does not matter how many times other people have already had the same idea. By contrast, a valuable idea is H-creative if it is P-creative and no one else, in all human history, has ever had it before." (Boden, 1994, p.76)

Hence, it may be appropriate to consider infants' and children's musical creativity from a psychological perspective, primarily as a kind of intrinsic activity to create or discover the acoustic dimensions of their environment. However, a prerequisite for studying musical creativity and to get a comprehensive view within children's development, is to look at the musical behavior (e.g. listening, improvisation, composition), when it is practiced. This means that children often display a musical behavior that could be considered as P-creative, caused by the lack of musical knowledge, etc. (see in this regard 1.4.2 on page 64). But, during an ongoing practice of music, enculturalization processes take place, through which a more culturalized level of P-Creativity usually emerges.[28]

To get a better understanding of such a perspective of a developing musical creativity, it is useful to look at TAFURI's model (2006)[29] of 'interaction between culture and creative ability' (see Figure 2.7), which points to musical creativity as an ability to expand with culturalization. He wrote: "[. . .] from left to right [in Figure 2.7] along the horizontal axis (i.e., growing up) i indicates a progressive enculturalization and acculturalization that provide both familiarization with and assimilation of habits, rules, products, and interpretations of reality (physical, social, and personal) as well as the acquisition of different skills in different domains (for example managing a musical instrument). Moving upwards along the vertical axis (the creativity line) I indicates the development of creativity considered as a continuum from the first manifestations to the highest level: in other words, the realization of each individual's own potential, a progressive ability to act in a novel, meaningful, and original way. This ability is manifested in different kinds of accomplished tasks in relation to what happens along the "culture" line." (Tafuni, 2006, pp.136-137)

Although development does not take place in such a 'line continuum', and furthermore, depends on various other influences as well[30], TAFURI's idea suggests that there may be a developmental shift of creative efforts in music. Starting from

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[27] For detailed information see (Boden, 1994).

[28] For detailed information see 'A Head-and-Shoulders View of Musical Creativity' (see 2.2 on page 115).

[29] TAFURI (2006) applied WELCH's model (1998) for the ontogenesis of musical behavior.

[30] This is also indicated by the author.

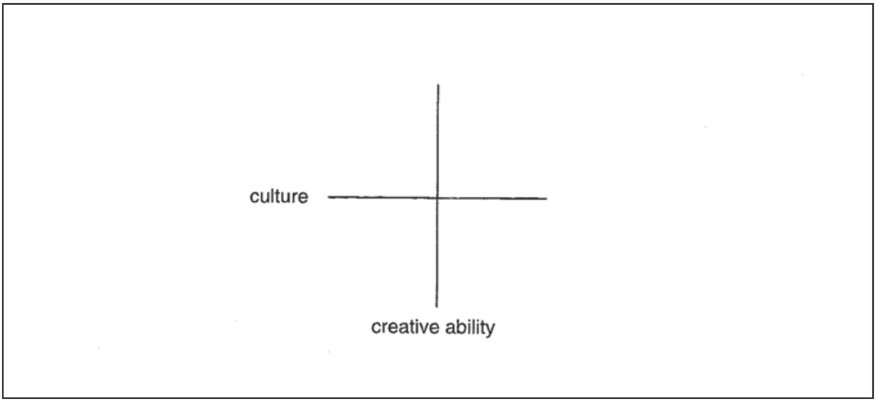


Fig. 2.7 "Interaction between culture and creative ability" (Tafuri, 2006, p.136)

a kind of P-creativity, which can lead into a more culturalized P-creativity through assimilation of mental models, skills, etc. In further progression, enculturalization can structure an understanding of what H-creative means in music.

Interestingly, ELLIOT (1995) similarly proposed that to be a creative musician, one must have developed a 'creative musical promise detector' (see 2.2 on page 116) assuming that

> "Musical Creativity pivots on making decisions and predictions about the musical potential or promise of one's musical choices, goals, and subgoals." (Elliot, 1995, p.226)

His 'creative musical promise detector' and therefore, a problem finding and problem-solving perspective on musical creativity, can be conceived as a progression in understanding what H-creative efforts are in the domain of music – techniques, music pieces, etc.

This again suggests that, when the intrinsic activity (see in this regard 2.1.3 on page 99) of P-creative efforts in music is strong enough in children, adolescents or adults, a developmental shift towards 'H-musical creativity' may take place. Probably above a certain level, musical creativity or creative thinking in sound is also guided from one's own understanding about what can be H-creative in the domain of music, with the focus of trying to be H-creative as well.

2.3.2 *Perspectives to Measure the Potential and its Development within 'the Psychometric Approach' of Musical Creativity*

In the previous section, we have discussed a perspective of musical creativity which suggests that a developmental shift of creative efforts can take place in music (see 2.3.1 on page 118). However, as already GUILFORD (1957) first supposed, general creativity seems to be multidimensional in nature, and furthermore, musical creativity in particular is a construct which can be understood in various ways (see 2.2 on page 111). The question arises: Can, and if so, how can the potential of musical creativity and its development be assessed?

To give a hint in advance: yes, it seems certain that dimensions of musical creativity and its development can partly be assessed. At least, this suggest the body of investigations which have developed measurements to assess the musical creativity or creative thinking in sound/music of individuals of various ages, such as for kindergarteners (Vold, 1986), children in primary-grades (Baltzer, 1989), 3-8-years-old children (Wang, 1985a), (see also Ryan/Brown, 2012), 6-9-years-old children (Webster, 1983; Webster, 1987a), students in 3rd grade (Swanner, 1985), students in 2nd, 4th, and 6th grades (Kiehn, 2003), students in 4th, 5th, and 6th grades (Hickey, 1997; Hickey, 2001), students in 6th grade (DeLorenzo, 1989), junior and senior high-school students (Gorder, 1976; Webster, 1979; Morgan, 1984), and college students (Madura, 1996; Priest, 2001).

However, while some of these test setups focus on the measurement of creative processes, by separating creativity in dimensions (e.g. fluency, flexibility, originality), others concentrate on creative products, by relying on the validity of the *Consensual Assessment Technique* (Amabile, 1979; Amabile, 1982; Amabile, 1983a). This again illustrates the previously explained variety of the concept of creativity (see 2.2 on page 111).

With that in mind, this section is intended to get a better insight in traditions, methods and predispositions from which the above listed measurements of musical creativity or creative thinking in sound emerge. Then the detailed presentation of some of the above mentioned studies will follow. This means we will first briefly inform about the historical development of the psychometric approach and its characteristics, strengths, and weaknesses. Afterwards, we will discuss and compare process and product-centered measurements of the potential, as well as the development of musical creativity or creative thinking in sound/music.

Psychometric Approaches of Creativity in General

> "Psychometric approaches to the study of creativity are those in which creativity is viewed as a mental trait that can be quantified by appropriate measurement instruments. The un-

> derlying views is of creativity as a mental trait: Creativity is best understood as a measureable human factor or characteristic." (Mayer, 1999, p.452)

First of all, although creative studies are also pursued within so-called experimental, biographical, historiometrical, and biometrical approaches, "[...] the majority of work dealing with creativity relies on psychometric methods – the direct measurement of creativity and/or its perceived correlates in individuals." (Plucker/Renzulli, 1999, p.35) In addition, four specific areas of investigations to creativity research have emerged, studying creativity from the latter perspective, namely: creative processes (see in this regard 2.1.1 on page 87), creative personality traits (see in this regard 2.1.3 on page 96), characteristics of creative products, and creativity-fostering environments (see in this regard 2.1.2 on page 90) (Plucker/Renzulli, 1999).

Let us go more in detail. Traditionally, the starting point of scientific creativity research is considered to be GUILFORD's (1950) proposal of creativity and his tests on divergent thinking (Guilford, 1967), which constitutes as well the starting point of the psychometric approach. The following 25 years after GUILFORD's first proposal were characterized by an extensive study of creativity – also so-called: The first golden age of creativity research (see Taylor, 1963). For example, *Torrance's Tests of Creative Thinking* (Torrance, 1966; Torrance, 1974) and GUILFORD's model (1971) *Structure of Intellect* were one of the cornerstones to standardize the evaluation of creativity. It is improtant to say that nearly all of creativity research during this time span were developed from psychometric approach perspectives. However, TORRENCE noted there were two opposite directions of psychometric studies of creativity:

> "Creativity tests tend to be of two types – those that involve cognitive-affective skills such as the *Torrence Test of Creative Thinking* [...] and those that attempt to tap a personality syndrome such as the *Alpha Biological Inventory* [...]. Some educators and psychologists have tried to make an issue of whether creativity is essential a personality syndrome that includes openness to experience, adventuresomeness, and self-confidence and whether the cognitive processes of rational and logical thinking in creative thinking are precisely the same as those used by high-IQ children." (Torrance, 1979, p.360)

Beyond these traditional cognitive and personality perspectives on creativity, the psychometric approach has followed a greater diversity, based on the variety of philosophical and methodological conditions which conducted the studies. Some researchers "[...] have used psychometric methods to measure creativity of products (see e.g. Besemer & O'Quin, 1986; Reis & Renzulli, 1991), to investigate the environmental characteristics that are associated with creativity (Amabile, Conti, Coon, Lazenby, & Herron in press [1996]), to refine measures of idea generation and evaluation (Runco, 1991; Runco & Mraz, 1992), and to develop new measures of personality characteristics associated with creative and inventive behavior

(Colangelo, Kerr, Hallowell, Hesman, & Gaeth, 1992)." (Plucker/Renzulli, 1999, p.36)

With the focus of explaining the traditions, methods and predispositions from which the measurements of musical creativity listed above emerge (see in this regard 2.3.2 on page 121) – most of the studies are based on two specific areas within the psychometric approach; namely: creative processes, such as divergent thinking and problem solving, and creative products, such as *Consensual Assessment Technique* – the subsequent explanations are limited to a brief overview of these two areas of psychometric investigation in general and their criticisms.

Creative Processes

> The quest to quantify the creative process, primarily through the use of divergent thinking batteries, has been a lightning rod for the psychometric study of creativity. [. . .] both researchers and educators have used tests of the creative process extensively for decades, and divergent thinking tests remain a popular measure of creative process and potential. The predominance of divergent-thinking tests is especially evident in our schools (Hunsaker & Callahan, 1995). [. . .] Among the first tests of divergent thinking were Guilford's (1967) Structure of the Intellect (SOI) divergent production tests, Torrance's (1962, 1974) Tests of Creative Thinking (TTCT), and those by Wallach and Kogan (1965) and Getzels and Jackson (1962). Almost all of these tests remain in wide use in creativity research and education." (Plucker/Renzulli, 1999, p.39)

Particularly the TTCT, based on aspects of SOI test, enjoys a wide international acceptance, maybe because of its update in (1974), and TORRANCE's large number of investigations as well as results from numerous longitudinal studies (1962); (1965); (1968), such as *fourth grade slump* (see Torrance, 1968).

Nevertheless, the question was often placed in terms of the general predictive validity of such divergent thinking tests (e.g. Clapham, 1996; Thompson/Anderson, 1983; Cooper, 1991; Rosen, 1985). Although the reliability of the tests explained above, and of similar investigations (e.g. Cline/Jr./Abe, 1962; Hoepfner/Hemenway, 1973; Torrance, 1981; Torrance/Khatena/Cunnington, 1973; Williams, 1979) is generally confirmed, and "[. . .] Torrance (1969, 1972a, 1972b, 1981a, 1981b; Torrance & Safter, 1989; Torrance, Tan, & Allman, 1970; Torrance & Wu, 1981) and others (Howieson, 1981; Milgram & Hong, 1994; Milgram & Milgram, 1976; Rotter, Langland & Berger, 1971; Runco, 1986; Yamada & Tam, 1996) conducted several studies that provide at least limited evidence of discriminant validity and of relationships between divergent-thinking test scores and various criteria, including adult creative accomplishment." (Plucker/Renzulli, 1999, p.49), BEAR (1993A); (1993B); (1994A) suggests that the predictive validity of such divergent thinking tests is only possible within specific areas of creativity – namely: task-specific measurement of creativity. RUNCO (1986) pointed at a related aspect, when he found that predictive validity is higher for gifted or high-achieving children than for their peers.

> “In addition, the conditions under which tests are administrated (e.g. gamelike vs. test-like, timed vs. untimed, individual vs. group, specific instructions to “be creative” vs. general instructions) appear to influence student originality and/or fluency scores (Chand & Runco, 1992; Harrington, 1975; Hattie, 1980; Renzulli, Owen, & Callahan, 1974; Runco, 1986a; Runco & Okuda, 1991b; Torrance, 1971). Critics occasionally note that scores on divergent production tests are susceptible to training and intervention effects (see evidence presented by Clapham, 1996; Feldhusen & Clinkenbeard, 1986; Torrance, 1972c, 1988).” (Plucker/Renzulli, 1999, p.40)

Beyond the creativity researches, which analyzed the generation of divergent ideas, other studies (Runco, 1991; Okuda/Runco/Berger, 1991; Wakefield, 1985; Primus/Okuda, 1988) within the psychometric approach extended the creative process by adding the aspects of problem-finding and problem-solving for creativity. This means the whole creative process “[...] involves the same kind of interactive and recursive pattern of divergent and convergent thought (Runco, 1994). “There should be some optimal balance between competence, problem solving, and convergent thinking, on the one hand, and independent knowledge, problem finding, and divergent thinking, on the other hand, for which creative potential is at its peak.” (Moneta, 1993, p. 30)” (Brophy, 1998, p.124) Concerning the predictive validity of problem-solving and problem-finding tests, for example GETZELS and CSIKSZENTMIHALYI (1976) observed that art students, who spent much more time to think about their work and prepare their work, were more creative (see in this regard 2.1.1 on page 88) – both authors defined preparation as a part of problem finding. The reassessment of these art students 18 years later showed that they had more success in their profession (Csikszentmihalyi, 1990). In addition, experience or expertise, from which in a certain domain creative thoughts emerge, is important for preparation (Simonton, 1990; Qin/Wallace, 1990; Sternberg, 1988). For example, in studies comparing cognitive styles with the ability to solve problems, MARTINSEN (1993); (1995) verified that, up to some point, expertise does support performance on creative problem-solving tasks.

In this way, many researchers (e.g. Okuda/Runco/Berger, 1991; Finke/Ward/Smith, 1992; Mobley/Doares/Mumford, 1992; Amabile, 1983b) have tried to understand creativity by focusing on cognitive processes present in the generation of novel ideas in terms of problem-finding and problem-solving. For instance, MUMFORD AND HIS COLLEAGUES (1996b); (1996a); (1996c); (1997a); (1997b) “[...] examined the available literature on four processes involved in creative thought: problem construction, information encoding, category selection, and category combination. They then developed measures explicitly intended to assess how people went about applying these processing capacities. The resulting measures proved useful in understanding effective process application. Furthermore, they were effective predictors of the quality and originality of the solutions obtained on several creative problem-solving tasks. The subscales included in these measures, furthermore, yielded gains in prediction compared with standard ability measures." (Mumford et al., 1997b, p.74)

Finally, after all these arguments for more or less predictive validity of divergent thinking and problem solving tests, RUNCO (2008), p.93 points out:

> "Wallach (1970) put it very well when he described divergent thinking tests as predictors rather than criteria of creative performance. I elaborated some what and defined divergent thinking tests as "estimates the potential for creative problem solving" (Runco, 1991b). This view, emphasizing tests as estimates and potential instead of guaranteed creative behavior, is very different from that which equates divergent thinking and actual creativity."

Creative Products

Beyond the assessment of creative processes in human thought as explained above, creativity researchers extended their understanding of creativity by theoretically studying creative products (e.g. Besemer/Treffinger, 1981; Jackson/Messick, 1965; Ghiselin, 1963; Guilford, 1957), and furthermore develop methods and instruments to measure or analyze specific characteristics of those (details later). The use of this widening perspective on creativity was also seen by REIS and RENZULLI (1991), p.128, who commented:

> "According to Rhodes [(Rhodes, 1987)], products can present a record of one's thoughts at the moment a new concept is born, and since products are artifacts of thought, the analysis of products can help to reconstruct the mental process of inventing."

In this context, "[. . .] Runco (1989a) noted that analysis of creative products[3] [[31]] may address the measurement problems caused by the inconsistent psychometric quality of divergent thinking tests and adult rating scales. A significant number of researchers and educators share MacKinnon's [[32]] and Runco's belief in the

[31] Footnote: "Again, psychometric analysis of creative products versus historiometric study of products differ primarily on the age of the product being studied. For example, a psychometric perspective might be used to create a rating scale for creative products for use by classroom teachers (e.g. Besemer & O'Quin, 1986), while historiometric analysis of products might entail the analysis of historical documentation of patents or notebooks to attempt the reconstruction of an inventor's creative experiences. Of course, historiometric methods are used to examine other areas that overlap with those frequently studied by psychometricians (e.g. personality; Simonton, 1986b)." (Plucker/Renzulli, 1999, p.51)

[32] Quotation: "I would argue that the starting point, indeed the bedrock of all studies of creativity, is an analysis of creative products, a determination of what it is that makes them different from more mundane products." (MacKinnon, 1978, p.187)

importance of the creative product (e.g. Taylor, 1960b; Treffinger & Poggio, 1972; Wallach, 1976)." (Plucker/Renzulli, 1999, p.44)

The assessment or measurement of creative products is considered to take place in a field of two contrasting endpoints – between a sort of rating scales (e.g. Besemer/O'Quin, 1993; Hargreaves/Galton/Robinson, 1996; Treffinger, 1989) on the one side, and *Consensual Assessment Technique* (Amabile, 1979; Amabile, 1982; Amabile, 1983a) on the other side (Plucker/Renzulli, 1999). Reminding that the subject is here to get a better insight in traditions, methods and predispositions from which the above listed measurements of musical creativity or creative thinking in sound emerge, this section is limited to brief information about the *Consensual Assessment Technique* (CAT)[33], because it was used to assess products of musical creativity or creative thinking in sound by BANGS (1992), DAIGNAULT (1997), HICKEY (1996); (1997); (2001) and PRIEST (2001); (1998) (see 2.3.2 on page 129).

First of all, BAER and MCKOOL (2009), p.3 note that contrary to "[...] every other technique for creativity assessment, the Consensual Assessment Technique is not *tied* [highlighted by the author] to any particular theory of creativity² [[34]].", because AMABILE used an amorphous definition of creativity: "[...] a product or response is creative to the extent that appropriate observers independently agree it is creative." (Amabile, 1982, p.1001)

> "Theoretically, CAT adherents believe the approach to be more valid than traditional creativity assessments due to the accent on real-world definitions of creativity: People know when they see it (Amabile, 1982; Bear, 1994b). This view is at least partially validated by the studies of implicit creativity theories and definitions discussed earlier [see (Plucker/Renzulli, 1999, pp.43-44)]." (Plucker/Renzulli, 1999, p.45)

In addition, CSIKSZENTMIHALYI (1999), p.314 noticed:

> "If creativity is to have a useful meaning, it must refer to a process that results in an idea or product that is recognized and adopted by others. Originality, freshness of perception, and

[33] For detailed information about the analysis of creative products by rating scales see (Plucker/Renzulli, 1999, pp.44-46).

[34] Footnote: "Tests of divergent thinking – the most commonly used tools for measuring creativity – are examples of a kind of creativity test that is anchored to a particular theory of creativity. Divergent thinking tests that ask test-takers to do things like list as many uses for empty tin cans as they can in a short period of time. The theory behind these tests claims that (a) this kind of thinking is important in creativity and (b) the particular content or domain from which the exercise is drawn does not matter. If this kind of divergent thinking is an important component of creativity, and if it doesn't matter what domain one uses to test it, then divergent thinking tests might indeed be valid measures of creativity. But if either the divergent thinking theory is wrong or the domain generality theory of creativity is wrong, then these tests cannot be valid ways to assess creativity. In contrast, the validity of the Consensual Assessment Technique is not dependent on the validity of any theory of creativity. It is equally valid no matter which creativity theories prove to be most useful or widely accepted, and because it is not linked to any theory, it can also be used to compare and evaluate theories." (Baer/McKool, 2009, p.13)

divergent-thinking ability are all well and good in their own right, as desirable personal traits. But without some sort of public recognition they do not constitute creativity. [...] The underlying assumption is that an objective quality called 'creativity' is revealed in the products, and that judges and raters can recognize it."

To be more particular, the basic procedure of *Consensual Assessment Technique* is described as follows:

"Subjects are given some basic instructions and, where necessary, materials, for creating some kind of product. All subjects are given the same materials and instructions. Then a group of experts, each working independently of one another, assesses the creativity of those creations. [...] The judges are *not* asked to explain or defend their ratings in any way, and it is important that no such instructions be given. Judges are simply instructed to use their expert sense of what is creative in the domain in question to rate the creativity of the products in relation to one another. That is, the ratings can be compared only *within* [highlighted by the author] the pool of artifacts being judged by a particular panel of experts." (Baer/McKool, 2009, p.4)

Evidence for the reliability and validity of the *Consensual Assessment Technique* can be seen in two ways. First, in the wide range of applications which used this procedure, such as musical compositions (see 2.3.2 on page 129), creative performances depending on intrinsic and extrinsic constrains (e.g. Amabile, 1983a; Amabile, 1996a), individual differences in creativity (e.g. Amabile, 1996a), gender and ethnic differences in creativity (e.g. Baer, 1997; Baer, 1998; Kaufman/Baer/Gentile, 2004), long-term stability of creativity (e.g. Baer, 1994a), and also the measuring of creative processes (e.g. Hennessey, 1994). Second, these assessments produce a good inter-rater reliability (between 0.80 to 0.90) – more judges, causes a higher inter-reliability.

In addition, although, the prevailing opinion is that "[...] there is no more valid measure of the creativity of a scientific theory than the collective opinions of scientists working in that field." (BAER/MCKOOL, 2009, P.5), and therefore, the first choice are 'experts in the domain in question', there are indications that judges with partial expertise in the focus-domain come to a similar assessment of creative products.

"Kaufman, Gentile, and Baer (2005) compared the ratings of expert judges and gifted novices (in this case, gifted high school students who were highly interested and talented in the domain being rated). The creativity ratings made by these gifted novices evidenced good inter-rater reliability and were significantly correlated with the creativity ratings of actual experts in those domains." (Kaufman/Baer/Cole, 2009, p.226)

However, expert judges also imply some problems and limitations for the assessment of creative products. Because, as partially indicated earlier, to be an appropriate judge depends on factors, such as expertise, the target domain, setup as well as the purpose of the assessment (e.g. Amabile, 1996a; Runco/McCarthy/Svenson, 1994; Runco/Chand, 1994). For example, RUNCO ET AL.(1994) observe "[...]

that expert assessments of artwork may be harsher than peer or self assessments." (Kaufman/Baer/Cole, 2009, p.225) Similarly,

> "Runco and Chand (1994) also suggest that experts who can judge their own products effectively do not necessarily possess the ability to evaluate the creative products of other individuals." (Plucker/Renzulli, 1999, p.45)

Another aspect is that "[...] assembling groups of expert judges is not simple and it may be expensive." (Baer/McKool, 2009, p.10) Furthermore,

> "The Consensual Assessment Technique relies on comparisons of levels of creativity within a particular group, and it is therefore not possible to create any kind of standardized scoring using Consensual Assessment Technique ratings that might allow comparisons to be made across settings." (Baer/McKool, 2009, p.3)

On the other hand, the *Consensual Assessment Technique* does not depend on a certain theory of creativity, and therefore, judgments about creative products are always 'up to date', or, that is to say, define 'real world creativity'. The second major advantage is that it can be used in any field for judging creativity, and on any level of creativity.

For this reason, CARSON (2006) called this procedure the *gold standard* of creativity assessment.

Psychometric Approaches to Measure Creativity in Music

As previously seen in various studies (see 2.2 on page 111), musical creativity or creative thinking in sound is conceived as a heterogeneous construct because, inter alia, of the variation of the studied musical behaviors (e.g. listening, improvisation, composition), or whether the focus is on the creative process (see in this regard 2.3.2 on page 123), or the creative product (see in this regard 2.3.2 on page 125). A permanently controversial problem in the measurement of musical creativity or creative thinking in sound/music points to the identification of suitable assessment constructs, which should at least partly capture the complexity of behaviors, displaying creativity in music. Therefore, this section is designed to get an overview about slightly different perspectives or focuses on measurement of musical creativity, through: first, separation of studies concerning creative processes and creative products, and second, by means of approaches measuring musical creativity at different developmental phases.

Creative Processes

Much of the research measuring creative processes in music, from 1980 on, are based on the groundwork developed by the pioneers of the general creativity research explained above (see 2.3.2 on page 123).

This means that GUILFORD's (1967) dimensions of general creativity (fluency, flexibility, originality, and elaboration)[35] are the basis for most of musical creativity tests developed (e.g. Gorder, 1976; Gorder, 1980; Webster, 1979; Webster, 1983; Webster, 1987a; Wang, 1985a; Vold, 1986; Kiehn, 2003).[36] Furthermore, "[...] many tests of children's [musical] creativity through improvisational tasks are based on Guilford and Torrance's scoring criteria (Gorder, 1976; Vaughan 1971; Vold, 1986; Webster, 1977, 1983, 1987, 1994). Fluency, originality, and flexibility criteria are common to most (Gorder, 1976; Vold, 1986; Webster, 1977, 1983, 1987, 1994) but not all (Vaughan, 1971) tests. Comparisons of test scoring criteria show early researchers generally agree on definitions for fluency as the sheer number of responses (Gorder, 1976; Void, 1986) and originality as the uniqueness of response (Gorder, 1976; Webster, 1977, 1987, 1994), but not on the flexibility criterion." (Kiehn, 2003, p.280)

To go more in detail, although most of instruments measuring creative processes in music are similar in conceptual framework (see above), every study has developed its own test setup, and presented individual aspects, which offer the opportunity to get an extended picture of musical creativity or creative thinking in sound/music at different phases of experience in music. Subsequently, we will present some slightly different instruments designed to assess, first, creative processes in young children, and second, creative processes in older children and adolescents.

[35] "1. Fluency, defined as the ability to provide multiple answers from the same information within a certain amount of time; 2. Flexibility, described as the ability to produce shifts in meaning from the same information; 3. Originality, which referred to the production of responses that were novel and remotely associated with the information given; and 4. Elaboration, defined as the ability to provide a higher level of detail and complexity of information than that called upon for the response." (Brophy, 1998, p.156)

[36] Although, some researchers have also investigated musical creativity from a problem-solving perspective (e.g. DeLorenzo, 1989).

Two Instruments Proposed for Younger Children

Based on TORRANCE' (1981) test *Thinking Creatively in Action and Movement* (TCAM)[37] , WANG (1985a); (1985b) developed *Measures of Creativity in Sound and Music* (MCSM) "[...] to measure the Fluency and Imagination factors of Divergent Thinking skills of lower-elementary grade children." (Wang, 1985b) This means, his test "[...] is designed for use with children of ages 3 through 8 and consists of four activities that provide scores of musical fluency and musical imagination." (Baltzer, 1988, p.236)

> "Activities one and three measure musical fluency by counting the number of responses provided by the child who is asked to produce steady beats and ostinati (maintain a simple pattern). Activities two and four measure musical imagination; subjects are asked to portray described events with rhythm instruments and more move appropriately to recorded music." (Ryan/Brown, 2012, p.114) [38]

The validity and reliability of WANG's (1985a); (1985b) proposal was tested in a study of BALTZER (1988), with the conclusion "[...] that the MCSM is a valid measure of musical creativity in elementary schools and can be a valuable tool in future research into musical creativity." (Running, 2008, p.14)[39] Furthermore, he "[...] found no significant differences between the responses of males and females on any of the activities. These findings again support those of previous studies (e.g., Swanner, 1985; Torrance, 1974; Torrance, 1981; Webster, 1983) [...] The finding of a positive but non significant relationship between age and creativity [...] the music teacher's ratings were the best predictor variable for musical fluency, accounting for a level of variance that perhaps indicates practical significance. This relationship was also reflected in the moderate and statistically significant correlation between the music teacher's ratings and fluency. [...] The fact that none of the variables was a significant predictor of imagination under scores the difficulty of assessing musical originality." (Baltzer, 1988, p.246)

WEBSTER's (1987a); (1994) test *Measure of Creative Thinking in Music II* (MCTM-II) – an improvement of the MCTM (see Webster, 1983), is also intended to assess musical creativity, but between the ages 6 to 9, by measuring different aspects of musical creativity, which are structured in four musical factors, and processed in ten tasks, divided into three sections.

Musical factors are:

> "Musical Extensiveness, the actual clock time (in seconds) involved in a musical response; Musical Flexibility, the extent to which the three musical parameters low to high, soft to

[37] It measures a general creativity in young children.

[38] For detailed information about the four activities (see Wang, 1985b).

[39] "Inter-item reliability coefficients ranged from .83 to .92 and inter-judge reliability coefficients were .99 to .92, and .96 for four activities." (Ryan/Brown, 2012, p.115)

> loud, fast to slow are demonstrated in responses; Musical Originality, the extent to which the child manipulates musical phenomena in a unique fashion; and Musical Syntax, the extent to which the child manipulates musical phenomena in a logical and inherently musical manner, with no attention to the shaping of the whole response and not just a single part. (Webster, 1987a, p.264)

The three sections are organized as follows:

> "The exploration section is designed to help the children become more familiar with the instruments used and how they are arranged. The application tasks require children to engage in more challenging activities with the instruments and focus on the creation of music using each of the instruments singly. In the synthesis section, the children are encouraged to see multiple instruments in tasks whose settings are the least structured." (Webster, 1987a, p.266)

Furthermore, all "[...] tasks of the MCTM-II require children to use three materials: tempo blocks, a round sponge ball on a piano or keyboard, and their voices with a microphone. The test is administered to children individually. In the exploration section, the child is asked to use the three materials to make the sound of rain falling into a bucket (slow/fast), the sound of voice on a magical elevator (low/high), and the sound of a truck coming toward the child (soft/loud). In the application tasks, the child enters into a kind of musical question/answer dialogue with the administrator for some tasks, and more elaborate creative experiences for others. [...] For the Synthesis section, the child is asked to make sounds that tell a story based on a trip into outer space, and to create a composition that used all the instruments and that has a beginning, middle and an end." (Ryan/Brown, 2012, p.114)[40]

In terms of reliability of the MCTM-II, WEBSTER stated:

> "Reliability and validity data have been collected in a number of studies (Webster 1983, 1987, 1988, 1990b and Wanner, 1985). MCTM has also been used in a study of cognitive style by Schmidt and Sinor (1986). In terms of inter-score reliability for the factors of MO [musical originality] and MS [musical syntax], coefficients range from .53 to .78 with the average of .70. Internal reliability, measured in the form of Cronbach Alpha coefficients range from .45 to .80 with the average of .65 (.69 for the most recent version). Test-Re-test reliability indicate a range between .56 and .79 with and average of .76." (Webster, 2013)

Two Instruments Proposed for Older Children/Adolescents

A more recent test to assess older children's musical creativity or creative thinking in sound was developed by KIEHN (2003). By using a modified [...] Vaughan Test of Musical Creativity (TMC) [(see Vaughan, 1971)], a measure of music

[40] For detailed information about *Measure of Creative Thinking in Music II* see administrative guidelines (Webster, 1994).

improvisational creativity, and the Torrance Tests of Creative Thinking (TTCT) [(see Torrance, 1974)], a standardized test of divergent thinking which measures figural/artistic creativity through pictorial drawing tasks." (Kiehn, 2003, p.281), KIEHN studied 89 older children (in the grades of 2, 4, and 6).

The six open-ended improvisational tasks of the TMC are as follows[41]:

> "In Task 1, the student is asked to play a steady beat on the drum while the tester plays a duple rhythm pattern on the claves. This warm-up activity is the only item that is not scored. The second task requires the student to create an answer rhythm on the drum (consequent phrase) to several four-measure phrase questions (antecedent) performed by the tester. In Task 3, the tester performs a steady beat pattern on the claves and asks the student to improvise a drum rhythm. In Task 4, the tester plays several two-measure melodies on the bells (F-sharp pentatonic), and asks the student to respond to each melody with an answering tune on the black bells only. The tester plays a simple C-G ostinato pattern in Task 5 and then asks the student to improvise a tune on the white bells only. The final task requires the participant to make up a piece showing how she or he feels during a thunderstorm." (Kiehn, 2003, p.281)

After the scoring of both tests, KIEHN concluded that "[...] music creativity abilities may vary with the grade level of students. A creativity growth stage seems to exist from Grades 2 to 4, followed by a developmental leveling (no significant change in test scores) between Grades 4 and 6. This finding lends support to Brophy's (1998) identification of a "developmental plateau" among intermediate students (Grade 4-6). [...] Limited growth in music creativity from Grade 4 to 6 may also be due to sociological or psychological factors. Intermediate grade students may feel pressured to conform socially. If being creative is viewed negatively by other students as being different, then individuals may shy away from engaging in creative behavior. Swanner (1985) reported that certain personality traits such as imagination, curiosity, and anxiety were significantly related to music creativity among third grade students. [...] The findings in the present study also suggest a small, but significant positive correlation between music creativity and figural creativity. This finding is consistent with Vaughan (1971, 1973) and Webster (1977), suggesting that the ability to draw artistic shapes and figures may be related to the ability to create music improvisations. The relationship of music improvisational creativity and artistic drawing might exist because fluency and originality dimensions are very similarly defined in the scoring procedures for the Vaughan, Webster, and Torrance measures." (Kiehn, 2003, p.285)

Another test developed by WEBSTER (1979) studied 77 high school students' creative expressions in music, namely: composition, performance, and analysis.[42] In addition to criteria measuring creativity in music, WEBSTER also tests other abilities: general creative ability (*Torrance Tests of Creative Thinking* (see Tor-

[41] For detailed information about the TTCT procedure (see Torrance, 1966; Torrance, 1974).

[42] For detailed information about the test activities (see Webster, 1979).

rance, 1974)), musical achievement (*Colwell Music Achievement Tests* (see Colwell, 1970)), and musical aptitude (GORDON's *Musical Aptitude Profile* (see Gordon, 1965)), to get a more complete picture about adolescents and their musical creativity or creative thinking in music. This test has revealed, "[...] that those students who scored highly in music achievement tend to score highly on all three criteria measures of music creativity. This suggests that a firm grounding in the basic skills of aural discrimination may be important in establishing a basis for creative ability. A study of individual subscores also reveals the importance of instrumental recognition for improvisation, auditory-visual discrimination for composition, and pitch recognition for analysis. The results also suggest that in each mode, the achievement test battery taken as a whole is the best single predictor of music creativity potential." (Webster, 1979, p.240) Furthermore, WEBSTER's results indicate a tendency of higher scoring on all creative expressions in music, if students benefit from a piano playing background.

But, "[...] variables of age, grade level, and performance medium would seem to have no significant relationship to any of the three modes of creative behavior investigated. On the basis of these results, creative potential in music cannot be necessarily associated with age, grade level, or performance medium." (Webster, 1979, p.240)

In terms of the relationship between the three observed creative behaviors in music, WEBSTER observed:

> "The significant relationship between analysis and composition suggests that those high school students who exhibit potential in analysis creativity may also be creative in terms of composition and vice versa. It also appears that, on the basis of this study, high school students who are creative in improvisation may not necessarily be creative in terms of analysis and composition." (Webster, 1979, p.240)

Creative Products

Besides research to measure creative processes (see 2.3.2 on page 129), some scientists (e.g. Bangs, 1992; Daignault, 1997; Hickey, 1996; Hickey, 1997; Hickey, 2001; Priest, 1998; Priest, 2001) adopt AMABILE's (Amabile, 1979; Amabile, 1982; Amabile, 1983a) *Consensual Assessment Technique* (CAT) (see in this regard 2.3.2 on page 125) to assess creative musical products composed by children and adolescents at various phases of their experience with music.

Going more into detail about intentions and results of these studies, BANGS (1992) studied the effects of third grade students' intrinsic and extrinsic motivational treatments in their compositions. As AMABILE supposed previously (see 2.1.3 on page 99), BANGS found out that intrinsic motivation is considered as beneficial for the development of creative products, while extrinsic motivation seems to be more detrimental. DAIGNAULT (1997) study of children's compositional processes and products by using MIDI keyboards, has revealed that partly opposed to WEBSTER's (1979) findings (see 2.3.2 on page 132), pianists do not develop more creative compositions than their non-pianist counterparts. Important in this context, this observation is consistent with findings of various studies (Gorder, 1980; Gardner, 1982; Flohr, 1985; Webster, 1987a; Hickey, 1996) proposing that students' experience in music performance is not significantly related to their creative abilities in terms in composing music.

HICKEY (1997) also used MIDI keyboards to study students (4th to 6th grades) compositions. According to HICKEY, RUNNING (2008), P.12 noted,

> "An analysis of the various products demonstrated that what separated students in the high ability level from the middle and low level was an advanced ability to manipulate and experiment with musical motifs as well as invent new musical ideas quickly."

PRIEST (2001) presented a similar observation when he found relations between a deeper understanding of music and musical creativity. That is to say, "[...] individuals who produced compositions that were rated as highly creative were much more likely to use statements that described temporal factors as contributing to creativity and craftsmanship than were individuals who produced compositions that were rated at middle- and low-creativity levels. These data suggest that individuals who were rated as highly creative composers were more aware of temporal factors than their middle and low counterparts." (Priest, 2001, pp.253-254)

Finally, concerning the problems and limitations previously noted concerning expert judges within the *Consensual Assessment Technique* (see 2.3.2 on page 127), HICKEY's study (2001) raised an important question about the assessment of musical-creative products:

> "When using the consensual assessment technique, who are the "experts" or "appropriate judges" to rate the creativity of [musical] products? Are the professional creators (i.e., composers, painters, and sculptors) the experts? Are teachers the experts? And can children reliably assess the creativity of other children's creative products?" (Hickey, 2001, p.236)

To approach a possible answer, HICKEY studied and compared the assessment of five different groups of judges, when rating the compositions of 4th and 5th grade students[43].[44] After assessing, as seen in Figure 2.8, he found significant correlations "[...] between the groups of music teachers, between the music teachers and music theorists, and between the two groups of children. Although the music teachers and music theorists agreed with each other, and the groups of children had

[43] "The 12 compositions used for assessment in this study were randomly selected from a total pool of 21 original compositions generated by fourth- and fifth-grade subjects in a previous study (Hickey, 1996)." (Hickey, 2001, p.237)

[44] For detailed information about method and procedure see (Hickey, 2001).

a high positive correlation with each other, the theorists and teachers showed moderate to low correlations with the groups of children. Worth noting is not only the lack of any strong positive correlation among the composers and between the composers and the other groups, but also the several instances of negative correlations between the composers with themselves and others." (Hickey, 2001, p.240)

About the question concerning the best experts able to judge children's compositions, HICKEY supposes "[. . .] that the best "experts", or at least the most reliable judges, may be the very music teachers who teach the children – the general/choral music teachers." (Hickey, 2001, p.241)[45]

Correlations of Mean Creativity Ratings between Groups of Judges

Judges	1	2	3	4	5	6	7	8	9
1. Composer A									
2. Composer B	–.02								
3. Composer C	.07	–.26							
4. Music theorists	.16	–.02	.58						
5. All music teachers	.35	.01	.37	.90**					
6. Instrumental teachers	.45	–.09	.39	.88**	—				
7. Mixed teachers	.18	.11	.35	.86**	–.78**				
8. General/ choral teachers	.14	.17	.19	.63*	–.68*	.72*			
9. 7th-grade children	.09	.08	.37	.26	.03	–.01	.27	–.21	
10. 2nd-grade children	.19	–.03	.19	.38	.18	.11	.41	–.01	.83**

** $p<.01$, * $p<.05$.

Fig. 2.8 "Correlations of mean creativity ratings between groups of judges" (Hickey, 2001, p.240)

45 "It is clear from these findings that while the consensual assessment technique is indeed a moderately reliable technique for measuring the creativity of children's compositions by most groups of judges, composers were the least consistent group to do so. The groups of music teachers, music theorists, and seventh-grade children showed agreement within their respective groups, with the general/choral teachers clearly the highest, at .81." (Hickey, 2001, p.240)

Surprisingly, in this study, composers seem not to be the best experts for assessing children's compositions, but, in contrast, the group which is least able to assess the creativity of children's compositions. HICKEY presumes the following reason:

> "Perhaps music teachers should have reason to feel more confident in their ability to accurately assess the relative creativity of their students' musical compositions. The world in which professional composers work may be too far removed from the world of children's musical creative thinking. It may be simple exposure to children's compositions that is needed." [...] However, if the lack of exposure to, or expectations of, children's compositions were the confounding variable, one would hypothesize that the music theorists would also have difficulty in coming to agreement. This was not true in the present study." (Hickey, 2001, p.241)

2.3.3 Conclusions – Measurement of Musical Creativity/Creative Thinking in Sound/Music and their Development

By beginning this section, we supposed a possible development of musical creativity or creative thinking in sound/music (see 2.3.1 on page 118), consisting rougly of three steps ('P-musical-creativity' –> 'P-culturalized-musical-creativity' –> 'H-musical-creativity')[46].

This means that infants start from a sort of 'P-musical-creativity' which, during an ongoing practice, usually leads to a more 'P-culturalized-musical-creativity'. If enculturalization structures an understanding of what can be H-creatice in music, and furthermore, the intrinsic activity (see in this regard 2.1.3 on page 99) of P-creative efforts in music are strong enough in children, adolescents, and adults, a developmental shift towards 'H-musical creativity' may take place. Beyond a certain stage, musical creativity or creative thinking in sound is probably also guided by one's understanding about what can be H-creative in the domain of music, with the focus to try to be H-creative as well.

Regarding the validity of such a perspective, most of the studies exposed above (see 2.3.2 on page 128) indicate that measured musical creativity or creative thinking in sound/music depends on developmental factors in general, as well as specifically musical. Indeed, it is obvious, first, that tests concerning (not only) children's musical creativity include explicit instructions, such as 'use an instrument', 'produce steady beats and ostinati', or, 'respond melodically to a stimulus'. Second, the same tests were not performed by children under the age of about three years. Therefore, all measurements of children's musical creativity listed above address creativity in the tension field between 'P-musical-creativity' and 'P-culturalized-musical-creativity', because such tests presuppose acquired abilities in general,

[46] P means Psychological, and H means Historical.

such as language and directed action – caused and developed through and within a culturalized environment – enabling to understand instructions and process activities (see in this regard 1.3.2 on page 49; 1.4.1 on page 58), and also basic abilities in music, as sketched by HARGREAVES (1996) (see 1.4.2.1 on page 65), SWANWICK and TILLMAN (1986)(see 1.4.2.2 on page 69), and SCHUBERT and MCPHERSON (2006) (see 1.4.2.3 on page 72).

A further indication for a development of musical creativity or creative thinking in sound/music is the general observation that enculturalization processes, or the acquirement of expertise, is significantly related to creative behavior in music (Webster, 1979; Hickey, 1997; Priest, 2001). That is to say, WEBSTER (1979), P.240 has revealed "[...] that a firm grounding in the basic skills of aural discrimination may be important in establishing a basis for creative ability. A study of individual subscores also reveals the importance of instrumental recognition for improvisation, auditory-visual discrimination for composition, and pitch recognition for analysis. The results also suggest that in each mode, the achievement test battery taken as a whole is the best single predictor of music creativity potential." According to HICKEY (1997), RUNNING (2008), p.12 noted "[...] that what separated students in the high ability level from the middle and low level was an advanced ability to manipulate and experiment with musical motifs as well as invent new musical ideas quickly." And PRIEST (2001), p.254 found out, "[...] that individuals who were rated as highly creative composers were more aware of temporal factors than their middle and low counterparts."

However, an important question remains: What kind of musical expertise or experience supports creative musical behaviors and products?

It seems there are some consistent findings in the studies presented above. For instance, WEBSTER measures "[...] that those students who scored highly in music achievement [[47]] tend to score highly on all three criteria measures of music creativity [[48]]." (Webster, 1979, p.240) In addition, about the interrelationship within the observed creative behavior, WEBSTER specified that students having expertise or potential in music analysis are also significantly creative in composition and vice versa. But, "[...] students who are creative in improvisation may not necessarily be creative in terms of analysis and composition." (Webster, 1979, p.241) A similar observation makes DAIGNAULT (1997) state that 'pianists do not develop more creative compositions than their nonpianists' counterparts'. These findings are furthermore consistent with results of 'various studies (Gorder, 1980; Gardner, 1982; Flohr, 1985; Webster, 1987a; Hickey, 1996), which propose that students'

[47] The *Corwell Music Achievement Test* used by Webster measures abilities, such as pitch discrimination, interval discrimination, meter discrimination, major-minor discrimination, feeling for the tonal center.

[48] The three criteria measures of musical creativity are composition, improvisation, and analysis.

experience in music performance is not significantly related to their creative abilities in terms of composing music.'

Finally, we can confirm that musical creativity or creative thinking in sound/music, defined as: "[...] the engagement of the mind in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11)[49], can at least partly be assessed through process- and product-centered measurements (see 2.3.2 on page 128), and significantly depends, inter alia (see chapter 2 on page 85), on expertise or experience in music. This suggests a course of development, and presuppose enculturalization, processed by 'mental models or integrated sets of hypotheses (see *Model of Musical Extrapolations* 3 on page 209), which can lead to efforts of 'H-musical-creativity'.

Concerning the question about which method of measurement of musical creativity (see 2.3.2 on page 128) could be a suitable instrument, all depends on the intention, and the further use of the results. For example, relying on RUNCO's statement (see 2.3.2 on page 125), defining 'divergent thinking tests as estimates the potential for creative problem solving. [...] instead of guaranteed creative behavior', musical divergent thinking tests (Vaughan, 1971; Gorder, 1976; Webster, 1979; Wang, 1985b; Vold, 1986; Webster, 1987a; Baltzer, 1988; DeLorenzo, 1989; Kiehn, 2003) are suitable instruments to measure mental traits[50] which are considered as important prerequisites to produce creative musical products. Therefore, an intention, or a use of such test results can support educational strategies to foster creative handling with musical expertise or experience in music (explained above). However, this can also be made after tests concerning musical products (see 2.3.2 on page 133) which means, based on the assessment of products, judges can get a better insight in composers their musical expertise and their creative handling. Incidentally such a procedure is crucial between composition students and their mentors – but not as a test –, because students usually prepare musical ideas, concepts, and compositions, and, in a discussion about these musical products, composition teachers foster the development of their students' "[...] engagement [...] in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11)

Concerning the question of which judges are suitable for a certain level of musical creativity, HICKEY's (2001) study indicates that music teachers, or persons which are familiar with children's creative musical behavior, are most suitable to assess kinds of 'P-culturalized-musical-creativity'. In contrast, professional composer seem less appropriate to judge children's compositions, probably because "[...] professional composers' work may be too far removed from the world of children's musical creative thinking." (Hickey, 2001, p.241)

[49] See in this regard section 'Musical Creativity/Creative Thinking in Sound' (2.2 on page 111).

[50] such as musical fluency, musical originality, musical extensiveness, musical flexibility

The most important difference between process- and product-centered measurements is maybe the validity in assessing 'H-musical-creativity'. First of all, we must clarify: What usually defines 'H-musical-creativity' in music? For me, the simple answer is: comparable musical behavior. That is to say: mental and physical musical efforts, such as composition or performance, is recognized as a musical product. Only through this can musicology compare musical efforts to previous efforts, and thereby, assess whether a musical behavior is creative or not in a historical context. In *exclusively* process-centered measurements, it seems difficult to define or compare 'H-musical-creativity' endeavors. A further argument for using product-centered measurements to evaluate creativity at the high(est) musical level is its comparable usage: if one looks at the procedure to nominate winners, for example for the Nobel, or Pulitzer prizes. BAER and MCKOOL (2009) put it very well when they describe:

> "These kinds of decisions aren't based on a procedure or rubric that awards points for different attributes of a painting, composition, or theory. There is no test to determine which historian's theories, which biochemist's models, or which screenwriter's movies are the most creative. Nobel Prize committees don't apply rubrics, complete checklists, or score tests. What do they do? They ask experts. The most valid assessment of the creativity of an idea or creation in any field is the collective judgment of recognized experts in that field. And while it's true that experts in different times and places may come to different conclusions (and pity the unfortunate artists and scientists whose genius is only recognized when it is too late for them to enjoy their posthumous fame), at any given time the best judgment one can make of the creativity of anyone's ideas, poems, theories, artworks, compositions, or other creations is the overall judgment of experts in their field² [51]." (Baer/McKool, 2009, p.2)

Nevertheless, the differences sketched above between process and product-centered measurements, concern academic activities. This means that, based in different scientific traditions and predispositions, researcher try to conceptualize issues. To be recognized, theories must be validated (mostly), through such measurements. These test setups again possess certain characteristics, and, in relation to other proposals, strengths and weaknesses.

We have shown that, concerning the issue of the measurement of musical creativity, both approaches are all possible and good in their own right. Used together, they offer the opportunity to get an extended picture of musical creativity or creative thinking in sound/music at different stages of musical experience.

[51] Footnote: "Even within a given field, different experts might be more appropriate for judging different kinds of works. For example, Pulitzer Prize committees might not be ideal judges of the creativity of compositions by 12-year-old writers; it might be better in that case to have writers and critics who also have familiarity with writings by students of that age serve as judges." (Baer/McKool, 2009, p.12)

2.4 Creativity in Listening to Music

After the presentation of important perspectives on creativity research in general (see 2.1 on page 85), followed by definitions of musical creativity/creative thinking in sound (see 2.2 on page 111), and finally outlining possibilities of measurement of musical creativity in the course of development (see 2.3 on page 118), the next two sections build on those foundations, and go further at the heart of this chapter 'Perspectives on Creativity in General and while Music is being Listened to and Composed'. This means that we will first present arguments which, opposed to a traditional understanding of listening to music as 'merely receptive', conceive listening as an activity which 'makes' the music. In a second step, our focus goes on detailed explanations of such a 'making' of music, through SCHAEFFER's and TUURI and EEROLA's theories proposing various ways of listening to music. The third part of this section goes another step further, because it relates findings of the preceding subsections (2.4.1 - 2.4.2) to various proposals contouring listening to music from the point of view of creativity research, and, by that, reveals an extended picture of creative processes carried out while listening to music.

2.4.1 Listeners as (Creative) Makers of Music

As already noted above, listening to music is often conceived as merely receptive, assuming that "[. . .] composer creates music; performer re-creates it; and the listener appreciates the product of the creativity and skills of the performer." (Peterson, 2006, p.15). It obviously seems that such a perspective is constitutive of music education, because listening activities are often focused on deductive reasoning. However, in terms of essentials enculturalization processes

(see in this regard 2.3 on page 118; 1.4.2 on page 64; 2.1.2 on page 90), the fact is often neglected that a general development of listening competences (which is far more than deductive reasoning) is really a product of a creative 'making' of music. For example, first, HARGREAVES and NORTH (2012) argue:

> "Listeners *adapt* the sound environment by *assimilating* new sounds or musical objects to their existing mental structures: this gives rise to the *accommodation* of those structures, which change as a result, and this gives rise to a state of balance, or equilibrium, between the listener's internal model and the external sound world. However, new sounds are continually being heard, and as soon as this happens the system once again reaches a state of imbalance, or what Piaget called 'disequilibration'.[[52]] The system is therefore always trying to reach a state of equilibrium (though it can never do so, as there are always more sounds 'out there' in the world than the listener can experience), so that equilibration

[52] For detailed information about PIAGET's concepts see 1.4.1 on page 58.

