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ISBN 978-3-319-56055-7 ISBN 978-3-319-56056-4 (eBook)
DOI 10.1007/978-3-319-56056-4

Library of Congress Control Number: 2017935557

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This is rather as if you imagine a puddle waking up one morning and thinking, 'This is an interesting world I find myself in—an interesting hole I find myself in—fits me rather neatly, doesn't it? In fact it fits me staggeringly well, must have been made to have me in it!' This is such a powerful idea that as the sun rises in the sky and the air heats up and as, gradually, the puddle gets smaller and smaller, it's still frantically hanging on to the notion that everything's going to be alright, because this world was meant to have him in it, was built to have him in it; so the moment he disappears catches him rather by surprise (Adams 1998).

Preface

This book is about learning and knowledge as the abilities that ground appropriate responses to an ever-changing world. It is also a synthesis of many disciplines. Although the neurobiological and the cognitive perspectives frame the work, throughout, the assumption has been that learning and knowledge are multifaceted phenomena and that transgression of traditional academic boundaries is necessary in order to grasp them in their entirety.

Thus, this multidisciplinary attempt mirrors the complexity and heterogeneity of the theme. Learning and knowledge are both tacit and automatic as well as voluntary and socially endorsed processes. Any attempt to address these phenomena must cope with the risk of internally contrasting perspectives and the challenge of numerous blind spots since only a selection of academically relevant sources may be covered.

However, explaining human knowledge acquisition with the evolutionary origin of cognition in mind in an attempt to address humans as part of the biological world is worth the putative vulnerability and in some places academic weakness.

I have benefited tremendously from generous readers who commented on chapters in their areas of expertise: Gitte Balling, Simon Nørby, Cathrine Hasse and Claus Emmeche. I also wish to thank the many students who have participated in inspiring exchanges throughout the years.

In particular, I wish to thank my mother Ute Schmidt who in her professional career as teacher impersonates what I attempt to scientifically address. I thank my geologist husband Niels Hansen to whom I always turn because of his exceptionally competent ability to grasp ideas outside his own discipline and awaken them to life. Uncountable are the numbers of days we migrated with our dogs sharing thoughts. Lastly, my greatest debts are to my children, Maximilian, Nathalia, Ruben, Adrian and Rakel, my main teachers with whom I daily re-experience and interpret life and to whom I dedicate this work.

Hareskov, Denmark — Theresa Schilhab
April 2017

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Introduction to the Book

1.1 The Material World

To biologists, cognition is the set of abilities that permits organisms to navigate aptly in relation to both their physical and social environment. In evolutionary terms, any organism that successfully tracks regularities in the surroundings as signs of concealed phenomena or events (e.g., anticipates) increases its competitive fitness and the chance of contributing to successive generations. Apparently, the ability to track and appropriately respond connects organisms to the world's contingencies. Incessant experiences with the environment and subsequent retention in memory drive cognitive abilities. Why is this important? First, the dependence on immersion accentuates that *reality* in the form of concrete *perceptible* material located in time and space is central to the principles governing cognitive processes. Thus, cognition and learning are contextually and processually defined phenomena which only make sense in a dynamically changing world. Second, cognitive processes, which in humans include linguistic processes, involve some kind of *representation* of 'real' phenomena. Philosophically, representations are met with skepticism. In biological terms, however, it makes sense to maintain that organisms represent their worlds, somehow. What is actually meant by representation will soon become clear. Here, it suffices to posit that representations are correlates of the 'now' of the organism. The now entails both responses to the environment, interoception and memory (Barrett, 2009). Thus, it is important to note that any representation is a conglomerate of several processes spread over time and space and not merely based on the here and now of the body in the world. Furthermore, the conglomerate may be interpreted at a number of levels. At the neural level, which is to some extent pursued here, the conglomerate may be dissected as ongoing neural activity based on molecular processes. Representations could, however, also be addressed at the functional survival level, phenomenologically, at the level of the experience of the current state of mind, at the level of *external* influences, at the level of social groups, etc. The ambition to describe cognition will often traverse

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_1

one or more of these levels. Nevertheless, at the end of this chapter, I will list a few reasons for this account to address cognition primarily at the neural representational level.

The biological conception of cognition as outlined above poses a dilemma. With representations, it appears then as if knowledge is always of something that has a measurable (and material) impact on us. As if knowledge equals the impact made on us by a particular phenomenon and always materialises as a cognitive correlation to this impact. However, much human knowledge is in fact knowledge concerned with phenomena, events, or objects with arguable reality. For example, objects may seem quite different from events even if both are categorised as concrete. However, insofar as events may be systematically categorised by particular perceptual activations in the individual, such as 'a morning assembly', 'waiting for green light before crossing the road', 'the smell of coffee' or 'attending church service', with respect to stereotyped neural activations, as we will see events might in fact compare with objects.