> functions as a kind of 'cognitive drive' for people to seek out and explore new sounds and ideas." (Hargreaves/Miell/MacDonald, 2012, p.159)[53]

And, second, from a cognitive perspective, in an approach of listening to music as perceptual problem solving, BAMBERGER (1994) asserts that "[...] sound/time phenomena do not come already structured, but rather hold the potential for being structured." (Bamberger, 1994, p.134)

The listeners' adaptation, and their ability to structure sounds, both point to a developing 'P-culturalized-musical-creativity' discussed earlier, which is built on musical experiences which are stored in kinds of memory structures. However, to store, retrieve and compare information in memory, are not linear processes, but important parts of the creative 'making' carried on while listening to music. This becomes clearer if one consider aspects of SNYDER's (2000) memory model concerning music.

At first, it is helpful to give a short overview of his conception. As seen in Figure 2.9, in a tension field between bottom-up and top-down processing, SNYDER proposes a model consisting of three processes: echoic memory and early processing; short-term memory; and long-term memory. He describes these as follows:[54]

> "In the first process of the memory model, *echoic memory and early processing*, the inner ear converts sounds into trains of nerve impulses that represent the frequency and amplitude of individual acoustical vibrations (see Buser and Imbert, 1992: 156-172). [...] During *feature extraction*, individual acoustical features (e.g. pitch, overtone structure, presence of frequency slides) are extracted from the continuous data of echoic memory by many specialized groups of neurons (see Bharucha, 1999: 413-418). During *perceptual binding*, these features are then bound together, with different features that are simultaneous, covarying, or both and correlated into single, coherent auditory *events* (see Bregman, 1994: 213-394). [...] Feature extraction and perceptual binding together constitute what Gerald Edelman (1989, 1992) has referred to as "perceptual categorization". After separate features have been bound into events, these events are themselves organized into groupings based on similarity and proximity [...]. The events then activate those parts of long-term memory (LTM) activated by similar events in the past. Called "conceptual categories", these long-term memories comprise knowledge about the events that evoked them and consist of content usually not in conscious awareness (not activated), which must be retrieved from unconsciousness. [...] indeed, many are thought to remain unconscious, forming a *context* for current awareness (see Baars, 1988: 137-176). This context takes the form of expectations, memory of the recent past, and other related knowledge that can influence the direction that current consciousness takes, even though it is not itself conscious. [...] Some of the information from long-term memory is in the highest state of activation, and is said to be "in the focus of conscious awareness", as may be information from current perception (see Baars, 1997: 90-91). Information in the focus of conscious awareness is *our immediate conscious experience.* This means that the current consciousness can consist of two parts; a vivid perceptual act, and a conceptual

[53] This proposal is coherent with perspectives of creativity research in general (see 2.1.2 on page 90; 2.1.2 on page 91).

[54] For detailed information (see Snyder, 2000).

aspect from long-term memory. Long-term memories that have reached this higher state of activation can then persist as current *short-term memory* (STM). If not displayed by new information, short-term memories may be held for an average of 3-5 sec (sometimes longer). They will then decay (disappear from consciousness) if not repeated or *rehearsed* internally, which involves bringing the information back into the focus of awareness from STM. If rehearsal takes place consciously, or if the information is particularly striking or novel in some way, it can be passed back to LTM and added to our cause modifications of similar memories already established. It may then become part of permanent LTM.“ (Snyder, 2000, pp.4-5)

After reading this brief overview, one can see memory structures as a sort of clockwork, in which each part is consistently connected with certain other parts. But, as SNYDER states himself about the Figure 2.9: "[...] connections would not be "hard-wired", but would be constantly changing." (Snyder, 2000, p.6) Therefore, the keyword in this matter is 'association' in a 'soft-wired' meaning. Because, for example, in the early processing, perceptual categories are built up based on various associations between groups of simultaneously activated neurons. Besides, there are sequential associations, that is to say, "[...] early processing can favor segmentation or continuity – every musical event either develops a connection with the previous event or separates itself from it to some degree." (Snyder, 2000, p.32) Over these levels of 'meaningful segments' creation, we usually have little control. In addition, they built up the groundwork for a developing cognition of music. For instance, the auditory structuring of newborns already automatically process very well theses 'primitive groupings' (see 1.3 on page 46).

Associations are also created in a higher-order structuring of music, that is in different levels of long-term memory, which SNYDER calls cuings[55] between chunks[56]. Such storage and retrieval processes can be considered as highly creative because, first, various musical expectations can arise, and, second, different 'makings' can be created, while listening the same music.

"[First] hearing a particular passage in a piece of music may cause us to think of another passage about to happen. Associations can rapidly move through different parts of the brain as different groups of neurons become activated [...]. Indeed, the cuing process usually causes a low level of activation of considerable numbers of associated memories. Although many may not become fully activated (conscious), these semiactivated memories are said to be "primed" for further activation, which increases the likelihood of their

[55] "There are three types of cuing: (1) recollection, where we intentionally try to cue a memory; (2) reminding, where an event in the environment automatically cues an associated memory of something else; and (3) recognition, where an event in the environment automatically acts as its own cue. Recognition and reminding are spontaneous processes that are going on constantly." (Snyder, 2000, p.70)

[56] "Chunking is the consolidation of small groups of associated memory elements. [...] a chunk can itself become (through strengthening of associations) an element in a larger chunk. In this way, chunking leads to the creation of structured hierarchies of associations." (Snyder, 2000, p.54)

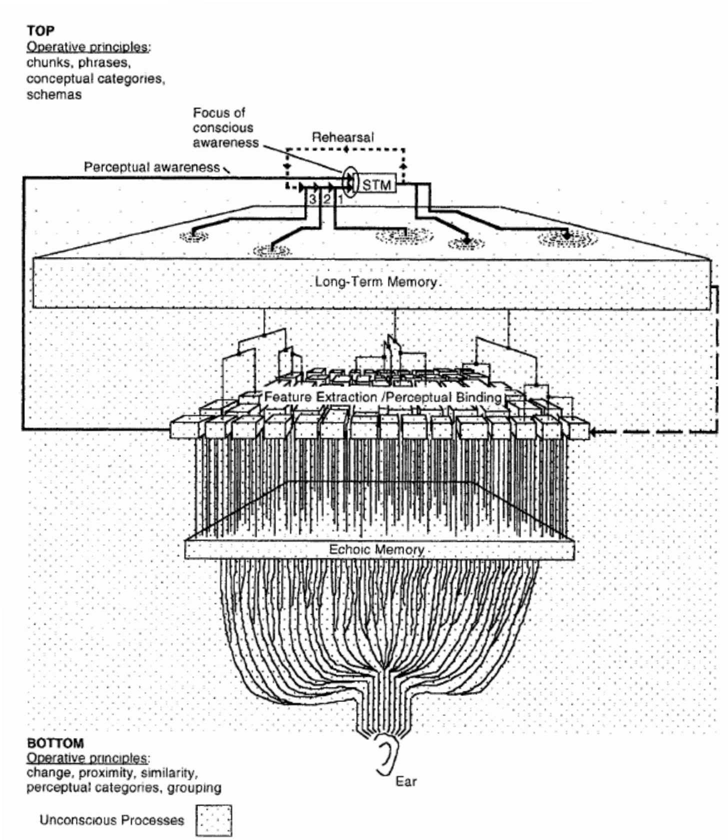


Fig. 2.9 "Some aspects of auditory memory. Note that this represents a "snapshot" of a few milliseconds' duration and that connections would not be "hard-wired", but would be constantly changing." (Snyder, 2000, p.6)

becoming conscious. Primed associations form the context of currently activated memory and can shape our expectations." (Snyder, 2000, p.70)

"[Second] In addition to creating structured hierarchies [see footnote 56], association allows mobility between chunks in *different* hierarchical LTM structures. Indeed, we can move through many types of memories from whole different types of experiences. If it were not for this "free" associative mode of memory retrieval, we would be trapped inside of hierarchical sequences of reminding [. . .] and thought would lack much of its

> fluidity[57]. [. . .] This process may continue on multiple levels and multiple directions of associations so that memory representations of sequences or bodies of knowledge of considerable size may be built up." (Snyder, 2000, pp.56-70)

However, it is important to say that, while listening to music, the current cognitive performance of the free and hierarchical associations explained above is mainly influenced by affective processes as well, such as core affect, mood, or emotional episode. Because, as seen in subsection 'Personality and Emotion' (see 2.1.3 on page 102), affect influences the quality of cognitive processing[58] in different ways. That is to say, affective processes are implied in attention, perception, thinking, judgment, storage, mental simulation, and retrieval from memory. Moreover, affect seems to induce motivating forces to be creative (intrinsic-extrinsic perspective (see 2.1.3 on page 99) and/or trigger knowledge which was saved together with a particular emotion (embodied-cognition perspective (see 2.1.3 on page 106). Therefore, levels of affect states, conceptualized as core affect, mood, emotional episode, etc. seem to constitute essential information, while creating *cues* between different levels of associated memory structures, and their retrieval in a certain listening situation.

Finally, after the creative processes while listening to music, sketched above from the perspective of neuroscience, the question is inevitably raised: What are the musical effects of assignment/associations between sound/time phenomena, developed with the assistance of memory structures in a certain listening situation?

To approach a possible answer, the next subsection outlines aspects of two comprehensive theories offering explanations about how meaning-creations can be performed in the process of listening (to music). That is: the listener's ability to create "[. . .] different, even contradictory, levels of interpretations, emotions and other meaningful experiences on the basis of the same physical sound." (Tuuri/Eerola, 2012, p.138)

2.4.2 Various Ways of Listening (to Music)

As we have seen, listening (to music) is an active process. But very few investigations concerning music listening and music perception, as well as music cognition, try to explain how sounds are listened for, in a certain situation, or what sorts of meaning-creation can be developed. Opposed to this, there are tendencies in Western tradition to conceive meaning-creation of music as a homogeneous domain,

[57] The investigations of processes similar to fluidity, such as flexibility, fluency, etc. are important concerns in creativity research applied to music (see 2.3.2 on page 129).

[58] However, there are perspectives who doubt that is always so. For example, ZAJONC (1980) proposed "[...] affect could be generated, without a prior cognitive process." (Zajonc, 1984, p.117)

which has its own language of musical meanings (see Clarke, 2005), and by that, includes 'predefined' types of 'assignments/associations of sound/time phenomena' (see in this regard 2.4.1 on page 140). However, in such an autonomous perspective, it is difficult to explain current tendencies of meaning-creation in music, such as Sound Art. This suggests again that, in Western music tradition, a 'proposed' specific structure-orientated way of listening is only one way of creative 'making' while listening to music. Moreover, as we will suppose in this section, meaning-creation (not only) of Western music already builds up on various ways of listening, which can be chosen when listeners intend to 'create' music. In this way, SCHAEFFER (1966) already noted:

> "Nothing can stop a listener from varying [listening] passing from one system to another or from a reduced listening to one that is not. (...) it is this swirl of intentions that creates connections or exchanges of information" (343)." (Dack/North, 2009, p.27)

To get a more detailed insight on various ways of listening, and on their impact on the 'creating' of music, we first start with CHION's (Dack/North, 2009) exegesis of SCHAFFER's (1966) theory which, among other, proposes different modes of listening. In a second step, we will discuss TUURI and EEROLA's (2012) current taxonomy for modes of listening, which is based on Schaffer's/Chion's considerations, but extends it in various aspects.

Chion's exegesis of Schaeffer's legacy

Through developments of various mechanical sound reproductions (e.g. tapes), new possibilities opened up in the 20th century to manipulate sounds, and, by that, new kinds of music could be created. This had the effect that,

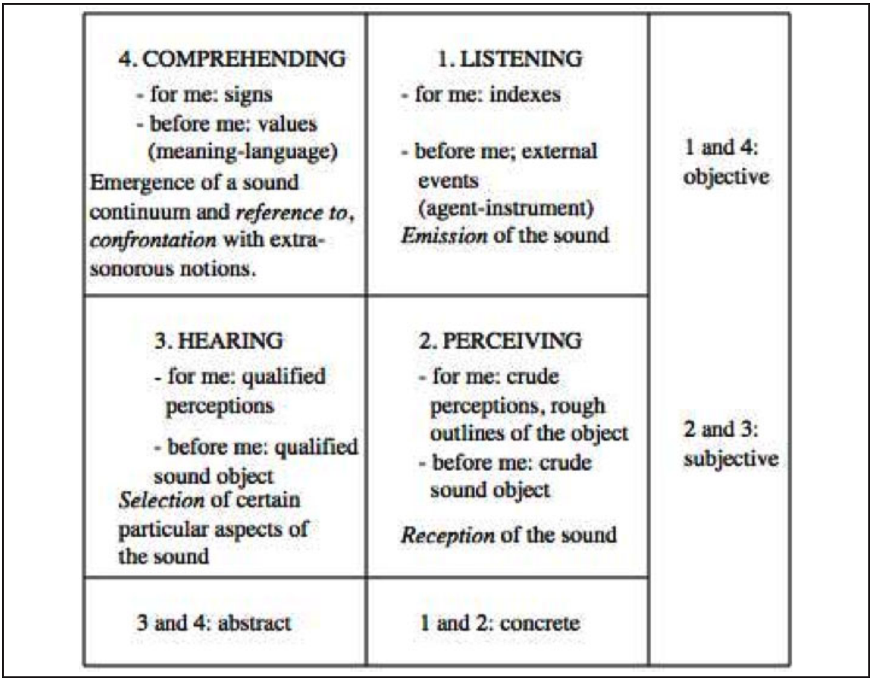
> "In contrast to 'natural' encounters with sounds, the usage of the technology was suddenly able to create novel circumstances for listening, where sound sources were no longer necessarily present and visible. Pierre Schaeffer, an electroacoustic composer and theorist, recognized how alterations in listening conditions have an effect on the way we hear, and thus acknowledged the significance of studying epistemological issues of listening." (Tuuri/Eerola, 2012, p.139)

In his most important work 'Traité des objets musicaux' (1966), SCHAEFFER argues for two distinctive systems of meaning-creation while listening, namely *ordinary listening* and *reduced listening* – metaphorically speaking *'What's going on?'* and *'What does it mean?'*, which CHION (DACK/NORTH, 2009) defines as follows:

> "In reduced listening, our listening intention targets the event which the sound object is in itself (and not to which it refers) and the values which it carries in itself (and not the ones it suggests). [. . .] In "ordinary" listening the sound is always treated as a *vehicle*. Reduced

> listening is therefore an "anti-natural" process, which goes against all conditioning. The act of removing all our habitual references in listening is a *willed* and artificial act which allows us to clarify many phenomena implicit in our perception." (Dack/North, 2009, p.31)

Let us be more particular in these two listening perspectives. As schematically seen in Figure 2.10, SCHAEFFER/CHION (1966); (1983) initially distinguished four modes of ordinary listening: 1. *listening* (écouter), which means listening to something or someone, causing identification of the source, event, cause, as a sign of this source (concrete/objective); 2. *perceiving* (ouı¨r), refers to a 'raw' (passive) level of perception, without any intention to conceptualize the perceptions (concrete/subjective); 3. *hearing* (entendre), means paying attention to what is perceived and what particularly interests us of the perceived sound (abstract/subjective); 4. *comprehending* (comprendre) attribution of a semantic meaning to the sound, by language, sign, or a code (abstract/objective).[59]



4. COMPREHENDING - for me: signs - before me: values (meaning-language) Emergence of a sound continuum and *reference to, confrontation* with extra-sonorous notions.	**1. LISTENING** - for me: indexes - before me; external events (agent-instrument) *Emission* of the sound	1 and 4: objective
3. HEARING - for me: qualified perceptions - before me: qualified sound object *Selection* of certain particular aspects of the sound	**2. PERCEIVING** - for me: crude perceptions, rough outlines of the object - before me: crude sound object *Reception* of the sound	2 and 3: subjective
3 and 4: abstract	1 and 2: concrete	

Fig. 2.10 "Four listening modes diagram" (Dack and North, 2009, p.192)

[59] (see Dack/North, 2009)

Furthermore, it is suggested that during "[. . .] every act of listening (...) on the one hand there is the encounter between a person receptive within certain limits and an objective reality; and on the other hand, abstract value-judgments, logical ways of describing, detach themselves from what is given in the real-world, which tends to organize itself around these, but without ever being reduced to them" (119). [. . .] Every listener can "specialise" in one "of the four poles which arise from this two-fold tension" (119), but always in relation to the 3 others: "No specialist can in fact dispense with "going round" the whole cycle of quadrants several times, because no-one can escape from his own subjectivity when dealing with a supposedly [abstract] objective meaning or [concrete] event, or from the [abstract] logical deciphering of a [concrete] event inexplicable in itself, and hence from the uncertainties and the progressive learning process of perception"(119-120)." (Dack/North, 2009, p.22)

The other proposed way of meaning-creation while listening is called reduced listening. It "[. . .] is a *new* hearing intention, consisting in turning the listening intentions, which seek a meaning or event beyond the sound, back on to the object itself." (Dack/North, 2009, p.27) This means, such a listening intention removes (if one exists!) the already experienced or learned source, cause, etc., and places the perceptions and cognitions in a new perspective, and by that, offers a possible explanation, why "[. . .] different, even contradictory, levels of interpretations, emotions and other meaningful experiences [can arise] on the basis of the same physical sound." (Tuuri/Eerola, 2012, p.138)

In addition, although SCHAEFFER'S concept of reduced listening was originally developed to explain meaning-creation in electro-acoustic music (keyword: 'acousmatic sounds'), it is also likely that reduced listening is essential during the development of musical creativity/creative thinking in sound/music in general.[60] This seems evident, if one recognizes that the musical creativity of infants and children is motivated by a kind of intrinsic activity[61] to create or discover the acoustic dimension of their environment.

Similarly, SWANWICK and TILLMAN's model of 'Developmental Spiral'[62] refers to earlier studies, which propose that, first, that the attention of 'six-month-old babies' is given first and foremost to the sound itself (see Moog, 1976), and, second, that

> "There are strong reasons for believing that a young child's primary responsiveness to music is first and foremost the tone itself, and not, as is sometimes asserted without any good evidence, to rhythm or to melody." (MURSELL, 1948, P.30)

[60] See subsection 'Definitions of Musical Creativity in the Course of Development' 2.3.1 on page 118.

[61] See in this regard Piaget's concept of 'intrinsic activity 1.4.1 on page 59, and subsection 'Personality and Motivation' 2.1.3 on page 99.

[62] See in this regard 1.4.2.2 on page 69.

Furthermore, although infants' intention to listen to environmental sounds can often be described as a sort of ordinary listening trying to discover what is the source, or cause of the sound, HARGREAVES (1996) has observed that, during the course of 'Musical-Artistic Development', and already in the 'sensorimotor-phase' (0-2 years), infants develop a limited competence of musical composition[63], and, by that, practice '*new* hearing (and producing) intentions' "[...] from exploration of the means of producing sounds towards an increasing control of the techniques of doing so. Infants' early fascination with variation of dynamic levels, as shown in 'strumming' on different instruments, gradually gives way to a more organized exploration of pitch, rhythm, and timbre." (Hargreaves, 1996, pp.157-158)

Such a meaning-creation again affects the ordinary listening and probably vice versa, because "[. . .] it is the swirl of intentions that creates connections or exchanges of information" (343)." (Dack/North, 2009, p.27) That is to say, as schematically seen in Figure 2.11, it is suggested that 'reduced listening still retains a link with "ordinary listening" and is like "its other side[s]": "[. . .] *if we cease to listen to an event mediated by sound, we nevertheless continue to listen to the sound as a sound event"* (271)." (Dack/North, 2009, p.31) And, if a sound event will be heard from or within a *new* perspective, this perspective can have implications again on listening intention(s) in relation to a particular interest of that sound, a certain code, language, its musical-structural organization, and probably affects further learning processes.

Finally we can say that SCHAEFFER/CHION's proposal of mutually influencing listening modes (ordinary and reduced) is, first of all, a concept arguing for a listener as a creative 'maker' of music. In relation to the development of musical creativity/creative thinking in sound/music discussed earlier, such a definition of reduced listening can be supposed to be at the very heart of individuals' musical development, because it offers an explanation how (not only) initial meanings of sounds are created. It seems furthermore plausible, if creative efforts in reduced listening are strong enough in children, adolescents or adults, and, are combined with practice in musical composition, that such a behavior could be a reliable variable to predict 'H-musical-creativity'[64]. Although such a proposal needs empirical validation, we can at least conclude that reduced listening explains (not only) a reflected intention: how new meanings of sounds are created in connection to ordinary ways of listening, and therefore describes how "[. . .] more creative or effective ways to utilize sound in a narrative or artistic context become possible." (Tuuri/Eerola, 2012, p.140)

[63] See 1.4.2.1 on page 66.

[64] For detailed information see 2.3.1 on page 118.

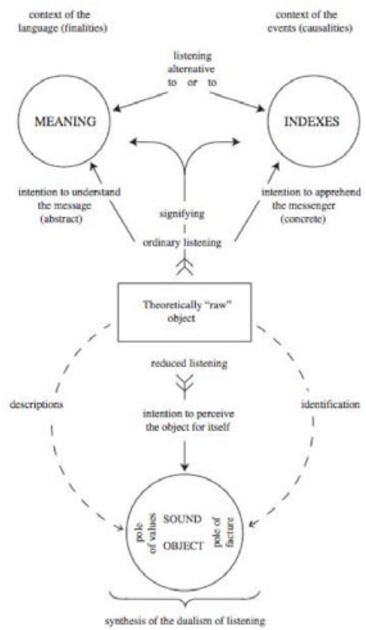


Fig. 2.11 "Final summary table of listening intentions" (Dack, 2009, p.193)

Tuuri and Eerola's 'Revised Taxonomy for Modes of Listening'

TUURI and EEROLA's (2012) taxonomy for listening modes, as schematically seen in Figure 2.12 (for detailed examples see Table B.1, Appendix 5 on page 346), is a revised scheme for listening modes, proposed earlier by TUURI ET AL. (2007), which "[. . .] extended the traditional three-mode scheme[[65]] with additional relevant perspectives in order to form a comprehensive outline of the listening modes." (Tuuri/Eerola, 2012, p.144), and, furthermore, suggested a separate taxonomy or dimensions of listening, including: attention, dispositions/listening styles, and intentionality/modes of listening (see Tuuri/Eerola, 2012, p.143, Figure B.1, Appendix 5 on page 346).

What makes this proposal more comprehensive seems to be the incorporation of concepts of 'experience-based approach to meaning' (see Lakoff, 1987; John-

[65] The traditional three-mode are: causal, semantic, and reduced listening. They correspond with the CHION/SCHAEFFER's three distinguished types of listening intention (see Figure 2.11), in the last subsection (see 2.4.2 on the preceding page).

son, 1987; Gallese/Lakoff, 2005; Johnson, 2007) and 'enactive perception' (see Noe, 2004), as well as current research in emotion, by means of HURON's (2002) "[...] six-component theory of auditory-evoked emotion." (Tuuri/Eerola, 2012, p.140)[66], and JUSLIN and VÄSTFJÄLL's (2008)¨'taxonomy of emotion-inducing mechanisms'.

To go more into detail, in relation to SCHAEFFER/CHION's/ modes of listening discussed earlier (ordinary and reduced, see 2.4.2 on page 145), TUURI and EEROLA (2012), pp.147-149 note that "[...] the class of denotative modes [see Figure 2.12] corresponds quite well to Schaeffer's ordinary listening and its two basic types of listening intentions [see Figure 2.11]; more source-oriented causal and emphatic modes relating to the intention to apprehend the 'indices', and more context-oriented functional and semantic modes relating to the intention to comprehend the meanings involved." However, TUURI'S and EEROLA's proposal of reduced listening, together with critical listening[67], are considered part of the reflective listening mode.

> "We conclude that these modes of listening are both *reflective* in nature, and therefore they both operate in the highest-level class of reflective listening. Even though the reduced mode of listening is often conceived of as having an orientation to sound qualities, we want to emphasize the more general function of this mode. We see that the essence of reduced listening is in self-reflective analysis of one's listening experience and, by resisting any denotations, also intentional manipulation of that experience." (Tuuri/Eerola, 2012, p.149)

Compared to SCHAFFER/CHION's proposal discussed earlier[68], TUURI and EERO-LA add an interesting class of meaning-creation, namely: the *experiental* domain (see Figure 2.12). Hence, they assume that meaning-creation builds up on corporal or sensorimotor processes. Referring to findings of 'experience-based approach to meaning' (see Lakoff, 1987; Johnson, 1987; Gallese/Lakoff, 2005; Johnson, 2007) and 'enactive perception' (see Noe, 2004), they suggest that "[...] sound perception essentially has a certain haptic or kinaesthetic character, and requires sensorimotor skills. There is evidence suggesting that, in perception and thinking, ideomotoric processing of actions indeed occurs at the neural level,

---

[66] "The activating systems are: Reflexive system: fast and automatic physiological responses.; Denotative system: processes which allow the listener to identify sound sources.; Connotative system: processes that allow the listener to infer various physical properties and passively learned associations; Associative system: arbitrary learned or conditioned associations.; Empathetic system: allows the listener to perceive cues that signals someone's state of mind.; Critical system: reflective self-monitoring concerning the verification of perception and the appropriateness of one's responses." (Tuuri/Eerola, 2012, pp.140-141)

[67] "Quite intuitively, critical listening essentially functions as a reflective mode, constantly judging the appropriateness of listening-based interpretations. Through these judgments, the critical element in listening evokes new meanings and reevaluates those already evoked." (Tuuri/Eerola, 2012, p.149)

[68] See in this regard 2.4.2 on page 145.

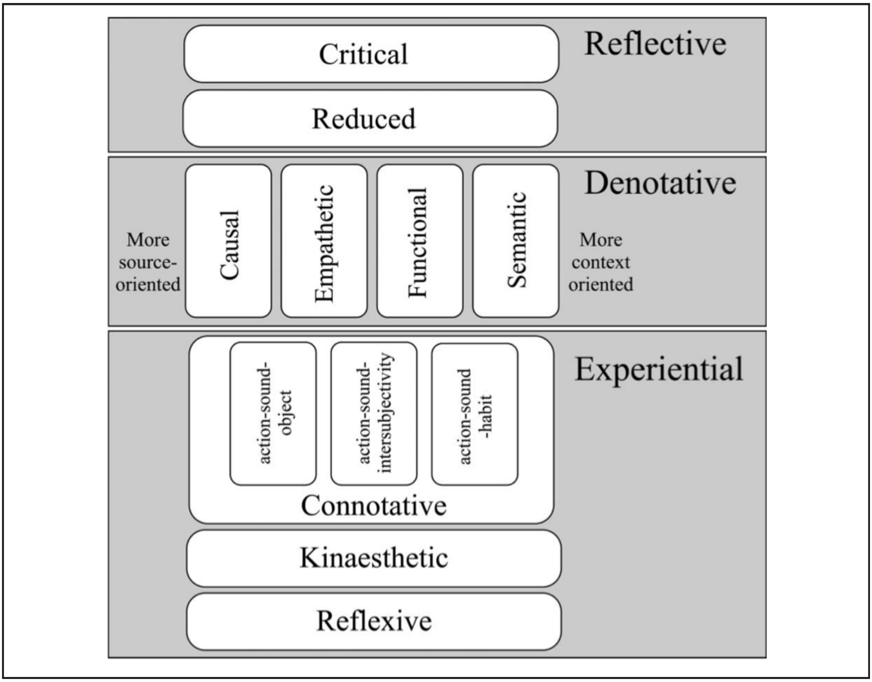


Fig. 2.12 "Overview of the revised scheme for modes of listening." (Tuuri and Eerola, 2012, p.147)

as embodied simulations. [. . .] Such a tight sensorimotor integration also offers an explanation for the synesthetic and kinaesthetic processes of perception which permit multimodal[[69]] and motoric imagery as a response to sounds or musical cues [[70]]." (Tuuri/Eerola, 2012, p.146)

Both authors thus propose that, within the experiental domain, meaning-creation is developed based on experienced 'action-sound couplings', schematically structured, for example, as 'body-schemas, motor-schemas or image schemas'. And, by using such schematic structures, listeners are "[. . .] able to project meaningful action-relevant mental images relating both to our body (kinaesthetic/somatic ontology) and the environment (action-oriented ontology of environment)." (Tuuri/Eerola, 2012, p.146)

[69] See in this regard subsection 'Personality and Emotion 2.1.3 on page 102.

[70] In subsection 'Perception of Time and Rhythmical Structures – a Sensorimotor Perspective' 1.3.2 on page 49, we suggested that perception and construction of music structures, and their development, are generally based on bodily experiences.

As seen in Figure 2.12, they distingish three levels of schematic structures in relation to sounds, namely: *reflexive*, *kinaesthetic*, and *connotative* couplings.

> "The first two mostly involve innate and early developed schemata while the last one likely involves schemata which are more adaptive and learned." (Tuuri/Eerola, 2012, p.146)

In detail, this means :

> "Reflexive action–sound couplings refer to quickly evoked, phylogenetically developed, innate action–sound reaction affordances. They are based on automated (or 'hard-wired') schemata which are due to the evolutionary adaptation to our ecology.[[71]]
>
> Kinaesthetic action–sound couplings refer to kinaesthetic affordances of a perceptual experience; an imaginative sense of motor-movements on the basis of sound perception. This gestural character of sound perception is arguably based on ideomotoric processes that manifest innate or early developed structures of kinaesthetic schemata concerning bodily movements, coordination and postures (Johnson, 1987; Merleau-Ponty, 1945). In the light of vitality affects (Stern, 1985; Johnson, 2007), kinaesthetic perception can also be seen as bodily resonated contours (or patterns) of feeling. These dynamic patterns may concern, for instance, sensitivity to the haptic and tactile feelings relating to movement (e.g. tensions and textures) [. . .].
>
> Connotations refer to vigorously activating imaginative projections of action-relevant values as resonances of schemata based on interactions with both natural and cultural constraints. All three sub-types of couplings, namely action–sound–object, action–sound–intersubjectivity and action–sound–habit [see Figure 2.12], likely involve the schemata mostly acquired by learning. Action–sound–object couplings refer to sonic experiences that are about actions of encountering and manipulating objects in the environment. Couplings of action–sound intersubjectivity refer to sonic experiences of interpersonal encounters. These couplings resonate especially with gestural signatures (or motoric invariants) in the patterns of kinaesthetic sensation, and function as gestalts for interpersonal understanding. It is suggested that mirror neurons act as a basic mechanism for such an empathetic involvement (Iacoboni, 2009); they permit bodily realized (ideomotoric) affordances of movement, which can be interpreted in terms of the perceiver's own body-based ontology of intentions and emotions (Leman, 2008a; Gallese et al., 2007). As a third category, couplings of action–sound–habit refer to various habituated aspects of cultural ecology that are involved in actions." (Tuuri/Eerola, 2012, pp.146-147)

Connotative meaning-creation is hypothesized as meaning-making through analogical[[72]] and metaphorical processes, and therefore are 'probably highly interactive' to denotative[73] as well as kinaesthetic and reflective levels. Such a metaphorical meaning-creation after listening to music could be, for instance, when someone

[71] See in this regard 1.4.2.3 on page 74.

[72] See in this regard 2.1.1 on page 87.

[73] That means, "[. . .] making interpretations relating to acting on the sounding objects of the world (causal and empathetic listening), to intersubjective attuning to emotions and intentionality (empathetic and functional listening) or to dealing with the norms of sound usages and sounding artefacts of the socio-cultural ecology (functional and semantic listening)." (Tuuri/Eerola, 2012, p.147)

describes a musical sequence as follows: During chord progressions the tension built up and released.

Finally, although some modes of listening probably depend on others, and therefore, TUURI'S and EEROLA'S taxonomy of listening includes hierarchical aspects[74], both authors also suggest that "[...] different listening modes can apply concurrently to the same sound, as listening can potentially incorporate a multitude of intentions. Listening modes thus do not exclude each other, hence the taxonomy will inherently retain the ability to take into account the multifunctionality of listening." (Tuuri/Eerola, 2012, p.138)

Such a perspective is coherent with SCHAEFFER/CHION's conception of listening discussed earlier, because both suggest, "[...] *if we cease to listen to an event mediated by sound, we nevertheless continue to listen to the sound as a sound event"* (271)." (Dack/North, 2009, p.31). Furthermore, it is also consistent with the assumption of multimodal perception and cognition (see also 2.1.3 on page 106). Because, as we have seen by means of SNYDER's memory model (see 2.4.1 on page 141), "[...] current consciousness can consist of two parts; a vivid perceptual act [*reflexive, 'kinaesthetic'*], and a conceptual aspect [*connotative, denotative, critical*, *'reduced'*] from long-term memory." (Snyder, 2000, p.5)

Furthermore, the *connotative* modes of listening correspond quite well to SNYDER's proposal of 'free associations' (see 2.4.1 on page 142) between chunks in different hierarchical long-term structures. Because, by processes of 'free associations', or, in TUURI's and EEROLA's conception, analogical and metaphorical connections between *reflexive/kinaesthethic* and *denotative* information while listening to sounds/music, the probability seems to be very high that *new* or *original* meaning will be created.

This leads to the conclusion that, beyond *reduced* listening[75], *connotative* modes of listening are also highly creative in nature.

2.4.3 Creativity Research in Terms of Listening to Music

In the previous subsections (2.4.1 on page 140 - 2.4.2 on page 144), we argued for a perspective that, first, listening to music is a creative act of meaning-creation in general, and, second, that musical meaning is built up by use of various listening modes. There are also found indications that some modes or ways of listening can cause 'more' creative processes than others, and, furthermore, that different

[74] They notice: "Compared to the earlier account of Tuuri et al. (2007), the most prominent changes in the revised taxonomy are the addition of a kinaesthetic mode of listening and the new, less hierarchic schematic arrangement of modes." (Tuuri/Eerola, 2012, p.149)

[75] For detailed information about the creativity of reduced listening see 2.4.2 on page 147.

modes 'can apply concurrently to the same sound'. This potential diversity in the meaning-creation while listening to sounds/music suggests arguments for the perspective that listeners can create "[...] different, even contradictory, levels of interpretations, emotions and other meaningful experiences on the basis of the same physical sound." (Tuuri/Eerola, 2012, p.138)

This section goes a step further, because it presents various proposals contouring listening to music from the point of view of creativity research, and, in a second step, these will be related to findings sketched above (subsections 2.4.1 - 2.4.2). By that, an extended picture about creative processes while listening to music becomes apparent.

First of all we can state that creativity research concerning listening to music also conceives listening as an active process of meaning-creation. This is partly evident if one looks at statements from composers, scientists, and musicians in this subject. For example, COPLAND (1952), p.7 noticed that an "[...] imaginative mind is essential to the creation of art in any medium, but it is even more essential in music precisely because music provides the broadest possible vista for the imagination since it is the freest, the most abstract, the least fettered of all the arts: no story content, no pictorial representation, no regularity of meter, no strict limitation of frame need hamper the intuitive functioning of the imaginative mind." Similarly, MURSELL (1943(1956)) indicates that,

> "Listening should by no means be considered mere passive reception not even when the main consideration is the evocation of a mood. The successful listener enters into the music, possesses it, is possessed by it, and so is inspired and enabled to make it for himself." (Mursell, 1943(1956), p.170)

And, according to REIMER (1989); (1992), DUNN (1997) also believed that,

> "A person who is truly involved in the listening process actively engages in creating a mental structure (perceptual structuring) of a piece as it unfolds. In this 'reflection-in-action' (Reimer, 1992, p. 99), the individual creates her own experience from the expressive possibilities within the music in several ways; by selecting what will be attended and at what level; perceiving what is occurring; reflecting on what has happened; creating expectations of what might follow; examining what actually occurred in light of those expectations; and affectively responding to the musical experience as a whole, mediated in part by past experience. In this sense, the overall experiencing of a piece of music is dependent on the individual listener." (Dunn, 1997, p.43)

To be more particular, as already discussed in section 'Musical Creativity/Creative Thinking in Sound' (see 2.2 on page 111), a model proposed by WEBSTER (2002) (see Figure 2.13), which combines divergent/convergent thinking with creative problem-solving processes, defines musical creativity as a "[...] structured process of thinking in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11) He thus primarily conceives listening as a product, which results from an intentional engagement in music. But, although it seems clear that WEBSTER intends to describe creative processes leading to a mental representation, or, a mental product of listening, we have seen previously (see 2.3.2 on page 128; 2.3.3 on page 136), after measurement of creativity/musical creatitvity, it is sometime difficult to define the level of creativity without an 'objective' product, such as a composition or a performance. That is why RUNCO defines process-centered instruments to measure musical creativity, such as divergent thinking tests, rather "[...] as estimates the potential for creative problem solving. [...] instead of guaranteed creative behaviour." (Runco, 2008, p.93) However, process-centered instruments seem to be 'suitable instruments to measure mental traits[76], which are considered as important prerequisites to produce creative products.'

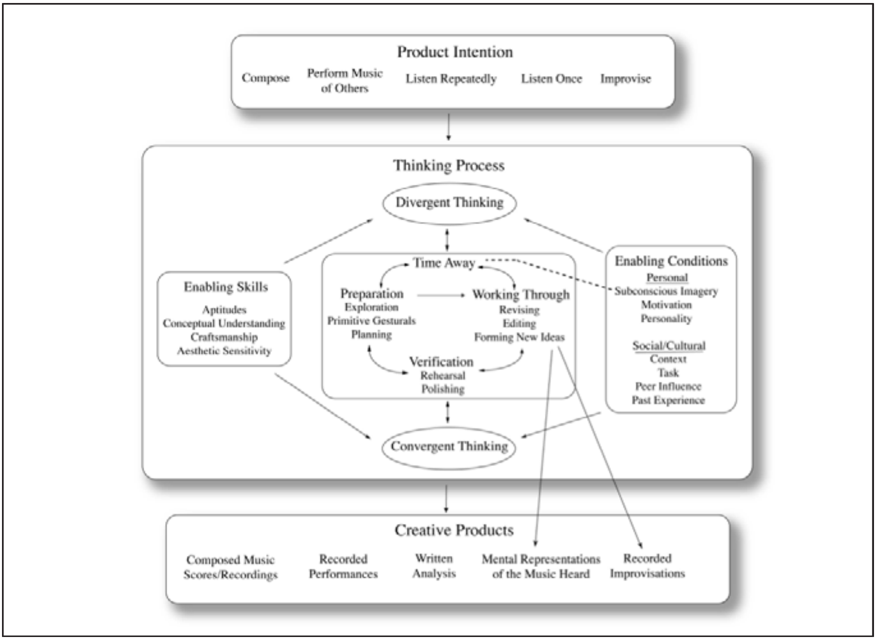


Fig. 2.13 Webster's (2003) model of 'creative thinking process in music' (source Webster, 2003, p.60)

In relation to the previously explained perspectives on listening, the first step (divergent thinking) within WEBSTER's model correspond quite well to SNYDER's 'free associations' (see in this regard 2.4.1 on page 141), and SCHAEF-

76 Such as musical fluency, musical originality, musical extensiveness, musical flexibility.

FER/CHION's (see 2.4.2 on page 145) as well as TUURI/EEROLA's (see 2.4.2 on page 149) proposed ways of listening. Because SCHAEFFER/CHION note: "[...] nothing can stop a listener from varying [listening] passing from one system to another or from a reduced listening to one that is not. (...) it is this swirl of intentions that creates connections or exchanges of information" (343)." (Dack/North, 2009, p.27), TUURI/EEROLA also argue that "[...] different listening modes can apply concurrently to the same sound, as listening can potentially incorporate a multitude of intentions. Listening modes thus do not exclude each other, hence the taxonomy will inherently retain the ability to take into account the multifunctionality of listening." (Tuuri/Eerola, 2012, p.138) WEBSTER defined such processes as divergent thinking: "[...] here the creator is exploring the many possibilities of music expression, always cataloging, sifting through, rejecting, accepting only to change yet again." (Webster, 2002, p.13) But he extends the observation of the meaning-creation process by noting that creative processes, such as divergent thinking, will be conceptualized in dependence on 'Enabled Skills' and 'Enabled Conditions' (see in this regard various explanations between section 1.4 on page 57 - 2.4 on page 140).

In addition, WEBSTER suggests a further new and important aspect in terms of listening to music, namely the distinction between 'In the moment vs. Reflective Thought'.

> One new aspect of the model is my attempt to account for the "in the moment" creativeness that occurs in improvisation and single-time, music listening. Composition, performance of previously written music, and music analysis resulting from repeated listening are all time-independent. The creative processes have the benefit of "time away." Improvisation and single-time listening unfolds in fixed time and the creative thinking is part of a flow of musical behavior that does not benefit from reflection to the extent that the others do. For this reason, I have tried to be specific about the differences between the two types of listening and between composition and improvisation in terms of their representation as intentions and products. This unfolds more completely in the center of the model and the depiction of stages. Here, I have added a line of movement from Preparation to Working Through and then lines that move from Working Through directly to the products. What I mean by this is that creators, during improvisation and single-time listening, form explorative ideas, work through them, and then move directly to product." (Webster, 2002, p.14)

In contrast, WEBSTER argues that 'reflective thought', as it may emerge from repeated listening, operates through *all* proposed stages, from preparation – such as problem identification and problem definition, where preparatory work explores the listening dimensions (see in this regard 2.4.2 on page 144) –, to the verification stage which, in relation to convergent thinking, allows to develop and test an effective and original/new creative product, such as an analysis of music heard repeatedly[77].

> "I still am quite sure that stages operate in the creative process and have retained the notions of preparation, verification, and incubation (though I have renamed this "Time Away" which seems to make more conceptual sense to me). I have come to believe that illumination is not as much a stage as a qualitative event that occurs many times in the creative process. I also feel that the notion of verification is best reserved for the final polishing stage of the creative processes that are more reflective in nature. The idea of "Working Through" is attractive because it functions both in terms of reflective thinking and "in the moment" thinking. It is this stage, too, that likely occupies the greatest percentage of creative time and is the most indicative of convergent/divergent thinking in combination." (Webster, 2002, p.14)

PETERSON (2002); (2006) also supports such a perspective after studying the creative dimension of listening by means of literature on cognition, music philosophy, and creativity.[78] She argues for a creative process, while listening to sound/music, "[. . .] as a combination of divergent and convergent thinking in a cyclical sequence of five stages[[79]] in three main phases." (Peterson, 2006, p.18)

Furthermore, she added two important aspects in our concerns. First, her conception of listening "[. . .] drawing a parallel with the creative processes involved in composition." (Dunn, 2011, p.41) Second, the product of listening can effect 'listener's subsequent thinking', and, by that, supports our own previous suggestions about developments of musical thinking in sound/musical creativity (see 2.3.1 on page 118).

> "The thinking in and with sound that generates such a mental model[[80]] is the music making carried out by listeners, just as the thinking in and with sound that generates a composition is the music making carried out by composers. This mental model persists in memory and can be further elaborated during subsequent hearings of the same work or even possibly through externally silent cognitive activity between hearings, cumulatively gaining coherence, complexity, and stability. The product of listening is also potentially novel and valuable to the listener and may have varying degrees of impact on the listener's subsequent musical thinking." (Peterson, 2006, p.18)

Let us return to the aspect of listening to music as problem-solving processes, following WEBSTER's suggestions of proceeding through the four stages: preparation, time away, working through, verification.

As discussed earlier, we have seen that individuals' creative efforts depend on their own personality, motivational aspects, and emotions. In listening to music,

[77] WEBSTER refers to aspects of the stage model from WALLAS (1926) (see in this regard 2.1.1 on page 88).

[78] For detailed information (see Peterson, 2006).

[79] immersion, incubation, insight, synthesis, and explication.

[80] PETERSON means here a mental model of the perceived musical work.

creative efforts can evolve within the following constellation: the individual is motivated "[. . .] to engage in an activity primarily for its own sake, [and,] perceives the activity as interesting, involving satisfaction, or personally challenging; it is marked by a focus on the challenge and the enjoyment of the work itself." (Collins/Amabile, 1999, pp. 299-300) Such a problem-solving perspective for both, 'in the moment' and 'reflective' listening (see 2.4.3 on page 156), as a voluntary effort to create the meanings of sounds, and of the relations between them, offers an explanation about the power, which is responsible for creating 'free associations' (see 2.4.1 on page 141), 'various ways of listening' (see 2.4.2 on page 144), products of listening according to WEBSTER (2002), or, in PETERSON's (2002); (2006) conception, the reason why listeners 'immerse' into the creative listening process, etc.

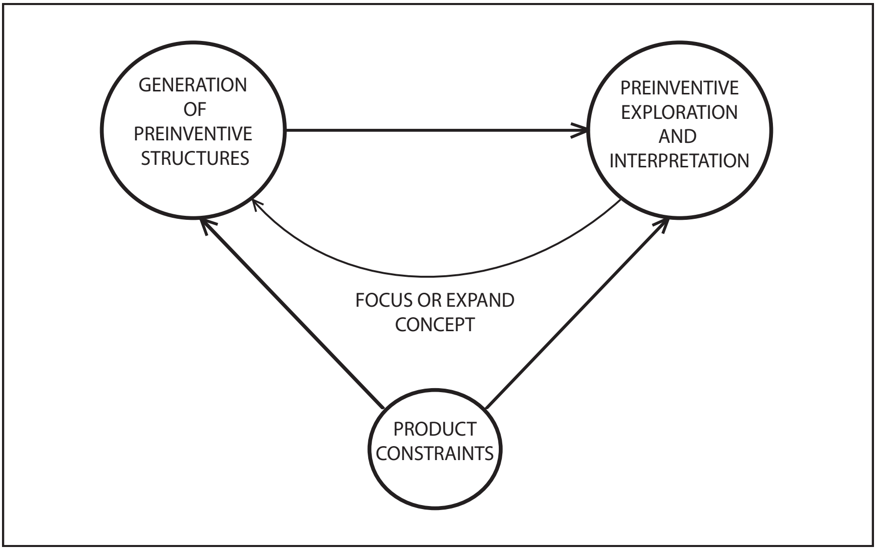


Fig. 2.14 Geneplore model of creativity

A more comprehensive insight in such creative problem-solving processes is possible by means of the 'geneplore model' (see Figure 2.14). It suggests that creative activities will often be processed in relation to an identified problem (see in this regard 2.1.1 on page 87): "[. . .] ideas are sometimes described as "preinventive" in the sense that they are not complete plans for some new product, tested solutions to vexing problems, or accurate answers to difficult puzzles." (Finke/Ward/Smith, 1999, p.191)

This means, in FINKE ET AL.'s (1999) conception, that the generation of pre-inventive structures includes processes, such as "[...] retrieval of existing structures from memory (Perkins, 1981; Smith, 1995b; Ward, 1994, 1995), the formation of simple associations among those structures (Mednick, 1962) or combinations of them (Baughman & Mumford, 1995; Hampton, 1987; Murphy, 1988), the mental synthesis of new structures (Thompson & Klatzky, 1978), the mental transformation of existing structures into new forms (Shepard & Feng, 1972), analogical transfer of information from one domain to another (Gentner, 1989; Holyoak & Thagard, 1995; Novick, 1988), and categorical reduction, in which existing structures are conceptually reduced to more primitive constituents (Finke et al., 1992)." [In a second step, the exploration and interpretation of these pre-inventive structures] can include the search for novel or desired attributes in the mental structures (Finke & Slayton, 1988), the search for metaphorical implications of the structures (Ortony, 1979), the search for potential functions of the structures (Finke, 1990), the evaluation of structures from different perspectives or within different contexts (Barsalou, 1987; Smith, 1979), the interpretation of structures as representing possible solutions to problems (Shepard, 1978), and the search for various practical or conceptual limitations that are suggested by the structures (Finke et al., 1992). [...] After the exploratory stage is completed, the preinventive stuctures can then be refined or regenerated in light of the discoveries and insights that might have occurred. The process can then be repeated, until the preinventive structures result in a final, creative idea or product." (Finke/Ward/Smith, 1999, pp.191-193)

Hence, if one conceives listening to sounds/music as a problem of interpretation within a certain context, creative processes could then, for example, be described as follows: "[...] a person might use analogical transfer from predisposed and experienced-based knowledge to produce a candidate idea for musical variation, and then explore how this structure might be useful as a new metaphor representing a musical motif." (Schmidt/Troge/Lorrain, 2013, p.3)

Finally, to see listening partly as a process solving a particular problem, has strong relations to learning through thinking within sound, and, by that, extends the previous discussions about the development of 'P-culturalized-musical creativity' (see 2.3.1 on page 118). Because, although thinking in sound/music through listening can only be processed within a cultural environment (music is a cultural product), the development of musical creativity by listening, performing, and composing is far more than enculturalization and acculturalization processes, as suggested earlier. Hence, creative activities while listening to music can be conceived as processes of thinking in sound for the purpose of solving problems of understanding. And, as repeatedly argued in this section, this supposes that individuals' understanding of musical processes as a cultural product is a highly active engagement to contrive variations of it.

2.4.4 Conclusions

We have discussed various proposals, according to which listeners perform a mental work – analized as processes of divergent thinking, working through, reduced listening, connotative listening, pre-inventive generation, exploration, interpretation, etc. These processes create musical patterns while listening to sounds, and between the sounds. We can also say that there is a consensus about this within investigations outside of creativity research. For example, BERNSTEIN (1954), LERDAHL AND JACKENDOFF (1983), LESTER (1986), SERAFINE (1988), BAMBERGER (1994), and HARGREAVES ET AL. (2012) found indications that listening to music offers opportunities for decision making. Moreover, in an extension to arguments from the neuroscience at the beginning of this chapter (see 2.4.1 on page 141), which outline listeners as creative makers of music, there are further indications from this field of research, namely: *musical imagery.*

> "Musical Imagery has often been viewed and considered as the ability to hear or recreate sounds in the mind even when no audible sounds are present (Godoy and Jorgensen, 2001)." (Clark/Williamon/Aksentijevic, 2012, p.352)

In addition, BAILES (2002) refers to suggestions of the American composer ROGER SESSIONS, who believes "[...] that internal imagery is central to musical understanding: In the primary sense, the listener's real and ultimate response to music consists not in merely hearing it, but in inwardly reproducing it, and his understanding of music consists in the ability to do this in his imagination. (Sessions, cited by Levinson, 1997:22)". (Bailes, 2002, p.15)

From the perspective of neuroscience, *musical imagery* has much in common with perceptual processes responding to music (see 1.2.2 on page 40; 1.3 on page 46), because it was found that imagination processes in music overlap with many of the same areas of the brain used in perception of music (Kosslyn/Ganis/Thompson, 2001; Zatorre/Halpern, 1993; Zatorre et al., 1996; Halpern/Zatorre, 1999; Zatorre, 1999; Zatorre/Evans/Meyer, 1994). But there are also differences, because KOSSLYN ET AL. (2001), P.636 state that "[...] imagery, unlike perception, does not require low-level organizational processing, whereas perception, unlike imagery, does not require us to activate information in memory when the stimulus is not present." It is further important to notice that, during imagery and perception tasks, neuronal patterns are not identical. Moreover, ZATORRE ET AL. (1996) has revealed that more secondary than primary auditory-cortex areas are active while imaging from songs.

> "This distinction may be important, and supports the idea that primary sensory regions are responsible for extracting stimulus features from the environment, while secondary regions are involved in higher-order processes, which might include the internal representation of complex familiar stimuli." (Zatorre et al., 1996, p.38)

Listening to music mostly[81] includes the activation of motor areas. This is a plausible connection, because, as seen previously (see 1.3.2 on page 49), infants' initial steps in musical processes are based on perceptions of time and rhythmical structures in relation to regulations of their own rhythms and temporal behaviors. For instance, CHEN ET AL. (2008) observed that, while listening to rhythmical music, supplementary motor area, mid-premotor cortex, and cerebellum will also be activated. Similarly, ZATORRE (1999) found activations in the supplement motor area, but during auditory imagery, but without any motor involvement.

There are also indications that musical imagery can be attained through the practice of music. For example, LOTZE ET AL. (2003) compared brain activation patterns in motor imagery of violinists and non-violinists, with the conclusion that "[...] professionals also demonstrated more focused activation patterns during imagined musical performance." (Lotze et al., 2003, p.1817) HERHOLZ ET AL. (2009) extended such observations by finding neurological indications for a development of musical imagery guided by musical expertise. Because, musicians react (iMMN)[82] to an incorrect tone after a purely imagined melody, but non-musicians do not. And ALEMAN ET AL. (2000) supports this perspective from the behavioral point of view, since musical experts performed better musical imagery tasks in their study.

Finally, as we have seen previously (see 2.3.2 on page 130), researches in the development of creative musical thinking also try to measure musical imagination processes (e.g. tonal, rhythmical, syntactical aspects), while listening to and producing music. In this field of research, indications were found that the level of expertise is significantly related to creative behavior in music. That is to say, beyond other factors, such as environmental influences, personality, etc. (see in this regard 2.1.2 on page 90; 2.1.3 on page 96), that "[...] a firm grounding in the basic skills of aural discrimination may be important in establishing a basis for creative ability. A study of individual subscores also reveals the importance of instrumental recognition for improvisation, auditory-visual discrimination for composition, and pitch recognition for analysis. The results also suggest that in each mode, the achievement test battery taken as a whole is the best single predictor of music creativity potential." (Webster, 1979, p.240) According to HICKEY (1997), RUNNING (2008), p.12 noted "[...] that what separated students in the high ability level from the middle and low level was an advanced ability to manipulate and experiment with musical motifs as well as invent new musical ideas quickly." And PRIEST (2001), p.254 observed, "[...] that individuals who were rated as highly creative composers were more aware of temporal factors than their middle and low counterparts."

[81] However, HALPERN ET AL. (2002), P.134 found that "[...] timbre can be processed without motor rehearsal mechanisms."

[82] imagined mismatch negativity response

Now, after the discussion of creative processes while listening to music, the question arises: Can, and, if so, how can creative processes be outlined while composing music? To give a brief answer in advance: yes, it seems that mental processes, such as imagination, divergent thinking, problem-solving, etc., are essential for composers while doing their work. Not only by the fact that "[...] Beethoven composed his violin concerto in D-major (op. 61) even though he was already deaf." (Kleber et al., 2007, p.889), and the common observation that many composers, such as SCHUBERT and MOZART, composed music without the presence of any musical instrument.

We will see in the next section that creative processes while composing music are similar to creative processes while listening of music, but however not identical.

2.5 Creativity while Composing of Music

The assessment of great compositions, and the evaluation of their level of creativity (see in this regard 2.3.1 on page 118), are usually based on critics having listened to and studied the music. These can thus be described as product-centered approaches of evaluation (see in this regard 2.3.2 on page 125; 2.3.2 on page 133). This conceptualization has a long tradition in historical and systematical musicology, in which it is possible, for example, to compare great compositions systematically. On the contrary, this section rather tries to investigate the creative 'in the moment' process (see in this regard 2.4.3 on page 156) happening while composing music, by discussing various processes which can contribute to the creative act of making a musical product.

First, as it was supposed in the case of listening to music (see 2.4.4 on page 160), we will discuss whether imagery and imagination are supporting processes for composers while doing their work. Second, we will present a perspective which conceptualizes compositional activities and processes as working in a tension field between problem-finding and problem-solving.

2.5.1 The Role of Imagery and Imagination

In his book *Music and Imagination* (1952), the famous composer AARON COPLAND states: "[...] I am convinced that it is the freely imaginative mind that is at the core of all vital music making and music listening." (Copland, 1952, p.7) Similarly, for composer ROBERT SAXTON, composing "[...] traces a path from the intangible imagination to the tangible reality of a created work.“ (Saxton, 1998, p.6)

And, as we have already seen in the previous section ’Creativity in Listening to Music’ (see 2.4.4 on page 160), musical imagery – “[. . .] as the ability to hear or recreate sounds in the mind even when no audible sounds are present (Godoy and Jorgensen, 2001).” (Clark/Williamon/Aksentijevic, 2012, p.352) – plays a role in construing a mental structure out of listened sounds, in a two-dimensional as well as three-dimensional manner. Therefore, it is obvious that, while composing, both musical imagery and musical imagination – as the ability to create new combinations of sounds in the mind – have strong relations to each other and can contribute to the creative act. However,

> “Imagination is more than imaging, involving a degree of creativity over mere visualizing or experiencing a ready-made copy. According to this, musical imagery might represent an intermediary point between imagination and what Saxton (1998) describes as the ’aural detection’ stages of creation. The process of developing a compositional idea implies a musical imagination to hear the desired sound, musical memory, and the ability to alter and mentally rehearse an image.” (Bailes, 2002, p.195)

A further indication for a relation between imagery and imagination can be seen in the extraordinary mental abilities of the great composers SCHUHMAN, MOZART, BERLIOZ, TSCHAIKOWSKY, and WAGNER (see Agnew, 1922). For example, it was narrated that “[. . .] Berlioz heard his compositions mentally. He objected to the use of any instrument in composing, dubbing the piano the "grave of original thought." Not only did he hear his own compositions in tonal imagery, but he imagined the productions of other composers, and was sometimes disappointed in their performance. [SCHUMANN] composed through his "inner hearing." He advised other composers to eschew the use of an instrument and to compose with the aid of their mental images alone. [. . .] Mozart composed in mental music without the aid of an instrument, and ’that his power in mental music constantly increased, and he soon imagined effects of which the original type existed only in his own brain’.” (Agnew, 1922, pp.280-284)

These explanations suggest that musical imagery and imagination processes stron-gly depend on the capacity of the human memory (see 2.4.1 on page 141). In this way, MOZART recognized elsewhere that his memory is ’perhaps’ his ’best gift’.

In relation to SNYDER’s memory model (see 2.4.1 on page 141), great composers have probably developed an extended capacity of memory in higher-order structuring of music, and can develop a greater number of associations between different levels of long-term memory (keywords: cuing, chunking). DAILEY ET AL. (1997) found indications for such a perspective, because “[. . .] individuals scoring highly on the ’Remote Associates Test’[[83]], which was used to assess cre-

[83] For detailed information see MEDNICK (1962).

ative potential, made stronger associations between synaesthetic components and emotional terms than those with lower score.” (Bailes/Bishop, 2012, pp.64-65)

Many composers use instruments to support composing processes, for example to select imagined ideas, or/and, because of the kinaesthetic reinforcement obtained from physical production. Moreover, initial musical imaginations can be further elaborated by improvising on an instrument. A plausible reason could be that unconscious and conscious knowledge about music, partly manifested in techniques of playing instruments, support composers in their elaboration of ideas. For instance, composer PETER WARLOCK noticed:

> “If I had ideas, I could not write them down without a piano! The sum total of my “compositions” – (I ought to say “compilations” for they were discovered at the piano...).” (Wiggins, 2012, p.236)

Furthermore, one composer (G.N.) interviewed by BAILES (2002) feels that the timbre he imagines while composing lacks in accuracy compared to the quality of its musical realization. And, by using a piano, it is possible for him “[...] to open up the sound of the piano more by imagining another instrument playing the same thing. So in a way it’s sort of orchestration at the piano.” (Bailes, 2002, p.203) This implies that the fashion in which composers use musical imagery and musical imagination, beyond their capacity to imagine music, also depend on their preferred way of composing.

To get a closer insight in processes of imagination, it may be helpful to discuss proposals which modelize creativity in relation to developmental orders of imagination. As schematically seen in Figure 2.15, AINSWOTH-LAND (1982) proposes a general model of creativity and imagination, in which she “[...] identified four stages of growth[[84]]: (1) the most primitive ability to elaborate; (2) a replicative stage in which form but not function is modified (for example improving through modification); (3) a mutualistic stage of high-level combinations, such as metaphors; and (4) transformation or invention, in which structure is destroyed and reintegrated. (Khatena, 1984)” (Bailes/Bishop, 2012, p.58)

AINSWORTH-LAND further suggests that, within the third stage, imaging “[...] results in the creation of a new product, theory or the like that is an integral combination of two or more ideas or products or functions. The resulting product is novel and contains at least as much “new” as “old”. One must be willing to give up images of what exists “out there” and be willing to encounter a new way of thinking and imaging in discovering what can be.” (Ainsworth-Land, 1982, p.15) If we include her suggestions about the fourth-order of imaging: “[...] one is losing a former perception of reality and creating a new paradigm.” (Ainsworth-Land,

[84] “These orders are not tied to specific periods of a child or adult development; rather, they potentially operate at all stages of life, as apporpriate to the creative activity in hand.” (Bailes/Bishop, 2012, p.58)

Order	Imaging	Creative Process
First	spontaneous, concrete, direct representation, realistic	spontaneous, perceiving, exploring, acting
Second	comfortable, predictable, awareness of ability to manipulate and control, analogical, comperative	catagorizing, comparing, analyzing, evaluating
Third	abstract, symbolic, super-imposing, metaphorical, controlled and spontaneous	abstracting, synthesizing, combining, metaphorical thinking, intuiting
Fourth	renunciation of control, chaotic, psychodelic, illuminating, receptivity to unconscious material	disintegrating, surrendering, accepting, opening, building new perceptual order

Fig. 2.15 Developmental Integration of Creativity and Imaging (after Ainsworth-Land, 1982, p.12)

1982, p.17), it seems that both processes of imagination correspond quite well to SCHAEFFER/CHION's as well as TUURI/EEROLA's proposed modes of *reduced listening* discussed earlier (see 2.4.2 on page 145; 2.4.2 on page 149). Because the mental "[. . .] act of removing all our habitual references in listening is a willed and artificial act which allows us to clarify many phenomena implicit in our perception." (Dack/North, 2009, p.31) Such a *reflective listening* perspective (see Tuuri/Eerola, 2012), or thinking about the listened sounds, can be based on imagery and imagination processes as well, and, by that, give indications for PETERSON's (2006) suggestions that creative processes while listening to music 'drawing a parallel with the creative processes involved in composition'.

In an extension based on AINSWORTH-LAND's (1982) framework, BAILES and BISHOP (2012) try to systematisize imaging processes while composing music, by describing "[. . .] various uses of musical imagery in composition, [but] skipping the first order [see Figure 2.15] since this signifies the most basic representation of sensory information." (Bailes/Bishop, 2012, p.59)

Second-Order Imaging

In this step of musical imagery, the creative process is "[...] goal-directed and involves a conscious manipulation of given material. [...] 'it is the intent – improving, strenghtening, extending, modifying [...]. Generating and mentally rehearsing a personal interpretation in music performance is an obvious example of second-order imaging." (Bailes/Bishop, 2012, p.59) These authors further suppose that second-order imaging supports various compositional strategies, such as 'holding a conscious musical image at moments of decision making.'

Third-Order Imaging

> "Third-order creativity necessitates a renunciation of familiar patterns, and a susceptibility to thinking and imaging in a new way. As in second-order imaging, the process of creation is intentional and goal directed, yet it is combined with the ability to spontaneously 'receive' unconscious material. [As AINSWORTH-LAND (1982), p.22 already mentioned, BAILES and BISHOP (2012) also propose that] third-order creativity and imaging require a change of perception. One needs to look through and into ideas, objects, functions, in order to break up one's perceptual set' and 'push against the limits of normal perception." (Bailes/Bishop, 2012, p.60)

Fourth-Order Imaging

> "Fourth-order imaging is characterized by spontaneity, and in that sense shares properties with first-order imagery. Where it differs is in the level of creativity represented, with fourth-order imaging akin to what is often dubbed 'inspiration'. [...] One of the myths is that inspiration takes the form of a complete and pure auditory image, to be translated in a sequential manner from the mind to paper. In reality, Mountain's [(Moutain, 2001)] evidence suggests that composers are more likely to have been mentally working on music for a while, perhaps progressing through lower orders of the Stage Development Model [see Figure 2.15], modifying and developing in image rather than transcribing one in virgin form." (Bailes/Bishop, 2012, p.61)

Although both authors repeatedly highlight conscious processes while imaging music in their proposal, they also define that "[...] the conscious experience of the qualia of music [...] is inevitably underpinned by unconscious processes (Finke, 1996)." (Bailes/Bishop, 2012, p.61) This observation is plausible and furthermore a recognized perspective in the scientific world. For example, as discussed earlier (see 2.4.1 on page 141), concerning the functionality of memory, SNYDER (2000) suggests that only long-term memory structures, which are activated at the highest level – by current perception and by previously activated memory – are 'in the focus of conscious awareness'. As schematically seen in Figure 2.16, one can see how much activated memory structures are unconscious, in relation to the small 'focus of conscious awareness'.

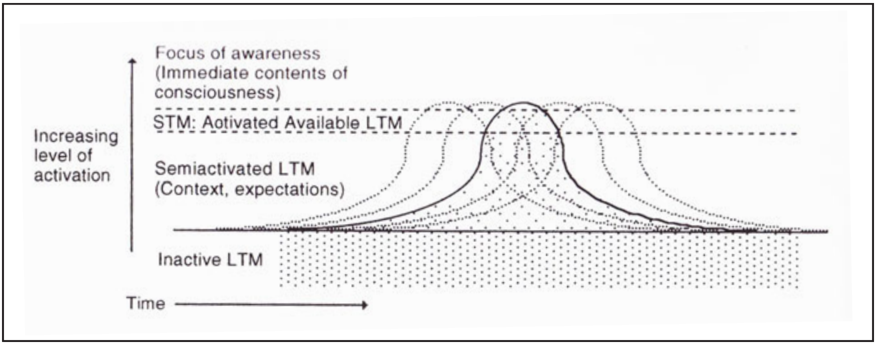


Fig. 2.16 "Levels of neural activation (after Fuster,1995). This diagram represents successive states of mind as waves of neural activation, with each successive wave involving different groups of neurons and lasting about 100msec. Degrees of unconsciousness are indicated by the density of the dot screen." (Snyder, 2000, p.52)

This physiological fact furthermore clarifies why so many theories about the creative process (e.g. Wallas, 1926; Mednick/Mednick/Mednick, 1964; Bowers et al., 1990; Campbell, 1960; Gruber, 1988; Weisberg, 1986; Schilling, 2005; Webster, 2002) highlight unconscious thinking or unconscious processing of information, which, in the case of music, can be the basis for conscious imagery and imagination processes. For instance, in the continuation of a decrease of unconscious processing after a certain period of conscious thinking (see Figure 2.16), STOCKHAUSEN reported about a continued unconscious processing over night, leading, the next morning, to a compositional *insight* (aha moment):

> "I remember that very often when I'd worked until at night, I gave up; the brain continued working on the problem during my sleep, and I knew the solution next morning." (Stockhausen, cited by Cott, 1974, p.52)

Concerning the repartition between activated conscious and unconscious memory (see Figure 2.16), and the above discussed abilities of experienced composer to imagine longer passages of music, one can get an idea of the enormous activated unconscious content or processing involved during the creative act of composing music. This means, for example, that implicit (and explicit) learned Western music tradition, including pitch systems, rhythms, genres, etc., and formal concepts, build the unconscious thinking fundament, from which properties, relations, etc., can appear in consciousness. In this, depending on the individual memory capacities, composers use musical imagery and imagination processes in order to extend, modify, combine, transform, destroy or reintegrate them in a novel way (see above Ainsworth-Land, 1982; Bailes/Bishop, 2012).

Finally, there are also good reasons to assume that composers use the learned possibility of divergent meaning-creation while listening to (the same) music, when they compose music (keyword: Ways of listening (see in this regard 2.4.2 on page 144)). This perspective is supported by WEBSTER's (2002) model, which proposes that listening to music and composing music are similar in their creative processes (see 2.2 on page 112; 2.4.3 on page 154).

In conclusion, as discussed from various perspectives, there are different indications that imagery and imagination are supporting processes in composers while doing their work, and that they vary in different degrees of complexity. Indeed, composers use these memory capacities not only for 'keeping in the mind for decision making', but also while extending, modifying, transforming, etc., their imagined ideas, and, by that, for their mental hearing while or after they imagine new music. Processes of imagery and imagination thus seem to constitute, together, unconsciously and consciously active explorations of latent possible divergent musical structures while composing (and listening to music, see 2.4.4 on page 160).

2.5.2 Composing Music – A Creative Problem-Solving Perspective

Based on the previous subsection, in which we discussed supporting processes of imagery and imagination while composing music, this section tries to extend this perspective, in such a way that compositional activities are considered as processes working in a tension field between problem-finding and problem-solving (see in this regard Mumford et al., 1993; Schraw/Dunkle/Bendixen, 1995). Such an approach can be suitable because, first, it corresponds quite well to statements of great composers about their compositional activities.

LUDWID VAN BEETHOVEN once wrote:

> "I carry my thoughts before writing them down [...] I change many things, discard others, and try again until I am satisfied; then in my head, I begin to elaborate the work in its breadth, its narrowness, its height, its depth [...]." (Beethoven, cited in Sloboda, 1985, p.107)

Similarly, the English composer MICHAEL TIPPETT noticed:

> "Like every artist, my days are spent pondering, considering, wrestling in my mind with an infinite permutation of possibilities." (Tippett, 1974, p.148)

Second, it can be very useful to see the process of composing music as creation, exploration and solution of self-imposed 'ill- and well-defined' problems[85]. Indeed, by that, it is possible to embed various concepts into the compositional processes, such as the role of personality (see 2.1.3 on page 96), motivation (see 2.1.3 on page 99), and emotion (see 2.1.3 on page 102), the fundamental openness to all possible solutions leading to the creative product, extra and intra-musical influences, and, not least, the attempts to model compositional processes from the more or less initial 'germinal idea' (see Bennett, 1976) to the final product.

2.5.2.1 Between Ill-defined Problems and Well-structured Solutions

As discussed earlier (see 2.1.3 on page 96), creative personalities tend to conceive ambiguous situations as desirable (Budner, 1962). Moreover, tolerance to ambiguity seems to be a natural prerequisite for creativity, because it shows "[...] a flexible cognitive style when approaching problems, that is, being able to "think outside the box" and not being tied to any one perspective (functional fixedness). Openness and flexibility in turn are related to having the imagination to think of how things could be, no just how they are." (Feist, 1998, p.300)

Creative processes, imagining how things could be, not just how they are, can be considered as a general ability of everyone. For example, to plan one's daily routine requires consideration of what is to be done today, what are the time constraints, what things have to be carried out in each period of time, or, in times between activities, etc. The work-process of a composer can be characterized in a similar manner: that solutions must be found to technical and aesthetical problems through their embodiment with a specific sound medium, "[...] as engagement in a dialogue between concept and material." (Burnhard/Younker, 2004, p.60) However, opposed to relatively well-defined problems and solutions to satisfactorily structure one's day's schedule, COLLINS (2011) rather specifies a composition process as a problem complex, which differs from simple cases in the sense that:

> "1. it is concerned with the making of an end product, rather than with a conceptual problem and its single point of origin
>
> 2. it is additive in nature – there are ever-emerging and proliferating points of origin
>
> 3. the problem is ill-defined, and is open to modification by the composer over time." (Collins/Dunn, 2011, p.51)

To define the composition of music as an ongoing process with ill-defined problems seems to be a plausible conception, because, although a well-structured com-

[85] Problem here is defined as "[...] a desirable situation [within] one strives to find or create [rather than] an undesired situation, difficulty, or obstacle that one wishes to avoid or mitigate [...]." (Jay/Perkins, 1997, p.259)

position will eventually be brought to existence, this well-structured composition is certainly not an intended solution structured from a well-defined starting point. On the contrary, composing music (as well as listening to music, see 2.4.3 on page 157; 2.4.2 on page 144) can be defined as processes structuring stimuli and data within ill-defined problem 'spaces'. For example, when composers start to prepare their compositions, they discover an ill-defined problem space in which, for instance, proper instruments should be used (e.g. classical, electronic, or mixed). Depending on their own experience, there may be good reasons and counter-arguments for every possible decision, and, after a solution is adopted, they can discover a next ill-defined problem. Such is the long process towards a finished composition...

If one considers processes structuring the question of instrumentation and its possible solutions, then it is obvious that such processes must operate with some kind of previously learned knowledge in relation to the current focus or intention. Learned knowledge includes various forms[86], such as procedural knowledge, which can generate hypotheses about possible implications of solutions. For example, if a composer opts for composing for classical instruments, he then knows that he needs instrumentalists, printed scores and parts, and that his target audience will probably have a different aesthetic preference than electronic music lovers.

Problem-solving processes within ill-defined domains were also extensively investigated in the cognitive sciences (e.g. Gettys/Fischer, 1979; Gettys et al., 1987; Meehle, 1982; Finke/Ward/Smith, 1999)[87], and "[...] results obtained in this research suggest that a recursive memory search is used to generate hypotheses that might account for, or structure, the available stimulus information. Subsequently, the degree to which these hypotheses are consistent with available data is used to test the adequacy of the problem construction. [...] these hypotheses, and the derivative hypothesis testing, suggest that problem construction provide a plan or framework for solution generation and implementation." (Mumford/Reiter-Palmon/Redmond, 1994, p.11) In this way, GICK and HOLYOAK (1980); (1983) and HOLYOAK (1984) discovered "[...] that individuals construct mental models, or an integrated set of hypotheses, that allow to structure ill-defined, novel problems, and subsequently generate viable problem solutions. In their initial research, Gick and Holyoak (1980, 1983) found that prior exposure to a problem could be used by individuals to abstract key features of the problem solution. The solution to this initial problem could then be applied to new, novel problems." (Mumford/Reiter-Palmon/Redmond, 1994, p.10) In relation to the instrument-choosing problem mentioned above, this suggests that knowledge about composing a piece for classical instruments can carry ready abstracted 'key features', e.g. composing for instrumentalists, preparing scores, etc. These 'key features' can further initiate

[86] For a good overview in this topic see (Anderson, 2009).

[87] See in this regard 'Geneplore Model' 2.4.3 on page 157.

problem defining, for example: are there enough musicians for a premiere involving these instruments? If this seems difficult to realize, the classical-instrument hypothesis will probably be discarded or modified. At this point, it will be obvious that evaluative skills and knowledge are at least as important — because they seem necessary to compose well-structured solutions – towards an assumed aspiration of professional composers to produce H-musical-creativity (see 2.3.3 on page 136). In this context, RUNCO and CHAND specify:

> "There are, for example, metacognitive assessments of problems, and evaluations of specific ideas and solutions. This is also a distinction between evaluative and valuative processes, and surprising differences between intrapersonal and interpersonal evaluations." (Runco/Chand, 1994, p.42)

Furthermore, by the example sketched above of choosing instruments for a current composition, it seems to be unrealistic that creative processes occur and progress homogeneously, as suggested by WALLAS (1926) and WEBSTER (2002)[88]. On the contrary, compositional activities can be characterized as parallel, recursive, and nested interactions. For instance *preparation* (see 2.1.1 on page 88) includes *problem finding* (see above; 2.1.1 on page 87) which again includes *verification* or *evaluation* (2.4.3 on page 154; see above), and interacts with *solution generation* and *divergent thinking* (see above).

However, a question remains: What is the driving force acting in composers and resulting in their extensive structuring of ill-defined problems, their ongoing search for possible solutions, their rejection of tentativeness followed by renewed work on the same problem?

Although various arguments exist for this ongoing drive towards creating well-structured compositions, it is possible that emotions[89] constitute a primordial driving.

For instance, WAKEFIELD writes:

> "Traditional accounts suggest that problem finding begins with *feeling*[[90]]. The expressions "sensing gaps," "dissatisfaction with the status quo," or "frustration or irritation that something doesn't work as it might" are commonly used to describe problem finding." (Wakefield, 1994, p.99)

This suggests that the motivation of composers to work starts from an experienced or sensed tension which initiates creative problem-solving processes. Moreover, based on the previously discussed effects of emotions on creativity in general (see 2.1.3 on page 102), we can now assume the existence of different affective

[88] See in this regard 2.2 on page 112; 2.4.3 on page 154.

[89] For a detailed information about emotions and creativity see 2.1.3 on page 102.

[90] Feeling is a less precise term, because there are affective and non-affective feelings – affective feelings include not only emotions but also moods (see in this regard 2.1.3 on page 102).

processes while composing music, and their support for certain cognitive processing.

As WAKEFIELD, various other researchers (e.g. McCrae/Costa, 1987; Isen, 1993; Isen et al., 1985; Mitchell/Madigan, 1984; Jamison, 1993; Mumford, 2003; Rothenberg, 1990; Weisberg, 1986; Ludwig, 1995) have also studied the contribution of affect to creative processes. Concerning *problem finding,* there are indications that a negative (mildly depressed) mood or affect state increases the creative output in the *problem finding* process, because "[. . .] people in a negative mood tend to be more adept in critical and analytical thinking (cf. Melton, 1995)." (Kaufmann/Vosburg, 1997, p.152) This means that, if composers find and define an instrumentation problem (see above), a negative (mildly depressed) mood or affect state can foster the search for problem-relevant information and bring to the mind more realistic possible implications of previously generated hypotheses. AMABILE also describes such an effect in problem solving, because "[. . .] when people are experiencing negative affect, are aware of that affective state, and are in a situation that clearly calls for creativity, they will interpret their negative mood as an indication that they must try harder to find a creative solution." (AMABILE et al., 2005, PP.370-371) Besides effects of negative (mildly depressed) mood or affect states to solve problems, there are also various indications for effects of positive mood or affect states for creative problem-solving.

At first glance, it may be paradoxical, why should both, contradictory mood or affect states, be conducive to problem solving. One possible explanation could be that different conditions motivate composers to solve problems creatively. According to COLLINS and AMABILE, if the current activity directed "[. . .] primarily for its own sake, because the individual perceives the activity as interesting, involving satisfying, or personally challenging [. . .]." (Collins/Amabile, 1999, p.299), positive mood or affect states increase the probability that a composer's hypotheses about possible solutions can possess a high potential of ideational fluency, combinational thinking, divergent thinking, and transformational processes of existing knowledge into new patterns of configurations (see Schuldberg, 1990; Schuldberg, 1999; Shapiro/Weisberg, 1999; Shapiro/Weisberg/Alloy, 2000; Russ, 1993; Greene/Noice, 1988; Abele, 1992). In contrast, when motivational conditions for the current activity are "[. . .] primarily in order to meet some goal external to the work itself [which] is marked by a focus on external reward, external recognition, and external direction of one's work [. . .]." (Collins/Amabile, 1999, p.300), the probability seems to be high that the composer feels a tension and dissatisfaction with his current work in relation to extrinsic constraints, from which more systematic and analytical thinking about his work is provoked, as a kind of critical *evaluation* (see above).

In conclusion, we can suppose that composing music, as an activity originating from ill-defined problems, needs different mood or affect states in relation to parallel, recursive, and nested interactions of cognitive processing for well-structured creative solutions. This suggests again that problems and solutions are created in dependence to different perspectives and constraints, driven from different moods or affect states. A general indication for a relation between changing mood or affect states and creativity can be seen, not only by the fact that various famous artists, such as ERNEST HEMMINGWAY, ROBERT SCHUHMAN, HUGO WOLF, VINCENT VAN GOGH, EDVARD MUNCH had bipolar-disorders (manic depressive illness), but also by means of systematic investigations (Ludwig, 1995; Andreason, 1987; Jamison, 1993; Post, 1996; Feist, 1999b) which found relationships between creative individuals and variations of affective disorder (see in this regard 2.1.3 on page 109).

Concerning different mood or affect states while composing music, it seems likely that *problem finding* and *verification* or *evaluation* processes have a greater potential to produce creative output if, first, the composer is also focussed on extrinsic criteria in relation to his work; and, second, if he is more in a negative (mildly depressed) mood or affect state. There are also indications for the perspective that *solution generation* and *divergent thinking* works better in a more opposite mood or affect state. Because *solution generation* and *divergent thinking* processes are less related to extrinsic criteria than *finding* or *verification* or *evaluation*, and, by that, they can probably direct the attention to particular attributes (e.g. rhythm or dynamics), through which dealing with a certain aspect becomes possible. Such a detailed playfulness, related to musical activities, can already be observed while children discover their musical environment. It likely constitutes a driving force for an ongoing engagement in all other musical activities. At least, GARDNER (1993b) presents indications for such a perspective, because he concludes that famous personalities, such as EINSTEIN, PICASSO, or STRAWINSKY possessed traits of playfulness.

2.5.2.2 Influences while Composing of Music

In the last subsection we discussed arguments for the perspective that composing music can be conceptualized as efforts to solve more or less self-imposed problems[91]. By extension, we found indications that emotions are a driving force for creative problem-solving processes.

[91] Problem here is defined more as "[. . .] a desirable situation [within] one strives to find or create [than] an undesired situation, difficulty, or obstacle that one wishes to avoid or mitigate [. . .]." (Jay/Perkins, 1997, p.259)

This gives rise to the question: Besides the force of emotions[92], what influences can be relevant to drive inspirations of composers to find interesting problems, structure them, evaluate possible compositional solutions, etc.?

First and foremost, the famous composer WOLFGANG RIHM states: A composer is almost all the time inspired; the problem is to make the right choice.[93] This statement is remarkable, because it suggests, first: that inspiration does not fall from nowhere, but mostly occurs in relation to stimuli and pre-existing knowledge; second, that activities 'to make the right choice' point on interpretation processes in relation to a variant context, as a kind of transformation[94] for certain compositional activities. A good example for such transformation processes, but in a reversed direction, can be seen in the design influences for the *Phillips Pavillion*[95]. As shown in Figure 2.17, IANNIS XENAKIS notated glissandi graphically in his composition *Metastaseis* (1952/1953), in such a way that the resulting sound space corresponded to ruled surfaces (mathematic hyperbolic paraboloids). This same concept, he also used in the design of the architecture of the *Phillips Pavillion.*

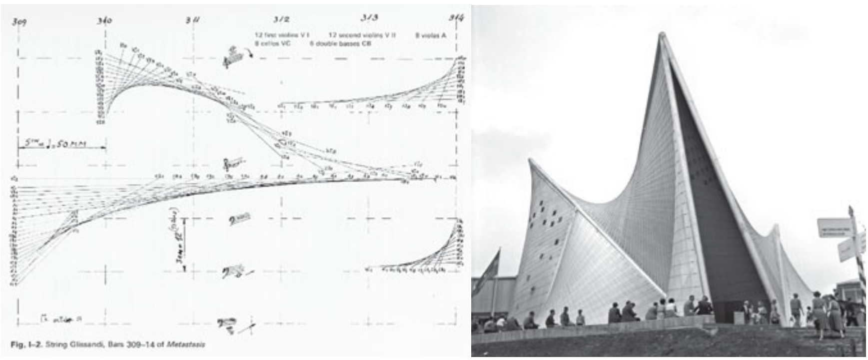


Fig. 2.17 Score of 'Metastaseis' (source: Xenakis Archives, Paris) and 'Phillips Pavillion' (source: Wikipedia)

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[92] To define emotion as an inspiring influence, means that mood or affect states are conducive for compositional processes.

[93] This statement answered a question about his sources of inspiration (International musicological symposium: 'Klangbeschreibung' (at 3th May 2012, University of Music, Karlsruhe)).

[94] See in this regard 'Geneplore model' (see 2.4.3 on page 158), and AINSWOTH-LAND (1982) third order, of the general model of creativity and imagination she proposes (see 2.5.1 on page 164).

[95] The Philips Pavilion designed for Expo 1958 in Brussels, by the office of LE CORBUSIER (Charles-Édouard Jeanneret-Gris). But much of the project management was assigned to IANNIS XENAKIS.

In relation to RIHM'S understanding of inspiration in the above quotation, such processes portray a very special perspective (not only) of composers on, or into the world, through which musical and non-musical environmental stimuli, and preexisting knowledge, are interpreted for or into aspects of their current work.

Furthermore, RIHM's problem of 'idea-selection' among his multiple inspiration[96] illustrates a persistent uncertainty or doubt about 'the right choice', whether the selection from a potentially large number of possibilities, is adequate for the current compositional target, in relation to environmental constraints. As suggested in the previous section (see 2.5.2.1 on page 169), doubt or uncertainty is probably an accompanying factor within compositional problem-finding and evaluation processes.

However,

> "Later - retrospectively - it mostly looks different; during the composition process, chance or accident may have never led to new musical structures, but if ever they did, then it would only have happened as an intended accident."(translated from Rihm, 1997, p.100)

Although, RIHM's statement is formulated as a critique against the often proposed conception of a composer, as a pioneer, or scientist, who has precisely located influences of the compositional process, he also highlights one of the most important inspirational influences for compositional processes, conceptualized as chance or accident. In relation to inspiration, STRAWINSKY once said:

> "One does not contrive an accident: one observes it to draw inspiration therefrom. An accident is perhaps the only thing that really inspires us." (Stravinsky, 1947, p.55)

If one combines both statements with the previous explanations, a chance or an accident while composing activities seems to be a sudden discovery of a new perspective, significantly based on associative processes (see 2.4.1 on page 142) which can structure a new mental model or problem-space (see 2.5.2.1 on page 169), caused by current stimuli in relation to pre-existing knowledge. A compositional activity which provokes such a chance or an accident is, for example, improvisation on an instrument. In this way, JOSEPH HAYDN often improvised at the piano until he found a promising musical idea (Dies, 1810). His musical thoughts, such as sounds, harmonies, and rhythms were probably enriched through associations from moment to moment, in relation to his current compositional target.

Opposed to the influence of chance or accident as a psychological factor for compositional processes, JOHN CAGE put chance or accident as a compositional principle[97] largly independently from the composer's current 'problem-

[96] Idea-selection in relation to a wide range of possibilities, STRAWINSKY felt: "The more constraints one imposes, the more one frees one's self of the chains that shackle the spirit." (Stravinsky, 1947, p.65)

[97] Key works are for example: 'Music of Changes' (1951), and 'Imagery Landscapes No.4' (1951).

construction and problem-finding', 'idea-generation', 'evaluation', and by that, from his musical taste as well as processes of designing or constructing a musical piece[98]. Because after CAGE's conception in the 1950's, the music should not be composed (only) by a composer, but by processing different chance or accident operations[99].

At this point a possible connection to another domain of influences on composing processes arises. Because, although CAGE proposes that the composition of musical works can happen without a psychological 'choice' (see RIHM's explanations above) generated from composer's inspiration, his conception of music was significantly inspired from influences from outside the musical domain. First of all, CAGE was a boarder crosser between philosophy, visual arts, literature, music, dance-performance, etc. and, by that, found influences from far beyond the musical domain. For example, CAGE had a special relationship to the visual arts, and drew inspiration from these. This can be seen in his behavior after buying the oil painting *Mediation* of the expressionist ALEXEJ VON JEWLENSKY in 1936. Being so inspired he wrote to VON JAWELENSKY: 'Now it is in me. I write music. You are my teacher'. In relation to his conception of music (see above), CAGE was strongly inspired by MARCEL DUCHAMP's artistic games of chance or accident with everyday objects (see Herzogenrath/Nierhoff-Wielk, 2012). In this context, he wrote:

> "I've always admired his [MARCEL DUCHAMP] work, and then when i was busy with chance or accident actions, i realized, that he had already dealt with it, not only in [visual] art, but also in music, and fifty years before me." ((translated from) Cage, cited by Zimmermann, 1993, p.360)

Besides such individual influences on composers, we can suppose that a significant part of the composing processes were/are inspired by influences outside the musical domain, such as from an inspiring conceptual program (e.g. philosophy, poetry, painting, nature, history). This is particularly evident in the case of *Programme Music*[100], and in various examples from different musical epochs, such as for VIVALDI's '*Vier Jahreszeiten*', MOZART's '*Ein musikalischer Spaß*', BERLIOZ' '*Symphonie Fantastique*', the *Symphonic Poems* of LISZT and STRAUSS.

A third main influence on composing processes can be seen in the power of musical ideas themselves (see Katz/Gardner, 2012). For example, the initial *germinal*

[98] However, CAGE construed constraints, factors, and processes for his compositions. This presupposes a finished problem-solving process, focused on a concept which should be significantly noticeable when music is heard.

[99] For detailed information about CAGE's work and philosophical premises (see Metzger/Riehn, 1990).

[100] After *The New Growe*, the definition of *Programme Music* is: "Music of a narrative or descriptive kind; the term if often extended to all music that represent extra-musical concepts without resort to sung words." (Scuton, 2001, p.396)

idea[101] (see 2.5.2.3 on page 181) can be relevant for composers' inspirations to find interesting problems, structure them, generate possible compositional solutions, etc., because this mental model[102]can constrain all composing processes followed afterwards, such as RIHM's initial musical idea of *Dis-Kontur* (1974/1984)[103]. In addition to the musical ideas that influence compositions at their beginnings, musical ideas in general can be conceived as single 'inspiration units', by which different sound meanings (see in this regard 2.4.2 on page 149) with associated long-term structures (see 2.4.1 on page 141) can be activated, explored, and interesting problems can probably be found in relation to a current compositional focus.

In this context, STRAUSS once wrote:

> "It has been my own experience in creative activity that a motive or a two to four measure melodic phrase occurs to me suddenly. I put it down on paper and immediately extend it to an eight, sixteen, or thirty-two bar phrase, which naturally does not remain unaltered, but after a shorter or longer 'maturing' is gradually worked out in definitive form." (Strauss, cited by Sloboda, 1985, p.115)

Similarly, BOULEZ states:

> "For me, a musical idea is like a seed: you plant it in a particular earth and suddenly it multiplies like weeds. Then you have to weed." (translated from Boulez, 1976, p.15)

As shown in Figure 2.18, a good example of such a growing musical idea, based on expertise or knowledge in the musical domain, can be seen in SCHOENBERG's compositional working out of a melodic formulation of the main theme of his *String Quartett op.7* (1907). As shown by documents of *Schoenberg's collected edition* (1986), S142 is the earliest conception of the main theme. The later S1 is also an outline of the main theme, but it was developed and enhanced by repetitions and variation of stressed notes.

S144 displayed further melodic formulations, and SCHOENBERG's structural extension concerning the musical accompaniment of the first bars. And subsequently, S2 extended the melodic material of S1 from bar 1-2,1/2 to bar 1-4. In addition, derived from bar 2 (S1), SCHOENBERG composes a further rising figure (bar 7), and as in S1, the theme ends with the target tone f", but after an extended chromatical play around b" - a" - gis" - g".

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[101] BENNETT (1976) describes in his study concerning classical composers that the inital *germinal idea*, "[...] variously termed the "germ," the "kernel," the "inspiration," or the "idea." [...] may take a variety of forms – a melodic theme, a rhythm, a chord progression, a texture, a "kind of sound," or a total picture of the work. [And] the germinal idea is a really potent one, [because] the author has found that it is seldom forgotten." (Bennett, 1976, pp.7-8)

[102] As discussed in the last subsection (see 2.5.2.1 on page 169), a 'current mental models, or, an integrated set of hypotheses allows to structure ill-defined, novel problems, and subsequently can generate viable problem solutions.' This definition corresponds quite well to the concept of *germinal idea*, or, in the meaning of Rihm, to make the 'right choice' (see above).

[103] For detailed information see his explanations (Rihm, 1997, p.86).

Fig. 2.18 Stages of melody formulation concerning the main theme of SCHOENBERG's *Steichquartett op.7* (source: Schoenberg's collected edition (1986).

In relation to the above metaphor of a musical idea as a seed which grows up, maybe S1 can be defined as such a seed, because it already contains the entire material of the main theme of *String Quartett op. 7* later developed (Stephan, 1986). This can be seen as a further indication for my proposal that musical ideas can be conceived as important influences for creative problem-solving processes. Because, after the development of a musical idea, a definition has occurred, of what is, and what is not part of the current musical mental model. This again influences all subsequently compositional activities in the current musical piece, because it constrains the possibilities of making 'a choice' (see RIHMS explanations above). For example, SCHOENBERG's later works are composed on the constraints of a twelve-tone row.[104]

Hence, SCHOENBERG's initial 'choice' of a new appropriate row, subsequently influences all findings, generations, and elaborations of various musical ideas for the current musical piece.

A further interesting aspect related to the metaphor of a musical idea as a seed is visible, if one conceives 'a particular earth' (see BOULEZ above) as an environmental context. Because, the most famous composers, such as SCHOENBERG, WEBERN, STRAWINSKY, BEETHOVEN used sketchbooks, loose letters, etc. to notate (not only) their spontanous musical ideas. For example, it was found that STRAWINSKY wrote down ideas for his *Sacre du Printemps* on a telegram form and a restaurant bill. Both cases suggest a spontaneous inspiration far away from a 'usual' working environment (see Scherliess, 1993).

On the subject of a musical idea in relation to different compositional contexts, BEETHOVEN commented in his sketchbooks that he often worked on different compositions simultaneously, from which one can suppose that certain musical ideas or aspects of one composition influenced compositional activities of the other (see Nottebohm, 1979). This can also be assumed for influences on the above discussed *Steichquartett op.7*. Because, based on the assumption of chronological sequence of notations in SCHOENBERG's *Sketchbook I* (Stephan, 1986), it was found that the first outlines of *op.7* were notated between outlines to *Sechs Orchesterlieder op.8,2* and *op.8,4*.

In conclusion, this subsection has tried to outline conducive influences for compositional activities conceived as creative problem-solving processes. Particularly conducive seems to be chance or accident (also provoked), which arise during composition activities, because they hold the potential to change current musical mental models, and, by that, new interesting problems or perspectives can be defined, explored, etc. It can be further assumed that nearly all composers are inspired by influences from outside the musical domain, which can induce a general philosophy of compositional activities, as CAGE proposed (see above), but mostly trigger transformation processes which, for example, can support the structuring of a single musical idea.

Finally, musical ideas themselves, such as a rousing 'germinal idea' leading to the motivation to start a new piece, as well as every musical idea which is relevant for further problem-solving process, can influence those compositional processes by its extraordinary structure. This means that a musical idea defines or constrains

[104] SCHOENBERG defines a twelve-tone-row as a basic set, which "[...] functions in the manner of a motive. The explains why such a basic set has to be invented anew for every piece. It has to be the first creative thought." (Schoenberg, cited by Schmidt, 1993, p.249)

composer's current musical mental model, based on which ideas are further elaborated, and, by that, aids the composition's 'growth'. This can be seen in vivid manner in the development of the main theme of *Steichquartett op.7* discussed above. Because the initial chromatical setting of d' - cis' - d' as well as the rising figure f' - e' - b' - d' seem to have influenced (and constrained) SCHOENBERG's further processes in the composition of the main theme.

2.5.2.3 Models describing Creative Problem-Solving in Terms of Composing Music

After discussing arguments, supporting that creative problem-finding and solving can be characterized as an integral aspect of musical composition (see 2.5.2.1 on page 169; 2.5.2.2 on page 173), this subsection extends this perspective in the manner that we will present and discuss three different proposals about composing processes, in the light of creative problem-solving. Each model was designed based on individual assumptions, data processing, and describing particular issues. Therefore, each model highlights different aspects. But, in relation to one another, this section offers the opportunity to sketch an extended picture about musical composition conceptualized as creative problem-solving processes.

Bennett's Stage Model of Musical Composition

Based on the intention to reexamine and reinterpret BAHLE's (1934); (1935); (1936); (1939) and GRAF's (1947) suggestions about creative processes in the case of (composing) music, BENNETT (1976) interviewed eight professional composers of classical music[105] residing in the Washington D. C. area about, among others, their strategies and conditions while creating music. For example, they should describe in detail the process by which they compose music; the conditions under which they had composed their last piece; the physical conditions facilitating the compositional process; and, if there were particular emotional states which motivated them to compose.[106] After interpretation of the collected data, BENNETT has come to the conclusion that all "[...] composers included in this study seem to proceed through somewhat similar steps [see Figure 2.19] in creating music." (BENNETT, 1976, P.6)

[105] "The music written by these eight composers is not what would presently be labeled as avant-garde, with one or two possible exceptions. [...] One of these composers has begun to combine instrumental and electronic music; another has utilized music and film simultaneously." (BENNETT, 1976, PP.4-5)

[106] For extended information see (BENNETT, 1976, P.5).

He thus suggests that the "[. . .] initial phase involves the crucial step of getting what may be called the *germinal idea*[107]. Once the germinal idea has been found, the composer may simply let it run around in his head for a while. Sometimes the germinal idea is played over and over on some musical instrument, but more frequently it is written down [. . .]." (BENNETT, 1976, P.7) This initial phase results in a sketch after a few minutes, or even after several years. Both, the sketch and its formulation in the first draft, can again initiate new germinal ideas. In the *elaboration and refinement* stage, the first draft "[. . .] is reworked and added to where appropriate. The compositional process usually concludes with the completion of the final draft and copying of the score. [. . .] Following performance of the work, *revisions* are sometimes made." (BENNETT, 1976, P.9)

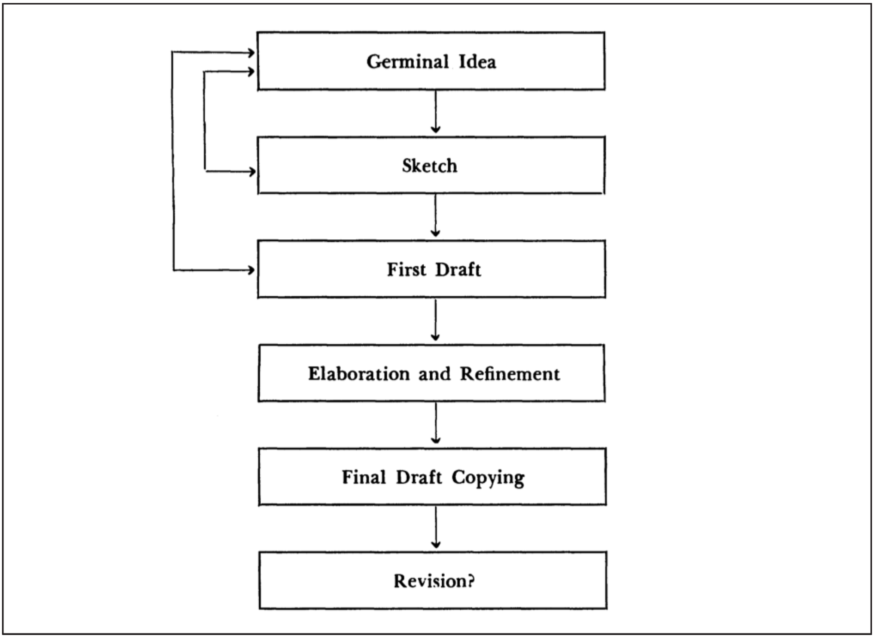

Fig. 2.19 Model of Stages of musical composition (source: Bennett, 1976, p.7)

It seems that the work approaches of the interviewed composers depict some general phases of composition, because BENNETT's model corresponds fairly well to abstract rasters of famous composers' activities, such as BARTOK, STRAWINSKY, and SCHOENBERG (see Danuser/Katzenberger, 1993). Concerning the lat-

[107] See in this regard (see 2.5.2.2 on page 176).

ter composer, SCHMIDT (1993) for example found four prototypical phases of SCHOENBERG's creative process: first, sketches and concepts; second, first record; third, final clean copy; and fourth, printed composition. On the other hand, however, SCHOENBERG often worked out the 'final clean copy' in relation to the 'first record' (see Schmidt, 1993, p.244).

Furthermore, BENNETT's conclusions about motivating emotional states fostering composing activities can be conceived as indications confirming previous suggestions about optimal mood-states for creative-problem solving in musical composition (see 2.5.2.1 on page 171). He writes in this context:

> "A high level of emotional arousal could be utterly disruptive during creation of the first draft, elaboration and refinement, final draft, and revision of the composition. An elevated emotional state may present fewer problems during the germinal idea and sketching stages." (Bennett, 1976, p.10)

This suggests that problems which occur during the conception of the first draft, can be supported by analytical and critical thinking[108], such as a systematical overview about individual ideas in relation to each other, and with regard to the current compositional target. And the generation of initial musical ideas, and their formulated sketches, can be supported by processes of divergent thinking, ideational fluency, combinational thinking[109]. Similarly, we have seen that *problem finding* and *verification* or *evaluation* processes have greater potential to produce creative output if, first, the composer is more focused on extrinsic criteria in relation to his work; and second, he is more in a negative (mildly depressed) mood or affect state. There are also indications for the perspective that *solution generation* and *divergent thinking* works better in a more opposite mood or affect state. Indeed, *solution generation* and *divergent thinking* processes are less related to extrinsic criteria as *finding or verification or evaluation*, and, by that, the composer can probably direct his attention to particular attributes (e.g. rhythm or dynamics), which makes it is possible to deal with a certain aspect of the compositional task.[110]

But, opposed to BENNETT's model, which is partly based on the stage theory of Wallas (1926)[111], it can be supposed that, during the phase of *elaboration and refinement* new 'germinal ideas' can arise, such as from a compositional chance or accident (see 2.5.2.2 on page 175), or, from current influences from outside the musical domain (see 2.5.2.2 on page 176). This means, as already proposed earlier (see 2.5.2.1 on page 171), that creative thinking while composing music

[108] There are indications that negative (slightly depressed) mood or affect states can support analytical thinking and critical thinking (see 2.1.3 on page 109).

[109] There are indications that positive mood or affect states can support divergent thinking, ideational fluency, combinational thinking (see 2.1.3 on page 107).

[110] For detailed information see 2.5.2.1 on page 171; 2.1.3 on page 107.

[111] See in this regard 2.1.1 on page 88.

must be, with great probability no stage-to-stage process, but a complex, of which the defined stages are a simplification for research purposes (see Runco/Chand, 1994).

Sloboda's Proposal of Compositional Resources and Processes

Like BENNETT (1976) (see 2.5.2.3 on page 180), SLOBODA (1985) also hypothesizes a stage model, proposing that composition is more or less a linear process. However, he affirms that his model, schematically seen in Figure 2.20, "[. . .] is not a 'theory' or an 'explanation' of the compositional process, but simply an economical way of describing some of the elements present in composers' accounts of their activities which makes clear the possible relationships between them. A rigorous psychological theory of composition would need to specify the contents of the various boxes and the nature of the transformations operating upon them in some detail." (Sloboda, 1985, p.119)

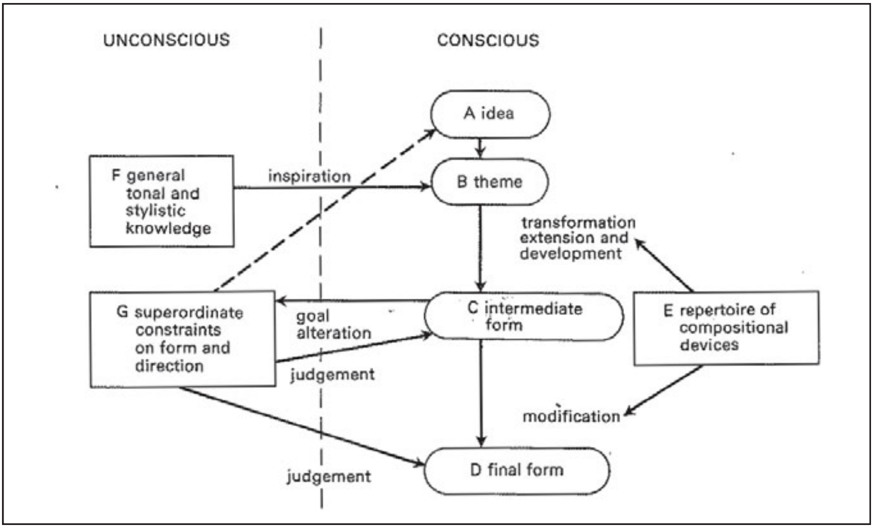

Fig. 2.20 "Diagram of typical compositional resources and processes" (Sloboda, 1985, p.118)

Despite the limitation formulated by the author himself, his proposal presents interesting aspects in relation to BENNETT's model discussed in the previous subsection. But, first and foremost, let us quote SLOBODA's descriptions to Figure 2.20:

> "There appears to be a distinction between those processes on which a composer is able to report fairly easily and those on which he is not. For convenience these have been labelled 'conscious' and 'unconscious'. Square-edged boxes depict knowledge or structures that are stored in long term memory. The curved boxes contain the transitory materials that constitute successive versions of a composition as it grows in the composer's mind. The square boxes represent items of long-term knowledge which a composer has built up over the years, and which can be applied to new compositional problems. The lines joining boxes represent processes which transform or use the contents of the various boxes. Box B represents the thematic kernel that springs 'unbidden' to mind out of the storehouse of thematic knowledge (F). Box A is optionally present in view of the comments (e.g. Sessions 1941)[[112]] that sometimes a more or less specific idea of the *kind* of music required precedes an actual theme in awareness. Box C represents the results of applying compositional techniques of transformation and modification (E) to the original theme. Its contents are then judged against criteria of 'rightness' (G) and, if found wanting, are modified until a satisfactory final form (D) is reached. The path 'goal alternation' acknowledges the fact that discovered properties of intermediate themes can actually overwrite originally held goals [. . .]." (Sloboda, 1985, pp.118-119)

What is striking in SLOBODA's model is its division in unconscious and conscious knowledge and processes[113]. That is to say, in a first stage called 'inspiration'[114], "[. . .] a skeletal idea or theme appears in consciousness." (Sloboda, 1985, pp.116) from the unconscious long-term memory structures of boxes F and G. The second stage which SLOBODA called 'execution' differs in the manner that "[. . .] the musical idea is subject to a series of more conscious and deliberate processes of extension and transformation." (Sloboda, 1985, pp.116)

SLOBODA's notion of unconscious processing, leading to the emergence of an idea or theme, is justified by the argument that "[. . .] if the creative artist has consciously known repertoire for generating things he can do with basic material, but has no such repertoires for generating the first germs on which he exercises his craft." (Sloboda, 1985, pp.116) These suggestions are intersting, because they correspond to aspects of a memory model discussed above (see 2.4.1 on page 141). That is to say, the unconscious "[. . .] context takes the form of expectations, memory of the recent past, and other related knowledge[[115]] that can influence the direction that current consciousness takes, even though it is not itself conscious. [. . .] Some of the information from long-term memory is in the highest state of activa-

[112] "The first stage in the composer's work is ... 'inspiration'. The composer ... 'has an idea' ... consisting of definite musical notes and rhythms which will engender for him the monumentum with which his musical thoughts proceed. The inspiration may come in a flash, or as sometimes happens it may grow and develop gradually. [In the latter case] the inspiration takes the form ... not of a sudden flash of music, but a clearly envisaged impulse towards a certain goal for which the composer was obliged to strive..."(Sessions, cited by Sloboda, 1985, p.115).

[113] He concretized in this context that "[. . .] for different composers, the line dividing conscious from unconscious processes can be drawn in different places." (Sloboda, 1985, p.119)

[114] See fotenote 110.

[115] See in this regard subsection 'Influences while Composing Music' 2.5.2.2 on page 173.

tion, and is said to be "in the focus of conscious awareness" [...] Information in the focus of conscious awareness is *our immediate conscious experience.*" (Snyder, 2000, p.5)

Such an 'immediate conscious experience' in music can entirely be conceived as "[...] a skeletal idea or theme [which] appears in consciousness." (Sloboda, 1985, pp.116), or "[...] the thematic kernel that springs 'unbidden' to mind [...]." (Sloboda, 1985, p.119)

The second stage 'execution' of SLOBODA's model relates compositional processes more to a creative problem-solving perspective, as discussed earlier (see-2.5.2.1 on page 169; 2.5.2.2 on page 173), because: "[...] compositional processes, those over which composers have greatest conscious control, can possibly identified as solution-generators in the theory of *Newell et al* [(1962)]. These are the repertoires of ways of 'turning themes to account' by exploiting and transforming their properties in principled ways. The process of judgement, whereby a particular development is accepted or rejected as achieving compositional goals, can be identified as the verification processes postulated by *Newell et al* [(1962)]. It is here where, arguably, testing of a trail solution against higher-order constraints takes place." (Sloboda, 1985, p.117)

Finally, although SLOBODA's model extends BENNETT's (see 2.5.2.3 on page 180) observation of compositional activities with the important perspective of unconscious and conscious processing, his distinction between purely unconscious and conscious processing can not be confirmed for several reasons: first, as seen in Figure 2.16 (see 2.5.1 on page 167) for every conscious activity, such as transformation, or extension of a musical idea or theme, a relatively higher proportion of unconscious memory structures are activated; second, we have seen that the extension of musical materials can be influenced by associative processes, which suddenly structure a new 'problem space' – associative processes can be triggered as described within the 'inspiration' stage (see above); and, not least, a statement of the famous composer KARLHEINZ STOCKHAUSEN shows that the solution of a particular compositional problem can be found in a kind of unconscious processing, called 'incubation' over night.

> "I remember that very often when I'd worked until at night, I gave up; the brain continued working on the problem during my sleep, and I knew the solution next morning." (Stockhausem, cited by Cott, 1974, p.52)

Burnhard's and Younker's Proposal of Various Composing Pathways

BURNHARD's and YOUNKER's (2002); (2004) proposals of various composing pathways add further aspects to the perspective of creative-problem-solving in the case of composition. Because, by using data (see Figure 2.21) from earlier cross-cultural research (Canada, England, and Australia) (Younker, 2000b; Younker, 2000a; Burnhard, 1999; Burnhard, 2000a; Burnhard, 2000b; Burnhard, 1995), which has examined students' compositions in an educational framework, differences appeared in the ways how students compose. This means that, in addition to previous proposals of composing processes (see 2.5.2.3 on page 180; 2.5.2.3 on page 183), BURNHARD and YOUNKER highlight *different strategies,* defined as plans "[. . .] involving significant decision-making moments for the overall composition. By mapping the range, flow and direction of strategies, as decision-making moments, we could characterize pathways as reflecting particular kinds of sound-sequence occurrences. As mentioned earlier in this paper[[116]], *constraints* are defined as sets of limitations or conditions that guide the process of decision-making (Johnson-Laird, 1988)." (Burnhard/Younker, 2002, p.248)

This means, both authors propose differences of how constraints are perceived and construed, and by that, different ways of how problems are found and solved in musical composition.

Data bank	Location	Participants' age	*n*	Formal tuition	Composition task	Sessions
1	Canada	8–11–14 years	9	Without	Piece with technology	3 × 40 minutes
2	UK	12 years	18	14 with, 4 without	Self-determined	21 × 60 minutes
3	Australia	16 years	11	With	4 varied tasks	40 × 60 minutes
4	Canada	20–21 years	6	Music majors	Piece to given text	3 × 30 minutes

Fig. 2.21 "Overview of data banks" (Burnhard and Younker, 2002, p.249)

To go more into detail, BURNHARD's and YOUNKER's working definition of of creative thinking in music "[. . .] is considered to be a dynamic mental process alternating between divergent (imaginative) and convergent (factual) thinking, moving in stages over time (Guildford, 1967). [Furthermore they] adopted the view that composing, as a time-based process, involves strategies that occur along a pathway that moves through stages in the creative process. The strategies involve musical decision-making moments that may be influenced by self-imposed con-

116 "Creative pathways, whether imposed or self-determined are channeled, limited and governed by constraints. Stravinsky (1947) made clear the role of 'constraints' as an essential aspect of his composing when he said 'my freedom consists in my moving about within the narrow frame that I have designed myself ... the more constraints one imposes, the more one frees one's self of the chains that shackle the spirit' (p. 68). To convey the notion of absolute pre-determinism, we could use the metaphor of a tightrope walker as a continuum of possibilities being anchored to each 'momentary' act of creation. As a metaphor for 'freedom', we might think of a bungee jumper making a leap of faith, a flight of imagination or free-fall release of possibilities." (Burnhard/Younker, 2002, p.245)

straints and freedoms. These stages refer to the creative operations taking place over time, adapted from a model by Wallas (1926) as outlined below[117]:

> 1. Preparation is when the individual thinks about the overall scope, setting, instrumentation of the piece, and prepares, researches and focuses on planning and resourcing issues in readiness to begin with actual musical content details.
>
> 2. Incubation denotes when the individual begins to generate specific musical ideas and content and considers various possibilities. It is during this exploration phase that musical possibilities are found, new ideas, alternatives and options explored. The focus is on brainstorming and divergence of ideas.
>
> 3. Illumination is when material is evaluated, selected, modified chunked and organised into sound structures and sequenced events. The focus is on selection and convergence of ideas.
>
> 4. Verification denotes evaluation of the piece, when notation or recorded play-backs, 'fixing' ideas and 'play-throughs' verify decisions made." (Burnhard/Younker, 2002, p.248)

As seen in Figure 2.22, BURNHARD and YOUNKER (2002) conceptualize the creative process in musical composition as progresses and interactions within and between stages of *preparation*, *incubation*. *illumination*, and *verification.*

Building on this, both authors (Burnhard/Younker, 2004) found six levels of students' creative thinking (see 5 on page 347), from so called 'simplest' to 'most sophisticated' (see Figure 2.22) composing 'realities'. In this way, they define that the quality of the composing strategies "[. . .] and the movement between and across the creative thinking stages, varied. At one end of the continuum we had Rob (an 11-year-old with no formal training) who demonstrated a 'linear' pathway because of the limited shifts between phases. [And at the other end] Angie (a 16-year-old cellist), her composing pathway [see Figure 2.22] was regulated with increased movement across and between all phases." (Burnhard/Younker, 2002, p.257)

This means for example that within the 'linear pathway' of LIA:

> "Her accounts of composing emphasized the revisiting of 'made up pieces' (preparation) that she 'play(ed) different but the same each time'. Lia was partly guided by the 'stuff' of formal learning but spent little or no time away from her instrument thinking about the emerging piece (absence of incubation). She composed four pieces for guitar, working in a preparatory generative phase in which she described herself as 'always starting with some chords' (drawing upon previous experience) and '... then I keep playing around with them and settle on a few ideas'. Once she had recognized the musical starting point (illumination), she continued by shifting to a verification phase where she played 'a quick piece'. She would 'go on and play more or less what I had and add some more bits' (an additive generative approach with little or no verification). There is little detail provided in her talk about detailing a problem or solution, and little interaction between individual elements in the process. When the 'making' phase of a guitar piece was completed she played the whole piece again, whereupon 'some things sound different, some sound the same'. There are no feedback loops across phases and little or no interaction between elements in the process." (Burnhard/Younker, 2004, pp.66-67)

117 See in this regard 2.1.1 on page 88.

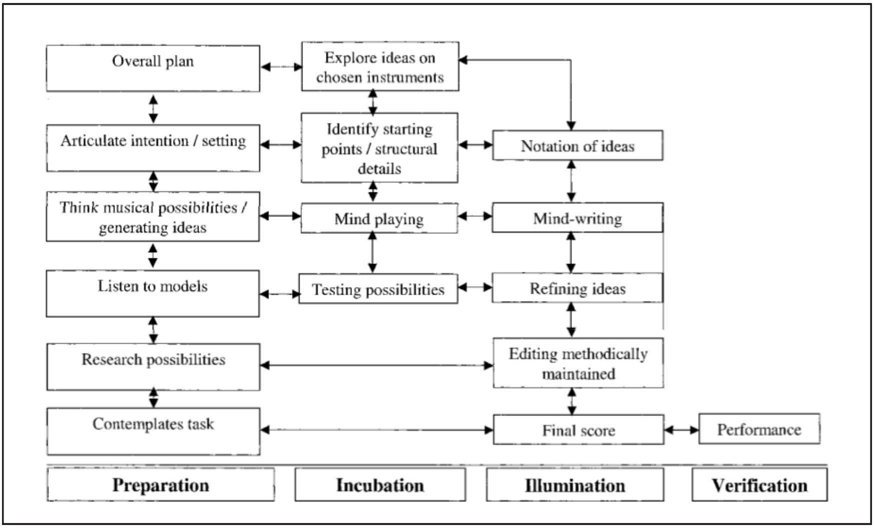

Fig. 2.22 "Mapping composing pathways: regulated strategies exhibited by a 16-year-old cellist." (Burnhard and Younker, 2002, p.256)

On the contrary, ANGIE's 'regulated pathway' (see Figure 2.22) involves "[. . .] a constant interplay between the generative phases of preparation (exploration, activates resources, discovery, clarification of purpose, defining goals), incubation ('mind writing', 'mind-playing', thinking about), illumination (selection/rejection, aural testing and experiment) and verification (evaluation, adjusting, refining) processes. Importantly, the physicality of sound was less emphasized as a tool for realizing ideas as thinking in sound. For Angie, her creative process was at its strongest as a regulated interplay between the use of a full range of generative and verification processes, and focused on what was essentially a procedure in which she made inductions from experience about 'what will and won't work'; she reflexively tested, recorded, revised and refined evolving drafts of a piece." (Burnhard/ Younker, 2004, p.69)

After BURNHARD's and YOUNKER's explanations about two different composing pathways of students[118], one can suppose that creative problem-solving in musical composition is a kind of competence which develops in dependence on various factors or influences.

For example, a factor for the difference presented above between LIA's and ANGIE's composing pathways can be assumed in their general psychological development (see 1.4.1 on page 60), suspected in the age difference, etc. Probably

[118] For further composing pathways see BURNHARD (2002); (2004), and 5 on page 347.

more important is the difference in their domain-specific knowledge or expertise or experience. Namely: LIA (12 years old) "[...] had played the guitar since the age of six [, and] had guitar tuition for one year [...]. (Burnhard/Younker, 2004, p.66) On the contrary, "[...] Angie [16 years old] was a principal study cellist with seven years of tuition, had one year of voice lessons as her second practical study, three years of piano in her junior years of schooling, and rehearsed regularly with four performing groups." (Burnhard/Younker, 2004, p.69) These facts, related to earlier indications[119] (e.g. Webster, 1979; Hickey, 1997; Priest, 2001), that musical expertise or knowledge or experience is significantly related to creative behaviors in music, suggest that LIA's 'absence of incubation' (see above), and, consequently, a kind of 'absence' of generation and exploration of possible musical ideas is related to her "[...] minimal setting of constraints while decision-making moments." (see Burnhard/Younker, 2002, p.253), partly caused by her limited musical knowledge or expertise or experience, by which musical ideas can be a constraint or structured.

In contrast, ANGIE (see Figure 2.22) extensively worked within the so-called incubation phase, because she processed "[...] 'musical mapping', 'imagining possibilities' from situated problems and 'mind-playing' and 'mind-writing' [as well as] combined the use of imagined sounds[[120]] and carefully notated manuscripts [...]." (Burnhard/Younker, 2004, p.69) Her creative process seems to highly involve an interplay between *problem finding*, *solution generation and divergent thinking*, and *verification and elaboration* phases (see 2.5.2.1 on page 171). This observation furthermore refers to a permanent inclusion of constraints in composing processes. Indeed, we have seen that *problem finding* and *verification and elaboration* are related with some kind of critical, analytical, and systematical thinking, caused by extrinsic and/or self-imposed constraints, which depend on stored knowledge or expertise or experience within (and outside) the musical domain.

Besides LIA's and ANGIE's obvious difference in knowledge or expertise or experience, one can suppose more general factors which probably lead to different composing pathways. For example, by the fact that LIA "'play(ed) different but the same each time' and 'always starting with some chords'", one can draw suppositions about some of her personality traits in general. That is to say, in section 'Creativity in Dependence on Personality, Motivation, and Emotion' (see 2.1.3 on page 96), we have seen that traits, such as openness to experience, are fundamental factors for creative thinking processes[121]. This means for example: "[...] openness is closely related to having a flexible cognitive style when approach-

[119] See 2.3.3 on page 137.

[120] See in this regard the subsection 'The Role of Imagery and Imagination' 2.5.1 on page 162.

[121] In this way, WEBSTER suggests: "[...] what creativity in music really is: the engagement of the mind in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11)

ing problems, that is, being able to "think outside the box" and not being tied to any one perspective (functional fixedness)." (Feist, 1998, p.300) After this definition, LIA's pathway seems to be far away from a 'flexible cognitive style'. If one observes ANGIE's cognitive style to work, then flexibility can be sketched as a core-trait of her composing progression. Regardless of the fact that a flexible cognitive style certainly also depends on knowledge or expertise or experience, one can suppose differences in their general intrinsic motivation towards musical engagements. First, while LIA studied 'only' guitar, ANGIE successively extended her musical skills with different instruments (see 5 on page 347), and, by that, shows a high level of intrinsic motivation to explore different aspects of the musical domain. Second, by means of ANGIE's composing pathway, one can see an elaboration process, which is marked by a strong intrinsic activity and motivation to be creative in a 'sophisticated' manner, which implies a highly interplay within and between 'generative phases'.

In relation to the above suggestion: 'one can suppose that creative problem-solving in terms of composing music is a kind of competence that develops, in dependence of various factors or influences', we found that intrinsic motivation is one of the first indicators for potential in the given talented domain (e.g. Csikszentmihalyi, 1988; Csikszentmihalyi, 1990; Woodman/Schoenfeldt, 1990; Gardner, 1993b). Therefore, we can speculate about the creative potential of composed products (see 2.3.2 on page 125), personality traits (see 2.1.3 on page 96), intrinsic (and extrinsic) motivators (see 2.1.3 on page 99; 2.1.3 on page 102), and thereby can speculate about the further compositional development of individuals, which uses kinds of so-called 'simplest' or 'sophisticated' composing pathways. Individuals using rather simpler pathways are probably at the beginning of such a development, and individuals using rather complex composing pathways possess more potential to eventually produce 'H-musical-creativity' (see 2.3.3 on page 136).

In conclusion, related to SLOBODA's (1985) model of 'compositional resources and processes of typical composers', and BENNETT's (1976) 'stage model of musical composition' discussed above, BURNHARD's and YOUNKER's (2002); (2004) definitions of 'individual composing pathways' show that creative problem-solving in musical composition seems to be much more complex, regarding its processes and factors, as well as the interplay between them. This is consistent with previous suggestions (see 2.5.2.1 on page 169), in which musical composition was 'characterized as parallel, recursive, and nested interactions, such as *preparation* includes *problem finding*, which includes *verification* or *evaluation* again, and interact with *solution generation* and *divergent thinking*.' Furthermore, we can propose that the quality of composing strategies, aside from knowledge or expertise or experience within (and outside 2.5.2.2 on page 176) the musical domain, also depends on personality traits, motivational factors (including emotions see 2.1.3 on page 102), shaped by environmental influences (see 2.1.2 on page 90), conceptualized as guiding constraints of *how* people are engaged in music. This means that various conditions, all together, determine whether one has the capability, or not, to pursue one's development towards more and more complex composing strategies.

2.6 Summary

In this chapter, our focus was to outline creativity from two complementary perspectives. At first, we characterized creativity in general, using concepts from creative cognition, developmental psychology, personality research, motivation and emotions research. In the second step, we extended our discussion by reviewing investigations trying to outline, first: creativity in music; second, developmental aspects of musical creativity; third, creative processes involved while listening to music; and fourth, perspectives on creativity while composing music.

Starting with section 'Creativity and Cognition' (see 2.1.1 on page 85), we presented an overview on various prominent theories, which describe creativity and its relations to cognitive processes. Among other, it was discussed that human intelligence (measured in IQ-tests) is loosely related to creative potential, because a highly intellect person is not necessarily creative. But on the other hand, 'no one with extremely low IQ does highly creative work', and, 'at the highest level of IQ creativity is very difficult or even impossible'. In this context, arguments were presented that intelligence is more related to convergent thinking than to divergent (original) thinking, and furthermore, that creativity depends on the domain of observation. This means that, when individuals are interested in a certain domain, divergent thinking tests within the latter yield higher scores than in other domains.

From a further perspective relating cognition and creativity, we discussed the mental operations: application, analogy, combination, and abstraction, and found indications that 'everyday creativity is derived primarily from application and analogy operations', and high creativity 'results from a longer period in which several operations are put to use during the discovery process.' In addition, because many scientists generally characterize discovery processes as problem-finding and problem-solving processes, we reviewed various investigations and theories about individuals' creative problem-solving processes. These have unveiled the fact that, although some (older) theories explaining creative problem-solving in a kind of step-by-step movement, more recent theories define creative problem-solving as processes interacting together, without the requirement of a linear progress.

In the subsequent section 'Developmental and Social Influences on Creativity' (see 2.1.2 on page 90), we extended our characterization of creativity in general, assuming that creative output is also influenced by individuals' development in a given culture. First of all, we found indications that creativity research and developmental psychology share many concepts and theoretical frameworks. For example, there seems to be parallels between PIAGET's stage-to-stage transitions and creative insight. Moreover, some scientists partly explain creative processes as a kind of pass through stages or phases, and periods of children's development are conceptualized as showing certain levels of creativity.

In terms of social and developmental influences, we also discussed factors of adaptation, adversity, and family dependent variables, which seem to influence the creative potential during the childhood. Adaptation describes processes of assimilation and accommodation[122] occurring when the individual experiences a kind of disequilibrium. And, in creativity research, both processes are used together to explain sudden insights that characterize many creative "aha" moments, as well as new occurring stage-to-stage transitions within individuals' development. Adversity is often used to explain individuals' high motivation for creative efforts to change certain (environmental) circumstances. To illustrate, several investigations studying autobiographical data of eminent persons have shown that most of them had childhood experienced trauma, deprivations, frustrations, lost their parents early, or endured most brutal treatment from their fathers. From this facts, it was suggested that one reason for adults' significant achievements was the development of a strong motivation to think flexible during childhood, in order to avoid certain kinds of adversity. Not least, we discovered that structures and processes occurring within family life have a tremendous impact on the development of children's creative potential. Besides, a seemingly controversial discussion about birth order and creativity potential and output, shows that divergent thinking is more frequent within families with large children. In addition, we could outline factors which can play a significant role for individuals' creative development during their lifespan, such as the parents' own creativity, parents' attitude toward education, parental independence, special training early in life, benefit from role models and mentors, and socio-economic situation.

Finally, based on the observation that most of famous discoveries, inventions, or works in art are products of individuals' creative thinking and behavior during adulthood – defined as a more sophisticated form of creativity – we suggested ongoing developmental and social influences affecting the creative individuals until a late age. Hence, (not only) 'in domains that are less logically ordered, such as musical composition, literature, and philosophy' it is proposed that 'specialized knowledge is not enough; one needs to reflect on a great amount of experience [from society] before being able to say something new'.

Because both, 'cognitive individual differences in creativity' and individuals' developmental and social influences during their life time, seem to have a decisive impact on individuals' personality, motivations to be creative, and emotions while being creative, the subsequent section 'Creativity in Dependence on Personality,

[122] For detailed information see 1.4.1 on page 60.

Motivation, and Emotion' (see 2.1.3 on page 96) has tried to outline individual traits and characteristics related to creativity, personality and creative activity, from the point of view of intrinsic and extrinsic motivation, and the strong impact of emotions on creative motivation.

Starting with personality, we outlined that the most obvious personality traits of creative individuals are their relatively independence, autonomy, and their non-conventional thinking. Indeed, independence traits are well marked in artists, and 'empirical literature on personality and artistic creativity supports the nonconforming, rebellious nature of artists'. In addition, several personality studies suggested that creative persons also predominantly possess traits of openness to experience, tolerance of ambiguity, imagination, and playfulness. For example, openness is considered as a fundamental factor for creative output in different domains, and we could find indications to the effect that first: artists are more open to experience than nonartists. Second, 'creative and eminent scientists tend to be open to experience and more flexible in thought than less creative and eminent scientists'. Tolerance to ambiguity was detected as a natural prerequisite for creativity as well, and some investigations concluded that individuals' degree of tolerance to ambiguity correlates with their degree of creativity. In terms of imagination and playfulness, we characterized imagination as 'a form of playful analogical thinking that draws on previous experiences, but combines them in unusual ways, generating new patterns of meaning.' And playfulness generally increases the likelihood of creative results when approaching the task in such a state of mind. Arguments for this thesis could be found in the fact that kindergarteners with higher rates on playfulness receive higher scores on divergent thinking, and that famous creators, e.g. EINSTEIN, PICASSO, or STRAWINSKY, had childlike traits, which involve a kind of playfulness. Several investigations relating personality and creativity also highlighted traits, such as anxiety, sensitivity, impulsity, labile emotions, and mental and affective illness. For instance, some empirical studies concluded that 'artists are indeed more emotional and sensitive than non-artists'. Others found that performing artists (actors, dancers, musicians, and singers) 'scored significantly higher than control subjects on anxiety, guilt, and hypochondriasis'. Not at least, one study, including 1005 eminent individuals of 18 professions, discovered higher rates of mental and affective illness than within the control group, and furthermore pointed that, 'all forms of psychopathology (alcohol and drug abuse, psychosis, anxiety disorders, somatic problems, and suicide, among others) were more common in the artistic professions than in all other professions.'

The following subsection 'Personality and Motivation' (see 2.1.3 on page 99) extended the focus, and asked: What motivates personalities to creative efforts? Trying to paraphrase this big question, we followed the most common perspective of motivation in creativity research, which distinguishes between intrinsic and extrinsic motivation. In this approach, 'intrinsic motivation is defined as the motivation to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving satisfaction, or personally challenging; it is marked by a focus on the challenge and the enjoyment of the work itself. By contrast, extrinsic motivation is defined as the motivation to engage in an activity primarily in order to meet some goal external to the work itself, such as attaining an expected reward, winning a competition, or meeting some requirement; it is marked by a focus on external reward, external recognition, and external direction of one's work.' From this perspective, we reviewed that intrinsic motivation is being indispensable for the creative process, and it is furthermore one of the first indicators for individuals' potential in a given talented domain. But, because intrinsic motivation is only one side of the coin of individuals motivation, we discussed various extrinsic motivation concepts. The personality and its motivation to be creative is formed through extrinsic socio-cultural constraints and motivators. In the end, we have shown that, simultaneously to intrinsic motivation, extrinsic constraints can motivate in different ways, but can also boil down the pleasure in creativity work. This is because, perception and construction of extrinsic constraints and motivators are always an expression of personality traits, which moreover depend on temporary sensitivities.

This relationship led to a further more complicated perspective on creative individuals, means the relations between creativity and emotions (see 2.1.3 on page 102). First of all, because scientists from various theoretical traditions still controversially discuss what defines emotions, and which processes cause emotions, we initially have taken the perspective of a kind of intrinsic activity in emotional feelings, a so-called 'neurophysiological state that is consciously accessible as a simple, nonreflective feeling', from which an affect is generated. This raw emotional feeling or 'core affect' reflects 'an assessment of one's current condition', is a 'sense of mobilization and energy', and 'can be experienced in relation to no known stimulus – in a free-floating form – as seen in moods'. 'As a direct consequence, core affect is implicated in attention, perception, thinking, judgment, mental simulation, and retrieval from memory.' Hence, we suggested that the degree of neurophysiological activity – conceptualized as core affect or mood, etc. – marked a starting point from which creative processes evolve in individuals, and various degrees of these neurophysiological activities can lead to different creative thoughts, performances and products.

We additionally discussed a proposal which does not distinguish between emotional and cognitive processing per se, but conceives emotions as interactions between the body and subcortical as well as cortical regions in the brain. This perspective – similar to proposals labeled under 'theories of embodied cognition' – is very useful to describe processes contributing to individuals' development. Because not only during initial stages of development (sensorimotor phase), bodily sensations and intermodal activities in the brain (auditory, visual, motor, etc.) are the basis to produce knowledge in various kinds. This has led us to the final conclusion that a 'neurophysiological state that is consciously accessible as a simple, nonreflective feeling' is 'mostly'[123] connected with cognitive processing.

Taking up our previous conclusion that 'core affect or mood, etc., marked a starting point from which creative processes evolve in individuals, and various degrees of these neurophysiological activities can lead to different creative thoughts, performances and products' (see above), we found additionally arguments to the effect that mood or affect states influence creative problem solving as well as divergent thinking. This means, first, that positive mood or affect state increase the potential of ideational fluency, combinational thinking, divergent thinking, heuristic problem-solving tasks, and transformational processes of existing knowledge into new patterns of configurations. Second, that negative (mildly depressed) mood or affect states tend to be more adaptive to critical and analytical thinking, systematic processing, problem-finding, and 'leads to more realistic perceptions and judgments'. Beyond strict positive-mood-creativity as well as negative-mood-creativity hypotheses, we also discussed proposals which found curvilinear relations between creativity and affect. For example, one study demonstrates that intense emotional experiences per se stimulate the amygdala and regions associated with memory processing. Other studies again propose that particular changes in affect states contribute to creativity, such as shifts from positive to negative states.

In the end, after the seemingly controversial discussion about affect states and their contribution to creative efforts that we summarized that most of the studies discussed indicate that kinds of 'affect-laden knowledge' or 'affect-laden thoughts' and 'affect-laden free-floating states'[124] in general reinforce creative processes. Because various kinds of a 'neurophysiological state that is consciously accessible as a simple, nonreflective feeling' seem to induce motivating forces (instrinsic-extrinsic perspective) and/or trigger knowledges which were saved together with a particular emotion (embodied-cognition perspective).

In the next section 'Musical Creativity/Creative Thinking in Sound' (see 2.2 on page 111), we started by trying to outline creativity in relation to music. We first reviewed proposals related to the variety of connotations of the expression 'musical creativity'. Each individual proposal emphasizes its own conception of musical creativity, such as musical divergent thinking, musical problem-solving, flow and musical processes, imagination and musical processes, etc. However, we also found indications that 'the term "creativity" is most commonly used in relation to composing and that creativity is often used as a means of building support for ideas regarding music education', and that it 'is associated with notions such as

[123] However, some perspectives doubt that it is always so. For example, ZAJONC (1980) proposed "[. . .] affect could be generated, without a prior cognitive process." (Zajonc, 1984, p.117)

[124] This signifies a high level of core affect, experienced in relation to no known stimulus.

novelty, originality, and flexibility but also with divine intuition, passion, and the courage to express personal emotions'.

Subsequently, proposals were discussed suggesting that there are differences in underlying structures of musical behaviors related to musical creativity (e.g. improvisation and composition). An indication for such a perspective seems to be that, while improvisation and single-time listening are totally inserted in short time – individuals possess a limited mental capacity to process successive acoustic stimuli – , composing music can benefit from 'time'. This distinction between 'In the Moment vs. Reflective Thought' was discussed by WEBSTER's (2002) well known model of musical creativity, generally suggesting, 'what creativity in music really is: the engagement of the mind in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator.' In his model, WEBSTER related various perspectives of creativity research (e.g. convergent-divergent thinking, stages of problem-solving, personality research, developmental and social conditions) and psychology research (e.g. conceptual understanding, aesthetic sensitivity) with musical processes, and adjoined the time dimension to creative processes. Indeed, a new aspect of his model is the 'attempt to account for the "in the moment" creativeness that occurs in improvisation and single-time, music listening. Composition, performance of previously written music, and music analysis resulting from repeated listening are all time-independent.' The second model discussed, of ELLIOT (1995), highlights the perspective that originality, which is often associated with creativity, 'is only part of the story'. Because, creative musical achievements always depend on 'previous achievements in a history of practice'. This means for example, 'Beethoven's "Eroica" (his third symphony) stands on the shoulders of previous musical works that Beethoven's predecessors and colleagues composed or that Beethoven himself composed. [...] compositional practices are ongoing social practices. When a composer begins to compose, he or she is not acting alone. Whatever music gets done is connected to a network of direct and indirect musical, social, and cultural achievements and relationships. People who achieve results inevitably stand on the shoulders of past and present doers and makers in their domain.'

As WEBSTER and other researchers, ELLIOT also emphasizes that creative thinking and doing in music can be conceptualized as an ensemble of problem-solving and problem-finding strategies. Because he suggests that 'creating is like trying to hit a moving target; new goals and problems are constantly arising in the course of challenging projects. [...] A proficient level of musicianship not only makes it possible to generate and select musical possibilities, it also alerts us to problems and opportunities that hold the promise of musical significance.'

Finally, although we found various definitions of musical creativity, we could conclude that all of the definitions listed above emphasize the aspect of creating new – whether studying the process or the product.

Such a developmental perspective on musical creativity has led us to an extended discussion, subject in the next section 'Developmental Aspects in Terms of Musical Creativity/Creative Thinking in Sound' (see 2.3 on page 118).

Initially, our focus was to define musical creativity in its course of development. Based on two prominent suggestions – first: that creativity is a potential, completely given from birth, basically used when children create or transform new meanings from sense impressions; second: BODEN's distinction between psychological (P-creative) and historical (H-creative) creativity[125]– we proposed three rough steps of a developmental musical creativity:

- infants start from a kind of 'P-musical-creativity', which, during an ongoing practice, usually leads to a more 'P-culturalized-musical creativity'
- if enculturalization processes structure understandings of what can be H-creatice in music, and, furthermore, if the intrinsic activity of P-creative efforts in music is strong enough in children, adolescents, and adults, a developmental shift towards 'H-musical creativity' may take place
- indeed, probably after a certain stage, musical creativity or creative thinking in sound is also guided by the individual's own understanding of what can be H-creative in music, with the focus to try to think or act in a H-creative fashion as well.

In the next subsection, we presented an overview of psychometric investigations which measured certain dimensions of musical creativity and its development. First, we briefly sketched the historical development of the psychometric approach and its characteristics, strengths, and weaknesses. In the second step, two specific areas were discussed: creative process and creative product. Afterwards, we compared process- and product-centered measurements concerning the assessment of the creative potential in music and its development.

Generally, we found out that musical creativity can at least partly be assessed through process- and product-centered measurements. In terms of the proposed development of musical creativity presented above, we also discovered that most of the studies examined relate the development of musical creativity with expertise or experience in music. This is indicated by that fact that a high level creativity corresponds with an 'advanced ability to manipulate and experiment with musical motifs', 'a firm grounding in the basic skills of aural discrimination', and the 'more aware of temporal factors', etc. The question about which method of measurement could be the most suitable instrument, depends on particular intentions about the use of the results. For example, process-centered measurements assess

125 "A valuable idea is P-creative if the person in whose mind it arises could not have had it before; it does not matter how many times other people have already had the same idea. By contrast, a valuable idea is H-creative if it is P-creative and no one else, in all human history, has ever had it before." (Boden, 1994, p.76)

mental traits, such as musical fluency, musical originality, musical extensiveness, musical flexibility, and, by that, can support educational strategies to foster creative handling with musical expertise or experience in music. Product-centered measurements can also support educational strategies, but in a different manner. For example, based on the assessment of musical products, judges can get a better insight of composers', their musical expertise, their aesthetic taste, and often can conjecture about their creative handling. Consequently, by discussing about musical products, judges or composition teachers can foster the development of students.

Finally, we could define one essential difference between process- and product-centered measurements: the validity to assess 'H-musical-creativity'. By using process-centered measurements, it is only possible 'to estimates the potential for musical creativity instead of garanteed creative behavior'. In contrast, product-centered measurements define creativity after a guaranteed performed behavior, which is moreover very well comparable. By that, musicology can compare musical products to previous musical products, and, thereby, can assess whether musical behavior is 'H-musical-creative' or not within a historical context. With respect to exclusively process-centered measurements, it seems difficult to define or compare 'H-musical-creativity' endeavors.

In connection to that, the following section about musical creativity starts with the discussion of a perspective on musical behavior, which fell more into the second part of the chapter's title 'Perspectives on Creativity in General and while Music is being Listened to and Composed'. We reviewed a number of investigations intented to outline an extended picture of creative processes while listening to music. At first, based on new findings and results discussed in previous sections, we proposed that listening to music is really a product of a creative 'making' of music. For example, from a perspective of developmental psychology, the act of listening can be conceptualized as the adaptation to 'the sound environment by assimilating new sounds or musical objects to their existing mental structures: this gives rise to the accommodation of those structures, which change as a result, and this gives rise to a state of balance, or equilibrium, between the listener's internal model and the external sound world. However, new sounds are continually being heard, and as soon as this happens the system once again reaches a state of imbalance, or what Piaget called 'disequilibration'. The system is therefore always trying to reach a state of equilibrium (though it can never do so, as there are always more sounds 'out there' in the world than the listener can experience), so that equilibration functions as a kind of 'cognitive drive' for people to seek out and explore new sounds and ideas.' From the cognitive science perspective, we stated that 'sound/time phenomena do not come already structured, but rather hold the potential for being structured.' Moreover, based on SNYDER's (2000) memory model concerning music, we discovered that storage, retrieval and comparison of information, as performed by the memory, are non-linear processes, which as well cause the creative 'making' while listening to music. Because first, primitive groupings, their structuring, and the assignment of acoustic information to perceptual categories, can be defined as a creative process intended to develop 'meaningful segments'. Second, higher-order storage and retrieval processes in terms of cuings[126] between chunks[127] cause musical expectations, and may cause different meanings while listening to the same music. In addition, we also pointed out that these so-called free and hierarchical associations which are created, are mainly influenced by affective processes, such as core affect, mood, and emotional episode. As we have seen: affective processes influence attention, perception, thinking, judgment, storage, mental simulation, and retrieval from memory.

After the creative processes while listening to music, as above sketched from the perspective of neuroscience, we discussed the musical effects of such assignments and associations between sound and time phenomena in the next section 'Various Ways of Listening (to Music)' (see 2.4.2 on page 144). Generally, we proposed two ideas. First, the 'offered' specific structure-orientated way of listening, in the Western music tradition, is only one sort of creative 'making' while listening to music. Second, meaning-creation (not only) in terms of Western music is already constructed in various ways of listening – from those which can be chosen when listeners intend to 'create' music. We found arguments for this perspective in two prominent proposals.

First, the famous composer PIERRE SCHAEFFER, in his most important work *Traité des objets musicaux* (1966), argues for two distinctive systems of meaning-creation while listening, namely: ordinary listening and reduced listening – metaphorically speaking 'What's going on?' and 'What does it mean?'. Unlike ordinary listening, by which 'the sound is always treated as a vehicle', SCHAEFFER proposed that reduced listening reflects 'a new hearing intention, consisting in turning the listening intentions, which seek a meaning or event beyond the sound, back on to the object itself.' Regarding the perspective concerning the development of musical creativity by listening, we presented various arguments to the effect that reduced listening is essential during the development of musical creativity, or creative thinking in sound/music in general. Not at least because, if one recognizes that infants' and children's musical creativity is developed from a sort of intrin-

[126] "There are three types of cuing: (1) recollection, where we intentionally try to cue a memory; (2) reminding, where an event in the environment automatically cues an associated memory of something else; and (3) recognition, where an event in the environment automatically acts as its own cue. Recognition and reminding are spontaneous processes that are going on constantly." (Snyder, 2000, p.70)

[127] "Chunking is the consolidation of small groups of associated memory elements. [...] a chunk can itself become (through strengthening of associations) an element in a larger chunk. In this way, chunking leads to the creation of structured hierarchies of associations." (Snyder, 2000, p.54)

sic activity consisting in creating or discovering the acoustic dimension of their environment.

The second proposal of TUURI and EEROLA (2012) extended SCHAEFFER's system of meaning-creation while listening. In addition to the proposed domain of denotative modes (including: causal, emphatic, functional, and semantic listening) – which corresponds quite well to SCHAEFFER's ordinary listening – both authors proposed a reflective domain of meaning creation, including reduced and critical mode, and, furthermore, add an experiental domain.

To clarify this, we discussed that both reduced and critical modes, are proposed as 'operating in the highest-level class of reflective listening'. For example, reduced listening will be conceptualized as a 'self-reflective analysis of one's listening experience and, by resisting any denotations, also intentional manipulation of that experience'. Critical listening 'is about reflective judgment of auditory perception and concerns appropriateness or authenticity of a sound in a given context. It also considers the appropriateness of one's responses, which includes judgements of possible misunderstanding, deception, false urgency or generally the need to be concerned with the sound. Additionally, at its highest level, critical judgments are based on aesthetical dispositions.'

Regarding the experiental domain (including: reflexive, kinaesthetic, and connotative listening), both authors propose that meaning-creation is also based on experienced 'action-sound couplings', schematically structured, for example as 'body-schemas, motor-schemas or image schemas'. By using such schematic structures, listeners are 'able to project meaningful action-relevant mental images relating both to our body (kinaesthetic/somatic ontology) and the environment (action-oriented ontology of environment).' For example, 'reflexive action-sound couplings refer to quickly evoked, phylogenetically developed, innate action-sound reaction affordances. They are based on automated (or 'hard-wired') schemas. 'Kinaesthetic action-sound couplings refer to kinaesthetic affordances of a perceptual experience; an imaginative sense of motor-movements on the basis of sound perception. These dynamic patterns may concern, for instance, sensitivity to the haptic and tactile feelings relating to movement (e.g. tensions and textures).' And, 'connotations refer to vigorously activating imaginative projections of action-relevant values as resonances of schemata based on interactions with both natural and cultural constraints.' Connotative meaning-creation is moreover hypothesized as meaning-making through analogical and metaphorical processes, and therefore are 'probably highly interactive' to denotative as well as kinaesthetic and reflective modes of listening.

Finally, similarly to SCHAEFFER's proposal of 'nothing can stop a listener from varying [listening] passing from one system to another or from a reduced listening to one that is not.', TUURI and EEROLA emphasize that 'different listening modes can apply concurrently to the same sound, as listening can potentially incorporate a multitude of intentions. Listening modes thus do not exclude each other, hence the taxonomy will inherently retain the ability to take into account the multifunctionality of listening.' Both perspectives could furthermore be found consistent, with the assumption of multimodal perception and cognition, by means of SNYDER's memory model. Indeed, 'current consciousness can consist of two parts; a vivid perceptual act [reflexive, kinaesthetic], and a conceptual aspect [connotative, denotative, critical, reduced] from long-term memory.'

The subsequent section goes a step further, and presents various proposals from the creativity research outlining musical listening. After discussing some statements, which all conceive listening as an active process of meaning-creation, we have gone more into detail about WEBSTER's (2002) model of creativity in music – combining divergent and convergent thinking with creative problem-solving processes. He first conceives listening as a product, which results from an intentional engagement in music. In relation to the various ways of listening to music explained earlier, we found similarities to WEBSTER's notions of divergent thinking: 'the creator is exploring the many possibilities of music expression, always cataloging, sifting through, rejecting, accepting only to change yet again.' He furthermore extended his observation of meaning-creation while listening, in defining creative processes as a movement between divergent and convergent thinking in dependence on 'Enabled Skills', 'Enabled Conditions', and working through stages of problem-solving, namely: preparation and working through. This means that, because listening to music is very inserted in time, and because of the limitation of the listener's capacity to process all acoustic stimuli, WEBSTER proposed 'that creators, during improvisation and single-time listening, form explorative ideas, work through them, and then move directly to [the creative] product.'

Based on various models and studies, we subsequently structured a more comprehensive perspective about creative problem-solving processes while listening to music. This has led to the conclusion that listening to music can generally be conceived as processes of thinking in sound for the purpose of solving problems of understanding. Moreover, we characterized that listening, as a process of solving certain problems, has strong relations to learning through thinking, and, by that, process individuals' 'P-culturalized-musical creativity'. But, although thinking in sound/music through listening can only be processed within a cultural environment (music is a cultural product), the development of musical creativity through listening activities is far more than enculturalization and acculturalization processes. Indeed, it is a highly active engagement to contrive variations of it.

After the discussion of various proposals, suggesting that listeners perform creative mental tasks – conceptualized as processes of divergent thinking, working through, reduced listening, connotative listening, pre-inventive generation, exploration, interpretation, etc. – we additionally found extending arguments for this perspective from the neuroscience, especially the field of so called musical imagery. 'Musical Imagery has often been viewed and considered as the ability to hear or recreate sounds in the mind even when no audible sounds are present.' In connection to this, the composer ROGER SESSIONS testified that, while listening, 'internal imagery is central to musical understanding: In the primary sense, the listener's real and ultimate response to music consists not in merely hearing it, but in inwardly reproducing it, and his understanding of music consists in the ability to do this in his imagination.' Hence, we synthesized that listening to sounds and recreating sounds in the mind when no audible sounds are present includes processes of imagery and imagination. Indications for this thesis could be seen in the fact that while listening to music, and also during auditory imagery, activations could be found in the supplement motor area of the brain. In addition, musical imagery processes overlaps with many of the same areas of the brain used in the perception of music. However, musical imagery and imagination do not seem to depend on low-level organizational processing per se. This is indicated by the fact that secondary auditory-cortex areas are more activated than primary.

In conclusion, all these findings together argue for the perspective that individuals create the music while listening. Listening, as, often proposed, is not mere passive reception. Interestingly, such a listening creative mental task seems to be at least partly related to the mental tasks performed while individually practicing music – for instance while playing an instrument. At least, neurological findings argue for the perspective that the development of musical imagery abilities are guided by practice of music, and musical expertise.

The following section 'Creativity while Composing Music' (see 2.5 on page 162) tried to investigate the creative 'in the moment' process while composing music, through the discussion of various processes contributing to the creative act of making a musical product. This means first, as supposed while listening to music, and as we also suggested, that musical imagery and imagination are supporting processes for composers while performing their tasks. Second, we presented a perspective which conceptualizes compositional activities and processes, performed in a tension field between problem-finding and problem-solving.

Starting with imagery and imagination processes, we proposed that both musical imagery and musical imagination have strong relations to each other. However, 'imagination is more than imaging, involving a degree of creativity over mere visualizing or experiencing a ready-made copy. [...] The process of developing a compositional idea implies a musical imagination to hear the desired sound, musical memory, and the ability to alter and mentally rehearse an image.' Further indications for the supporting character of musical imagery and imagination processes in the composition of music could be found in the fact that extraordinary composers, such as SCHUHMANN, MOZART, BERLIOZ, TSCHAIKOWSKY, or WAGNER partly 'composed without the aid of any instruments'; 'heard their compositions mentally'; 'imagined the productions of other composers, and were sometimes disappointed in their performance', etc. However, we also found statements of composers who use musical imagination as a kind of orchestration at the piano, when they imagine an another instrument playing the same musical text, etc. Subsequently, we discussed the three stages taxonomy of BAILES and BISHOP (2012), which presents a more structured view on the act of composition, seen as imaging new sound structures. Both authors argue, among others, for a goal-directed activity of composition, which involves the conscious manipulation of a given material. This means that sounds structures are mentally improved, strengthened, extended, modified, etc. Furthermore, they suggest that a composer 'needs to look through and into ideas, objects, functions, in order to break up one's perceptual set' and 'push against the limits of normal perception.' Furthermore, although both authors have defined the act of composition as conscious processes, they have also noted that 'the conscious experience of the qualia of music [...] is inevitably underpinned by unconscious processes.' We also emphasized this essential perspective, and presented additional indications. For example, SNYDER's memory model accentuates that for most individuals, activated long-term memory structures is unconscious and, furthermore, highly influences the direction taken by the current consciousness. Indeed, we found a statement of the composer KARL HEINZ STOCKHAUSEN, who suggests that unconscious processing happening over night, leads to a compositional insight (aha moment) occurring the next morning.

At the end of this subsection, we finally concluded that imagery and imagination processes, such as 'keeping in the mind for decision making', but also the mental extension, modification, and transformation of ideas, the mental internal hearing during or after the imagination of new structures, etc. seems to be very conducive for composers while performing their work.

In connection to this, we opened a creative problem-solving view on compositional activities, defining composition of music as a process of creating, exploring and solving of self-imposed 'ill- and well-defined' problems. Such a perspective is plausible, because the progression of the work of composers can be characterized by the fact that they must find solutions for technical and aesthetical problems during the process, 'as engagement in a dialogue between concept and material'. In this way, we characterized composition processes as problem complexes, which are additive in nature and more ill-defined, as well as open to modification over time. Furthermore, we defined that processes structuring compositional problems and possible solutions must operate with some kind of previously learned knowledge. Not least, findings from the cognitive sciences argue for such a perspective. For example, it was discovered that 'recursive memory search is used to generate hypotheses that might account for, or structure, the available stimulus information. Subsequently, the degree to which these hypotheses are consistent with available data is used to test the adequacy of the problem construction. [...] these hypotheses, and the derivative hypothesis testing, suggest that problem construction provide a plan or framework for solution generation and implementation.' Moreover, it was proposed 'that individuals construct mental models, or an integrated set of hypotheses, that allow to structure ill-defined, novel problems, and subsequently generate viable problem solutions. And, prior exposure to a problem could be used by individuals to abstract key features of the problem solution. The solution to this initial problem could then be applied to new, novel problems.' Finally, we argued against the perspective that creative processes occur and progress homogeneously, as suggested by stage theories, because, compositional activities should be characterized as parallel, recursive, and nested interactions, such as preparation. These include problem-finding, which is again related to verification or evaluation processes, and interact with solution generation and divergent thinking.

Regarding the question: What is the driving force for composers to structure ill-defined problems extensively, their ongoing search for possible solutions, etc., we have taken up our previous findings about creativity in dependence on emotions, in order to link them with the creative problem-solving perspective on compositional activities. Assumed that 'problem finding begins with feeling. The expressions "sensing gaps," "dissatisfaction with the status quo," or "frustration or irritation that something doesn't work as it might', we suggested that composers' initial intention to work starts from an experienced tension that initiates creative problem-solving processes. But, more important, we could made assumptions about different affective processes involved while composing music, and their support for certain cognitive processing. That is to say, it seems likely that problem finding and verification or evaluation processes have greater potential to produce creative output if, first: the composer is focused on extrinsic criteria in relation to his work, and second: he is more in a negative (mildly depressed) mood or affect state. There are also indications for the fact that solution generation and divergent thinking works better in a more opposite mood or affect state. Because, solution generation and divergent thinking processes are less related to extrinsic criteria as finding or verification or evaluation, and probably by that, composers can direct their attention to particular attributes (e.g. rhythm or dynamics), through which they can cope with a certain limited aspect of the ongoing process.

Aside from the force of emotions, in the subsequent section, we asked: Which influences can be relevant for composers' inspirations to find interesting problems, their structuring, the evaluation of possible compositional solutions, etc.?

During the analysis of various composers' works and statements, we could point three main influences on compositional activities. First, chance or accident, which arises (or can also be provoked) seems to be particularly conducive while composing. Indeed, such eventualities change current musical mental models, and, by that, new interesting problems or perspectives can be defined, explored, etc. Second, we assumed that nearly all composers are inspired by influences outside the musical domain. These can for example induce a general philosophy of compositional activities – as JOHN CAGE proposed. In addition extra-musical influences trigger transformation processes, which support the structuring of unique musical ideas. Third, musical ideas themselves are central influences for compositional activities, such as a ’germinal idea’, which is relevant for further problem-solving processes – by their structure, problem-solving processes are extraordinary influencable. This means that a musical idea defines or constrains composer’s current mental musical model. On this basis, ideas are further elaborated, and compositions can evolve and come to existence.

In the last step of our observation on creativity while composing music, we presented and discussed three different proposals, structuring composing processes, for the purpose to offer an extended picture of composing music conceptualized as creative problem-solving processes.

Starting with BENNETT’s (1976) stage model of musical composition, he concluded that the observed ’classical music’ composer ’proceed through somewhat similar steps in creating music’. This means the ’initial phase involves the crucial step of getting what may be called the germinal idea. Once the germinal idea has been found, the composer may simply let it run around in his head for a while. Sometimes the germinal idea is played over and over on some musical instrument, but more frequently it is written down’, as a sketch in few minutes, or even after several years. Both, the sketch and its formulation into the first draft, can initiate new germinal ideas again. In the elaboration and refinement stage, the first draft ’is reworked and added to where appropriate. The compositional process usually concludes with the completion of the final draft and copying of the score. [. . .] Following performance of the work, revisions are sometimes made.’ BENNETT also found indications which are related to our previous suggestions concerning optimal mood-states for creative-problem solving. Indeed, problems which occur during the conception of the first draft, can be supported by analytical and critical thinking, such as a systematical overview about individual ideas in relation to each other, and with regard to the current compositional target. The generation of initial musical ideas, and their formulated sketches, can be supported by processes of divergent thinking, ideational fluency, combinational thinking.

The second model discussed, referring to SLOBODA (1985), also characterizes composition as a more or less a linear problem-solving process. In comparison to BENNETT’s model, however, he divides compositional activities in unconscious and conscious knowledge and processes. That is to say, in a first stage called ’inspiration’, ’a skeletal idea or theme appears in consciousness’ from the unconscious long-term memory structures. The second stage which SLOBODA called ’execution’ differs in that ’the musical idea is subject to a series of more conscious and deliberate processes of extension and transformation.’ However, although SLOBODA presented an important part for our discussion about the composition of music, regarding unconscious and conscious processing, we disagreed with his distinction between purely unconscious and conscious processing for two reasons: first, findings from neuroscience (see Figure 2.16) propose that for every conscious activity, a relatively higher proportion of unconscious memory structures are activated, e.g. during the development of a musical idea or theme; second, the extension of musical materials is often influenced by associative processes, and by that, new 'problem spaces' are structured suddenly: unconscious processing supports associative processes.

BURNHARD's and YOUNKER's (2002); (2004) proposals of various composing pathways adds further aspects to our discussion about creative-problem-solving during composition, namely: the differences between how individuals compose. Based on the definition of creative thinking in music as 'a dynamic mental process alternating between divergent (imaginative) and convergent (factual) thinking, moving in stages over time', both authors found different strategies, defined as kinds of plans 'involving significant decision-making moments for the overall composition. By mapping the range, flow and direction of strategies, as decision-making moments, we could characterise pathways as reflecting particular kinds of soundsequence occurrences'. In this way, BURNHARD and YOUNKER (2004) conceptualized six levels of students' creative thinking, from the so-called 'simplest' to the 'most sophisticated' composing strategies (see Figure 2.22).

Based on the different composing pathways of students presented, we could moreover conclude some factors, which probably influence creative problem-solving during the composition of music. First, a kind of 'flexible cognitive style' showed by students while approaching compositional problems. Second, a high level intrinsic motivation causing an extended exploration of different aspects within the musical domain, such as to learn multiple instrument playing techniques. Third, domain-specific knowledge or expertise or experience, because significantly related to composing strategies. Furthermore, we speculated about the relation between composing pathways and their potential to produce good or creative compositions. We could at least suggest that individuals using rather simple pathways possess a low level creativity, and that individuals which use rather complex composing pathways detain more potential to produce 'H-musical-creativity'.

Finally, we concluded that, based on the discussions of SLOBODA's (1985) model of 'compositional resources and processes of typical composers', and BENNETT's (1976) 'stage model of musical composition' discussed above, as well as BURNHARD's and YOUNKER's (2002); (2004) definitions of 'individual composing pathways' it could structurally be shown that creative problem-solving in composition of music are much more complex than often proposed, with respect to processes and factors, as well as regarding their interplay.

Part II
Musical Extrapolations – Towards a Model of Creativity in Music

Chapter 3
At the Very Heart (of Music)

In the preceding chapters I have first discussed predispositions, factors, influences and constraints for individuals growing experience, skills or expertise in terms of music within the field of developmental psychology (see 1 on page 27). Second, defining listening to music as well as composing of music as creative processes, which depend on experience, and by that, suggest a kind of development in skills or expertise when music is experienced or practiced (see 2 on page 85). The present Chapter and the following are now intended to incorporate those (and other) findings into a broader perspective called *musical extrapolations*, proposed as a model of creativity in music, and defined as an activity, in dependence on a particular context[1],

1. to predict, based on pre-disposed and experience-based structures[2]
2. to modify, extend, and combine[3], based on pre-disposed and experience-based structures

To obtain a closer picture about this concept, and its implications on musical matters, this Chapter is intended to outline various processes of *extrapolations.* First by means of general descriptions; second by using general concepts and tools of cognitive sciences; and third on the basis of descriptions in terms of music.

A good point to start from is perhaps ERIC KANDEL's metaphor of the brain as a creative machine that constantly constructs the world (see Kandel, 2012), and his further suggestion:

> "Making models of the world is also the core function of perceptual, emotional, and social systems in the brain. It is this modeling capability that makes possible both the artist's cre-

[1] For detailed information, see 4.3 on page 239.

[2] For detailed information about pre-disposed and experience-based structures see 4.2 on page 228.

[3] For detailed information see 4.4.1 on page 249 – 4.4.3 on page 264.

S. Schmidt, *Musical Extrapolations,* DOI 10.1007/978-3-658-11125-0_3,

> ation of a work of art and the beholder's re-creation of it. Both derive from the intrinsically creative workings of the brain." (Kandel, 2012, p.449)

Activities of 'modeling the world' are so deeply rooted in all facets of life since early childhood, that they do not usually appear at first sight. For example, visual pictures on the human retina always have two dimensions; however, the brain constructs a vivid impression of a three dimensional world. In terms of music, similar modeling processes can probably be seen within perceptual mechanisms of the auditory structuring, because the human nervous system seems to have an innate tendency (see Shepard, 1981; Bregman, 1994) to group and separate acoustical information out of the ongoing auditory continuum (see 1.3 on page 46). In addition to such basic modeling processes, every thought or stimulus is probably embedded in a context, which means that individuals try to create complex hypotheses about any given situation, always coping to conform to the latest information received. I may illustrate this through an anecdote I have experienced with my 2 ½-year-old daughter, when reading to her a new book.

As I started to read the story about a little girl Janna and her brother Hannes, my daughter looked at the book's illustration (see Figure 3.1), and asked me excitedly: Why doesn't the girl notice that her balloon flies away[4]. Jelenkovich, B./ Gernhäuser, S.; Amm, Elke, editor Sachen suchen: Meine Wimmelbilder. Ravensburger Verlag, 2011

I was fascinated by this, because her question must have been preceded complex hypotheses about the situation in Figure 3.1. Because of a sort of problem with the balloon, placed at a certain angle in the sky, she generated models or integrated sets of hypotheses, supported through activated *scenarios* (Sanford/Garrod, 1981), *frames* (Minsky, 1975)*, scripts* (Schank/Abelson, 1977), etc., which included and put in relation various aspects of my daughter's own experience or knowledge about situations on a marketplace, possible behaviors of free-floating balloons, her own emotional experience when losing something, etc. In this way, once a suitable model or integrated set of hypotheses was generated, she probably tried to find within the picture any further information about this model, supplemented by additional models to enhance her understanding, and by that, 'modeling a world' around the balloon. After my daughter decided for the solution that the balloon must belong to the girl with the balloon, she structured the next problem, 'Why doesn't the girl notice that her balloon flies away?'. Then, because she couldn't obtain further information from the picture to order to generate models or hypotheses leading to a satisfactory solution or answer, she asked me to add more information.

[4] She has obviously not used exactly those words, but this corresponds approximately to her question.

Fig. 3.1 Picture from JELENKOVICH (2011, p.2) which triggered a complex mental model in the 2 1/2- year old girl Sontje.

In addition to such *extrapolation* processes, involved in trying to solve a focused problem of understanding, JEFF HAWKINS (2004) made a remarkable self-observation which shows how incredibly versatile our brain constantly constructs our surrounding environment (mostly unconscious), and moreover generates hypotheses about further perceptions which can be brought to us in this context. He asked himself: 'What do brains do if they aren't generating behavior? What does a brain do when it is passively listening to speech? What is your brain doing right now while it is reading? What are the neurons doing when they understand?' (see Hawkins/Blakeslee, 2004)

To solve these questions he developed a thought experiment: What would happen, "[...] if a new object, one I had never seen before appeared in the [well known] room – say, a blue coffee cup. The answer seemed simple. I would notice the new object as not belonging. It would catch my attention as being new. It would just jump out as not belonging. Underlying that seemingly trivial answer is a powerful concept. To notice that something is different, some neurons in my brain that weren't active before would have to become active. How would these neurons know that the blue coffee cup was new and hundreds of other objects in the room were not? The answer to this question still surprises me. *Our brains use stored memories to constantly make predictions about everything we see, feel, and hear.* When I look around the room, my brain is using memories to form predictions about what it expects to experience before I experience it. The majority of predictions occur outside of awareness."[5] (Hawkins/Blakeslee, 2004, p.86)

By that one can further suppose that unconscious predictions or hypotheses of 'what can still happen' often lead to current conscious experiences if they do not correspond with perceptions[6]. This is evident from an example I have experienced while visiting IRCAM[7] in the context of my studies in Music Informatics. Many exciting research projects were presented there, but for me, one room was particularly interesting, which was equipped in the manner to create almost no room-reverberation (see Figure 3.2).

It was possible for all visitors to walk into this room to make a kind of self-test. Every person staying in the room experienced it as more or less peculiar 'to be in there'. As myself, some felt uncomfortable in the beginning, or experienced increased heartbeat, others immediately wanted to leave the room. What happened there?

The researchers declared the effect caused by the fact that the current mental model or integrated set of hypotheses of 'to be in the room', is built on memory information of multiple senses (see Niedenthal, 2007; Niedenthal et al., 2009), and that this model does not match with actual acoustical perceptions[8]. The experienced emotion of 'to be more or less peculiarly in the room' resulted from this perceptual dichotomy.

Based on this example it is also possible to illustrate on a micro-level why *extrapolation* processes cause or create a psychological development. Because, as I stood in this room for a while, my uncomfortable feeling decreased. After the initial perceptual problem, modified hypotheses are probably generated, and again compared with some subsequent perceptions, until deviations are reduced to an

[5] The emphasis was added.

[6] Note here that Charles S. Peirce's philosophical proposal of *abductive reasoning* describes such a procedure, which he considered as the only process (logical operation), which introduces any new idea (Peirce, 1958). For a short introduction in terms of musical processes (see Schmidt/Troge/Lorrain, 2013).

[7] Institut de Recherche et Coordination Acoustique/Musique: a french institute for musical applications of science, sound acoustics and avant-garde electro-acoustical art music.

[8] Most people had never entered such a room.

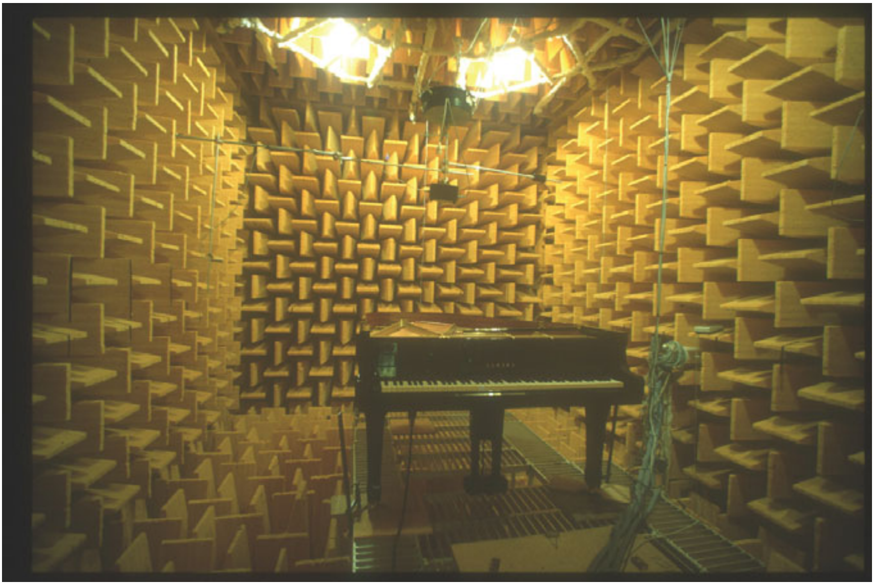

Fig. 3.2 Anechoic test room with almost no room acoustics. (IRCAM, 2007)

irrelevant level. My uncomfortable feeling decreased through such a process. In addition to such a kind of perceptual learning, we have shown (see Figure 3.1) that trying to solve focused problems of understanding can generate complex models or integrated sets of hypotheses. In this manner, learning processes take place, when *new* generated *extrapolations,* enabling 'to modify, extend, and combine, based on pre-disposed and experience-based structures in dependence on a particular context' (see definition above), will be evaluated as satisfactory solutions.[9]

If one relates the above suggestions in terms of music, it seems that processes of *extrapolations* are also at play at the very heart of music. For instance, at every single moment of listening, exclusively one chord or sound is audible, which in itself is quite meaningless. The elusive quality of music can be brought into mental existence only by using memory structures creating extrapolations about:

first, possible future occurring events;
second, their musical meanings;
third, and the meanings of their inter-relations.

Experimental psychology has shown that processes of 'creating *extrapolations* about possible future occurring events' have some kind of physical reality: by

[9] For more information, see discussion about Figure 3.5.

measuring neural responses after an acoustical event, brain activities can be determined, and hence assumptions can be made about the processing of stimuli. In this way it was found, first: that, already fetuses between 29 and 33 weeks, fetuses of gestational age have a limited ability to extrapolate acoustical parameters, that is to say they predict the last perceived acoustical stimulus (Lengle/Chen/Wakai, 2001; Wakai/Leuthold/Martin, 1996)[10]. Second, at around 4 months after birth, MMN[11] responses to changes of sound features are adult-like (He/Hotson/Trainor, 2007), and 7-month-old infants can respond to changes in two simultaneous melodies separately (Marie/Trainor, 2012), like adults (Fuijoka et al., 2005) – this suggests that even the nervous system of infants automatically creates more than one hypothesis about sound features of future events. Third, by measuring heart rate responses, it was found that already between the 2nd and 7th month after birth, infants are able to anticipate auditory events temporally (see 1.3.2 on page 52). Fourth, by passive exposure, or experience in performing or producing music, 6-year-old children already have acquired a comprehensive implicit knowledge of Western music, which allows them to predict culture-specific aspects of music, such as tonal and harmonic regularities (see Koelsch/Gunter/Friederici, 2000).

Concerning the meaning of music, we have discussed previously (see 2.4.2 on page 144) that, although "[. . .] many composers believe that the meaning of music is the music itself and nothing more." (Copland, 2004, cited by Katz, 2012, p.171), meanings at a psychological level are important for individiuals, and moreover "[. . .] different, even contradictory, levels of interpretations, emotions and other meaningful experiences [can arise] on the basis of the same physical sound." (Tuuri/Eerola, 2012, p.138)[12] In this way, it seems that creating *extrapolations* about musical meanings are mainly supported by three factors:

first, through pre-disposed structures, such as perceptual mechanisms of auditory structuring, by which acoustical information are processed out of the ongoing auditory continuum (e.g. grouping, stream segregation[13]). These involve:

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[10] For detailed information see 4.2 on page 228.

[11] A negativity mismatch (MMN) is a component of the auditory event-related brain potential, which evidenced a sound discrimination. In addition, this advocates for the implication of sensory-memory structures, in which "[...] each sound forms a memory trace in the auditory system, if an incoming sound violates the neural memory representation of the recently heard sounds, it elicits an MMN." (Kujala/Tervaniemi/Schröger, 2007, p.3)

[12] For detailed information see 2.4.2 on page 149.

[13] See in this regard 1.3.1 on page 47.

second, preceded mental models[14] or integrated sets of hypotheses[15] concerning the current situation;

third, the current mental state[16]: for example, the degree of general wakefulness or tiredness (physical or mental), paying attention to a particular point of interest, including motivational aspects[17], and particular mood and affect states, which seem to support certain cognitive processes[18].

A good example illustrating the factors proposed above for creating *extrapolations* about (in this case visual) meanings, can be seen in the ambiguous girl/old woman picture (Figure 3.3) – first made by the Harvard psychologist E. G. BORING.

Fig. 3.3 Ambiguous picture of a girl/old woman (cited by Kandel, 2012, p.311)

[14] For information about mental models in terms of music see 2.4.3 on page 157; 2.5.2.1 on page 170; 2.5.2.2 on page 176.

[15] For information about memory structures included in mental models or integrated sets of hypotheses see 4.2.2 on page 232.

[16] For further information about factors influencing mental states see 4.1 on page 223.

[17] See 2.1.3 on page 99.

[18] See 2.1.3 on page 108; 2.1.3 on page 109).

Looking at this Figure 3.3, we can suppose that, through pre-disposed structures (e.g. Gestalts[19]) and experience-based structures about side views of people, a satisfactory mental model of a young girl can immediately be generated. But, when attention is focused on the girl's ear, it is suddenly possible to see an old woman's eye, and by that, *extrapolations* about the meaning of Figure 3.3 are changed. KANDEL (2012) proposed that this image suggests "[...] that having once stored a figure in memory, we can use top-down processing[[20]] – with its reliance on memory – to make a switch at will [. Furthermore] top-down processing appears to use hypothesis testing of images in our memory to infer the category, meaning, utility, and value of a retina image [which] starts off with a hypothesis about what is out there to see at a given moment." (Kandel, 2012, p.311)

Fixed instances, in which one pays attention to a particular perception at one time, are related by supporting factors to the creation of extrapolations about meanings (see above) while listening to music.

For example, in the equal-tempered pitch system (Wohltemperierte Stimmung), the same chord can bear different meanings, which allows for example, a musical modulation from one key to another. A chord can therefore be defined as a kind of 'ambiguous picture' in music, and furthermore corresponds quite well to the ear of girl's ear and the women's eye in Figure 3.3. Similarly, it can be seen in Figure 3.4, a G maj triad can for example be a part of two mental models – fifth degree of the C major scale, or first degree of the G major scale. But, opposed to the possibility of getting visual information at will, and by that, 'to make a switch at will' (see above), in case of music, perceptions while listening depend (mostly) on uncontrolled processes of sounds happening and fading away. This doesn't mean that such a physical concatenation is a complete reality in mental models of music, but they are time critical reference points.

However, in both visual and musical matters, when creating *extrapolations* about meanings, the second factor – 'preceded models/integrated sets of hypotheses concerning the current situation' (see above) – usually has a significant influence towards meanings (maybe stronger in music than in visual matters). In terms of music this could mean that a G maj chord receives its extended meaning based on preceded models.

In addition to such a structure-oriented way of meaning-creation, specific to Western music tradition, we have seen previously that meaning-creation in Western music (but not only) is already founded on various modes of listening, which can change when listeners (and composers, of course) intend to create musical meanings and inter-relations among them (see 2.4.1 on page 140).

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[19] See in this regard 1.3.1 on page 47.

[20] For detailed information about top-down processing in terms of memory structures see 2.4.1 on page 141; and (Snyder, 2000).

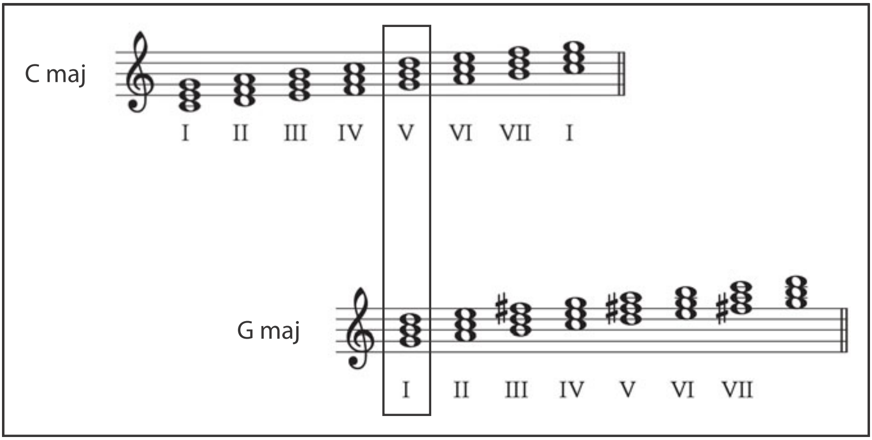

Fig. 3.4 An 'ambiguous picture' in music

For example, TUURI and EEROLA, propose a 'denotative listening mode', which has "[...] four basic types of listening intentions [see Figure 2.12]; more source-oriented causal and emphatic modes relating to the intention to apprehend the 'indices', and more context-oriented functional and semantic modes relating to the intention to comprehend the meanings involved." (Tuuri/Eerola, 2012, p.149) In that sort of listening intention – that is to say, creating *extrapolations* about particular musical meanings – the G maj chord of the example discussed above can be assigned the current meaning. However, it is common sense that musical processes consist in much more than such semantics. Therefore, TUURI and EEROLA also propose that "[...] sound perception essentially has a certain haptic or kinaesthetic character, and requires sensorimotor skills." (Tuuri/Eerola, 2012, p.146) Based on this presupposition, the authors suggest a 'kinaesthetic mode' of creating extrapolations about musical meanings (see 2.4.2 on page 150), which rather reflects a gestural character in sound perception, "[...] based on ideomotoric processes that manifest innate or early developed structures of kinaesthetic schemata concerning bodily movements, coordination and postures (Johnson, 1987; Merleau-Ponty, 1945). In the light of vitality affects (Stern, 1985; Johnson, 2007), kinaesthetic perception can also be seen as bodily resonated contours (or patterns) of feeling. These dynamic patterns may concern, for instance, sensitivity to the haptic and tactile feelings relating to movement (e.g. tensions and textures), [...]." (Tuuri/Eerola, 2012, p.146)

In addition to these two modes of listening intentions and creating *extrapolations* about musical meanings, TUURI and EEROLA (2012) as well as CHION and SCHAEFFER (DACK/NORTH, 2009) found indications for further listening intentions, such as *reduced*, *critical*, *connotative*, and *reflexive* listening (see 2.4.2 on page 149), as well as *ordinary* listening (see 2.4.2 on page 145). From which one can suppose that the core of music can be defined as 'ambiguous pictures' (see Figure 3.3; Figure 3.4). Supported by factors of preceded models or integrated sets of hypotheses[21], pre-disposed structures (e.g. groupings), and the listener's current mental state, such as paying attention to a particular information, the 'ambiguous musical picture' can receive its current meaning through processes of *musical extrapolation*, defined above (see 3 on page 209).

From the above explanations we can assume that extrapolations about possible occurring events in time, their musical meanings, and meanings of their inter-relations, are not separate processes, but interconnected and mutually dependent. In accordance with the first definition of *musical extrapolations* (see in this regard 3 on page 209), I thus propose that in a certain context it is possible to predict occurring events in time, based on pre-disposed and experience-based structures. These events *always* possess a particular kind of meaning due to their projection because, as we have seen, *extrapolations* about musical meanings are based on the supporting factor of preceded models or integrated sets of hypotheses, which can be defined as structured models of meanings. These models again presuppose particular inter-dependencies, or, that is to say, inter-relations of musical meanings, which in their turn can appear by *extrapolations* about possible occurring events in time.

This raises the question: How are experience-based structures created or developed, as well as the ability to predict events, their meanings, and the meanings of their inter-relations?

To anticipate an answer[22], an individual's developmental process of experience-based structures probably takes place in a kind of cyclical interplay of processes included in both definitions of *musical extrapolations* (schematically seen in Figure 3.5).[23]

This means that, based on pre-disposed and experience-based structures, when predictions or hypotheses in dependence on a particular context are not evaluated as satisfied and/or are not compatible with current perceptions, then predictions or hypotheses are modified, extended, and combined in a certain way. When these **new** predictions or hypotheses achieve a certain kind of satisfaction during perceptions and evaluations, then this working mental model can be used to *extrapolate* its containing meanings and inter-relations in a particular context. Experience shows that, in performing or producing music, 6-year-old children can predict possible occurring events within tonal and harmonic regularities (see (Koelsch/Gunter/Friederici, 2000)).

[21] This includes activated memory structures, or, in other words, experience-based structures.

[22] For detailed information see the next chapter.

[23] For detailed information about the development of musical extrapolations see 4 on page 223.

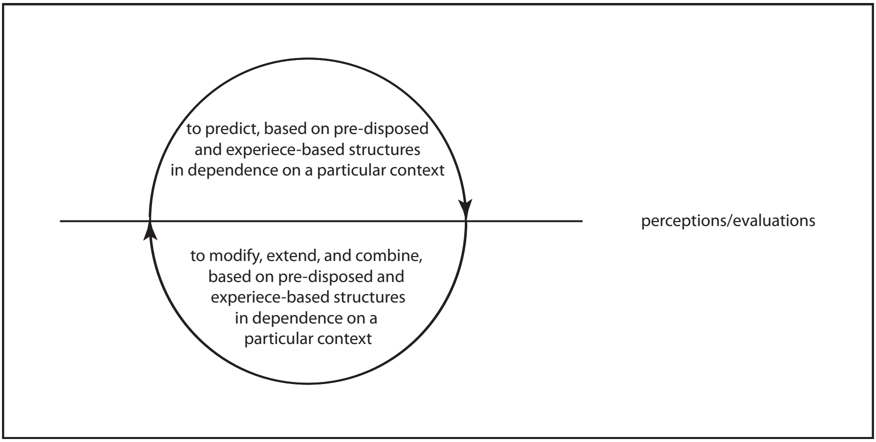

Fig. 3.5 Schematic development process of experience-based structures

Now, if one relates the above definitions of *musical extrapolations* with activities of individuals while they are engaged in composing music, then it seems, that factors and conditions for *musical extrapolations* while composing are similar to factors and conditions while listening. But they differ in some aspects as well. While composing also (see above), memory structures are essential, whereby music can be brought into a kind of a 'composed existence' by creating *extrapolations* about:

first, possible future occurring events;
second, their musical meanings;
third, and the meanings of their inter-relations.

However, opposed to listening, which 'depends (mostly) on uncontrolled processes of sounds happening and fading away' (see above), composition activities take place in a more time-independent manner. This observation is important, because it allows to presume differences between *extrapolation* processes while composing and listening. For example, if one conceives listening to sounds or music as a problem of interpretation within a certain context (see 2.4.3 on page 157), then it is obvious that this context includes time critical reference points. Based on these, but not only, individuals can create *extrapolations* about possible occurring events in time, their meanings, and the meanings of their inter-relations. If one relates these facts with the observation of humans limited mental capacities, for instance to process input information[24], then it is very likely that creative pro-

[24] See explanations about the capacitiy of the short-term memory (see 2.4.1 on page 141; (Snyder, 2000)).

cesses of single-time listening do "[...] not benefit from reflection to the extent that the others[25] do. [...]" (Webster, 2002, p.14)[26] This assumption corresponds quite well to proposals made in models of compositional processes (see 2.5.2.3 on page 180). For example, BURNHARD'S AND YOUNKER'S (2002); (2004) investigations suggest that creative problem solving in the context of composing music seems to be much more complex than listening, with respect to factors, time, and interplay (see 2.5.2.3 on page 185). Because, while listening, important reference points in time are given and hold a structural potential for the *extrapolations* of listeners. Based on pre-disposed and experience-based structures, listeners can use these reference points to structure a relatively limited mental model, whereby possibilities of creating *extrapolations* are constrained.

While composing music also, *extrapolation* processes bring music into a kind of 'existence', and by that, meanings in terms of music are also built on pre-disposed structures, preceded models or integrated sets of hypotheses, and current mental states. But, in contrast, composers are faced with the problem that they must first themselves create reference points in time, which can later 'hold a structural potential for *extrapolations* of listeners'. This means that, while listeners are faced with relatively 'well-defined'[27] problem-spaces, composers must *extrapolate* musical meanings, inter-related, and structured in time, from ill-defined problem-spaces (see 2.5.2.1 on page 169). That is to say, the self-imposed or self-selected reference points of composers are highly versatile, and, as discussed previously, are often outside of the musical domain: they have to be first interpreted and transformed into structuring mental models or integrated sets of hypotheses (see 2.5.2.2 on page 173). Creating *extrapolations* for compositional purposes can be done on this basis. Moreover, compared to the situation of viewers and listeners, to paint pictures and to compose music presupposes more specific developments in various kinds of experience-based structures (see 1.4.1 on page 58; 1.4.2 on page 64; 2.1.2 on page 90). For example, by earlier practices of painting and composing, mental models or integrated sets of hypotheses about painting and composing can be expanded, and thus, in a particular context or problem-space while doing their work, previously created *extrapolations*[28] can then be painted/composed. This also points to another important difference of *musical extrapolations* between listening to music and composing. In listening, no reference points are created, but mental models are built on the basis of given reference points. Furthermore, there are differences in terms of 'preceded mental models or integrated sets of hypotheses': in contrast to listening, it is essential for composing that preceded mental models and

[25] It is meant, composition, music analysis, music interpretation.

[26] See in this regard 2.4.3 on page 156.

[27] Well-defined refers only to the complex problem spaces of composers.

[28] Here I refer to the second definition of musical extrapolation: to modify, extend, and combine based on pre-disposed and experience-based structures in dependence on a particular context.

their structure, meanings and their inter-relations, are at least partially accessible through consciousness (see 2.5.2.3 on page 183; 2.5.1 on page 166). For example, we saw that 'by passive exposure, or experience in performing or producing music, already 6-year-old children have acquired a comprehensive implicit knowledge or experience-based structures of Western music, based on this, they can predict culture-specific aspects of music, such as tonal and harmonic regularities (see Koelsch/Gunter/Friederici, 2000).' This implies that, if such children possess comprehensive implicit knowledge or experience-based structures about Western music, they can *extrapolate* possible events in time, musical meanings, and their inter-relations while listening. But, if these mental models are not structurally accessible through consciousness, it is rather unlikely to use these knowledge or experience-based structures in order to create 'reference points' – to compose music.

Based on the existence of implicit experience-based structures, and structures which are partly 'accessible by consciousness', a kind of musical development may be conceivable. For example, to put 'reference points', in the context of music as a cultural product (see 2.3.3 on page 136), it can mostly be done in terms of explicit experience-based structures, such as pitch systems, rhythms, genres, etc., and formal concepts of a certain music tradition. This presupposes again the development of complex mental models, and stored knowledge in terms of music.

By that, it is obvious that the proposed underlying processes (see Figure 3.5), which foster psychological development, are too simplified to explain complex creative processes and varied development opportunities in relation to music. For example, as previously discussed extensively (see 1 on page 27), all infants are *per se* pre-disposed for music, because around one year after birth, they can process nearly all acoustical parameters, and can mentally organize these parameters – although in a limited fashion. Furthermore, we have seen (2.1.2 on page 90) that creativity, as potential, is given to all infants from birth. This is seen when infants create/transform new meanings from sense impressions. Despite this, not every child is fascinated enough to experiment with all kinds of sound sources, tries to acquire and learns musical instrumental techniques, begins to compose music and later develops an understanding about what can be H-creative[29] in the domain of music, and attempts to compose H-creative music (see 2.3.3 on page 136).

Therefore, if one tries to conceptualize a more comprehensive description of creative processes in relation to music, it is necessary to incorporate further factors and describe their interactions, such as intrinsic activity and motivation, biological maturation, personality traits, and various environmental influences, organized in a *Model of Musical Extrapolations*. Furthermore, processes of creating *musical extrapolations* must be defined more precisely than: 'to predict' and 'to modify, extend, and combine, based on pre-disposed and experience-based structures

[29] Means historical creativity see 2.3.1 on page 118; (Boden, 1994).

in dependence on a particular context'. This means, based on findings exposed within previous discussions about perspectives of creativity in general (see 2.1 on page 85), and in terms of music (see 2.2 on page 111;

2.3 on page 118), as well as creativity in listening to music (see 2.4 on page 140) and creative processes while composing music (see 2.5 on page 162), that musical extrapolations of 'predicting, modifying, extending, and combining' include processes of problem-construction and problem-finding, idea-generation, but also evaluation processes[30]. Hence, a coherent structuring of these (and other) factors and processes into a *Model of Musical Extrapolations* will be subject in the next chapter.

[30] For detailed information see 4.4.1 on page 249 – 4.4.3 on page 264.

Chapter 4
The Model of Musical Extrapolations – Basic Factors and their Inter-dependencies

4.1 Intrinsic Activity and Motivation

In the previous chapter (see 3 on page 209), among other subjects, I introduced a perspective of *musical extrapolations*, based on the fact that human brains constantly generate models or integrated sets of hypotheses about the world, and 'make predictions about everything we see, feel, and hear'.

It is obvious that such processes are constantly driven by a kind of force. Moreover, it seems that this force has two characteristics. First: it is generally essential in every facet of our life; second, its degrees are critical factors for various physiological and psychological developments.

In order to describe this power which is 'essential in every facet of our life', it can be helpful to resort to the biological concept *homeosthasis*[1]. Because, if we try to outline the living, unicellular or multicellular organisms which are often characterized by processes of "[...] exergonic metabolism, growth and internal molecular reproduction. [That means,] exergonic metabolism is required to provide energy for the endergonic synthesis of specific polymers (proteins, nucleic acids, lipids, polysaccharides) from the corresponding monomers, that is, for growth and replication; special replication procedures secure that the polymers synthesized are specific, that they should have the monomer sequence proper to their class; specific polymers (enzymes) are required for the exergonic metabolism and the synthesis of specific polymers (proteins, nucleic acids, lipids, polysaccharides) [Cf. Commoner, 1965]. This circular organization constitutes a homeostatic system whose function is to produce and maintain this very same circular organization by determining that the components that specify it be those whose synthesis or maintenance it secures." (Maturana, 1970)

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[1] For detailed information see (Maturana, 1970; Damasio, 2010).

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If one agrees with MATURANA's description, one can consequently assume that at a very basic level there is a kind of intrinsic activity[2] or motivation which constantly strives to organize "[...] the chemical parameters of a body's interior (its internal milieu) within the magic range compatible with life. The magic range is known as homeostatic, and the process of achieving this balanced state is called homeostasis." (Damasio, 2010, p.29)

In organisms such as mammals, there are complex mechanisms which influence the degree of intrinsic activity or motivation, when the current state is out of balance. For example, if an organism has not ingested liquid or food for a long time, the intrinsic activity or motivation increases with the focus to resolve this internal imbalance. Such basic natural needs trigger motivated problem-solving activities which influence the behavior of animals and humans in certain directions. This is important, because "[...] attempting to correct homeostatic imbalances after they begin is inefficient and risky. Evolution took care of this problem by introducing devices that allow organisms to anticipate imbalances and that motivate them to explore environments likely to offer solutions." (Damasio, 2010, p.31) For example, there are devices which can predict whether a possible occurring event or situation is useful or dangerous for the organism. One mechanism of this sort is that an beneficial event is announced through the distribution of molecules such as Dopamine and Oxytocitin, and on the other hand through the distribution of molecules of Cortisol-Releasing hormones or Prolactin. The distribution of such molecules again motivate behaviors which are necessary, for example, to avoid the predicted dangerous situation.

Besides such mechanisms, brain structures have been developed, which work in context. This is meant, based on processing of perceived pattern, it is possible to make predictions about stimuli that can occur in the future. Because as seen previously (see 2.4.1 on page 140), in a particular context, associations are created between groups of simultaneously and sequentially activated neurons. From these facts, one can suggest, if humans again find themselves in a similar context again, these associations can establish what was defined in the previous chapter as a mental model or integrated set of hypotheses. Parts of this model can be predicted or, that is to say, *extrapolated*.

Prediction seems to be a fundamental intrinsic activity in most animals and all humans, because they must always be prepared to cope with various changes in the environment, in order to ultimately maintain their own homeostasis. This perspective seems even more plausible when further arguments are incorporated, which suggest that prediction activities are processed nearly from the time at which fetus's brain structures are interconnected. As we have seen, between the 29th and the 33th week of gestational age, fetuses have a limited ability to *extrapo-*

[2] This intrinsic activity probably has to do with fundamental processes which determine interactions of molecules: molecules attract or repel each other, etc.

late acoustical parameters, that is to say they predict the last perceived acoustical stimulus (Lengle/Chen/Wakai, 2001; Wakai/Leuthold/Martin, 1996). These results match findings concerning the myelination of the brainstem and central auditory pathways at about the 29th week of gestation age (see Perazzo/Moore/Braun 1995; Draganova et al. 2007). Therefore, based on this very early ability, it can be assumed that the intrinsic activity of prediction is pre-implemented in the human genome, and that it starts in fetuses as soon as the nervous system is ready to work. At least, we can affirm that prediction activities function very early and, furthermore, that they are important mechanisms to investigate fetuses' and infants' abilities to perceive and process acoustical stimuli, such as used to define fetuses' memory structures (see 1.1.3 on page 33), infants' threshold sensitivities (see 1.2.1 on page 35), infants' pitch discrimination abilities (see 1.2.2 on page 42), and abilities to group and segregate auditory information (see 1.3.1 on page 47).

In addition to the fundamental intrinsic activity of trying to predict, based on predisposed and limited experience-based structures, for a suitable interaction with the environment – to ultimately remain in homeostasis –, highly specialized sense organs and well-developed nervous systems have been formed during the course of evolution. By all those means, it is possible to form humans, for example, that cannot only predict current changes in the environment, but incorporate a broad amount of 'pre-disposed and experience-based structures'[3] to extensively explore and interact with the environment. And above all human's live is much more than 'just' staying alive.

For example, infants construct or discover the environment intrinsically, motivated by means of activities conceptualized as *play*. That is to say, *playing* constitutes an intrinsic activity per se, whereby it is possible to explore unknown structures, and by that, can be defined as an important factor for individuals' psychological development. This definition is quite pertinent in musical terms because, as discussed previously (see 1.3.2 on page 49), infants *play* with extrinsic temporal patterns very early. Through this activity, their sensorimotor system will develop, which is essential for the development towards processing and producing sounds (see 1.4.2 on page 64). Hargreaves (1996) presents further indications of this because he found an increasing activity of 'vocal play and babbling', as well as 'rhythmic dancing' within the first 2 years of life (see 1.4.2.1 on page 65). Swanwick and Tillman (1986) also discovered in their study of 745 musical compositions of 48 children (see in this regard 1.4.2.2 on page 69), that children within the first 3 years of life are fascinated by the 'impressiveness of sounds'. They experiment with all kinds of sound sources, such as through the unusual use of conventional instruments. Moreover, both authors conclude that "[...] play, a very important human activity, is intrinsically bound up with all artistic activity, the early and obviously playful activities of children being sublimated into activities

[3] For detailed information see 4.2 on page 228.

such as painting pictures, playing music and reading novels." (Swanwick/Tillman, 1986, p.306) Such a relation seems to be plausible, because PIAGET (1951) already suggests that play has something of creative imagination[4], which in turn can drive artistic activities. LIEBERMAN (1965) found indications for such a perspective, because he detected that kindergarteners with higher rates of playfulness receive higher scores on divergent thinking[5 6].

Nevertheless, although intrinsic *play* activities are important for individuals' development in general and in musical matters, *play* seems to be too limited to conceptualize the force which drives the large number of possible creative behaviors in music, such as processes of *musical extrapolations*. For example, composition activities can be conceived by artists as problem solving work, rather than play. In this way I assume that composition implies processes in which composers have to find adequate solutions to their self-imposed constraints in order to finish a composition according to their aesthetic choice (see 2.5.2.1 on page 169).

For instance, the English composer MICHAEL TIPPETT noticed:

> "Like every artist, my days are spent pondering, considering, wrestling in my mind with an infinite permutation of possibilities." (Tippett, 1974, p.148)

Similarly, the composer WOLFGANG RIHM refers to a persistent uncertainty or doubt of making 'the right choice' (see 2.5.2.2 on page 173), or whether a selection from a potentially large number of possibilities is adequate for the current compositional target.

Therefore, to describe in a more comprehensive way individuals' drive to extensively work (and play) in the musical domain, their fascination to repeatedly create or solve problems, to try to develop ideas for possible solutions, and thus repeatedly 'predict' and 'modify, extend, and combine based on pre-disposed and experience-based structures in dependence on a particular context[7]', I propose to name this drive *motivation*.

As discussed previously (see 2.1.3 on page 99), *motivation* is indispensable to describe creativity, because it can explain, among others, initiation, direction, intensity and persistence of creative behavior, especially goal-directed behavior, such as creative problem-solving activities (see Brophy, 1998). Following this perspective, the *motivation* occupies a central place in the proposed model of *musical extrapolations* (schematically seen in Figure 4.4). Indeed, it strongly affects all structures contributing to creative processes of *musical extrapolations*, and, by

[4] For detailed information about imagination in terms of music see 2.4.4 on page 160; 2.5.1 on page 162.

[5] Divergent thinking: Generation of creative ideas through the exploration of many possible solutions.

[6] For detailed information see section 'Idea-generation' 4.4.2 on page 254.

[7] For the definitions of musical extrapolations, see 3 on page 209).

that, affects the potential of creative products (see 2.3.2 on page 133), as well as individuals' psychological development in terms of music (see 2.3.3 on page 136).

This means for example, in terms of pre-disposed structures[8], there already exists a kind of intrinsic motivation in newborns (see 1.3.1 on page 47), which drives for instance so-called 'primitive groupings' (Snyder, 2000), whereby auditory information is processed out of the ongoing continuum of perceptions: those structures, which have a kind of similarity, proximity, continuity, etc. to each other, are grouped together into a 'something wholes'. By such processes, and working together with an interplay of further pre-disposed structures, such as processing of frequencies, pitch, and timbre information as well as pitch and temporal pattern (see 1.1.2 on page 30), and infants' intrinsic activities *to predict* and *to play* (see above), it is possible, first: to explore the acoustical environment; and second, to construct and extend experience-based structures. Such a development – conceptualized as a cyclical interplay of processes 'to predict' and 'to modify, extend, and combine, based on pre-disposed and experience-based structures' (see Figure 3.5), are also driven through mechanisms[9], which contribute to so-called intrinsic as well as extrinsic motivations (see 2.1.3 on page 99).

Again, both kinds of *motivation* can be initiated and directed through factors like 'environmental pressure' (see 4.3 on page 239), which have affected the development of personality traits (see 2.1.3 on page 96) and their intensity and persistence.

Finally, all the above described processes – sketching intrinsic activities and motivations in general and in terms of music – are essential, because they drive processes inside and between further factors such as: 'problem-construction and problem-finding', 'idea-generation', and 'evaluation'[10] (see Figure 4.4). And, it will be seen in more detail later, the interplay of these factors reflects the core of creative processes involved in listening (see in this regard 2.4 on page 140) and composing (see in this regard 2.5 on page 162) of music from the perspective of *musical extrapolations.* Indeed, through their interplay, **new** *musical extrapolations* can be generated. This means that, driven by intrinsic activities as well as intrinsic and extrinsic motivation, and supported by pre-disposed and experience-based structures, processes of 'problem-construction and problem-finding' generate 'mental models or integrated sets of hypotheses' (see 3 on page 209) depending on a particular context or 'environmental pressure'. Based on these models or integrated sets of hypotheses', and their interplay with processes of 'idea-generation' and 'evaluation', 'music can be brought into a kind of mental and composed ex-

[8] For detailed information about pre-disposed structures, see 4.2.1 on the next page.

[9] One of the most important mechanisms which motivate create activities are *emotions* (see 4.2.1 on page 230; 2.1.3 on page 102; 2.5.2.1 on page 171).

[10] For detailed informantion see 4.4.1 on page 249 – 4.4.3 on page 264.

istence by creating *extrapolations* about: first, possible future occurring events; second, their musical meanings; third, and meanings about inter-relations'[11].

4.2 Pre-disposed and Experience-based Structures

As already indicated in the previous section, pre-disposed and experience-based structures are essential for creative processes in general and in terms of music. The reason for this is that both reflect those structures which, driven by intrinsic activities and motivations, can be modified, extended, and combined[12] in dependence on a particular context. To get a better understanding about the meaning of pre-disposed and experience-based structures, this section is intended to outline important structures and their contribution for *extrapolation* processes, by means of scientific findings discussed previously within perspectives of cognitive sciences in terms of music (see I on page 25).

4.2.1 Pre-disposed

The factor 'pre-disposed structures' reflects an important concept within the proposed model of *musical extrapolations,* because humans base their *extrapolation* processes and, by that, their exploration of acoustical environments on so-called pre-disposed structures, which already function before and immediately after birth and evolve through a kind of biological maturation[13]. This means that *intrinsic activities*, such as *'to predict*' (see 4.1 on page 223) need, or are dependent on, pre-disposed structures whereby information can solely be processed out of the surrounding acoustical continuum.

Already with fetuses, pre-disposed structures process acoustical information in a comprehensive manner. This means that before birth, at certain gestational ages, structures allow to respond to music-relevant information such as a wide range of frequencies (Hepper/Shahidullah, 1994), changes of musical notes (Lecanuet et al., 2000), melodic contour (Granier-Deferre et al., 1998), tempo variation[14] as well as recognizion of human voices (see DeCasper/Spence, 1986) and discrimination

[11] For extended information see Chapter 3.

[12] This is the second definition of *musical extrapolations* (see 3 on page 209).

[13] However, it is difficult to define a pure biological maturation, since experience always affects the biological maturation.

[14] (Kisilevsky et al., 2004)

between their mother's and a stranger's voice (Kisilevsky et al., 2003) (see 1.1.2 on page 30).

Furthermore, fetuses possess limited auditory memory structures (see 1.1.3 on page 33), which are necessary to detect changes in frequencies, notes, melodies, voices, etc. At about the 29th week of gestation age, fetuses possess auditory working sensory-memory structures (Wakai/Leuthold/Martin, 1996; Lengle/Chen/Wakai, 2001), a procedural short-term memory of at least 10 min (Granier-Deferre et al., 2011; van Hereren et al., 2000), and a procedural long-term memory of 24 hours (van Hereren et al., 2000). Moreover, it was shown that fetuses at 34 weeks of gestational age have a 4-week memory (Dirix et al., 2009, p.1152).

Regarding the biological maturation of these capabilities, there are strong indications that, within a relatively short time after birth, infants develop an enhanced sensitivity in structures contributing to the discrimination between frequencies (see 1.2.2 on page 41), pitch (see 1.2.2 on page 42), and timbre (see 1.2.2 on page 44), as well as processing of pitch (see 1.3.3 on page 55), and temporal pattern (see 1.3.2 on page 52), and of auditory threshold (see 1.2.1 on page 35).

It is important to notice that all the pre-disposed structures presented above function together with mechanisms of grouping and segregation processes[15], which seem to be also innate[16] (Shepard, 1981; Bregman, 1994), and by which acoustical information can initially be processed out of the ongoing auditory continuum. Indeed, if fetuses detect changes in frequencies or melodic contour, etc. then "[...] features, such as frequency, amplitude, and boundaries where events begin and end, are detected in the earliest stage of processing, feature extraction, which extracts cues that can be recognized by higher-level processing (long-term memory). These basic features are bound into events by *simultaneous* grouping processes[[17]], and these events are then themselves grouped together over a longer time span by *sequential* grouping processes." (Snyder, 2000, p.32)[18]

If one relates the pre-disposed structures outline above to the core of creative processes within the proposed model of musical extrapolations – defined as 'problem-construction and problem-finding', 'idea-generation', and 'evaluation' (see Figure 4.4) – then it is obvious that pre-disposed structures are the foundations for the 'mental models or integrated sets of hypotheses'[19] involved while listening to music (see in this regard 2.4 on page 140) and composing music (see in this regard 2.5 on page 162). This means that through pre-disposed structures, the ongoing auditory continuum can be detected and structured into 'coherent auditory

[15] Further indications for this thesis are discussed, see 1.3.1 on page 47.

[16] They undergo a biological maturation as well, see 1.3.1 on page 47.

[17] This is called 'perceptual binding' see 2.4.1 on page 141.

[18] For detailed information about grouping and segregation processes see (Bregman, 1994; Snyder, 2000; Deutsch, 2013).

[19] See Chapter 3.

events'[20] (see Bregman, 1994, pp.213-394), which in relation to 'preceded mental models or integrated sets of hypotheses'[21][22], and already generated *extrapolations* about possible occurring events, their meanings; and the meanings of their interrelations, it is possible, first: to define a problems from these perceptions; second, to generate ideas to resolve a possible problem; and third, to evaluate ideas and/or perceptions[23], as discussed about Figure 3.2 (see 3 on page 212).

However to define a problem[24] from an auditory perception, and by that, to evaluate[25] the current perception in relation to already generated *extrapolations*, one must refer to further mechanisms, which are essential for such processes, and furthermore seem to be innate or pre-disposed in their basic structure. This means, as we have discussed previously, that humans have access to a "[...] neurophysiological state that is consciously accessible as a simple, nonreflective feeling [...]." (Russell, 2003b, p.147)[26], from which, and in relation to a perceived stimulus, an *affect* is generated (see 2.1.3 on page 102). Such an emotional experience can change the degree of *intrinsic activity* and *motivation* (see 4.1 on page 223) in order to find the problem, generate ideas for a possible solution, and have an impact on the evaluation processes. Indications for innate affects in terms of acoustical information defined by HURON (2002) as well as TUURI and EEROLA (2012). Indeed, predisposed reflexive and kinaesthetic mechansims contribute to meaning-creation while listening to acoustical information or music (see Tuuri/Eerola, 2012). In this way, it can be assumed that intrinsically grouped frequencies, pitches, timbre, auditory thresholds, organized into simultaneous and sequential pitch and temporal pattern, get assigned an extended meaning by multifariously evoked *affects*, resulting from current perceptions put relation to 'preceded (primitive) models or integrated sets of hypotheses' and their *extrapolations* about the current context[27]. This in turn implies that an *affect* or an emotional experience, in relation to certain

[20] SNYDER noticed in this context: "Feature extraction and perceptual binding together constitute what Gerald Edelman (1989); (1992) has referred to as "perceptual categorization." (Snyder, 2000, p.4)

[21] See definition in the previous Chapter 3 on page 214.

[22] Usually, mental models are founded on experience-based structures (see 4.2.2 on page 232), and feature different degrees of complexities. However, the above described perceptual auditory processing can be defined as 'primitive' models or integrated sets of hypotheses in dependence on a particular context, mainly processed by pre-disposed structures.

[23] For detailed information about problem-construction and problem-finding; idea-generation; evaluation see 4.4.1 on page 249 – 4.4.3 on page 264.

[24] See 4.4.1 on page 249.

[25] See 4.4.3 on page 264.

[26] RUSSELL (2003A) defined this raw emotional feeling as *Core Affect*.

[27] An Indication for this perspective discussed by SCHUBERT and MCPHERSON: "One of the earliest and more important examples is an infant who startlet by an unexpected *subito forte* chord while being exposed to an orchestral work. Some researchers believe that this type of reflexive

grouped acoustical information, reflects initial cues for experience-based structures.

This points to an important aspect concerning any proposed model of creativity. Although *extrapolation* processes usually include experience-based structures in perceptual activations of long-term structures[28] (see SNYDER's (2000) model of memory 2.4.1 on page 142), a working model of creativity in music based on creative processes should explain how the first experience-based structures are developed. Because, as commonly defined, creative activities are an engagement of the mind in a process of thinking to produce something new[29] for the creator. However, at the origin of fetuses' creative experience, aiming to construct and discover (among other) the acoustical environment, there are **no** experience-based structures. Fetuses must create these structures!

Let us see whether the proposed model of *musical extrapolations* can offer a possibility of describing how fetuses create initial experience-based structures in terms of acoustical information.

As we have discussed, at about the 29th week of gestational stage, fetuses' central auditory pathways are myelinated with the brainstem. At the same time, fetuses possess limited memory structures (see above), wherein acoustical information can be saved. Fortunately, it was found that the start of working sensory-memory structures in fetuses is associated with the *intrinsic activity* 'to predict' (see 4.1 on page 224), or, that is to say, "[...] each sound forms a memory trace in the auditory system, if an incoming sound violates the neural memory representation of the recently heard sounds, it elicits an MMN[[30]]." (Kujala/Tervaniemi/Schröger, 2007, p.3) This working mechanism is very informative, because it reflects an *intrinsic activity* "[. . .] in the auditory system for predicting future sound events on the basis of the recent past, and the brain's reaction when those predictions are not fulfilled." (Trainor/Zatorre, 2009, p.172)

These processes can be defined as highly creative. In addition, they produce initial experience-based structures. This means that, by the *intrinsic activity* and *motivation* (see 4.1 on page 223), *pre-disposed structures* detect and organize the ongoing auditory continuum into 'coherent auditory events' (see above), whereby the perceptual system can orient itself within the sound domain, and in some sort define it. In the model of *musical extrapolations,* these processes are called:

response to an acoustic signal is a hard-wired connection that is phylogenetically present (Gaston, 1951; Masterson & Crawford, 1982)." (Schubert/McPherson, 2006, pp.195-196)

[28] Or recent experience-based structures persisting in the short-term memory and sensory memory (see Anderson, 1990; see Barsalou, 1992).

[29] There are additional definitions. See in this regard 2.2 on page 111.

[30] A negativity mismatch (MMN) is a component of the auditory event-related brain potential, which evidenced a sound discrimination.

'problem-construction and problem-finding'[31]. Based on this, the auditory system generates a very limited explorative guess[32]. In a certain way, it predicts[33] the last sound. This *extrapolation* will be evaluated[34] in relation to subsequently defined (perceived) sounds. If current *extrapolations* are violated by actual perceptions, then new experience-based structures are built, in such a way that a new and different future perception is expected. The next time, during this performative process, sounds are associated to each other, simply because they follow each other within a short time delay[35]. Thereafter, the newly learned association between distinct sounds can be further used to predict upcoming events, especially when this connection is strengthened (e.g. by repetition).

Finally, these processes can be defined as the groundwork for a developing cognition in music. Initial '(primitive) mental models or integrated sets of hypotheses'[36] are constantly 'modified, extended and combined'[37] into gradually more complex models, coded in memory as kinds of experience-based structures.

4.2.2 Experience-based

What is meant by experience-based structures?

In the last section we have proposed that experience is an active organization of stimuli in organisms, which, within the model of *musical extrapolations,* depend on

- factors of *intrinsic activity* and *motivation* (see 4.1 on page 223)
- *pre-disposed structures* of the nervous system itself (see 4.2.1 on page 228)
- pre-existing *experience-based structures*
- and *environmental pressure*[38].

These factors create so-called experience-based structures, in relation to an interplay of proposed creative processes, namely:

[31] For detailed information see 4.4.1 on page 249.

[32] For detailed information see 4.4.2 on page 254.

[33] This is the first definition of *musical extrapolations* see 3 on page 209.

[34] Note the discussion above. For detailed information see 4.4.3 on page 264.

[35] Such processes can be conceptualized as Gestalt principles of proximity see 1.3.1 on page 47.

[36] The definition of a sound by pre-disposed structures is enunciated as a kind of primitive mental model or integrated set of hypotheses.

[37] See in this regard the second definition of *musical extrapolations:* 'to modify, extend, and combine, based on pre-disposed and experience-based structures in dependence on a particular context' 3 on page 209.

[38] For detailed information see 4.3 on page 239.

- *problem-construction and problem-finding*
- *idea-generation*
- and *evaluation*[39] (see in this regard Figure 4.4).

From this perspective, it can be suggested that *experience-based structures* are *new musical extrapolations* coded in memory.

In order to describe experience-based structures, and their contribution to *musical extrapolations*, we must take into account how these structures are classified within perspectives of cognitive sciences. In a second step, this section is intended to interpret findings of developmental psychology and creativity research, aiming at making some generalizations about experience-based structures.

Let us start with the question: How can experience-based structures be classified?

It can be assumed that experience is coded in memory mainly in two modes: *declarative knowledge* and *procedural knowledge.*

Declarative knowledge includes facts, categories, schemas, concepts, etc., and relationships between them, which reflect an extended understanding in a certain domain of knowledge (see Anderson, 2009). For example, in terms of categories, we have seen that, during 'perceptual categorization', the ongoing auditory continuum is structured into 'coherent auditory events'. This process can be seen as an important mechanism to built up initial meanings (see 4.2.1 on page 228). Based on this, basic structures of experience, so-called conceptual categories, are organized in memory, which allow us to

- identify and generalize perceptual categories
- link stored perceptions together, which occurred at different times.

These categories do not depend on any kind of language; possess a graded structure; can be idiosyncratic; and are organized in hierarchical structures (see Snyder, 2000; Zbikowski, 2002).

> "Categories form the connection between perception and thought, creating a concise form in which experience can be coded and retained. [. . .] Categories are the primary terms in which many types of memories are stored and recalled." (Snyder, 2000, p.81)

In musical terms, individuals develop, at several different levels, categories of pitches, musical intervals, rhythmical organizations, melodic patterns, etc., to organize experience-based structures, and by that, develop integrated concepts about musical matters.

Furthermore, relations between concepts[40] lead to one of the most important form of organization in declarative knowledge, namely *schemas*. This means that

[39] For detailed information see 4.4.1 on page 249 – 4.4.3 on page 264.

[40] A concept refers to all the knowledge that one has about a category.

"[...] categories are the elements or slots from which schemas are constructed." (Snyder, 2000, p.141) Schemas store abstracted knowledge about relationships of concepts, and experiences in different situations and at different times, that have some common aspects. Such a coded experience can be defined as a kind of ecological management of knowledge in memory. Indeed, not every detail is stored, but invariant aspects summarized into a schema[41]. In addition to cognitive structures, emotions can also be coded as a kind of declarative knowledge. This means that, based on the current "[...] neurophysiological state that is consciously accessible as a simple, nonreflective feeling [...]." (Russell, 2003a, p.147) an affect can be generated in relation to a perceived stimulus (see 2.1.3 on page 102). Such coded affects are beneficial for musical extrapolation processes, because they specify declarative knowledge and differentiate its meanings.

This is what makes declarative knowledge very important for organizing 'mental models or integrated sets of hypotheses' about the current perceptions. The understanding of certain perceptions within situations, abstract relations of schemas, concepts, categories, etc., and related emotional experiences, is used to organize a current mental model. The development of *new musical extrapolations* are thus facilitated by using this abstract knowledge, in the form of abstract relations represented in a concrete imaginable situation. Or, that is to say, a 'mental model or an integrated set of hypotheses' usually includes instantiations of one or more schemas. And, if parts of activated declarative knowledge are explicit emotional memories, e.g. negative affect, an interpretation of this emotion can increase *intrinsic activity* and *motivation* (see 4.1 on page 223) in *musical extrapolation* processes, such as trying harder to generate creative ideas for solve a defined problem (see 2.5.2.1 on page 171).

Procedural knowledge builds the second part of experience-based structures that help to organize current 'mental models or integrated sets of hypotheses'. It consists of the knowledge which is exercised in solving a certain problem, or in other words, a procedure which organizes how we think. As declarative knowledge, procedural knowledge also possesses emotional structures. CLYMAN (1991) defines that "[...] processes which culminate in an emotional state[[42]], as well as the consequences of that emotional state, are procedurally organized." (Clyman,

[41] The structure of schemas themselves contribute to the activity 'to predict, based on predisposed and experience-based structures in dependence on a particular context' (This is the first definition of musical extrapolations, see 3 on page 209.). For instance, if a schema of a melodic sequence of sounds exists, the recognition of this scheme during listening will enable the prediction of future sounds. In this context, we assume that "[...] schemas in the form of musical patterns and styles are largerly responsible for our feelings of expectation while listening of music."(Snyder, 2000, p.96)

[42] The definition 'emotional state' corresponds quite well to the description above: "[...] neurophysiological state that is consciously accessible as a simple, nonreflective feeling [...]." (Russell, 2003a, p.147)

1991, p.356) Such so-called *emotional procedures* are very important for creative processes, because they often have decisive influence on the direction of *extrapolations* while listening to music and composing. For example, composers' compositional processes are guided by exercised emotional procedures. First, sound perceptions are supported by activated affects – bodily reactions, such as muscle tension, or changes in blood pressure and heart rate (see LeDoux, 1996) – , which were stored in conjunction with previous acoustical perceptions. Such coded patterns of affects, or emotional procedures, influence and "[. . .] process the meaning, significance, or value of a stimulus to the individual (Arnold, 1960); (Campos et al., 1989)." (Clyman, 1991, p.357) Second, emotional procedures seem to be in general conducive for composers' attitude to work. Because, if performed emotional procedures[43] culminate in an emotional state which is consciously accessible, then we have seen that the quality and type of cognitive processing can be influenced (see 2.5.2.1 on page 171).

Typically, procedural knowledge and emotional procedures cannot easily be articulated by individuals, because they are mostly unconscious. For instance, if one asks a pianist to describe both knowledge he/she exercises while performing a certain piece of music, he/she certainly has problems to articulate this knowledge.

Moreover, it is important to say that procedural and declarative knowledge reflect memory processes which are fully present at different phases in the development of individuals. CLYMAN (1991) states "[. . .] that procedures are present soon after birth[[44]], but the declarative memory system does not emerge until the end of infancy (Mandler, 1983); (Schacter and Moscovitch, 1984); (Nadel and Zola-Morgan, 1984)." (Clyman, 1991, p.354) One reason for the missing declarative memory system seems to be that involved pre-disposed structures are immature, particularly the postnatal hippocampus (Nadal/Zola-Morgan, 1984).

These findings correspond quite well to some aspects observed at the beginning of one's individual's creative experience with music. For example, SCHUBERT and MCPHERSON (2006) discovered that "[...] infants are born with basic kinds of mechanisms that enable them to interpret the emotional meaning of sounds in the environment and, in particular, from their caregiver (see 1.4.2.3 on page 72). Furthermore, we have seen that infants' temporal abilities develop from perceptual and motor procedures. Also, it seems that wide ranged pre- and postnatal perceptions of rhythms, and practiced motor procedures such as sucking rate, are essential foundations to *extrapolate* time and rhythmical structures in musical terms (see 1.3.2 on page 49). Finally, HARGREAVES (1996) as well as SWANWICK and TILLMAN (1986) could not find that infants up to 3 years use declarative knowledge while

43 An emotional procedure can also be termed as a scheme of action that is performed while composing, and is familiar and comfortable for the composer, e.g. to compose at the piano.

44 However, research has revealed that already fetuses possess a limited procedural memory (see 4.2.1 on page 229).

they are engaged in music – assumed by their unsteady and unorganized musical play (see 1.4.2 on page 64). Approximately at the age of five, experience seems to be coded in memory in declarative fashion, which permits later processes whereby "[...] individual contours and intervals are reproduced accurately [...]" (Hargreaves, 1996, p.162). Children are able to schematically recognize and use artistic conventions, and begin to compose more melodic and rhythmic patterns including repetitions as well as the appearance of musical conventions, such as musical phrases and meter. Around this age as well, children "[...] have entered the first stage of conventional music-making." (Swanwick/Tillman, 1986, p.332), because they use conventional categories, schemas, concepts of music, and relationships between them, whereby an observer can often predict what a child will compose.

Finally, to understand the telicity of human activities, using declarative and procedural knowledge to achieve objectives[45] is intimately tied to the concept of *musical extrapolations*. Within our proposed model to creatively generate *extrapolations* while being engaged in music is defined as a creative problem-solving process. This is, among other, supported by procedural and declarative knowledge, e.g. the *extrapolation* of meanings about a musical piece while listening as it unfolds (see 2.4.3 on page 153). More obviously, both kinds of knowledge are essential for composers to create a musical product. A composition task can not be performed only by means of declarative knowledge about the composition of music and its associated emotional aura. The frequently used example of a germinal idea (see 2.5.2.3 on page 180) which will gradually be elaborated into a structured composition can only be realized in relation to procedural knowledge and emotional procedures, and by using techniques, methods, and strategies to elaborate interesting compositional problems and to solve them in a satisfactory fashion (see 2.5.2 on page 168).

After classifying and defining experience-based structures, and their coding in memory from the perspective of cognitive sciences, in a second step, we can made further generalizations about declarative and procedural knowledge, as created through *extrapolations* processes in musical contexts, based on the interpretation of findings in developmental psychology (see 1.4 on page 57) and creativity research (see 2 on page 85).

We have seen that fetuses already possess an *intrinsic activity* and *motivation* (see 4.1 on page 223) to process comprehensive pre-disposed structures (see 4.2.1 on page 228), and by that, *extrapolate*[46] or create initial experience-based structures in terms of acoustic information. However, as later discussed in more detail,

[45] This is also a prominent thesis within the cognitive sciences (Anderson, 1983; Newell, 1980).

[46] Reminder: Two definitions of musical extrapolations are defined: first, to predict, based on pre-disposed and experience-based structures in dependence on a particular context; and second, to modify, extend, and combine, based on pre-disposed and experience-based structures in dependence on a particular context (see 3 on page 209).

all creation processes, leading to experience-based structures, depend strongly on *environmental pressure* (see 4.3 on page 239). This means that the conditions of the environment reflect those possible information which can initially be detected by pre-disposed structures, and which, in relation to activated experience-based structures, generate 'mental models or integrated sets of hypotheses'. And those mental models at work, or, that is to say, virtually satisfactory *musical extrapolations,* can be coded as procedural and declarative knowledge in memory.

It can generally be assumed that these saved memorized structures lay the very foundation of musical extrapolations, based on the fact that individuals can recognize that there exists a gap or a musical problem which is interesting enough to spend some time on it. Moreover, to be creative, in the sense of producing something entirely new or original for the musical society – defined previously as *H-musical creativity*[47] (see 2.3.3 on page 136) – as well as the recognition of creative products conforming to this definition, presupposes a comprehensive knowledge about H-creative efforts in music. Without any knowledge about musical achievements, such as existing sonorities, techniques, music pieces, genres, etc., H-creative efforts can not be recognized and honored by listeners, and certainly, composing music with such a level of creativity is hardly possible. Indeed, "[. . .] without some relationship to other accomplishments – without the context or background of past achievements – new productions would merely be bizarre, not original." (Elliot, 1995, pp.216-217)[48]

This points at the fundamental character of experience itself. It is the groundwork for individuals' further development: based on previous experience-based structures, new experiences are created, and the knowledge is built which can be used to 'recognize that there exists a gap or a musical problem which is interesting enough to spend some time on it' (see above). This implies two things: although child prodigies are found in music history, e.g. MOZART, first, the construction of knowledge is constrained through a kind of individual biological maturation; and second, H-creative efforts require a previous period which evolves *musical extrapolations* which can be characterized as *P-culturalized-musical creativity* (see 2.3.3 on page 136).

Indications for this perspective are found in different sections in Part II (see I on page 25). First, PIAGET (1952) discovered that mental abilities which organize perceptions depend on a kind of biological maturation. For example, at around the age of five years, children can better classify objects "[. . .] on the basis of perceptual categories such as size, shape and color." (Cockcroft, 2009, p.333) Further, PIAGET defined that at around the age of 11 - 16, children develop the ability to logically handle abstract concepts (see 1.4.1 on page 60). Second, HARG-

[47] BODEN (1994), p.76 suggests that [. . .] a valuable idea is H-creative if it is P-creative and no one else, in all human history, has ever had it before." (see in this regard 2.3.1 on page 118)

[48] For detailed information about ELLIOT's approach, see 2.2 on page 115.

REAVES (1996) found indication for age related phases of musical-artistic development: namely: sensorimotor, figural, schematic, rule systems, and professional (see 1.4.2.1 on page 65). Third, SCHUBERT and MCPHERSON (2006) present indications that there an 'enhanced ability to perceive emotional connotations of major and minor modes' is fully present at the age of 7 or 8 (see 1.4.2.3 on page 72). And, finally, SWANWICK and TILLMAN discovered that composition students at around the age of 15 seem to develop "[...] what psychologists call Meta-cognition. Basically, meta-cognition is to become aware of one's own thought processes. [...] Central to this awareness is the development of a steady and often intense commitment to what Bunting [(1977)] calls 'the inner emotional content of music at a personal level'. A strong sense of value, often publicly declared, permeates this stage." (Swanwick/Tillman, 1986, p.330)[49]

In creativity research, indications can also be found for the fact that experience is the 'the groundwork for individuals' further development – building an important factor for possible *H-creative* efforts. This means that increases in the degree of expertise or experience-based structures occur frequently in correlation with increases in H-creative efforts. This can be seen by the fact that most famous discoveries, inventions, or works in art are products of creative thinking and behavior during adulthood. Even for creative efforts which do not reach a high level of creativity, activated declarative and procedural knowledge is essential. For example, WEBSTER (1979), p.240 discovered "[...] that a firm grounding in the basic skills of aural discrimination may be important in establishing a basis for creative ability." PRIEST (2001), p.254 found out, "[...] that individuals who were rated as highly creative composers were more aware of temporal factors than their middle and low counterparts." And BURNHARD and YOUCKER (2002) discovered that composition students with limited formal tuition in music produce a "[...] minimal setting of constraints while decision-making moments." (Burnhard/Younker, 2002, p.253)[50]

In addition to essential domain-specific knowledge or experience-based structures, NAKAMURA and CSIKSZENTMIHALI (2003), pp.187-188 suggest further that in domains "[...] that are less logically ordered, such as musical composition, literature, and philosophy, [...] specialized knowledge is not enough; one needs to reflect on a great amount of experience before being able to say something new. Therefore, one would expect important new contributions in these domains to he made late in life."

KOHLBERG (1987) defined such late life creative thinking as *post-conventional thinking* (see 2.1.2 on page 91), whereby an "[...] individual takes account of external constraints and conventional values, but is able to produce novelty despite this." (Cropley, 1999, p.514)

[49] See in this regard 1.4.2.2 on page 69.

[50] See in this regard 2.5.2.3 on page 185.

A famous example of such a post-conventional thinking can be seen in JOHANN SEBASTIAN BACH's late life composition *The Art of Fugue* (origi. Die Kunst der Fuge). Indeed, although its last cycle variation remained unfinished, this work is the highlight of the polyphonic art of composition, and is characterized by a high degree of contrapuntal complexity.

> "*The Art of Fugue* stands before us as the most comprehensive summary of the aged Bach's instrumental language." (Wolff, 2001, p.437)

Finally, based on the discussed arguments above, it appears that experience-based structures stored in memory – classified as declarative knowledge and procedural knowledge – are essential for *musical extrapolations*. Because they organize current perceptions in such a way that explanatory 'mental models or integrated sets of hypotheses' will be generated. Hence one can recognize that 'there is a gap or a musical problem which is interesting enough to spend some time on it'. Consequently, music can be brought into mental existence through creative *musical extrapolations*[51]: about events in time, musical meanings, and their inter-relations, while listening to composing music.

4.3 Environmental Pressure

After discussing factors of *intrinsic activity* and *motivation* (see 4.1 on page 223) as well as *pre-disposed* (see 4.2.1 on page 228) and *experience-based structures* (see 4.2.2 on page 232), which contribute to *musical extrapolation*[52] processes, this section is intended to define, first, the factor of *environmental pressure*[53], essential for the *Model of Musical Extrapolations* (see in this regard Figure 4.4). In a second step, various *organizational structures,* and their impact on individuals' development, will be investigated in developmental psychology and creativity research. This means we will outline *environmental pressures* which impact psychological developments in dealing with music, starting from conducive conditions for *P-culturalized-musical creativity* (see 2.3.3 on page 136), up to conditions supporting *H-creative*[54] efforts to compose musical pieces.

Let us start with the question: How can *environmental pressure* be defined within the *Model of Musical Extrapolations*?

Generally, the concept of *environmental pressure* reflects all possible information which can be detected by *pre-disposed structures*, and supported by activated

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[51] See definitions of *musical extrapolations* 3 on page 209.

[52] For the definitions of *musical extrapolations,* see 3 on page 209.

[53] Indeed, without a given environment an individual and music is not thinkable.

[54] See discussion in the previous section.

experience-based structures. It will be organized in 'mental models or integrated sets of hypotheses', among other, to build the current environment with its meanings. This implies that there is no **one** *environmental pressure*, but many possible, individually constructed pressures. This perspective can very well be verified in music. For example, if one asks individuals about their experiences while listening to a certain piece of music, every individual will describe slightly different experiences, expressed in terms of music theory and/or aesthetic descriptions, emotions, etc.

Therefore, we can state that music listening experiences, but also composers' experiences while conceiving a musical product, are a part of a personal *synchronic environmental pressure* created by individuals.

It is important to notice that the creation of a *synchronic environmental pressure* strongly depends on the current *intrinsic activity* and *motivation* (see in this regard 2.1.3 on page 99 4.1 on page 226) and its related *emotional* aspects (see in this regard 2.5.2.1 on page 171; 4.2.2 on page 232). *Intrinsic activity* and *motivation* means, on a basic level, the current mental state. For example, the degree of general wakefulness or tiredness (physical or mental). But, more interesting, creativity research has revealed that individuals possess a highly intrinsic motivation[55] to extensively work (and play) in their talented domain. In other words, they possess in their domain an intrinsic drive to repeatedly create and solve problems, trying to develop ideas for possible solutions, and thus repeatedly 'predict' and 'modify, extend, and combine based on pre-disposed and experience-based structures in dependence on a particular context[56]'. Although in most cases individuals have many opportunities to create a personal *synchronic environmental pressure* from different perceived stimuli (visual, acoustical, tactile, etc.), this implies that intrinsically musically motivated individuals are highly focussed on music-related stimuli, and their organizations in 'mental models or integrated sets of hypotheses' to create *musical extrapolations,* and, by that, process a *P-culturalized-musical creativity* (see 2.3.3 on page 136). Indications for such a perspective were found by ALBERT (1990) as well as CSIKSZENTMIHALI and CSIKSZENTMIHALI (1988) by revealing that a strong *intrinsic motivation* in a certain domain is one of the first indicator for a creative potential in this domain.

Let us now deal with emotional aspects and their contribution to the creation of a personal *synchronic environmental pressure*, as shown previously (see 2.1.3 on page 102). Emotions are inseparably connected with intrinsic (and extrinsic) motivation, and by that, support and guide the motivation to create a personal *syn-*

[55] "Intrinsic motivation is defined as the motivation to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving satisfying, or personally challenging; it is marked by a focus on the challenge and the enjoyment of the work itself." (Collins/Amabile, 1999, p.299)

[56] For definitions of *musical extrapolations*, see 3 on page 209.

chronic environmental pressure. For example, we have seen (see 4.2.1 on page 228) that humans have access to a "[...] neurophysiological state that is consciously accessible as a simple, nonreflective feeling [...]." (Russell, 2003b, p.147)[57]. From this, and in relation to a perceived stimulus, an *affect* is generated (see 2.1.3 on page 102). Such an emotional experience can change the degree of *intrinsic activity* and *motivation* (see 4.1 on page 223) to construct and find a problem, generate ideas for a possible solution, and have an impact on evaluation processes[58]. One reason for this seems to be that affects trigger declarative and procedural knowledge (see 4.2.2 on page 232), memorized in correlation with a particular emotional aspect (embodied-cognition perspective, see 2.1.3 on page 106).

Moreover, creativity research also proposes that the kind of 'neurophysiological state that is consciously accessible as a simple, nonreflective feeling' (see above) guides the direction of cognitive processing, and, hence, guides the construction of a possible *synchronic environmental pressure* by individuals. For example, beyond perspectives which suggest a curvilinear relation between creativity and affect (see 2.1.3 on page 110), it is often proposed that positive mood[59] has a facilitating effect on heuristic problem-solving tasks, divergent thinking, and it leads to "[. . .] high levels of ideational fluency, speed of association, combinatorial thinking (including incongruent combinations and metaphors), and loose processing involving irrelevant intrusions in thought (cf. Schuldberg, 1990, 1999; Shapiro & Weisberg, 1999; Shapiro et al., 2000)." (Kaufmann/Vosburg, 2002, p.318) In comparison, it was found that a negative mood supports analytical and critical thinking, triggers problem-finding and solving activities, etc. AMABILE (2005) suggests in this context that "[. . .] when people are experiencing negative affect, are aware of that affective state, and are in a situation that clearly calls for creativity, they will interpret their negative mood as an indication that they must try harder to find a creative solution." (Amabile et al., 2005, pp.370-371)

However, it is important to stress that, beyond the above described intra-individual processes forming a personal *synchronic environmental pressure* – with its musical parts, for instance when music is being listened to or composed –, certain *organizational structures* must also be present in the current environment, which will be perceived and foster intra-individual processes.

Such *organizational structures* are most important factors, guiding individuals' creative experience or their psychological development (not only) in dealing with music. For example, at the very beginning of humans' creative experience, fetuses are immersed in a structure, which is mainly pre-organized by their mothers. At

[57] RUSSELL (2003A) defined this raw emotional feeling as *Core Affect*.

[58] For detailed information about problem-construction and problem-finding, idea-generation, and evaluation processes, see 4.4 on page 247.

[59] A mood is an affect state, but less likely to be triggered by a particular stimulus or event (see 2.1.3 on page 102).

a basic level, this means fetuses are embedded in the acoustical environment of their mother's voice, etc. (see 1.1 on page 27), which can be defined as an *organizational structure*. Fetuses can thus create their initial personal *synchronic environmental pressures*. Such initial meanings or experience-based structures, which will be subsequently coded in memory (see 4.2.2 on page 232), are the first steps of a psychological development dealing with 'musical' information[60]. This can be verified by the facts that newborns prefer their mother's voice (DeCasper/Fifer, 1980) and mother's tongue (Mehler et al., 1988).

During subsequent psychological development, one can assume that the creation of personal *synchronic environmental pressures* depends mainly on detected and 'recognized'[61] *organizational structures*, caused or pre-organized by parents, cargivers, and the inner family life. An argument for such an perspective is that, when music listening and playing constitutes a central familial activity, these ongoing musical activities become with a higher probability important parts of infants' or children's personal *synchronic environmental pressures*. Such experience-based structures (see 4.2.2 on page 232) in terms of music or a so-called *diachronic environmental pressure* can affect the further development musical development (e.g. The BACH family (see Derr et al., 1997)). This also implies that personality traits (see 2.1.3 on page 96) of parents, caregivers, etc. and their attitude when interacting with infants or children are mainly responsible for infants' or children's available *organizational structures*. For example, parents allow children to make certain experiences, such as learning a musical instrument, and by that, pre-organize the current environment of children. In this context, SPERA (2005) reviewed that infants' or children's socialization processes depend on two dimensions of a parent-child interaction, namely: parental practices and parental styles (see Spera, 2005). One reason for this is that children often fail to recognize *organizational structures*. Often they are not aware of the importance of the recognition and processing of *organizational structures*, such as to practice *P-culturalized-musical creativity* (see above). Therefore, individuals' early psychological development in relation to music, and by that their socialization processes, mainly depend on *organizational structures* caused and prepared within family, e.g. to be exposed to music, music lessons, to be accompanied in the practice of music playing, encouraged into improvisation and composition of music, attending concerts, etc.

Indeed, creativity research has revealed that families' socio-economic situation (Bruininks/Feldman, 1970; Dudek, 1994), parents' attitude to education (Runco/Albert, 1985), and furthermore, parents' own creativity (Runco/Albert, 1986; Noble/Runco/Ozkaragoz, 1993) can play a significant role for individuals' creative

[60] See in this regard: Section 'Various Ways of Listening (to Music)' 2.4.2 on page 144.

[61] Although infants can recognize and process structures in a limited fashion, such a recognition differs significantly from how older children and adolescences recognize structures (see in this regard 4.2.2 on page 232).

development, and by that, can support infants or children's *musical extrapolation* processes. In addition, RUNCO discovered that parents "[...] who allow independence tend to have children who think creatively. The highly original children have parents who allow independence at an early age." (Runco, 2007, p.52) One reason for this finding could be that children can experiment with various stimuli, and can discover their own inclinations or talents in certain domains. TORRANCE (1980) describes indications for this perspective in his longitudinal study over 22 years, namely: individuals who did what they liked to do were more creative in their pursuits.

Moreover, as we have seen previously (see 2.1.3 on page 96), characteristic behaviors of independence, autonomy and non-conventional thinking persisting over time and situations (Pharses, 1986), are conducive for adults' creative efforts. Because, "[...] originality may require some sort of autonomy. Originality implies that a person is doing something that is different what others are doing, and that is probably easiest if he or she is independent and autonomous." (Runco, 2007, p.288)

Although there is no unanimous opinion, it seems that available *organizational structures* for infants or children are also depend on siblings and the birth order within families (see 2.1.2 on page 93). The majority of studies (Csikszentmihalyi, 1965; Jarial, 1979; Dave, 1980; Runco/Bahleda, 1987; Feldman/Goldsmith, 1991) presents indications that siblings and the birth order lead to a valid prediction of individual's creative potential. For example, RUNCO and BAHLEDA (1987) found that divergent thinking happens more frequently in families with older children, and have measured higher skills in the oldest, followed by the youngest, and then by the middle children. BEAR ET AL. (2005) studied sibling sex- and age differences in relation to family size, and observe that "[...] growing up with a large group of opposite-sex siblings or with a large group of siblings relatively close in age seems to positively affect the creativity of firstborns." (Bear et al., 2005, p.75) Finally, CSIKSZENTMIHALYI (1965), p.87 thinks "[...] that the most original artists were more likely to be firstborns." And, FELDMAN (1991) proposes that prodigies are more common in firstborns.

These findings suggest two conclusions. First, the quantity and quality of *organizational structures* occurring in larger families is conducive for the development of individuals. Because they are more exposed to different information, creating a greater amount of personal *synchronic environmental pressures*. This implies that children in such family constellations are much more exposed to different problems, and have to develop an amount of knowledge about how these problems can be identified and solved. Second, first borns especially benefit from larger families, probably because of their advanced biological maturation (see 4.2.1 on page 228; 4.2.2 on page 232) and their amount of experience-based structures allowing them to organize all possible occurring information. Moreover, it seems that for first borns, receiving full attention from their parents at the beginning of their life is particularly conducive for their creative potential.

In addition to parents, siblings, and the inner family life, further factors can be defined, which can be responsible for children's available *organizational structures* in terms of music. For example, if parents recognize (and support) an intrinsic musical activity and motivation of their children (see above), often they send their children to music lessons. Music teachers organizing such lessons present the functional role of a new mentor or a new role model. Because, in a one-to-one relationship, they often present particular problems and inform students about specific knowledge, concepts, tactics and strategies to solve problems in order to attain goals. In this way, lessons can have a double impact over individuals. First, formal, as in the case of a piano teacher who prepares *organizational structures*, (not only) to enhance students' knowledge of piano playing. Second, the informal 'preparation' of *organizational structures* must also be taken into account. This means that music teachers present structures informally by their very actions and behaviors. For example, they give students the possibility to explore and discuss extended perspectives and inter-relations, and by that, mediate tactics, strategies, and their own appreciation of what could be important and what could be interesting. Composition teachers, for example, often encourage students to explore concepts and perspectives, away from music-specific declarative and procedural knowledge. In this way, non-musical concepts and perspectives can reflect new *organizational structures* which, in relation to students' highly intrinsic musical motivation (see above), can be transformed and interpreted within structuring 'mental models or integrated sets of hypotheses'.

GUILFORD and MICHAEL (1999) already point to transformations as the most critical factor for creativity. And, in music, we have seen with the examples of IANNIS XENAKIS and JOHN CAGE (see 2.5.2.2 on page 173), that such transformation processes often have a potential for *H-musical creativity.*

Finally, two key features can be outlined, which, formally or informally stimulated by parents, caregivers, siblings, musical mentors and role models, can forster individuals' *P-culturalized-musical creativity,* and by that, develop a 'music-colored' *diachronic environmental pressure* (see above) – an important foundation for *H-musical creativity*.

First, children's and students' *intrinsic activity* and *motivation* (see 4.1 on page 223), is stimulated by the presentation of interesting *organizational structures.*

> "Of course, both extrinsic motivation and intrinsic motivation can be involved in creative efforts, but intrinsic motivation may allow a student to follow his or her own interests without worrying about pleasing the teacher. The student may be self-expressive instead of conforming. Additionally, extrinsic factors sometimes direct one's thinking. A student may be thinking about "what does the teacher expect here" instead of thinking in a self-expressive manner." (Runco, 2007, p.191)

Hence, to emphasize *organizational structures* which too strongly motivate extrinsically, such as grades, rewards, etc. should be avoided. Because children and students can over justify their musical actions.

> "Overjustification occurs when a behavior is initially intrinsically motivated, but the individual begins to earn rewards for it as well. Sadly, the intrinsic interests are sometimes lost! It is as if the student sees the rewards and forgot about his or her own interests." (Runco, 2007, p.191)

The second feature is the stimulation of children's and students' *flexibility* in the processing of *organizational structures. Flexibility* is one of the most important precondition for creative efforts, and it is visible in a "[...] flexible cognitive style when approaching problems, that is, being able to "think outside the box" and not being tied to any one perspective (functional fixedness)." (Feist, 1998, p.300) As discussed above in terms of the inner family life, it seems that the great amount of *organizational structures* within larger families already increases the ability to think flexible, which can be seen as divergent thinking. Moreover, based on the assumption that human activities are telic in general (see 4.2.2 on page 236), it seems that individuals' sensitivity to different perspectives has its origin in different *organizational structures* encountered in childhood, as discussed above concerning music, but also through non-musical experiences, such as childhood trauma, deprivations, frustrations, and conflicts (Goetzel/Goetzel, 1962; Goetzel et al., 2004), parental loss (Albert, 1978), etc. In this way Runco (2007), p.404 suggests, these "[...] are alternatives, and having them available makes the person flexible and able the choose from [– or avoid –] various alternatives."

Flexibility in thinking is thus important for practicing *P-culturalized-musical creativity,* and especially for *H-creative efforts*.

This is visible when individuals compose music using themes and motifs, because *flexibility* is essential to vary sound structures within these concepts. Indeed, while composing, individuals must be able to set different perspectives in relation to the selected material, as discussed in section 'Various Ways of Listening to Music' (see 2.4.2 on page 144)[62]. This means on the one hand, that attention needs to be directed towards particular attributes (e.g. scales, rhythms or dynamics). On the other hand, perspectives of the overall organization of particular attributes must be involved. Furthermore, composers are often confronted with certain preconditions for composition processes, such as technical requirements, the fulfillment of composition commissions, Zeitgeist, circumstances of premiere, etc. All these perspectives, sometimes competing, require a high level of *flexibility* in thinking while composing of music, if it should be recognized and honored as *H-musical creativity.*

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[62] Such changes of perspectives again presuppose a certain amount of *experience-based structures* (see 4.2.2 on page 232).

This also means that to practice *P-culturalized-musical creativity* requires a high degree of *flexibility*, reflected through the process of learning itself. For example, creativity research has revealed that the attitude of being open to novelties, labelled *openness to experience*, is considered as a fundamental factor for creative output in different domains (Feist, 1998). *Openness to experience* involves a sensitivity to fantasy, feelings, aesthetics, ideas, actions, and values (see McCrae, 1987), which drive individuals' learning processes, such as to practice *P-culturalized-musical creativity.* But also in terms of *H-creative efforts*, AMABILE ET AL. (1993) found that professional artists particularly possess a strong tendency toward openness. Such a perspective is plausible, because composers draw compositional ideas from various influences. This is partly reflected in the titles of musical pieces. A further argument for a strong tendency toward openness of artists can be seen by the problem stated by the famous composer WOLFGANG RIHM: A composer is almost all the time inspired, the problem is to make the right choice (see 2.5.2.2 on page 173). This statement implies that RIHM's *openness to experience* or *flexibility* in thinking is a fundamental source of his creative efforts. However, simultaneously, a general openness may cause a persistent uncertainty and doubt about making 'the right choice', whether a selection out of a potentially large number of possibilities is adequate for the current compositional target, in relation to *organizational structures*.

In conclusion, a factor of *environmental pressure* can be defined within the *Model of Musical Extrapolations* as a mental construct, created by intra-individual processes in relation to *organizational structures.* In addition, we could present arguments for the perspective that parents, caregivers, siblings, the inner family life, musical mentors and role models have a crucial impact on children's and students' available *organizational structures*, and, by that, influence the directions of the personal *synchronic environmental pressures* created. Furthermore, *'intrinsic activity* and *motivation'* as well as *flexib*ility, were defined as two key features for the processing of environmental *organizational structures*. This again suggests, in terms of individuals' *musical extrapolations*, that parents, musical mentors, etc. should try to stimulate *intrinsic activity* and *motivation* as well as *flexibility* by presenting interesting alternatives or *organizational structures*, such as to allow to listen to different music, to encourage to learn a music instrument, to show children musical subjects and talk about them as well as to outline possible structures of musical pieces, but also, to present enhanced perspectives from philosophy, religion, and culture, mediate varieties of tactics and strategies for reaching goals, and let children and students make mistakes, etc.

4.4 At the Very Heart of *New* Musical Extrapolations

After describing basic factors of *intrinsic activity* and *motivation* (see 4.1 on page 223), *pre-disposed structures* (see 4.2.1 on page 228), *experience-based structures* (see 4.2.2 on page 232), as well as *environmental pressure* (see in this regard 4.3 on page 239), and their significances within the proposed model, this section is intended to incorporate these perspectives in order to define processes which are at play at the very heart of new *musical extrapolations* (see in this regard Figure 4.4).

To begin with, I propose that processes included in *musical extrapolations* are consistently creative. At a basic level, this means that individuals possess and perform an *intrinsic activity* (see 4.2.1 on page 228): they 'predict, based on *pre-disposed* and *expierence-based structures*'[63]: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations (see 3 on page 213). Subsequently, such *extrapolations* are 'modified, extended, and combined'[64], under the influence of perceptions and evaluations of ongoing *organizational structures* (see 4.3 on page 239) – e.g. when listening to music, occurring and fading sounds and chronological phenomena. Indeed, the cyclical interplay (see Figure 3.5, 3 on page 218) of processes included in both definitions of *musical extrapolations* **creates** the music, or, in other words, creates the personal *synchronic environmental pressure*, e.g. when music is being listened to (see 4.3 on page 241).

When composing music, individuals must also perform both kinds of *musical extrapolations*. This means that, within a current compositional context, composers conceive musical structures, such as rhythms, sound colors, motifs, etc., and by that, in a certain kind 'predict, based on *pre-disposed* and *expierence-based structures*': first, possible future occurring events; second, their musical meanings; third, and the meanings of their inter-relations (see above). These created *musical extrapolations* are sketched subsequently in various manners by composers, e.g. in sketchbooks (see 2.5.2.2 on page 179), or memorized (see 2.4.1 on page 141), in order to *modify*, *extend,* and *combine* these *extrapolations* in further composing processes, e.g. when structuring a musical motif-variation within a composition. Finally, as when listening to music, the cyclical interplay of both kinds of *musical extrapolations* creates the music when composing (as a mental construct). Moreover, in addition to listening, composition creates a musical product, which will later offer potential reference points for listeners to create further mental constructs of *musical extrapolations.*

[63] This is the first definition of *musical extrapolations*, see 3 on page 209.

[64] Second definition of *musical extrapolations,* see 3 on page 209.

Defining *musical extrapolations* as processes establishing musical mental constructs points towards a second assumption. I suggest that *musical extrapolations* can be described as organizing ’mental models or integrated sets of hypotheses’ (see 3 on page 209). This is an useful description, because, first: telic functions of mental models can be put forward to describe listening and composition activities. Second, within the concept of mental models, one can integrate complex information processing, as discussed previously in sections on *intrinsic activity* and *motivation* (see 4.1 on page 223), *pre-disposed structures* (see 4.2.1 on page 228), *experience-based structures* (see 4.2.2 on page 232), and *environmental pressure* (see 4.3 on page 239). For example, within the so-called perceptual auditory processing, the *intrinsic activity* related to *pre-disposed structures* of individuals processes information from the surrounding acoustic continuum, and thus, modelizes the acoustic environment (see 4.2.1 on page 228). But also, the *intrinsic activity* of fetuses ’predicting’ future sound events based on the recent past, reflects the ongoing modelization of at least two information together with their relations. In the further psychological development of individuals, as we have seen, the modelizing of acoustic information becomes increasingly complex. This is possible because activated *declarative* and *procedural knowledge*[65] (see 4.2.2 on page 232) organize ’mental models or integrated sets of hypotheses’ for certain purposes in relation to current acoustic perceptions. This can be seen very early in terms of listening to music: 6-year-old children can predict culture-specific aspects of music, such as tonal and harmonic regularities (see Koelsch/Gunter/Friederici, 2000).

Indeed, in the case of *musical extrapolation* processes while composing of music, mental models are essential to create new musical structures, and seem to include two aspects: First: musical imagination allowing to mentally hear desired sounds and their alteration – BAILES and BISHOP (2012) systemize indications for such a perspective, because they describe various steps of musical imagery and imagination processes while composing music (see 2.5.1 on page 165). And second, instantiations of more abstract schema, concepts and possible relations, such as scales, rhythms, tensions, phrases and their proportions and variations, the overall structure of the composition, but also concepts external to the musical domain, such as philosophy, religion, literature, visual arts, etc.

For instance, composers’ ’germinal ideas’[66] (see 2.5.2.3 on page 180), which often initiate new compositions, are more or less precise organized mental model

[65] Abstract relations of schemas, concepts, perceptual and conceptual categories, emotional experiences, etc.

[66] BENNETT (1976) describes in his study concerning classical composers that the inital germinal idea, “[. . .] variously termed the "germ," the "kernel," the "inspiration," or the "idea." [. . .] may take a variety of forms – a melodic theme, a rhythm, a chord progression, a texture, a "kind of sound," or a total picture of the work. [And] the germinal idea is a really potent one, [because] the author has found that it is seldom forgotten.” (Bennett, 1976, pp.7-8)

about relations of musical structures, based on *pre-disposed* and *experience-based structures.* Such an organization process allows the composer to mentally hear (and in a certain way 'to predict') a 'germinal idea'. Furthermore, this model is the design basis on which the composer can develop further thoughts to forward his compositions, and by that, *modify*, *extend,* and *combine,* incorporate abstract schemas, concepts in order to develop 'germinal ideas' into more and more elaborate composed structures.

Finally, after asserting that *musical extrapolations* are consistently creative, and assuming they consist in 'mental models or integrated sets of hypotheses', the following three subsections should outline processes, conditions and characteristics structuring these so-called 'mental models or integrated sets of hypotheses' within the perspective of the *Model of Musical Extrapolations.* Generally, the intention of these subsections is the description of processes which are responsible for the generation of **new** *musical extrapolations*. This means that I propose that the core of the *Model of Musical Extrapolations* (see in this regard Figure 4.4) consists in processes which, in relation to each other[67] create the music while listening and while composing, and simultaneously put forward individuals' *P-culturalized-musical creativity* (see 2.3.3 on page 136). These processes are defined as 'problem-construction and problem-finding' (see 4.4.1), 'idea-generation' (see 4.4.2 on page 254), and 'evaluation' (see 4.4.3 on page 264).

However, it is important to notice that the proposed processes, positioned at the very heart of new *musical extrapolations,* are no explicit stage-to-stage processes – from *problem-construction* and *problem-finding* to *idea-generation* to *evaluation* – but have to be conceptualized as cyclical, including simultaneous, recursive, etc. processes.

Nevertheless, to describe the processes of *musical extrapolations* in separate stages has the advantage of illuminating complex issues from different perspectives.

4.4.1 Problem-Construction and Problem-Finding

To start with, let us define the meaning of the term *problem* within the *Model of Musical Extrapolations.*

From the perspective of creativity research, RUNCO proposes:

> "A *problem* can be defined as a situation with a goal and an obstacle. The individual wants or needs something (the goal) but must first deal with the obstacle." (Runco, 2007, p.14)

[67] and to factors as well as processes of *intrinsic activity* and *motivation* (see 4.1 on page 223), *pre-disposed structures* (see 4.2.1 on page 228), *experience-based structures* (see 4.2.2 on page 232), as well as *environmental pressure* (see 4.3 on page 239)

Within the *Model of Musical Extrapolations* we have proposed (see 3 on page 218) that individuals possess and perform an *intrinsic activity*, 'based on pre-disposed and experience-based structures' in a more or less complex manner to predict: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations[68]. This means that, while listening, individuals constantly anticipate forthcoming musical structures (see in this regard Huron, 2006), and that, while composing, possible forthcoming musical structures are conceived (see 2.5 on page 162).
In this way, a so-called *problem* arises, when a complex of differences or tensions is *constructed* between previously generated *musical extrapolations* (representing a sort of goal) and current perceptions and evaluations (comparable to obstacles). This suggests that the term *problem* is a place holder for complex neurophysiological and psychological processes which drive *the intrinsic activity and motivation* (see 4.1 on page 223) to practice *'P-culturalized-musical creativity'*[69], or, that is to say, 'to modify, extend, and combine, based on pre-disposed and experience-based structures, in dependence on a particular context'[70].

Moreover, at the very basic level of acoustic information processing, we can also suppose that, based on *pre-disposed structures*, with various kinds of *problems* are constantly *constructed* and solved, such as to extract features, perceptual binding, stream segregation, grouping processes, etc. (see 2.4.1 on page 140; 1.3.1 on page 47). That is to say:

> "One of the main problems the auditory system has to solve is how to take the single continuous variation in air pressure present at each ear and, from this, form a representation of all the separate sound sources present." (Bregman, 1993, pp.12-14)

An example for processes *constructing* higher-order *problems* while listening to music[71] can be seen by the example of HAYDN's *Symphony no.94* – nicknamed: Surprise Symphony. As shown in Figure 4.1, HAYDN composed the first phrases of the main theme almost completely in the dynamic level *piano*. But, at the end of the second phrase, he writes an untypical isolated fortissimo chord occurring on the weaker second beat. For listeners, such *organizational structures* (see 4.3 on page 239) can construct some kind of *problem*: previously generated *musical extrapolations* in terms of schemas, concepts, categories etc. do not match current perceptions. As a consequence from this difference or tension, some kind of *problem* is constructed, illustrated by the highlighted affect (see 2.1.3 on page 102),

[68] This is the first definition of *musical extrapolations,* see 3 on page 209.

[69] See 2.3 on page 118.

[70] This is the second definition of *musical extrapolations,* see 3 on page 209.

[71] As discussed previously (see 2.4.3 on page 157), listening to music can generally be described as ongoing problem-solving processes.

which can modify the *intrinsic activity* and *motivation* involved in finding the problem. In this way, RUNCO (1994b) writes:

> "All problems have an affective component. If they did not, they would not be perceived as problematic (and worth one's effort). Problems by definition have goals – usually referred to as solutions – and these are presumably what motivates individuals." (Runco/Nemiro, 1994, p.237)

It is common sense in various areas of music research, such as music philosophy and music psychology, that affects in general, and especially elicited affects caused by confirmed and violated expectations, are one of the main reasons motivating individuals to expose themselves to music.

From the perspective of the *Model of Musical Extrapolations*, a constructed *problem* – which can be reflected by a generated affect – activates processes which try to *modify*, *extend,* and *combine* information within current 'mental models or integrated set of hypotheses' in order to solve this problem. That is to say, processes of *problem-construction* cause a re-organization of current 'mental models or integrated sets of hypotheses', in the form of enhanced involvement of *experience-based structures,* as well as detection of further environmental *organizational structures*, and, by that, cause a telic[72] activity 'to generate ideas' (for more information 4.4.2 on page 254) in terms of: 'first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations' (see 3 on page 213).

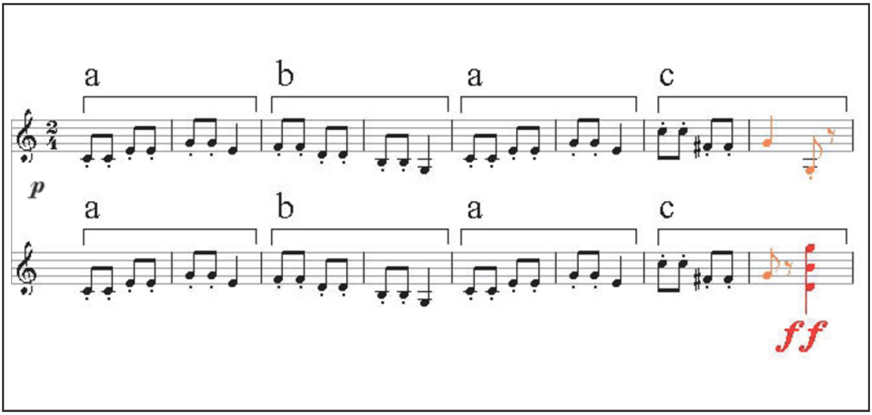

Fig. 4.1 Main theme of HAYDN's *Symphony no. 94* (source: Wikipedia)

[72] The perspective, that human cognition is gerally telic is a prominent thesis in cognitive sciences (e.g. Anderson, 1983; Newell, 1980).

The composition process can also be characterized as being confronted to various kinds of *problems*. This means that an obstacle arises at the beginning of the composition process. This obstacle is represented by 'the blank sheet' phenomenon. But a goal is also predominant, which is to attain a finished composition. However, 'the white sheet' is not the real problem, but it represents the laborious process of handling various obstacles before a composition is completed. Furthermore, the notes themselves are only the entity; they are also structured by processes already performed previous to notational activities.

If one relates processes responsible for the construction of *problems* while listening, to processes responsible for the construction of *problems* while composing, then it becomes obvious that they differ in some aspects. For example, listeners construct *problems,* mainly based on 'time critical reference points' (see 3 on page 218) – sounds happening and fading away. In contrast, composers must first themselves create reference points in time, which can later 'hold a structural potential for extrapolations of listeners'. Moreover, the nature of *problems* constructed by listener and composer differ significantly in structure, time exposure and complexity. This means, among other, that composers must *extrapolate* musical meanings, inter-related, and structured in time, from ill-defined problem-spaces (see 2.5.2.1 on page 169). That is to say, the self-imposed or self-selected reference points of composers are highly versatile, and, as discussed previously, are often outside of the musical domain: they have to be first re-organized within kinds of 'musical' 'mental models or an integrated set of hypotheses.

For composers, moreover, emotional experiences play an important role in *constructing problems*, rather than merely *finding problems*. This happens because, among others, these experiences influence attention, perception, thinking, judgment, storage, mental simulation, and retrieval from memory (see 2.1.3 on page 103).

These effects have implications of two sorts:

1. current affects signal and, by that, construct some sort of *problems,* when a complex of differences or tensions arises between previously generated *musical extrapolations* and current perceptions and evaluations;
2. the current mood state[73] – for example arising after the construction of a larger problem – effects the overall motivation for possible *problem-finding* and *problem-construction* processes.

Regarding the second implication, I conclude that, although there are seemingly controversial discussions about mood states and their contribution to creative efforts (see 2.1.3 on page 107), indications can be found for the perspective that a mildly depressed mood state increases the creative output for composers' *problem-finding* processes (see in this regard (Isen/Daubman, 1984; Isen, 1993; Isen et al.,

[73] Mood is an overall affect state, which is less triggered by an particular stimulus or event.

1985; Mitchell/Madigan, 1984; Jamison, 1993; Runco, 1994b; Rothenberg, 1990; Weisberg, 1986; Ludwig, 1995; Wakefield, 1994)). For example, WAKEFIELD (1994), p.99 proposes "[...] problem finding begins with feeling. The expressions "sensing gaps," "dissatisfaction with the status quo," or "frustration or irritation that something doesn't work as it might" are commonly used to describe problem finding." In this way, it was found that individuals feeling a mildly depressed mood or affect state, construct their task environment more problematically (Vosburg, 1998), are more persistent in searching task-relevant information, as compared with positive mood conditions (Martin et al., 1993). This "[...] leads to more realistic perceptions and judgments and decreases the tendency to be subject to biases (Alloy, 1986; Alloy & Abramson, 1979; Alloy, Abramson, & Viscuti, 1981; Forgas, 1998; Tabachnik, Crocker, & Alloy, 1989)." (Kaufmann/Vosburg, 2002, p.318)

Hence, I can conclude that a mildly depressed mood or affect state is very conducive for the composing process. Because, this state can increase the *intrinsic activity* and *motivation* for the ongoing re-organization of perceptions in relation to activated *experience-based structures,* in order to *find* and *construct* new problems – assuming that composers having in mind the goal of successfully completing their compositions.

Finally, it is important to notice that processes of *problem-construction* and *problem-finding* ultimately depend on *experience-based structures* as well as maturation of *pre-disposed structures*, or, that is to say: 'individuals can only be motivated if they have the skills to recognize that there is a gap or problem worth their time' (see in this regard Figure 4.4).

As comprehensively seen earlier (see 1.4 on page 57), this means that, during the psychological development of an adult, phases can be defined, in which individuals usually possess different skills in *constructing*, *finding* (and solving) various sorts of problems. For example, PIAGET (1952) proposes that children develop skills to 'solve abstract problems in a logical fashion' only around the age of eleven. HARGREAVES (1996) found indication for age related phases of musical-artistic development, namely: sensorimotor, figural, schematic, rule systems, and professional (see 1.4.2.1 on page 65). SCHUBERT and MCPHERSON (2006) present indications that a developmental ability to emotion perception in music (see 1.4.2.3 on page 72) exists. And SWANWICK and TILLMAN (1986) discovered that composition students, at around the age of 15, seem to develop what psychologists call Meta-cognition (see 1.4.2.2 on page 69).

Additionally, it has been discovered that, under the age of five, *declarative knowledge* – as a part of *experience-based structures* – can not be coherently coded in memory (see 4.2.2 on page 232). But, as discussed above, a *constructed problem* is based on tensions or differences between previously generated *extrapolations*[74]

[74] The generation of e*xtrapolations* is per se supported by activated *experience-based structures*!

and current perceptions and evaluations. Therefore, one can assume that, in the absence of comprehensive *declarative knowledge* and *procedural knowledge* – e.g. categories, concepts, schemas, emotional procedures, strategies, tactics, etc., organizing *musical extrapolations*, the quality of processes of *problem-construction* and *problem-finding* will both be restricted.

4.4.2 Idea-Generation

After defining the stages of *problem-construction* and *problem-finding,* this section is intended to outline various processes of *idea-generation,* or ideation, which are responsible for the generation of so-called *musical extrapolations.*

To recapitulate, we have defined that *musical extrapolations* rely on the *intrinsic activity* 'to predict, based on *pre-disposed* and *experience-based structures*'[75] towards: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations (see 3 on page 213). Subsequently, such *extrapolations* are 'modified, extended, and combined'[76], according to perceptions and evaluations of ongoing *organizational structures* (see 4.3 on page 239). Finally, I have concluded that the cyclical interplay of processes included in both definitions of *musical extrapolations* (see Figure 4.2) *creates* the music while listening as well as while composing, or, in other words, creates the personal *synchronic environmental pressure* – with its musical parts (see 4.3 on page 241), which in turn can be coded in memory as *experience-based structures.*

As shown schematically in Figure 4.2, I propose that processes of *idea-generation* or *ideation* can initially be differentiated into *more convergent* and *more divergent ideation* happening while individuals solve *constructed problems*, or, while they are trying to *find problems*. Let me present arguments which support such a conceptualization in a different manner.

At a general level we have discussed previously (see 4.2.2 on page 236), that the nervous system of humans, in its function, can be defined as telic[77], assumed that its basic function is to protect the body against a worst-case situation. For example, even when we sleep, the nervous system is fully active, and generates an immediate protective response, for example when one is pricked by a needle. Such an automatically generated behavior presupposes a certain kind of *ideas* or processes, which generate suitable responses to perceptually *constructed problems.* As seen in Figure 4.2, such processes can be defined as *more convergent ideation*, because *convergent ideation* coordinates processes, aiming more in the direction

[75] This is the first definition of *musical extrapolations*, see 3 on page 209.

[76] The second definition of *musical extrapolations,* see 3 on page 209.

[77] (Anderson, 1983; Newell, 1980)

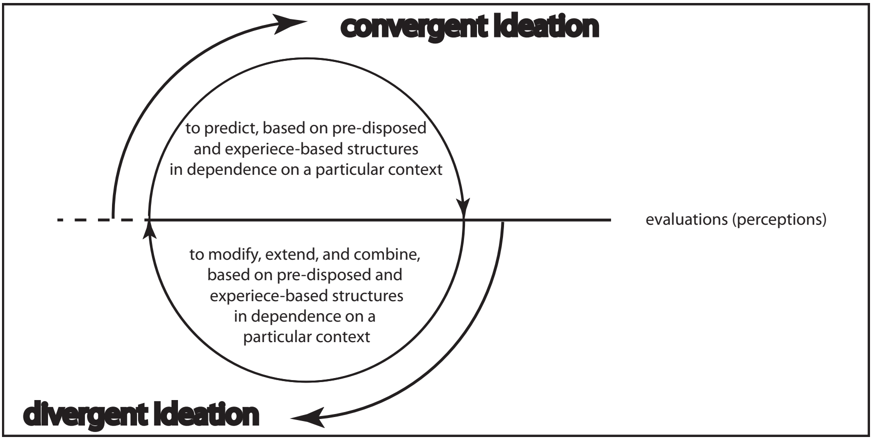

Fig. 4.2 Cyclical interplay of different Idea-Generation processes

of a single-precision solution. Concerning the example sketched above of a sleeping person pricked by a needle, this in turn means an *idea* is generated in terms of a suitable protective motor schema, because the nervous system 'predicts, based on pre-disposed and experience-based structures in dependence on a particular context' (see Figure 4.2), forthcoming pricks and tries to guard the body against further pain.

Such a *convergent* mechanism predicting possible stimuli related to those which have occurred in the recent past is very essential. It was defined previously as individuals' ongoing *intrinsic activity* (see 4.1 on page 223), which fetuses already perform in a limited fashion (in terms of acoustic stimuli) between the 29th and 33rd week of gestational age – as soon as the myelination of the brainstem and central auditory pathways functions. Moreover, it was found that complex *convergent ideation* aimed at predicting stimuli develops rapidly in a very short time. For example, already between the 2nd and 7th month after birth, infants are able to anticipate auditory events temporally (see 1.3.2 on page 52). And, by passive exposure, or experience in performing or producing music, 6-year-old children already have acquired a comprehensive implicit knowledge of Western music, which allows them to predict culture-specific aspects of music, such as tonal and harmonic regularities (see Koelsch/Gunter/Friederici, 2000).

If one keeps in mind that, at every single moment of listening (and during composition of course), exclusively one sound or chord is audible, which is quite meaningless in itself. But such isolated events need to be organized by activated *experience-based structures* (see 4.2.2 on page 232) in order to bring into mental existence the relations between elusive sounds or chords which have occurred at different times. Such organizations form the concepts of melodies, figurative repetitions, cadences, tension envelopes, etc. My colleagues and I have shown (see Schmidt/Troge/Lorrain, 2013) that activated *experience-based structures* often cause *more convergent ideation* automatically. Because instantiations of one or more schemas, concepts, categories, and related emotional experiences[78] automatically organize sounds to musical 'mental model or integrated set of hypotheses' (see 3 on page 209). And, as suggested earlier (see 3 on page 213), this mental organization automatically generates kind of *ideas* directed towards: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations (see 3 on page 213).

An example illustrating this kind of *ideation* found in listening to music can be seen in HAYDN's *Surprise Symphony*, discussed in the previous section (see Figure 4.1). Assuming that an individual is familiar with Western classical music, then, while listening to the 16 bars of the main theme, acoustic stimuli will be automatically[79] organized at a given moment by the activation of musical schemas, concepts, categories, emotional experiences, etc. from memory. This can be defined as a *more convergent ideation*, because the nervous system is continuously confronted with *problems* – how to organize various acoustic stimuli – and automatically tries to generate a suitable solution. Hence, when the first phrases of the main theme are heard, at one given moment, experience-based structures generate a *more convergent ideation* about the stimuli, which can be termed as one of the following concepts: classical music, two-bar melodic motif, melody-schema: a-b-a-c and d-d'-a'-c', kinaesthetic schemata, such as haptic and tactile feelings relating to movement, etc.

The product of such an ideation process is the singular moment which captures the meaning of the music being listened to. In other words, it is the 'mental model or integrated set of hypotheses' founded on processed *organizational structures* (see 4.2.2 on page 232) *at a certain moment*[80], which indeed 'predicts' future occurring events, etc. This can be seen very well in the sensation experienced at the end of HAYDN's main theme (see Figure 4.1), because a surprise arises when an untypical isolated fortissimo chord is played on the weaker second beat. The moment of surprise reflects a *constructed problem,* caused by *evaluation processes* (see 4.4.3 on page 264), which have detected differences or tensions between a more convergent generated ideation about future occurring events and the current perception of that loud acoustic stimulus.

[78] For detailed information see Section 4.2.2 on page 232.

[79] For detailed information see Sections 2.4.1 on page 140.

[80] In the course of listening, the current 'mental model or integrated set of hypotheses' is continuously modified, extended. This means that new arising problems are constructed, ideas are generated to solve problems, etc.

In addition to *more convergent ideation* which are often automatically processed while listening to music, *convergent ideation* processes can also be structured from *evaluation processes*[81], which try to[82] whittle down, combine, or select – consciously or unconsciously – *more divergent ideation* processes into or as a most feasible *idea*. Such an *idea* reflects a current organization about perceived acoustic stimuli in a certain manner, and furthermore, at this single moment, reflects a *more convergent ideation* about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations.

This implies again that the listening process creates music based on a constant interplay of these qualitatively different kinds of *ideation* processes (see Figure 4.2).

Let us go more precise about the second sort of *ideation* occurring while listening to music, the so-called *more divergent ideation.*

First, as extensively discussed earlier (see 2.4.2 on page 144),'Various Ways of Listening to Music' can be defined, or, that is to say, "[...] different, even contradictory, levels of interpretations, emotions and other meaningful experiences [can arise] on the basis of the same physical sound." (Tuuri/Eerola, 2012, p.138) Accordingly, TUURI and EEROLA (2012) present a comprehensive taxonomy of listening modes, and by that, suggest a potentially divergence of *ideation* processes occurring while listening. The famous composer PIERRE SCHAEFFER, in his most important work 'Traité des objets musicaux' (1966), also argues for two distinctive systems of meaning-creation while listening, namely: ordinary listening and reduced listening (see 2.4.2 on page 145). In this context, he states,

> "Nothing can stop a listener from varying [listening] passing from one system to another or from a reduced listening to one that is not. (...) it is this swirl of intentions that creates connections or exchanges of information" (343)." (Dack/North, 2009, p.27)

In the context of the *Model of Musical Extrapolations,* this suggests that acoustic stimuli, organized by *experience-based structures,* offer various possibilities for individuals to intentionally re-organize them into *divergent ideations* at certain moments while listening. This means, according to TUURI and EEROLA (2012), *more divergent ideation* processes can include *experiential ideations* (reflexes, kinaesthetic qualities, associative mental images), *denotative ideations* (causal, empathetic, functional and semantic listening), and *reflective ideations* (reduced and critical listening) (see Tuuri/Eerola, 2012).

Let me try to explain *more divergent ideation* processes, with the help of the (Allegro non troppo) of SHOSTAKOVICH's *8th Symphony.* As seen in Figure C.1, Appendix (see 5 on page 348), if one listens to the first 41 bars, it is easely possible

[81] For detailed information about evaluation processes, see 4.4.3 on page 264.

[82] estimate and/or

to define *divergent ideation* processes to TUURI and EEROLA's (2012) taxonomy, offered by acoustic *organizational structures.*

The 3rd movement starts with an ongoing machine-like motor rhythm played by a single viola voice. Within the following 16 rather monotonous bars, individuals can generate various *ideations*. First, *kinaesthetic ideation* processes can generate an idea about motion in terms of pitch changes and an ongoing strong rhythm, but also tension building and release across the sound progressions. The interpretation that the viola plays the notes as 'an ongoing machine-like motor rhythm' (see above) reflects *connotative ideation* processes, because such meanings are generated through analogical and metaphorical processes, as described by LAKOFF and JOHNSON (1999). At the same time *denotative ideation* processes can relate sounds to various concepts, such as viola, whole step progression, one-bar motive, etc.

At the beginning of bar 17 and bar 21, celli and contrabasses together play a loud chord. This causes *reflexive ideation* processes, because the chord can not be anticipated in the listening situation, and by that surprises listeners – although the repetition of that chord at the beginning of bar 25 and bar 27 can probably be anticipated by experienced listeners. Hence, *denotative ideation* processes also can relate sounds into 'mental models or integrated sets of hypotheses', termed as E minor chord, repetitive schema of an E minor chord, etc.

At the beginning of bar 34, *reflexive ideation* are again generated, because a two-bar motif occurs, played by woodwinds. At the same time, that motif can elicit *kinaesthetic ideation* processes, because it suggests highly tensed and 'shrilling' qualities in the progress of motion. Furthermore, listeners can generate various denotative ideations, such as a F# chord which transforms during 2 1/4 bars into a major ninth; or the recognition of the successive instruments oboe, piccolo, clarinet; or the identification of a motif consisting in the modified repetition of the chord combination starting from bar 38, etc. Simultaneously, *connotative ideation* can be processed. Namely, the woodwind motif in relation to the strong ongoing rhythm played by the viola, offers associations to the effect that something is depressed with all force. However, it is also possible that listeners generate *reduced ideations,* by resisting any denotations and rather orient their listening towards the intrinsic qualities of the perceived sounds.

Finally, based on the above example, it is obvious that *more divergent ideation* processes are at work while listening. This, moreover, offers a possible explanation of why people construct their very own personal *environmental pressure* (see 4.3 on page 239) while listening to music. Indeed, I show that all acoustic stimuli possess a rich potential for structuring *divergent ideations* in every listening situation.

In addition, it seems clear that different sorts of *ideations,* or *divergent ideations,* such as *reflexive*, *kinaesthetic*, *denotative ideation,* can be related to or combined[83]

[83] The combination of different *ideas* include *evaluation processes* (see 4.4.3 on page 264).

into a *more convergent ideation* – at a single moment while listening! This also reflects information about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations (see 3 on page 213).

I thus conclude that the cyclical interplay of both, more divergent ideation processes in relation to *more convergent ideations* (see Figure 4.2), creates personal 'mental models or integrated set of hypotheses' about the music which is listened to, or, in other words, both processes organize the elusive quality of sounds or chords, which have occurred at different times, into music. This is precisely what music actually is: a mental construct.

Let us turn to *ideation* processes during the composition of music.

First of all, we have explained previously (see 3 on page 219; 4.4.1 on page 252) that the nature of problems constructed by listeners and composers differ significantly in structure, time exposure, and complexity. Therefore, I assume that *ideation* processes occurring while listening and composing differ significantly in structure, time exposure as well as complexity. This is obvious when one imagines the difference between generated *ideation* processes of individuals while listening to the first 41 bars of the 3rd movement of SHOSTAKOVICH's *8th Symphony* (explained above), opposed to the *ideation* processes, which SHOSTAKOVICH probably generated as he composed these same bars. For instance, the generation of *ideas* intended to deal with instrumentation problems, is not part of listeners' mental constructions. This is because important reference points in time are given to the listener, and they hold a structural potential for their *extrapolations*. Compared to *ideations* during composition, listening can be defined as thinking in sorts of 'well-defined problem-spaces' (see 2.5.2.1 on page 169). Hence, it seems that the listener's *ideation* processes, caused by the construction of relatively well-defined problems, can as well easily generate solutions. On the contrary, for example, SHOSTAKOVICH has generated, while coping with more 'ill-defined problems': for which instruments should such a passage be orchestrated, or, finding the best phrasing for the woodwinds, etc.

Notwithstanding these enormous differences between *ideations* while occurring listening and composing, I propose that composers' *ideations*, can also be conceptualized into a cyclical interplay of *more divergent ideation* processes in relation to *more convergent ideations.*

Let us be more specific. As we have discussed earlier, first: BENNETT (1976) discovered that the initial phase of the act of composing can be characterized as facing the *problem* " [. . .] of getting what may be called the germinal idea. Once the germinal idea has been found, the composer may simply let it run around in his head for a while. Sometimes the germinal idea is played over and over on some musical instrument, but more frequently it is written down [...]." (Bennett, 1976, p.7) Second: DUNN (2011) states that compositional processes are "[. . .] additive in nature – there are ever-emerging and proliferating points of origin." (Dunn, 2011, p.51) And third: MUMFORD ET AL. (1994) propose that "[...] problem-construction provides a plan or a framework for solution generation and implementation." (Mumford/Reiter-Palmon/Redmond, 1994, p.11)

BENNETT's statement, in connection with the perspective of DUNN as well as MUMFORD ET AL., suggests that compositional processes of *problem-construction* and *problem-finding* (see 4.4.1 on page 249) often initially cause *more convergent ideations*. Indeed, we have seen that a *problem* reflects a 'situation with a goal and an obstacle' and 'problems by definition have goals' (see 4.4.1 on page 249). Therefore, as while listening, I propose that a constructed problem during composition often cause initially *more convergent ideations* automatically[84], such as a plan or a framework (see above), a schema, a texture, an 'image' of a sound, etc. – defined as a solution to a constructed *problem*. This means again that, at a *certain single moment* the composer 'predicts, based on *pre-disposed* and *experience-based structures*': first, possible future occurring events; second, their musical meanings; third, and meanings of their inter-relations (see above).

In creativity research, such an automatically generated *more convergent ideation* is called 'illumination' (Wallas, 1926) or 'aha experience' (Gruber, 1988), in which the individual experiences a singular insight, or, "[...] one solution pops in our heads, like bulb being turned on." (Runco, 2007, p.20) Hence, I propose that composition can be seen as an automatically generated *more convergent ideation*, such as a created 'germinal idea' – as RICHARD STRAUSS stated:

> "It has been my own experience in creative activity that a motive or a two to four measure melodic phrase occurs to me suddenly. I put it down on paper and immediately extend it to an eight, sixteen, or thirty-two bar phrase, which naturally does not remain unaltered, but after a shorter or longer 'maturing' is gradually worked out in definitive form." (Strauss, cited by Sloboda, 1985, p.115)

STRAUSS' statement that suddenly occurred *ideations* are extended into more elaborated musical forms points to the second sort of ideation processes occurring while composing: so-called *more divergent ideations*.

While composing, *more convergent ideations* usually cause subsequent new *problem-construction* and *problem-finding* processes, because individuals construct a problem based on tensions or differences between previously generated *ideations* and current perceptions and evaluations (see Figure 4.2). In other words, composition is 'additive in nature – there are ever-emerging and proliferating points of origin' (see above). These subsequent constructed *problems* may have different objectives, such as a revision of the current solution, the expansion of that solution, or a problem that addresses a different compositional detail.

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[84] This is because instantiations of one or more schemas, concepts, categories, and related emotional experiences automatically organize sounds to musical 'mental model or integrated set of hypotheses'.

For all such problems, I propose that composers usually process *more divergent ideations*, or, in other words, they usually 'modify, extend, and combine, based on pre-disposed and experience-based structures, in dependence on a particular context'[85] (see Figure 4.2).

Let us immerse ourselves more. First, we have seen that emotions play an important role in creative processes (see 2.1.3 on page 107), and, moreover, that positive affect and mood states increase the potential of ideational fluency, combinational thinking, divergent thinking, and transformational processes of existing knowledge into new patterns of configurations (see 2.5.2.1 on page 171). This suggests that experienced affect and mood states also direct the creative output while composing, or, that is to say, positive emotions support the potential of *more divergent ideation* processes. Second, I proposed that all acoustic stimuli possess a rich potential for structuring *divergent ideations* in every listening situation (see above). Therefore, I also suggest that a 'germinal idea' in terms of acoustic stimuli offers divergent possibilities for composers to generate *ideations* from it, such as *kinaesthetic ideations* or *denotative ideations*, or *kinaesthetic-denotative ideations*, etc. (see above).

In addition, it is assmued that combinational and transformational processes constitute the most critical factor for creativity (see Michael, 1999). Hence, I propose that *divergent ideations* for compositional purposes are mostly characterized by transformations and combinations. Indeed, composers intentionally try to transform and combine non-musical and/or different musical concepts into meanings of acoustic stimuli, and by that, try to develop *more divergent ideations* as possible compositional solutions. There are uncountable musical works which are obviously based on conceptual transformations or combinations. At a macro level, the border crosser JOHN CAGE transformed concepts from philosophy, visual arts, literature, music, dance-performance, etc. for his musical compositions. ARNOLD SCHOENBERG developed a transformation of the Western music pitch system, but keeping the established pitch-spacings, instruments, rhythms. IANNIS XENAKIS combined stochastic phenomena with acoustic stimuli, and by that, created the so-called Stochastic Music, etc. In addition to such transformations and combinations, which were recognized and honored as *H-musical creativity* (see 4.2.2 on page 237), I propose, from the perspective of cognitive sciences, that probably every compositional innovation is characterized by transformations and combinations of pre-existing *declarative* and *procedural knowledge* (see 4.2.2 on page 232). This means that abstract knowledge, such as schemas, concepts, categories, emotional procedures, etc. must intentionally be combined and transformed to organize the concrete compositional situation. By that, various compositional problems can be structured, and *more divergent ideations* – or possible solutions – can be generated about the concrete *organizational structures*. E.g. for a motivic

[85] This is the second definition of *musical extrapolations,* see 3 on page 209.

progression, composers must generate *more divergent ideations* about concrete sounds – based on the combination and transformation of pre-existing knowledge.

Indeed, as discussed previously about creativity research (see 2.3.2 on page 128), GUILFORD (1967) found four components of divergent production abilities, identified as:

1. *fluency*, the production of multiple answers from the same given information, in limited time.
2. *flexibility*, the production of shifts of meaning in response to the same given information.
3. *elaboration*, the production of detail or complexity of information, above that called for in response to given information.
4. *originality*, the production of responses, rare in the population to which the subject belongs, novel, or remotely associated with the given information (see Guilford/Hoepfner, 1971).

If one relates these concepts to *more divergent ideations* during composition, we have already seen (see 4.3 on page 239), that *flexibility* in the processing of *organizational structures* is one of the most important precondition for compositional efforts, and it seems that individuals' sensitivity to different perspectives finds its origin in different *organizational structures* encountered during childhood. Moreover, *flexibility* in thinking was defined as an essential personality trait of creative people (see 2.1.3 on page 96). This trait, in relation to a strong *intrinsic motivation* (see 4.1 on page 223) to extensively *play* (see 4.1 on page 225) with acoustic stimuli – or, in terms of the *Model of Musical Extrapolations*, an intrinsic drive to repeatedly create and solve problems, trying to develop various ideas for possible solutions – is one of the first indicator for a creative potential in any domain (Albert, 1990; Csikszentmihalyi/Csikszentmihalyi, 1988).

I also agree that, to a certain degree, people must necessarily think fluently to achieve compositional goals in a short time – in the above meaning of the term *fluency*, as 'the production of multiple answers from the same given information, in limited time'. But, in contrast to *more divergent ideations* while listening, defined as a highly time-critical process – because of its very insertion in time, and because of the limitation of the listener's capacity to process all acoustic stimuli – it is more important for composers to think flexibly, defined as the ability to generate divergent ideations from 'shifts of meaning in response to the same given information' (see above). Because divergent production processes – to observe different perspectives and to work out in detail – is more important than quickly moving forward. This can be explained with the help of the example discussed above of SHOSTAKOVICH's 3rd movement of the *8th Symphony*. Assuming that SHOSTAKOVICH has generated a *more convergent ideation* to compose a woodwind motif starting from bar 34, *flexibility* and *elaboration,* characterizing the generation of *more divergent ideations* about the woodwind motif, was probably more conducive for the creative potential of that motif, than *fluent* thinking alone would have had.

This leads to the conclusion that, in order to create a suitable compositional idea, it is first essential to structure sounds from different perspectives, discussed above. Second, suitable composed ideas are characterized by the fact that they will be worked out to the smallest detail – I assume that every smallest detail presupposes separate *more divergent ideations*. This means, for example, that SHOSTAKOVICH's composing processes to find the best expression of that woodwind motif probably caused a huge amount of *more divergent ideations* to various possible aspects considered.

In terms of *originality*, numerous studies concerned with measuring musical creativity (see 2.3.2 on page 128) have revealed that, among other, composers' abilities to generate *more divergent ideations* higly depend on their pre-existing *experience-based structures* (see 2.3.3 on page 137; 4.2.2 on page 232). This means, first, composers (and listeners of course) need *declarative* and *procedural knowledge*, if they process *P-culturalized-musical creativity* (see 2.3.3 on page 136), defined as "[. . .] the engagement of the mind in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator." (Webster, 2002, p.11), and second, that they ultimately need a huge amount of experience-based structures – not only in terms of music – striving to create *H-musical-creativity*[86]. Because, without any knowledge about music as a cultural product, such as existing sonorities, techniques, music pieces, genres, etc., H-creative efforts can not be recognized and honored by listeners, and, certainly, composing music with such a level of creativity is hardly possible. In this context, ELLIOT (1995) further clarified that "[. . .] without some relationship to other accomplishments – without the context or background of past achievements – new productions would merely be bizarre, not original." (Elliot, 1995, p.217) Therefore, I propose that *more divergent ideations* while composing – having the potential to be recognized by listeners as *original* in the above meaning – presupposes a very lengthy and elaborate *P-culturalized-musical-creativity* processing, which first lays the ground for possible later occurring *H-creative* composition efforts.

Finally, after outlining the role of *more divergent ideations* during composition, it is essential to state that during composition, as well as while listening (see above), *more divergent ideations* are estimated and/or whittled down, combined, or selected – consciously or unconsciously by *evaluation processes* (see 4.4.3 on the next page) – as or into a most feasible realistic idea. This final idea reflects a unique moment, in satisfying the mental organization of the current compositional concept in relation to perceived acoustic stimuli. In turn, it reflects, at this sin-

[86] BODEN (1994), p.76 suggests that "[. . .] a valuable idea is H-creative if it is P-creative and no one else, in all human history, has ever had it before." (see in this regard 2.3.1 on page 118)

gle compositional moment, a *more convergent ideation* about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations. Therefore, as seen above, because composition is 'additive in nature', a *more convergent ideation* causes subsequent new *problem-construction* and *problem-finding* processes, based on the fact that composers try to generate *more divergent ideations* to find possible compositional solutions. Finally, this argues for my initial proposal (see Figure 4.2): that processes structuring (compositional) ideas and their development can be characterized as a constant interplay of *more convergent ideations and more divergent ideations*.

4.4.3 Evaluation

As previously discussed, basic factors of *intrinsic activity* and *motivation* (see 4.1 on page 223), *pre-disposed structures* (see 4.2.1 on page 228), *experience-based structures* (see 4.2.2 on page 232), as well as *environmental pressure* (see 4.3 on page 239), are at play while processes of *problem-construction* and *problem-finding* (see 4.4.1 on page 249), as well as *idea-generation* (see 4.4.2 on page 254), create musical meanings and their inter-relations. However, it is essential to notice that *evaluation* also plays an important role. Hence, this section is intended to outline evaluation processes, which are in play at the very heart of new *musical extrapolations.*

To start with, let us define the term *evaluation*. For instance, in MEEKER's (1980) work measuring evaluation operations, the term is defined as

> "[...] the ability to reach decisions, to make decisions, to make judgments concerning a criterion satisfaction. That is, it is the demonstration of the kind of intelligence which allows one to survey the correctness, suitability, adequacy, desirability of alternative responses and then to choose the correct alternative actions." (Meeker, 1980, p.v (cited by, Runco and Chand, 1994, p.53))

Within a broader context, RUNCO (1995) added that often,

> "Evaluations are misunderstood because when they are recognized, they are typically convergent and critical and not specifically conducive to originality and flexibility (Runco, 1993)." (Runco/Chand, 1995, p.257)

This suggests that evaluations are especially important for individuals as they monitor the problem-solving process, such as the evaluation and selection of generated ideas in relation to the overall concept or strategy to reach a goal. Furthermore, to 'make decisions' in an adequate fashion and 'to choose the correct alternative actions' (see above) assumed that evaluations depend on the actual degree of *intrinsic activity* and *motivation* (see 4.1 on page 223), the maturation of *pre-disposed* *structures* (see 4.2.1 on page 228), and are further processed based on criteria, activated from *experience-based structures* (see 4.2.2 on page 232). CAMPBELL (1960) added that the scope of 'selective criteria' is an important factor for individuals' creativity, because a

> "[...] creative thought is opportunistic in the sense of having a wide number of selective criteria available at all times, against which the thought trails are judged. The more creative thinker may be able to keep in mind much more criteria, and therefore increase his likelihood of achieving a serendipitous advance on a problem." (Campbell, 1960, p.392)

Indeed, the perspective 'of having a wide number of selective criteria available at all times, against which the thought trails are judged' is related to earlier suggestions (see 4.2.2 on page 237) that experience is 'the groundwork for individuals' further development: based on previous experience-based structures, new experiences are created, and the knowledge is built which can be used to 'recognize [or evaluate] that there exists a gap or a problem which is interesting enough to spend some time on'. Therefore, increases in the degree of expertise or experience-based structures in music occur frequently in correlation with increases in *H-musical-creativity* (see 4.4.1 on page 252).

Let us now deal with *evaluation* processes and their contribution to meaning creation within the *Model of Musical Extrapolations.* As it can be seen in Figure 4.3, I propose that three *evaluation* processes are at play or are executed while music is being listened to and composed. Furthermore, that processes in play at the very heart of new *musical extrapolations* are no explicit stage-to-stage processes – from *problem-construction* and *problem-finding* to *idea-generation* to *evaluation* – but have to be conceptualized as cyclical, including simultaneous, recursive, etc. processes.

As discussed earlier (see 4.4.1 on page 249), 'a so-called problem arises, when a complex of differences or tensions is constructed between previously generated *musical extrapolations* (representing a sort of goal) and current perceptions and evaluations (comparable to obstacles).' As we have seen in Figure 4.3, I propose that this 'complex of differences or tensions' is revealed by a kind of *evaluation* (marked by the number 1) deciding that previously generated *more convergent ideation* (see 4.4.2 on page 254) are inappropriate in relation to current so-called *organizational structures* (see 4.3 on page 241). While listening to music, such processes are caused by the fact that listeners are confronted with ongoing acoustic stimuli, whereby generated *ideations* about the interpretation of stimuli and their inter-relations must be 'modified, extended, and combined'[87][88], driven by the *intrinsic activity* and *motivation* (see 4.1 on page 223) to make *evaluations* 'concerning a criterion satisfaction' (see above). Similarly, the process of composition

[87] This is the second definition of 'musical extrapolations'. (see 3 on page 209)

[88] This includes new *problem-construction* and *problem-finding* processes, as well *divergent ideation*, etc. (see Figure 4.3).

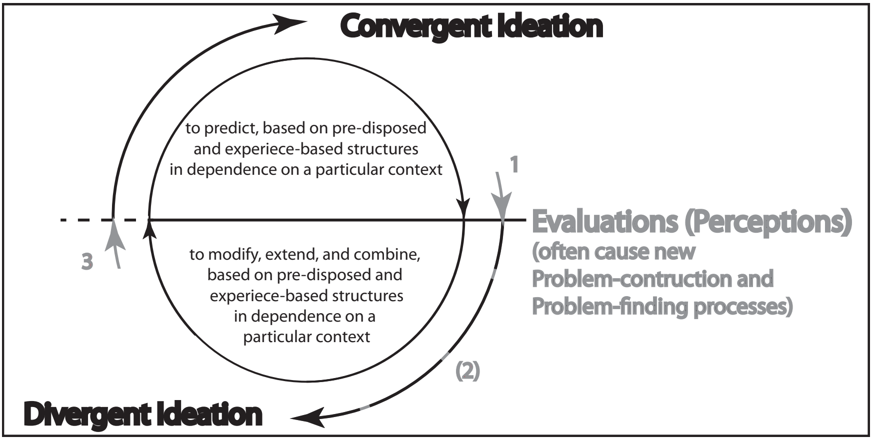

Fig. 4.3 Cyclical interplay of different evaluation processes

can be characterized as: ’additive in nature – there are ever-emerging and proliferating points of origin’ (see 2.5.2.1 on page 169). Therefore, we also conclude that until piece related compositional *ideations* are *evaluated* as more or less satisfied, generated *more convergent ideation* – such as a current idea about sound relations, composing strategy, or the overall conception of a piece, etc. – needed to be ’modified, extended, and combined’ to reach the self-imposed final goal, reflected in a completed composition.

However, as seen in the case of listening to music, it is important to notice that *evaluations* will often be done automatically, and appear to the consciousness only as a reference, such as an affect – when a more convergent ideation does not match current so-called *organizational structures*. This perspective is supported by findings from creativity research, in which numerous theories of incubation (e.g. Smith/Blankenship, 1989), illumination (e.g. Gruber, 1988), preconscious censors (e.g. Arieti, 1976), and intuition (e.g. Bowers et al., 1990) emphasize that intra-personal evaluations are made only partly consciously. Concerning intuition, FEIST (1991) specified for example that “[. . .] intuition is more often used in evaluating a work of art than a work of science [. . .].” (Feist, 1991, p.148) This means that implicit knowledge and criteria are often used to assess art works[89], and can appear to consciousness as a kind of feeling termed as intuition.

[89] Such processes play an important role within a technique measuring product-centered creativity, called *Consensual Assessment Technique* (see 2.3.2 on page 125). This procedure “[. . .] assumes that experts over the course of years have developed their own implicit criteria within their own domain by which they evaluate creative products.” (O’Quin/Besemer, 1999, p.417)

Let us now turn towards the perspective of *evaluation* during *more divergent ideation.* As seen in Figure 4.3, I propose further *evaluation* processes (marked by the number 2 and 3), which contribute to meaning creation while music is being listened to and composed.

To recapitulate, the previous section discusses (see 4.4.2 on page 254), first: all acoustic stimuli possess a rich potential for structuring *divergent ideations* in every listening situation; and second, different sorts of ideations, or divergent ideations, such as reflexive, kinaesthetic, denotative ideation, can be related or combined. Concerning composition, we have discussed, first: that *problem-finding* and *problem-construction* during composition often cause initially *more convergent ideation* automatically[90] – e.g. a 'germinal idea', defined as a solution to a constructed problem at a certain single moment. Second, such a 'germinal idea' in terms of acoustic stimuli also offers divergent possibilities for composers to generate ideations from it, such as in relations to concepts external to the musical domain, such as philosophy, religion, literature, visual arts, etc., as well as through transformations, extensions, combinations of kinaesthetic, connotative, denotative ideations, etc.

This suggests three sorts of consequences concerning evaluation processes (marked by the number 3 in Figure 4.3).

First, concerning listening to music, different sorts of generated ideations about acoustic stimuli can be estimated and/or whittled down, combined, or selected – consciously or unconsciously – by *evaluation* processes as or into a most feasible appropriate *more convergent ideation.* As discussed with the help of the 3rd movement (Allegro non troppo) of SHOSTAKOVICH's *8th Symphony* (see 4.4.2 on page 257), this can be illustrated, first: in terms of *evaluations* made after the beginning of bar 34, when kinaesthetic ideation processes of highly tensed and 'shrilling' qualities in the progress of motion can be combined with various possible denotative ideations, such as a F# chord which transforms during 2 1/4 bars into a major ninth; or the recognition of the successive instruments oboe, piccolo, clarinet, etc. Second, we have seen that after the beginning of bar 34, a possible *ideation* can as well be generated with the meaning that something is depressed with all force. This meaning, however, presupposes an *evaluated* ideation process, which of course includes various ideations made about different aspects of the music heard.

Therefore, I conclude that the mental product of both *evaluated* ideation processes is the singular moment in which, first: the meaning of *more divergent ideations* generated are captured into or as a 'suitable, adequate, or desirable' (see above) *more convergent ideation* – which indeed 'predicts' future occurring events,

[90] This is because instantiations of one ore more schemas, concepts, categories, etc., and related emotional experiences automatically organize sounds to musical 'mental model or integrated set of hypotheses' (see 4.2.2 on page 232).

their meanings, and meanings of their inter-relations[91] –; or, second: a new *problem* is constructed or discovered (see 4.4.1 on page 249).

Second, as well as for listening, *evaluation* processes while composing music can also estimate and/or whittle down, combine, or select different sorts of generated *divergent ideation* as or into a most feasible appropriate *more convergent ideation*. This can be done in a more conscious way, as described by LUDWIG VAN BEETHOVEN, "[...] "I carry my thoughts before writing them down [...] I change many things, discard others, and try again until I am satisfied [...]." (Beethoven, cited in Sloboda, 1985, p.107) An example of composers' *evaluation* performed more unconsciously can be seen in so-called provoked *chance* or *accident* (see 2.5.2.2 on page 175). This means that composers, such as JOSEPH HAYDN, often improvise on an instrument (see Dies, 1810) to develop divergent ideations as possible solutions to a given compositional problem, until *evaluated* ideation processes suddenly structure a new perspective, by the appearance of a *more convergent ideation*, or the construction of a new problem. This process is thus colloquially referred to as provoked chance or accident, because developed ideas, such as activated motor schemas, kinaesthetic ideations of movement progression, generated denotative ideations of musical concepts, etc., and evaluation processes – estimating and/or whittling down, combining, or selecting various ideations – partly work outside of consciousness. And often, only the finding appears consciously as an appropriate unique idea, or a new problem.

Third, because we assumed that *problem-finding*, *problem-construction*, and *idea-generation* processes occurring while listening and composing differ significantly in structure, time exposure as well as complexity (see 4.4.2 on page 259), consequently, we finally assume significant differences in *evaluation* processes between them. For example, it is obvious that in contrast to *evaluation* processes while listening, evaluations while composing can be repeated, and/or do not strongly depend on time progression. This also points at differences in the structure and complexity between both. Indeed, while listeners are confronted with a highly time-critical process to solve problems of understanding, composers are often more time independent, and can evaluate generated ideations based on different criteria, and by that, can judge about ideas in a more complex fashion. In this context RUNCO ET. AL. (1987) studied: "[...] what creators actually do when judging a potentially creative idea or product. [...] ideas or products are first evaluated for relevance and appropriateness; and then those which are deemed appropriate are further evaluated for their originality." (Runco/Chand, 1994, p.66) Relating this perspective with listening to music, indeed, I believe that listeners can evaluate music under the criteria of originality or *H-musical-creativity.* But, their involvement in a highly time-critical progression and the limitation of the their capacity to process all acoustic stimuli, suggest that, at least within the process of single-

[91] This is the first definition of *musical extrapolations*, see 3 on page 209.

time listening[92], evaluations of generated convergent and divergent ideations will at first be done among criteria, such as relevance, appropriateness, usefulness, etc. to solve problems of understanding about *organizational structures* of music being listened to (see 4.3 on page 241), before these appropriate and useful ideations can be judged in a more complex fashion, such as in terms of originality or *H-musical-creativity*. However, this sometimes lacks the mental capacity related to the flow of time while listening to music.

Finally, as seen in Figure 4.3, I need to say it is possible that during more divergent ideation processes, *evaluations* (marked by the bracketed number 2) also contribute to the meaning creation. This means that, in the case when divergent ideations at hand for the purpose of whittling down, combining, or selecting among them into a most feasible appropriate *more convergent ideation* (marked by the number 3), a kind of pre-evaluation is presupposed, which defines these ideations as possible solutions for a certain compositional problem, or, defines ideated aspects of acoustic stimuli as appropriate and useful to get closer to the solution of problems of understanding while listening. At least, we could find an indication from creativity research which supports such a perspective:

> "Given what we know about intrapersonal evaluative tendencies, it is unlikely that all judgements can actually be postponed. Here again we refer to the preconscious censors and secondary processes described by psychoanalytic views of creativity (e.g. Ariety, 1976)." (Runco/Chand, 1994, p.69)

In conclusion, through several explanations exposed in this section, we have tried to show that evaluative processes play a primordial role while music is being listened to and composed, and, furthermore, depend on the actual degree of *intrinsic activity* and *motivation* (see 4.1 on page 223), the maturation of *pre-disposed structures* (see 4.2.1 on page 228), and are processed based on criteria, activated from *experience-based structures* (see 4.2.2 on page 232). Indeed, generated ideations about music have to be judged in relation to criteria, such as 'suitability, adequacy, desirability', and originality, because only by that it is possible to conceive a more or less coherent mental construct while listening to or composing music. And, as we have seen, this can be done consciously, but evaluations are often processed unconsciously and appear to the consciousness only as a reference, such as an affect, a unique idea, or a new conceived problem.

Finally, within the *Model of Musical Extrapolations,* we concluded on three sorts of evaluations which, each in a different manner, contribute to the meaning creation while listening to and composing music.

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92 Webster proposed that "[...] single-time listening unfolds in fixed time and the creative thinking is part of a flow of musical behavior that does not benefit from reflection to the extent that the others do." (Webster, 2002, p.14) (see in this regard 2.4.3 on page 156)

1. *Evaluation* (marked by the number 1 in Figure 4.3) deciding whether previously generated *more convergent ideation* is suitable, adequate, or desirable, etc. in relation to current so-called *organizational structures*.
2. *Evaluation* (marked by the number 3 in Figure 4.3) which, first: estimate and/or whittle down, combine, or select different sorts of generated *more divergent ideation* as or into a most feasible appropriate *more convergent ideation*, or, second: construct and find a new problem.
3. A sort of *Pre-Evaluation* (marked by the bracketed number 2 in Figure 4.3) which defines *more divergent ideations* as **possible** solutions for a certain compositional problem, or, defines ideated aspects of acoustic stimuli as appropriate and useful to get closer to solve problems.

4.5 Summary

In this chapter, our focus was to modelize creative processes involved while music is being listened to and composed. For this reason, anchored in the interdisciplinary paradigm, we defined some basic factors and their inter-dependencies as a so-called *Model of Musical Extrapolations* (see Figure 4.4), which offers a possible explanation for our hypothesis that listening and composing activities are entirely creative processes.

To recapitulate, in the previous Chapter 'At the Very Heart (of Music)' (see 3 on page 209), we generally defined *musical extrapolations* as an activity, in dependence on a particular context, consisting of the following:

1. to predict, based on pre-disposed and experience-based structures
2. to modify, extend, and combine, based on pre-disposed and experience-based structures

According to a perspective of cognitive sciences on the brain as a creative machine that constantly constructs the world as 'mental models or integrated sets of hypotheses', we suggested that, first: the elusive quality of music can be brought into mental existence only by using memory structures creating *extrapolations* about:

1. possible future occurring events;
2. their musical meanings;
3. and the meanings of their inter-relations.

Second, these *extrapolations* are constantly 'modified, extended, and combined'[93], under the influence of perceptions and evaluations of ongoing *organizational structures* (see 4.3 on page 239).

[93] Second definition of *musical extrapolations,* see above.

This has led to the conclusion that an individual's development concerning the handling of music[94], or in other words, the growing of experience-based structures – including expertise and skills –, probably takes place in a kind of a cyclical interplay of processes included in both definitions of *musical extrapolations* (see Figure 3.5).

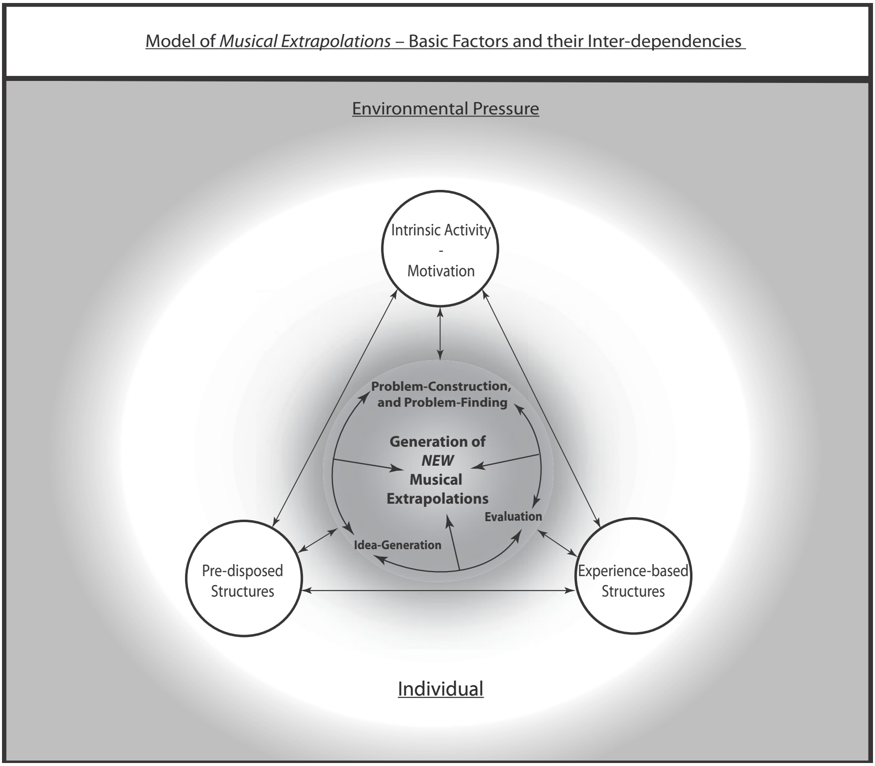

Fig. 4.4 Model of Musical Extrapolations

Based on these findings as well as on others exposed within previous discussions[95], this Chapter presented a constructivist model for musical creativity, which

[94] This was earlier defined as P-musical creativity (see 2.3.3 on page 136).

[95] This means findings from the Chapters: 'Ontogeny of musical abilities during the prenatal period', 'Infants' auditory sensitivity related to acoustical parameters of music', 'Perspectives of infants general musical organization', 'The evolving musical-artistic competence from infancy to adulthood', 'Perspectives of creativity in general', and 'in terms of music', as well as 'Creativity in listening to music', and 'Creative processes while composing of music'.

generally proposes: driven by ’intrinsic activities and motivations’, as well as supported by ’pre-disposed and experience-based structures’, processes of ’problem-construction and problem-finding’, ’idea-generation’ and ’evaluation’ create ’mental models or integrated sets of hypotheses’ depending on a particular context or an ’environmental pressure’. As a direct consequence, music can be brought into a kind of mental and composed existence, or, that is to say, *musical extrapolations* are created (see Figure 4.4).

Let us summarize the proposed *Model of Musical Extrapolations* in more detail, its basic factors, and their inter-dependencies.

Intrinsic Activity and Motivation

At a very basic level, we assumed a kind of intrinsic activity in humans, which constantly strives to organize ’the chemical parameters of a body’s interior (its internal milieu) within the magic range compatible with life’ – called the homeostatic range –, which changes when the current state is out of balance.[96] But, because, ’attempting to correct homeostatic imbalances after they begin is inefficient and risky’, we argued that, during the course of evolution, devices and mechanisms have emerged, which ’allow organisms to anticipate imbalances’, or, can predict whether a possible occurring event or situation is useful or dangerous for the organism, etc.

Indeed, we propose that prediction activities seem to be a fundamental intrinsic activity in most animals and all humans. We assume their pre-implemention in the human genome. They start in fetuses as soon as brain structures are interconnected – between the 29th and 33rd week of gestational age, when fetuses’ nervous systems consistently predict the last perceived acoustic stimulus. A further indication for this fundamental activity and its contribution to musical processes can be found in the fact that prediction activities are used to investigate fetuses’ and infants’ abilities to perceive and process acoustical stimuli, such as being used to define fetuses’ memory structures, infants’ threshold sensitivities, infants’ pitch discrimination abilities, and abilities to group and segregate auditory information, etc.

In addition, we defined that, during the course of evolution, highly specialized sense organs and well-developed nervous systems have been formed, which make possible not only to predict current changes in the environment, but to incorporate a broad amount of *pre-disposed* and *experience-based structures* to extensively explore and interact with the environment (details follow later). Such more complex

[96] This implies two characteristics. First: it is generally essential in every facet of our life; second, its degrees are critical factors for various physiological and psychological developments.

intrinsically motivated activities – we conceptualized as *play* – can be observed very well in infants, when they construct or discover the environment. That is to say that playing constitutes an *intrinsic activity* per se, whereby infants (not only) explore unknown structures. Activities of play were therefore defined as important factors for individuals' psychological development. In musical terms, we presented numerous indications for such a perspective, e.g. play drives individuals' development directed to processing and producing sounds, and seems to be in general 'intrinsically bound up with all artistic activity'.

We also mentioned that intrinsic activities of play seem to be too limited to comprehensively conceptualize the force which drives individuals to extensively work (and play) in the musical domain, their fascination to repeatedly create or solve musical problems, to try to develop ideas for possible solutions, and thus repeatedly 'predict' and 'modify, extend, and combine based on pre-disposed and experience-based structures in dependence on a particular context'[97]. Consequently, we extended our discussion, incorporating the concept of *motivation*. Motivation is conceived as indispensable to describe creativity, and can explain, among others, initiation, direction, intensity and persistence of creative behavior, especially goal-directed behavior, such as creative problem-solving activities.

Finally, we stated that drives conceptualized as intrinsic activity and motivation occupy a central place in the *Model of Musical Extrapolations*. Indeed, we assume that these drives strongly affect **all** factors and processes within the proposed model, and, by that, affect individuals' psychological development while handling musical phenomena during listening and composition as well.

Pre-disposed Structures

The *pre-disposed structures* factor reflects an important concept, because humans base their intrinsic activity and motivation on so-called pre-disposed structures, which already function before and immediately after birth and evolve through a kind of biological maturation. Generally, we defined pre-disposed structures as all those structures in humans, which seem to be basically innate or pre-disposed, and can physiologically process (not only) acoustical information in a comprehensive manner. Indeed, we found that fetuses possess broadly working structures, which allow to respond to music-relevant information such as a wide range of frequencies, changes of musical notes, melodic contour, tempo variation, as well as recognition of human voices, discrimination between their mother's and a stranger's voice, etc. Furthermore, we saw that fetuses possess innate mechanisms which group and segregate acoustic stimuli, and, at about the 29th week of gestation

[97] Both definitions of *musical extrapolations,* see above.

age, possess limited auditory memory structures – both structures are necessary together to detect changes in frequencies, notes, melodies, voices, etc.

Regarding the biological maturation of these capabilities, there are strong indications that, within a relatively short time after birth, infants develop an enhanced sensitivity in structures contributing to the discrimination between frequencies, pitch, and timbre, as well as processing of pitches, temporal patterns, and of auditory thresholds, etc.

In a second step, we discussed the contribution of pre-disposed structures to creative processes at the very heart of the proposed *Model of Musical Extrapolations* – defined as problem-construction and problem-finding, idea-generation, and evaluation (see Figure 4.4). In this context, we highlighted that, in order to define a problem from an auditory perception, and by that, to evaluate the current perception in relation to already generated *extrapolations*, one must refer to further mechanisms, which are essential for such processes, and furthermore seem to be innate or pre-disposed in their basic structure. This means that, because humans have access to a 'neurophysiological state that is consciously accessible as a simple, nonreflective feeling', from which, and in relation to a perceived stimulus, an affect is generated – such an emotional experience can change the degree of intrinsic activity and motivation –, we assumed that intrinsically grouped frequencies, pitches, timbre, auditory thresholds, organized into simultaneous and sequential pitch and temporal patterns, are assigned to an extended meaning by simultaneously evoked affects. These affects result from current perceptions put in relation with 'preceded (primitive) models or integrated sets of hypotheses' and their extrapolations about the current context. Such a process is part of problem-construction and evaluation processes. This in turn implies, however, that pre-disposed structures generating an affect or an emotional experience, in relation to certain grouped acoustical information, reflect initial cues for experience-based structures.

Finally, we highlighted that processes creating initial experience-based structures must be explained by a constructivist model of creativity. Indeed, at the origin of fetuses' creative experience, aiming to construct and discover (among other) their acoustical environment, there exists no experience-based structures. Fetuses must create these structures! Based on the proposed *Model of Musical Extrapolations*, we offered a possibility of describing how fetuses create these initial experience-based structures in terms of acoustical information, and moreover characterized such processes as the groundwork for a developing cognition in music.

Experience-based Structures

Experience-based structures were defined as generated musical extrapolations which are coded in memory in two modes: *declarative knowledge* and *procedural knowledge*. Furthermore, we defined that activated experience-based structures, in the form of abstract relations represented in a concrete imaginable situation, facilitate the organization of 'mental models or integrated sets of hypotheses' about the current perceptions, and by that, the active generation of musical extrapolations.

To be more specific, we discussed that declarative knowledge includes facts, categories, schemas, concepts, etc., and relationships between them, which reflect an extended understanding in a certain domain of knowledge. This means that, in the case of music, for example, during 'perceptual categorization', the ongoing auditory continuum is structured into 'coherent auditory events', which reflect an important mechanism allowing to build up initial meanings. Based on this, basic structures of experience, so-called conceptual categories, are organized in the memory, which allow to identify and generalize perceptual categories, and link stored perceptions together, although they may have occurred at different times. Furthermore, we highlighted that categories are essential to build schemas about acoustic/musical matters, or, that is to say: 'categories are the elements or slots from which schemas are constructed'. Indeed, schemas store abstracted knowledge about relationships of concepts[98], and experiences in different situations and at different times, which share some common aspects. We defined such a coded experience as a kind of ecological management of knowledge in the memory. This means that not every detail is stored, but that invariant aspects are summarized into a schema.

In addition to these sketched cognitive structures, we proposed that emotions can partly be defined as a sort of declarative knowledge, because they will often be coded into certain cognitive structures, and, by that, their meanings will be specified and differentiated.

These facets of memory structures, characterized as declarative knowledge, were proposed as very important for organizing current acoustic/musical perceptions. This means that the understanding of situations, the relations of schemas, concepts, categories, etc., and related emotional experiences, are used to organize 'current mental models or integrated sets of hypotheses' about certain perceptions. Furthermore, we noticed that activated declarative knowledge also affects the intrinsic activity and motivation in musical extrapolation processes (see Figure 4.4). For instance, if some explicit emotional memories were coded in relation to a specific knowledge, e.g. a negative affect, an interpretation of this activated emotion

[98] A concept refers to all the knowledge that one has about a category.

can increase the motivation, resulting for instance in trying harder to generate creative ideas for solving a constructed problem.

Procedural knowledge represents the second mode in which musical extrapolations are mainly coded in memory. As in the case of declarative knowledge, we defined that procedural knowledge helps to organize current perceptions and actions, but, furthermore, reflects a procedure which organizes how we think. Activated procedural knowledge cannot easily be articulated by individuals, because it is mostly exercised unconsciously. For example, if one asks a pianist to describe the procedural knowledge he/she exercises while performing a certain piece of music, he/she certainly will have problems to articulate this knowledge clearly.

We also found indications that procedural knowledge can possess emotional structures. Such so-called emotional procedures seem to be very important for creative processes, because they often have a decisive influence on the direction of extrapolations happening while listening to music, and also composing. For example, composers' compositional processes are guided by exercised emotional procedures. First, sound perceptions are supported by activated affects – bodily reactions, such as muscle tension, or changes in blood pressure and heart rate – , which were stored in conjunction with previous acoustical perceptions. Such coded patterns of affects, or emotional procedures, influence and 'process the meaning, significance, or value of a stimulus to the individual'. Second, emotional procedures seem to be in general conducive for composers' attitude to work. Because, if performed emotional procedures[99] culminate in an emotional state which is consciously accessible, then we have seen that the quality and type of cognitive processing can be influenced. Furthermore, it is important to state that a composition task can not be performed only by means of declarative knowledge about composition and its associated emotional aura. The frequently used example of a germinal idea which will gradually be elaborated into a structured composition, can only be explained in relation to procedural knowledge and emotional procedures, and through techniques, methods, and strategies helping to elaborate interesting compositional problems and to solve them in a satisfactory fashion.

In terms of the maturation of both memory structures, we found indications from the cognitive sciences that procedural and declarative knowledge are fully present at different phases in the development of individuals. This means that fetuses, already at 29th week of gestational age, possess a limited procedural memory and that 'procedures are present soon after birth'. However, 'the declarative memory system does not emerge until the end of infancy'. One reason for the delayed declarative memory system seems to be that the pre-disposed structures involved are immature, particularly the postnatal hippocampus. We could relate this perspective to some aspects observed at the beginning of individual's creative

[99] An emotional procedure can also be seen as a scheme of action that is performed while composing, and is familiar and comfortable for the composer, e.g. to compose at the piano.

experience with music, such as the fact that infants' temporal abilities develop from perceptual and motor procedures. Practiced motor procedures such as sucking rate, are essential foundations to extrapolate time and rhythmical structures in musical terms. Infants up to 3 years do not use declarative knowledge while being engaged in music – as it can be concluded from their unsteady and unorganized musical play. Approximately at the age of five, children are able to schematically recognize and use artistic conventions, and begin to compose more melodic and rhythmic patterns, including repetitions, as well as resort to musical conventions, such as musical phrases and meter.

In a second step, we made further generalizations about declarative and procedural knowledge, based on the interpretation of findings of developmental psychology and creativity research.

From the perspective of developmental psychology, it could generally be assumed that saved memorized structures lay the very foundation of musical extrapolations, based on the fact that individuals can recognize that there exists a gap or a musical problem which is interesting enough to spend some time on it. This points at the fundamental character of experience itself. It is the groundwork for individuals' further development: based on previous experience-based structures, new experiences are created, and the knowledge is built which can be used to 'recognize that there exists a gap or a musical problem'. This implies two things: although child prodigies are found in music history, e.g. Mozart, first, the construction of knowledge is constrained through a kind of individual biological maturation; and second, H-creative efforts require a previous period which must first develop musical extrapolations which can be characterized as P-culturalized-musical creativity. To verify this thesis, we discussed various results found within developmental psychology, in general and related to music.

In creativity research, indications could also be found for the fact that experience is the the groundwork for individuals' further development – building an important factor for possible H-creative efforts. This means that, increases in the degree of expertise or experience-based structures frequently occur in correlation with increases in H-creative efforts. This can be seen by the fact that most famous discoveries, inventions, or works in art, are products of creative thinking and behavior during adulthood. Indeed, musical creativity research presents indications for the fact that activated declarative and procedural knowledge is essential for creative efforts, such as 'a firm grounding in the basic skills of aural discrimination may be important in establishing a basis for creative ability'. Individuals who were rated as highly creative composers were more aware of temporal factors than their middle and low counterparts. And composition students with limited formal tuition in music produce a 'minimal setting of constraints while decision-making moments'.

Finally, we have completed the outline of so-called experience-based structures with arguments which indicate that, in addition to essential domain-specific knowledge or experience-based structures, in domains 'that are less logically ordered, such as musical composition, literature, and philosophy, 'specialized knowledge is not enough: one needs to base one's reflection on a great number of experiences before being able to say something new.'

Environmental Pressure

As schematically seen in Figure 4.4, we defined that the concept of environmental pressure reflects all possible information which can be detected by pre-disposed structures, and supported by activated experience-based structures. Detected information will be organized in so-called 'mental models or integrated sets of hypotheses' in order, among other, to construct the current environment with its meanings. This implies that there is no unique environmental pressure, but many possible, individually constructed pressures. We further specified that music listening experiences, but also composers' experiences while conceiving a musical product, are a part of a personal synchronic environmental pressure created by individuals.

We presented indications that the creation of a so-called synchronic environmental pressure strongly depends on the current intrinsic activity and motivation, and its related emotional aspects[100]. This means that, besides the degree of general wakefulness or tiredness (physical or mental), individuals which possess a highly intrinsic motivation to extensively work (and play) in the musical domain, are highly focussed on music-related stimuli, and their organization in 'mental models or integrated sets of hypotheses' to create musical extrapolations, and, by that, process a P-culturalized-musical creativity. Related emotions seem to support and guide the motivation to create a personal synchronic environmental pressure. Specifically, we referred to researches which indicate that generated affects can change the degree of intrinsic activity and motivation to, first: construct and find a problem, generate ideas for a possible solution, and have an impact on evaluation processes; and second, trigger declarative and procedural knowledge[101], memorized in correlation with a particular emotional aspect.

In a second step we stressed that, beyond intra-individual processes forming a personal synchronic environmental pressure – with its musical parts –, certain *organizational structures* must also be present in the current environment, which will be perceived and foster intra-individual processes. Such organizational structures are most important factors, guiding individuals' creative experience or their

[100] Emotions are inseparably connected with intrinsic (and extrinsic) motivation.

[101] See Section Experience-based Structures (4.2.2 on page 232).

psychological development (not only) in dealing with music. Based on findings from developmental psychology and creativity research, we outlined various organizational structures, and their impact on individuals' development. That is to say, we could present arguments for the perspective that parents, caregivers, siblings, the inner family life, musical mentors and role models have a crucial impact on children's and students' available organizational structures, and, by that, influence the directions of the personal synchronic environmental pressures created. Furthermore, intrinsic activity and motivation as well as flexibility, were defined as two key features for the processing of environmental organizational structures. This again suggests, in terms of individuals' musical extrapolations, that parents, musical mentors, etc. should try to stimulate intrinsic activity and motivation as well as flexibility by presenting interesting alternatives or organizational structures: for instance to allow to listen to various sorts of music, to encourage to learn a music instrument, to show and talk about musical subjects, as well as to outline possible structures of musical pieces, but also to present enhanced perspectives from philosophy, religion, and culture, mediate varieties of tactics and strategies for reaching goals, and let children and students make mistakes, etc.

At the very Heart of New Musical Extrapolations

In the final step, we defined processes which are at play at the very heart of the *Model of Musical Extrapolations*, namely: *problem-construction* and *problem-finding*; *idea-generation*; *evaluation*.

This means that we proposed that the core of the *Model of Musical Extrapolations* (see in this regard Figure 4.4) consists in processes which, in relation to each other, create the music while listening and while composing, and simultaneously put forward individuals' P-culturalized-musical creativity.

However, we emphasized that the proposed processes, positioned at the very heart of new musical extrapolations, are no explicit stage-to-stage processes – from problem-construction and problem-finding to idea-generation to evaluation – but have to be conceptualized as cyclical, and including simultaneous, recursive, etc. processes. Nevertheless, to describe the processes of musical extrapolations in separate stages has the advantage of illuminating complex issues from different perspectives.

Problem-construction and Problem-finding

Initially, we assumed that the human nervous system can be defined as telic in its function. Furthermore, we decided for the conception that ’a problem can be defined as a situation with a goal and an obstacle. The individual wants or needs something (the goal) but must first deal with the obstacle.’ In addition, we earlier proposed that individuals possess and perform an intrinsic activity, ’to predict: first, possible future occurring events; second, their musical meanings; and third, meanings of their inter-relations’[102] This means that, while listening, individuals constantly anticipate and conceive forthcoming musical structures, and that, while composing, possible forthcoming musical structures are conceived.

Consequently, we synthesized that a so-called problem arises when a complex of differences or tensions is constructed between previously generated musical extrapolations (representing a sort of goal) and current perceptions and evaluations (comparable to obstacles). This suggests that the term problem is a place holder for complex neurophysiological and psychological processes which drive the intrinsic activity and motivation to practice ’P-culturalized-musical creativity’, or, that is to say, ’to modify, extend, and combine, based on pre-disposed and experience-based structures, in dependence on a particular context’[103].

Referring to findings discussed in Chapter one, we supposed further that, at the very basic level of acoustic information processing, based on pre-disposed structures, various kinds of problems are constantly constructed and solved, such as features extraction, perceptual binding, stream segregation, grouping processes, etc. In addition, we proposed that, at a more conceptual level, listening to music can generally be described as constantly ongoing problem-solving processes. In order to support such a perspective, we discussed processes constructing higher-order problems while listening to music, by the example of HAYDN’s *Symphony no.94* – nicknamed: Surprise Symphony.

Finally, we concluded that, while listening, a constructed problem – which can be reflected by a generated affect – activates processes which try to modify, extend, and combine information within current so-called ’mental models or integrated set of hypotheses’ in order to solve this problem (of understanding). That is to say: processes of problem-construction cause a re-organization of current ’mental models or integrated sets of hypotheses’, in the form of enhanced involvement of experience-based structures, as well as detection of further environmental organizational structures, and, by that, cause a telic activity to generate ideas concerning: ’first, possible future occurring events; second, their musical meanings; and third, meanings of their inter-relations’.

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[102] First definition of *musical extrapolations,* see 3 on page 209.

[103] Second definition of *musical extrapolations,* see 3 on page 209.

Subsequently, we also characterized the composition process as being confronted to various kinds of problems, but highlighted that the nature of problems constructed by listeners and composers differ significantly in structure, time exposure and complexity. For example, from ill-defined problem-spaces, composers must extrapolate musical meanings which should be inter-related and structured in time. That is to say: the self-imposed or self-selected reference points of composers are highly versatile, and, as discussed previously, are often outside of the musical domain. They must be first re-organized within some kinds of 'musical' 'mental models or an integrated set of hypotheses'.

As for listening, we emphasized that emotional experiences play an important role for composers in constructing problems, rather than merely finding problems. Based on results of investigations, we proposed implications of two sorts:

1. current affects signal and, by that, construct some sort of problems, when a complex of differences or tensions arises between previously generated musical extrapolations and current perceptions and evaluations;
2. the current mood state – for example arisen after the construction of a larger problem – effects the overall motivation for possible problem-finding and problem-construction processes.

Furthermore, we could conclude that a mildly depressed mood or affect state is very conducive for the composing process. Because this state can increase the intrinsic activity and motivation for the ongoing re-organization of perceptions in relation to activated experience-based structures, in order to find and construct new problems – assuming that composers have in mind the goal of successfully completing their compositions.

Finally, based on findings from cognitive science and developmental psychology related to music discussed earlier, we suggested that processes of problem-construction and problem-finding ultimately depend on experience-based structures as well as maturation of pre-disposed structures. This means that, under the age of five, declarative knowledge – as a part of experience-based structures – can not be coherently coded in memory. And that, during the psychological development of an adult, phases can be defined, during which individuals usually possess different skills in constructing, finding (and solving) various sorts of problems.

Idea-generation

As seen in Figure 4.5, we defined that processes of idea-generation or ideation can initially be differentiated into more convergent and more divergent ideation happening while individuals solve constructed problems, or, while they are trying to find problems.

At a general level, we have seen that the human nervous system can be defined as telic in its function, assumed that its basic function is to protect the body against worst-case situations. Hence, we proposed that an automatically generated behavior to protect the body, presupposes a certain kind of ideas or processes which generate suitable responses to constructed problems. These processes can be defined as more convergent ideation, because convergent ideation coordinates processes which rather aim in the direction of a single-precision solution. This in turn means that, when an idea is generated as a suitable protective motor schema, the nervous system ’predicts, based on pre-disposed and experience-based structures in dependence on a particluar context’ (see Figure 4.5) forthcoming perceptions, and tries to prepare the body to react adequately.

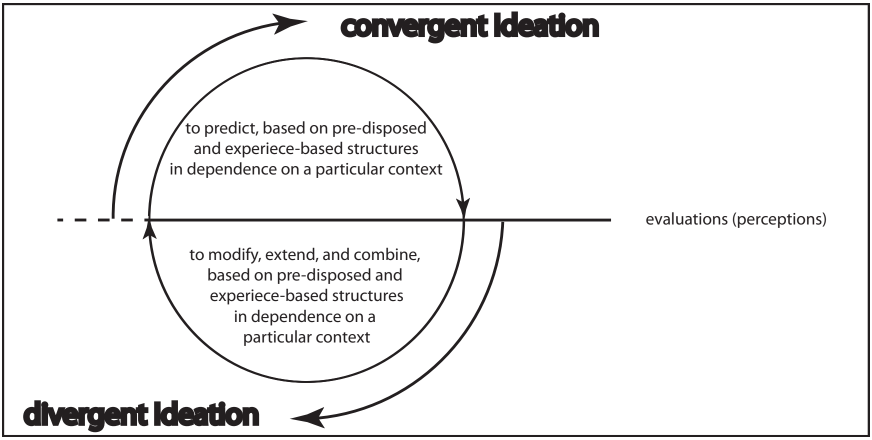

Fig. 4.5 Cyclical interplay of different Idea-Generation processes

Such a convergent mechanism predicting possible stimuli is very essential. It was previously defined as individuals’ ongoing intrinsic activity, which fetuses already perform in a limited fashion in presence of acoustic stimuli. Furthermore, this ability develops rapidly a very short time after birth. For example, 6-year-old children have already acquired a comprehensive implicit knowledge of Western music, which allows them to predict culture-specific aspects of music, such as tonal and harmonic regularities.

Moreover, we suggested that, by activation of experience-based structures, more convergent ideation are often caused automatically. Because instantiations of one or more schemas, concepts, categories, and related emotional experiences automatically organize sounds into so-called musical ’mental model or integrated sets of hypotheses’. And this mental organization automatically generates ideas directed towards: 'first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations'. To illustrate such an ideation found in listening to music, we repeatedly discussed the example of HAYDN's *Surprise Symphony*. We showed that indeed, at the end of HAYDN's main theme (see Figure 4.1), the experienced surprise, arising when an untypical isolated fortissimo chord is played on the weaker second beat, reflects a constructed problem, caused by evaluation processes, which have detected differences or tensions between a generated ideation about future occurring events and the current perception of that loud acoustic stimulus.

In addition to more convergent ideation which are often automatically processed while listening to music, convergent ideation processes can also be structured from evaluation processes, which try to whittle down, combine, or select – consciously or unconsciously – more divergent ideation processes into or as a most feasible idea (see dashed line in Figure 4.5).

Our conception of more divergent ideation processes based on earlier discussed taxonomies of listening modes, which suggest a potentially divergence of ideation processes occurring in every listening situation. Consequently, we specified that acoustic stimuli, organized by experience-based structures, offer various possibilities for individuals to intentionally re-organize them into divergent ideations at certain moments while listening. Incidentally, such processes offer a possible explanation of why people construct their very own personal environmental pressure while listening to music.

With the help of the 3rd movement (Allegro non troppo) of SHOSTAKOVICH's *8th Symphony*, it was easily possible to illustrate such more divergent ideation processes offered by acoustic organizational structures. That is to say, more divergent ideation processes during listening can include experiential ideations (reflexes, kinaesthetic qualities, associative mental images), denotative ideations (causal, empathetic, functional and semantic listening), and reflective ideations (reduced and critical listening).

In addition, we defined that different sorts of ideations, or divergent ideations, such as reflexive, kinaesthetic, denotative ideation, can be related to or combined into a more convergent ideation – all at a single instant during listening! This also reflects information about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations. We thus concluded that the cyclical interplay of both, more divergent ideation processes in relation to more convergent ideations, creates personal 'mental models or integrated sets of hypotheses' about the music which is listened to. In other words, both processes organize the elusive quality of sounds or chords into music, which have occurred at different times, into music, although they have occurred at different times. This is precisely what music actually is: a mental construct.

Thereafter, we turned to ideation processes during the composition of music. First at all, because we defined that the nature of problems constructed by listeners and composers differ significantly in structure, time exposure, and complexity, we assumed that ideation processes occurring while listening and composing differ significantly as well, in structure, time exposure and complexity. Notwithstanding these enormous differences between ideations occurring while listening and composing, we proposed that composers' ideations, can also be conceptualized into a cyclical interplay of more divergent ideation processes in relation to more convergent ideations.

This means, first, that compositional processes of problem-construction and pro-blem-finding often initially cause more convergent ideations automatically[104], such as a created 'germinal idea', a plan or a framework, a schema, a texture, an 'image' of a sound, etc. – defined as a solution to a constructed problem. We found arguments for such a perspective from creativity research, music psychology, and not least from statements of composers.

In addition, because composition is 'additive in nature – there are ever-emerging and proliferating points of origin', we defined that more convergent ideations usually cause subsequent new problem-construction and problem-finding processes. This means that individuals construct a problem based on tensions or differences between previously generated ideations and current perceptions and evaluations (see Figure 4.5). These subsequently constructed problems may have different objectives, such as a revision of the current solution, or the expansion of that solution, or a problem which addresses a different compositional detail. For all such problems, we proposed, however, that composers usually process more divergent ideations, or, in other words, they usually 'modify, extend, and combine, based on pre-disposed and experience-based structures, in dependence on a particular context' (see Figure 4.5).

Positive affects and mood states could play an important role for the potential of more divergent ideation processes. Indeed such states increase the potential of ideational fluency, combinational thinking, divergent thinking, and transformational processes of existing knowledge into new patterns of configurations. Furthermore, we also suggested that the musical 'mental model or integrated set of hypotheses' of a 'germinal idea', texture, sound, etc. in the case of acoustic stimuli, offers divergent possibilities for composers to generate ideations from it, such as kinaesthetic ideations or denotative ideations, or kinaesthetic-denotative ideations, etc. (see explanation about divergent ideations while listening).

Not least, based on examples from music history, we proposed that divergent ideations for compositional purposes are mostly characterized by transformations

[104] This is because instantiations of one or more schema, concepts, categories, and related emotional experiences automatically organize sounds to musical 'mental model or integrated set of hypotheses.

and combinations. This means that composers try to transform and combine non-musical and/or different musical concepts into meanings of acoustic stimuli, and, by that, try to develop more divergent ideations as possible compositional solutions. This perspective could also be supported by findings from cognitive sciences, because probably every compositional innovation is characterized by transformations and combinations of pre-existing declarative and procedural knowledge.

In the last step, we related GUILFORD's four components of divergent production abilities – identified as: fluency, flexibility, elaboration, and originality – to our concept of so-called more divergent ideation processes during composition. We emphasized that flexibility in the processing of organizational structures is one of the most important precondition for compositional efforts. We also agreed that, at a certain degree, people must necessarily think fluently to achieve compositional goals in a short time. More divergent ideations while listening were defined as a highly time-critical process because of the very insertion in time, and because of the limitation of the listener's capacity to process all acoustic stimuli. In contrast, it is more important for composers to think flexibly – defined as the ability to generate divergent ideations from 'shifts of meaning in response to the same given information' – and to elaborate their work – defined as 'the production of detail or complexity of information'.

Indeed, in order to create a suitable compositional idea, it is first essential to structure sounds from different perspectives. Second, suitable composed ideas are characterized by the fact that they will be worked out to the smallest detail (elaboration). We assume that every smallest detail presupposes separate more divergent ideations. By that we concluded that to find the best expression of a composing detail probably caused a huge number of more divergent ideations related to all various possible aspects considered.

Concerning the divergent production ability leading to compositional originality, we suggested that, in order to generate more divergent ideations leading to an original composition – thus having the potential to be recognized by listeners as original in the sense of 'responses rare in the population to which the subject belongs, novel, or remotely associated with the given information' – presupposes a very lengthy and elaborate P-culturalized-musical-creativity processing, which first lays the ground for possible later occurring H-creative composition efforts.

Finally, we completed the Section with the essential statement that, as while listening, more divergent ideations are estimated and/or whittled down, combined, or selected – consciously or unconsciously by evaluation processes – as or into a most feasible realistic idea (see dashed line in Figure 4.5). This final idea reflects a unique moment, in satisfying the mental organization of the current compositional concept in relation to perceived acoustic stimuli. In turn, it reflects, at this single compositional moment, a more convergent ideation about: first, possible future occurring events; second, their musical meanings; and third, the meanings of their inter-relations.

Consequently, this suggests that processes structuring (compositional) ideas and their development can be characterized as a constant interplay of more convergent ideations and more divergent ideations.

Evaluation

Finally, we outlined the important role of *evaluation* processes which are at play at the very heart of new musical extrapolations.

At first, we defined the term evaluation as ’the ability to reach decisions, to make decisions, to make judgments concerning a criterion satisfaction; that is, it is the demonstration of the kind of intelligence which allows one to survey the correctness suitability, adequacy, desirability of alternative responses and then to choose the correct alternative actions.’ Furthermore we added that often ’evaluations are misunderstood because when they are recognized, they are typically convergent and critical and not specifically conducive to originality and flexibility.’

This means that evaluations are especially important for individuals as they monitor the problem-solving process, such as the evaluation and selection of generated ideas in relation to the overall concept or strategy to reach a goal. Furthermore, to ’make decisions’ in an adequate fashion and ’to choose the correct alternative actions’ (see above) assumes that evaluations depend on the actual degree of intrinsic activity and motivation, the maturation of pre-disposed structures, and are further processed on the basis of criteria activated from experience-based structures. Especially, experience-based structures are essential for evaluation processes, because, based on previous experience-based structures, new experiences are created, and the knowledge is built which can be used to ’recognize [or evaluate] that there exists a gap or a problem which is interesting enough to spend some time on’.

Based on these definitions, we proposed three sorts of evaluation processes (see Figure 4.6) which, each in a different manner, contribute to the meaning creation while listening to and composing music:

1. Evaluation (marked by the number 1) deciding whether previously generated more convergent ideation is suitable, adequate, or desirable, etc. in relation to current so-called organizational structures.
2. Evaluation (marked by the number 3) which, first: estimate and/or whittle down, combine, or select different sorts of generated more divergent ideation as or into a most feasible appropriate more convergent ideation; second, alternately: construct and find a new problem.

3. A sort of Pre-Evaluation (marked by the bracketed number 2) which defines more divergent ideations as possible solutions for a certain compositional problem, or, defines ideated aspects of acoustic stimuli as appropriate and useful to get closer to the problem's solution.

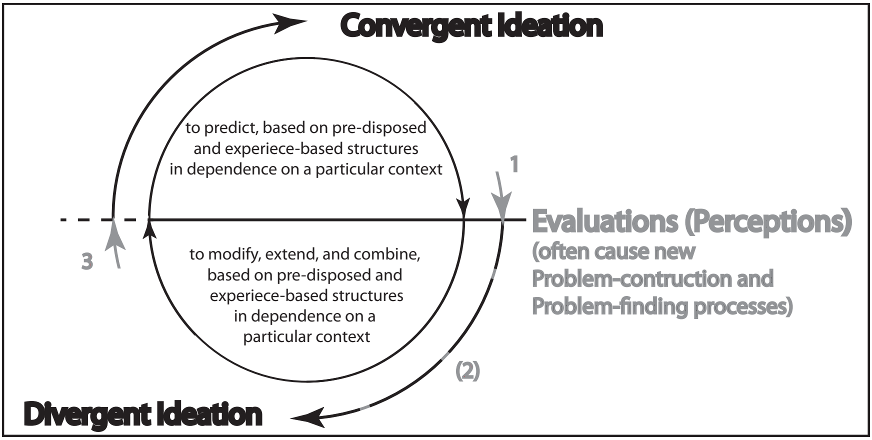

Fig. 4.6 Cyclical interplay of different evaluation processes

What is more, we discussed that 'a so-called problem arises, when a complex of differences or tensions is constructed between previously generated musical extrapolations (representing a sort of goal) and current perceptions and evaluations (comparable to obstacles).' We proposed that this 'complex of differences or tensions' is revealed by a kind of evaluation (marked by the number 1) deciding that previously generated more convergent ideation are inappropriate in relation to current so-called organizational structures.

This means that such processes are caused by the fact that listeners are confronted with ongoing acoustic stimuli, whereby generated ideations about the interpretation of stimuli and their inter-relations must be 'modified, extended, and combined', driven by the intrinsic activity and motivation to make evaluations 'concerning a criterion satisfaction' (see above). Similarly, until piece related compositional ideations are evaluated as more or less satisfied, generated more convergent ideation – such as a current idea about sound relations, composing strategy, or the overall conception of a piece, etc. – need to be 'modified, extended, and combined' to reach the self-imposed final goal, that is in a completed composition.

Supported by various findings from creativity research, we further noticed that evaluations will often be done automatically, and appear to the consciousness only as a reference, such as an affect – when a more convergent ideation does not match current so-called organizational structures.

Concerning evaluation processes marked by the number 3, with the help of the 3rd movement (Allegro non troppo) of SHOSTAKOVICH's *8th Symphony*, we illustrated that, first, while listening, different sorts of generated ideations about acoustic stimuli can be estimated and/or whittled down, combined, or selected – consciously or unconsciously – by evaluation processes as or into a most feasible appropriate more convergent ideation. This mental product indeed 'predicts' future occurring events, their meanings, and the meanings of their inter-relations. Otherwise, second, a new problem is constructed or discovered. Also, based on examples illustrating conscious and unconscious evaluation processes, we defined that, as in the case of listening, evaluations while composing music can also estimate and/or whittle down, combine, or select different sorts of generated divergent ideation as or into a most feasible appropriate more convergent ideation. Third, because we assumed that problem-finding, problem-construction, and idea-generation processes occurring while listening and composing differ significantly in structure, time exposure as well as complexity, we suggested that composers are often more time independent, and can evaluate generated ideations based on different criteria, and, by that, can judge ideas in a more complex fashion. This means that, although it is possible that listeners can evaluate music under the criteria of originality or H-musical creativity, their involvement in a highly time-critical progression, and the limitation of their capacity to process all acoustic stimuli, suggest that, at least within the process of single listening, evaluations of generated divergent (and convergent) ideations will at first be done among criteria, such as relevance, appropriateness, usefulness, etc. to solve problems of understanding about organizational structures of the music being listened to, before these appropriate and useful ideations can be judged in a more complex fashion – such as in terms of originality or H-musical-creativity. However, this sometimes suffers from limited mental capacities in dealing with the flow of time while listening to music.

In the end, it was essential to state that, during more divergent ideation processes, evaluations (marked by the bracketed number 2) can also contribute to the meaning creation. This means that, in the case when divergent ideations at hand for the purpose of whittling down, combining, or selecting among them into a most feasible appropriate more convergent ideation (marked by the number 3), a kind of pre-evaluation is supposed, which defines these ideations as possible solutions for a certain compositional problem, or which defines ideated aspects of acoustic stimuli as appropriate and useful to get closer to a satisfactory solution.

Chapter 5
Perspectives of Investigation Based on the Outlind Model of Musical Extrapolations

PETER ILICH TCHAIKOVSKY once wrote:

> "The germ of a future composition comes suddenly and unexpectedly. If the soil is ready – that is to say, if the disposition for work is there – it takes root with extraordinary force and rapidity, shoots up through the earth, puts forth brances, leaves and, finally, blossoms." (Tchaikovsky, 2004, p.274)

In contrast to such a rather romantic perspective[1] on composition, as a process of growth within an individual, and almost unwillingly, the preceding chapters of the present part (Musical Extrapolations: Towards a Model of Creativity in Music) outlined a more pragmatic and prosaic view on creative processes. That is to say, we do not consider music composition as a mystery that emerges as a complex of obscure forces and processes. Indeed, based on interdisciplinary perspective of cognitive sciences, we could modelize the processes involved while music is being composed, as the result of explicit and implicit problem-solving processes, which are tangibly guided by perceptual, affective, cognitive, and social factors. In addition, concerning the common opinion that listening to music and composing music constitute two different things in terms of intention, behavior, we could show that creative processes which organize, while listening as well as composing, the elusive quality of chords into musical mental constructs, are much more similar than commonly assumed – and partly identical. Consequently, we structured these findings into a model of creativity in music, which can describe creative processes involved while music is being listened to and composed.

A further essential perspective shown by this model, is that psychological development of musical abilities consists in far more than enculturalization and acculturalization processes. We defined such a course of development as processes of

[1] For more information about organic and genius perspectives on creativity, see (Weissberg, 1993; Leman, 1999).

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P-culturalized-musical creativity (see 4.3 on page 239), which take place in a kind of a cyclical interplay of processes included in both definitions of musical extrapolations (see Figure 3.5). Indeed, these findings suggest that individuals' understanding of music as a cultural product is a highly active engagement to construe variations of it. In other words, without the creative processes involved, no new compositions could be created by composers, and no psychological development could take place while music is being listened to and composed.

Now, after these final conclusions, the question arises: Which perspectives of investigation can the *Model of Musical Extrapolations* offer?

In our opinion this constructivist model of music provides an enormous potential for extended perspectives and future research.

For example, systematical musicology has developed methods and techniques which analyze composing processes. One of the most established technique investigates composing sketches, fragments, etc. of composers, with which music analysts try to reconstruct compositional problem solutions (see Danuser/ Katzenberger, 1993). This means that, through series of notational sketches, preparatory work, fragments and early versions, the development of a musical work could be understood. Moreover, it should be possible to reconstruct the sequence of thoughts which has taken place between two successive notational sketches, etc. However, in fact, incomplete source material can sustainably distort the hypotheses and evidence. In addition, the presented *Model of Musical Extrapolations* formulates indications to the fact that robust conclusions leading from notational sketches to their source in musical thoughts do not seem scientifically reliable. Not the least because, as we have shown, the processes resorted to by composers to find the best expression of a certain music structure, cause the formation of a huge amount of related but varied musical thoughts[2].

Based on the framework of the outlined Model of Musical Extrapolations, we propose a research subject which would empirically investigate the problem-solving processes of contemporary composers. This should allow to get closer to a reliable conclusion about those thoughts and processes which evolve into particular artistic results, e.g. notational sketches. Indeed, we assume that, while composing, the cyclical interplay of *problem-construction* and *problem-finding* processes (see 4.4.1 on page 249), *convergent* and *divergent ideations* (see 4.4.2 on page 254), and *evaluations* (see 4.4.3 on page 264) are fundamentally organized by activated so-called experience-based structures (see 4.2.2 on page 232). Consequently, a comprehensive detection of these experience-based structures – becoming visible in form of strategies used while composing – could help to get a more reliable insight in processes and thoughts of composers, relatively to limited conclusions deduced from notational sketches, etc. Furthermore, such a compre-

[2] For detailed information see 4.4 on page 247.

hensive investigation[3] of strategies used by composers could include a collection of contemporary composers' musical preferences, education and composing experience, motivational aspects, as well as their general creative potential and personality traits. These insightful data could then be used to formulate a taxonomy which can encompass and define composers' problem-solving strategies, and, furthermore, structure an extended knowledge in terms of composers' creative potential, their personality traits, and everyday work context. This taxonomy could ultimately produce a precious knowledge and useful tool for systematical musicology in its attempts to trace back from musical compositions to their generative processes.

Another promising domain of investigation could be pursued in music education research. Indeed, we concluded that individual's development is inseparably connected to creative processes. This means that individuals' development in dealing with music (not only) is highly effected by so-called *organizational structures* detected from the *environmental pressure* (see 4.3 on page 239). That is to say parents, caregivers, siblings, inner family life, musical mentors and role models have a crucial impact on children's and students' available organizational structures, and, by that, influence the directions of the created personal environmental pressures. Therefore, within the context of higher music education, a possible research subject could investigate, first: if explicitly presented knowledge from creativity research (e.g. models, strategies) has positive effects on the development of composers' abilities. By this we mean whether abstract and concrete concepts of (musical) creativity can be implemented in the training of individual artists, and can hence be transformed into applicable knowledge. Second, because we could outline that *flexibility* is a key feature, which, formally or informally stimulated by parents, caregivers, siblings, musical mentors and role models, can foster individuals' P-culturalized-musical creativity, and, it is common sense that composing mentors serve both as models for behaviors and strategies, and also as sources of information, a further research project could investigate the application and implementation of pedagogical concepts and techniques in secondary education, in order to stimulate and enhance the flexibility of composition students.

A further promising research field, which has, moreover, a maximum relevance in today's world, is human interaction with computers. We live today in a technological epoch, called Information Age[4], which has changed all areas of human life in a radical fashion, and gives way to an explosive increase of scientific knowl-

[3] This includes qualitative and quatitative methods for social sciences and humanities.

[4] The expression Digital Revolution, names the change from mechanical and electronic technology to digital technology. This transition marked the beginning of the Information Age.

edge[5] and innovative products based on a modern context of greater interdisciplinary communication and research. In fact, this ongoing explosive increase is created by the constant interplay of, first: (musical) extrapolations; and second, computers and their infrastructure.

Nowadays, every engineering product is developed with the assistance of comprehensive computational infrastructures, or, in other words, people interact with computers, whereby complex problem-solving strategies are created which forward innovative ideas and products. In the field of music, this launched a development in which computers play an increasingly important role in composition and sound realization. Today, almost all composition students, and many experienced composers, work with computers in different ways to forward their compositional ideas – from the basic use of notational-softwares, high-level programming while composing, real-time composition and performance, etc. This means that a development has begun in which the creative interaction of humans with computers has lead to uncountable innovative music concepts[6] and works.

If one realizes the significance of these interactions and their potential for future developments, in fact, a comprehensive investigation into the interaction of composers with computers could provide a precious knowledge, for composers themselves, educators and researchers, about different strategies available during the creative act of conceiving a musical product in a computer-aided manner. This again could be a conceptual starting point leading to novel technologies. For example, such an investigation could provide basic knowledge for future extended research, such as the integration of human creativity into algorithmic approaches to develop compositional assistance systems. But also, to develop human-instrument interface concepts, whereby a performer or performers can improvise music in a computer-aided fashion – a customized interface or instrument-playing-device usually implements strategies for users to perform or compose music in a certain manner. Consequently, such innovative developments would lead to the creation of new innovative musical concepts and works. Indeed, if one imagines the potential of past researches in new interfaces or instrument-playing-device technologies and compositional assistance systems, which have developed incredible possibilities for everyone, and at nearly any place, to easily listen to, perform, and compose music, it is clear that further investigations into human creative interaction with computers could present an enormous potential to improve our everyday life in varied fashions.

[5] Inter alia through access to a comprehensive scientific knowledge through the world-wide web; development, organization, simulation, and verification of complex models, made possible through specific computer programs

[6] E.g. Live-electronic music, Sound art, Live-coding.

There are certainly other possibilities of investigations, which can specify and extend the outlined *Model of Musical Extrapolations*, and outline new horizons in research besides the perspectives sketched above.

A possible promising extension of this Model might be the integration of concepts from personality research[7], as we have conceptualized listeners and composers as so-called individuals (see Figure 4.4), representing a complex of basic factors[8] and processes[9] involved while music is being listened to and composed. Furthermore, we emphasized the fundamental character of experience itself.

It is the groundwork for individuals' further development: based on previous experience-based structures, new experiences are created, and the knowledge is built which can be used to 'recognize that there exists a gap or a musical problem which is interesting enough to spend some time on'. Again, experience can only be created in cooperation with pre-disposed structures, because humans base their extrapolation processes and, by that, their exploration of acoustical environments on so-called pre-disposed structures. However, based on the discussed studies regarding infants' auditory sensitivities[10] and their general musical organization abilities[11], we have seen that these pre-disposed structures do not work in all infants in the same way. This suggests that individual differences in processing of pre-disposed structures must be more clearly studied within the proposed Model of Musical Extrapolations.

Therefore, the integration of more aspects of sensitive variability within the framework could be done by incorporating concepts of personality research, instead of the concept of the individual (see above). With the help of knowledge from personality research and differences in sensitivities, forms of super-ordinated behavior aspects could be integrated and expressed, e.g. non-conventional thinking, playfulness, anxiety, impulsivity, etc. Such a super-ordinated perspective on the processing of musical extrapolations could then open new possibilities within musical research and to other fields.

Finally, the extensions in research sketched above, and the myriad of results of investigations included in this study, naturally lead to academic activities. Based in different scientific traditions and predispositions, researchers are trying to formulate new questions to find jigsaw pieces within the giant puzzle of creativity in music. Our *Model of Musical Extrapolations* thus only provides a few jigsaw

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[7] See 2.1.3 on page 96.

[8] These are intrinsic activity and motivation; pre-disposed and experience-based structures; and environmental pressure.

[9] These are problem-construction and problem-finding; convergent and divergent ideation; and evaluation.

[10] See 1.2 on page 35.

[11] See 1.3 on page 46.

pieces. New questions could be formulated towards the major target, which would formulate a comprehensive model of creativity in music.

Or, to speak with the words of ALBERT EINSTEIN (1938), P.92,

> *"The mere formulation of a problem is far more often essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science."*

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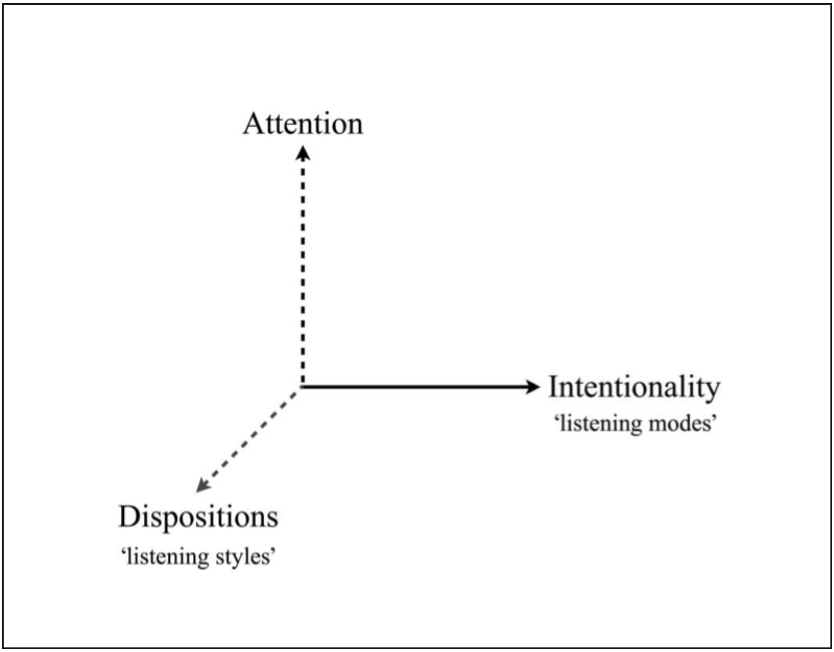
Appendices

Appendix A: Dimensions of listening/Listening modes with examples (Tuuri and Eerola, 2012, p.143)



S. Schmidt, *Musical Extrapolations,* DOI 10.1007/978-3-658-11125-0,

Table 1. Summary of the listening modes with examples.

Mode	Questions	Example 1: A cell phone rings during a lecture (with a classic 'Nokia-tune' ringtone)	Example 2: Listening to Bruce Springsteen Live Rendition of 'The River' on iPod whilst travelling
Experiential modes:			
Reflexive	Did you notice any reflexive responses triggered by sound?	Startle and orienting responses! It alarms and grabs attention. Sound was surprising because it was not anticipated in the situation.	No surprises, no reflexive responses. This is a recording I am well familiar with.
Kinaesthetic	How does it physically manifest? In what way does the sound imply movement?	Highly tensed and 'shrilling' qualities in the experienced path of motion, which overall feels descending but has distinct 'wavy' patterns with sharp onsets. Force feels evenly projected in the movement (as there are no changes in sound intensity).	Sense of a 'swaying' motion (driving rhythm), tension building and release across the chord progressions. Vocal attuning (sensations relating to the vocal apparatus) to the voice of the lead singer. An urge to play 'air drums'.
Connotative	What kind of freely formed associations did listening immediately evoke?	... something small and light (high pitch, not much energy) ... artificial ... plastic resonances ... ... arousing ... but feels cold and mechanistic ... ... ditties in electronic games of 1980s ... ringtones of 1990s ... old Nokia commercials ...	... feeling of a projection of a space ... live instruments played ... presence of large crowd ... ... self-confidence in voice ... emotionally charged ... ... rock-ballads ... Springsteen ... stadium concerts ... cigarette lighter lightshow ...
Denotative modes:			
Causal	What could have caused the sound?	It is a cell phone ringing on someone's desk.	Live musical performance by the E-street band. Played from a portable music player.
Empathetic	Does it feel as if the sound signals someone's state of mind or intentions?	First, the (tense and sharp) sound is like shouting at you, but when repeated, it starts to feel more like wailing, albeit in a machine-like way.	Melancholic and sad (flat tone of the voice), but nevertheless decisive or aggressive. Also a sense of shared togetherness (an audience singing with the lead singer).
Functional	What was the purpose of the sound? What function does the context indicate?	Somebody is calling; the sound has functions for alarming, identifying and locating. In general, the sound also has a branding function for the manufacturer. In musical terms, the melody manifests tonal functions of chord progression.	In the context of commuting, diverting the attention away from the mundane act of sitting in a bus and transporting the listener to an epic concert among thousands of listeners.
Semantic	Does the sound seem to represent any symbolic or conventional meanings?	Clearly, the sound represents Nokia. For me it also represents Finland. For the owner, it represents his or her choice of ringtone. This is a tonal melodic sequence in $\frac{3}{4}$ meter. It is a theme from a composition by Francisco Tárrega.	Nostalgic song from the early 1980s that epitomizes an era of rock ballads. Lyrics convey the feelings of readjustment and hopelessness after unemployment. A classic live stadium rock concert.
Reflective modes:			
Reduced	Can you describe the properties of the sound itself as objectively as possible?	The sound is a clearly separated, iterative object. It is in high-pitched register and a bit loud. The sharp onsets and tone quality resemble a simple sound synthesis. Overall, a big contrast to the previous quietness.	The trademark sound of the E-street band with harmonica, tingling piano arpeggios, and sparse guitar and bass backing. The vocal sound is rasping and forced, as if produced with great effort with respirations audible in many sections.
Critical	Was the sound appropriate for the situation? Did you understand it correctly?	No panic, this is not my iPhone. How disturbing ... it is totally inappropriate to keep your phone switched on! But hey, those classy ringtones are rare nowadays.	This music matches my current mood well. The time of the big stadium concerts has probably passed. How convincingly is Bruce singing about unemployment with his 20 Grammy awards?

Appendix B: Levels of creative thinking in terms of composing music (Burnhard and Younker, 2004, p.65)

Name	Data set	Age	Musical background	Composing pathway	Pathway description
Rob	Canada	11	School-based general music	Floater	*Much exploration *Minimal verification and incubation
Lia	UK	12	Guitar (1year)	Linear	*Much exploration *Skips direct to verification *Minimal phase interplay
Shira	Canada	20	Voice Music education major	Serial	*No preparation *Minimal verification *Minimal phase interplay
Katyia	Australia	16	Voice (3) Percussion (4) Piano (3) Flute (2)	Staged	*Progressive movement forward and across phases *Verification as notation *Expressive focus
Sarah	Canada	20	Voice Music education major	Recursive	*Time shared between preparation, incubation, illumination and verification. *Much interplay between phases *Expressive intention emphasized.
Angie	Australia	16	Cello (7) Voice (1) Piano (3)	Regulated	*Continuous interplay between phases *Much incubation (mind-writing and mind-playing) *Expressive intention realized as goal setting

Appendix C: The beginning of the 3rd movement of Shostakovich's 8th Symphony (op.65)