Nevertheless, entities that lack either in perceptual qualities or entities, settings, events, actions, introspections, properties, relations and so forth we have never actually encountered but know of only vicariously i.e. from stories or descriptions by others, are integrated parts of daily life. Despite the lack of direct experiences, they are present even to an extent that we believe conforms to valid knowledge. This also pertains to multimedia exemplified by television, phones and the internet that contribute to knowledge formation of phenomena, events and objects we do not have direct experience with in the biological conception of the term. Imagine, for instance, how nature films from exotic locations are excellent to induce experiences that border on direct experiences. The multimedia platforms entertain and stimulate us among other things by using concurrent analogue visual and audio signals. Besides, science and art are rich on ideas of virtual and non-realistic phenomena that exist only as conceptualisations such as 'unicorns' or 'perpetuum mobiles'. In light of such daily experiences, contrary to the core claim of the biological conception of knowledge presented here, it is apparent that direct experiences are not constitutive of knowledge. However, they are important, but are merely reduced to a special case of knowledge. Many ideas are in fact productive in virtue of being only partly related to the concrete. An interesting first example of how representations might digress from their immediate surroundings relates to the Palaeolithic artistry found in caves such as Lascaux in France and Altamira in the North of Spain. Thirty-thousand years ago, ancient artists represented directly experienced aurochs and wild boars but also never directly experienced fabulous animals that were pictured alongside imprints of the real fauna (Mithen 2001). Science fiction is a compelling modern example to the same effect.

The everyday experience of 'innocent' knowledge sharing that comes about without direct experiences (in the biological conception) is central to human

societal organisation[1]. When knowledge sharing occurs as part of deep conversations between a teacher and student or between professionals within a domain, language is an indispensable component. In such conditions, language becomes the prominent tool by which to obtain understanding by the unfolding of explanations. Here, the acquisition of knowledge is realised through language and the knowledge product seems entirely linguistic. However, linguistic exchanges are not unique to educational settings but hold true of most human interactions. In everyday life we tend to engage in linguistic exchanges about much more than what occurs in our immediate periphery and what might be directly accessible to our senses. We exchange ideas of pets, cycle routes, cooking recipes, memories of exotic travels, and childhood experiences and only to a lesser extent ideas about the present, auditorily perceived, magpie outside the windowpane or the smell of food from the cantina. Linguistic communication is incontestable as a vehicle of information about temporally or physically distant or non-existent phenomena, objects or events[2]. Apparently, language makes up for the absence of direct experiences and provides adequate knowledge to a comparable extent by its own means—or does it?

1.2 Embodied Cognition

In the light of current neurophysiological results within the research program of embodied cognition that relate linguistic skills to bodily experiences, valid linguistic knowledge *without* corroboration from perceptual experiences is at best

[1]In scholastic education, the cornerstone of modern western civilization, transfer of information of not directly experienced knowledge is crucial (e.g. Wackerhausen 1996), whereas experienced knowledge is downplayed. The anthropologist Tim Ingold phrases how this (in the scholastic perspective) underrated knowledge source helps us 'read' in the world:

> Why do we acknowledge only our textual sources but not the ground we walk, the ever-changing skies, mountains and rivers, rocks and trees, the houses we inhabit and the tools we use, not to mention the innumerable companions, both non-human animals and fellow humans, with which and with whom we share our lives? They are constantly inspiring us, challenging us, telling us things. If our aim is to read the world, as I believe it ought to be, then the purpose of written texts should be to enrich our reading so that we might be better advised by, and responsive to, what the world is telling us (2011, p. xii).

[2]The emphasis on language is not an attempt to ignore that body language, chemical transmission, facial expressions, pitch of tone, and motor activity to be copied, are on-line signals that probably systematically accompany those intersubjective information exchanges, where people physically or near physically (over skype or telephone) meet, hence also contribute productively to the linguistic exchange (e.g. Havas et al. 2010). As this account unfolds it may become increasingly clear that as a consequence of the pointing to the embodiment of language acquisition, all of these non-verbal components have to be assumed whenever we refer to language as vehicle of knowledge.

surprising, at worst unconvincing[3]. The everyday experience of being able to obtain legitimate knowledge about phenomena one has had no direct experience of is challenged. For instance, when passively reading words with strong olfactory associations, such as 'cinnamon' or 'garlic', primary olfactory cortices normally involved in perceptual processing are recruited (González et al. 2006). Thus, mere reading of words that refer to real objects recruits neuronal areas normally correlated to the actual experience of that particular smell. The explanation is that neurons activated as a result of direct experiences with the referent of a concept (i.e. garlic) later participate in the neural correlate of the concept even *without* simultaneous presentation of the actual object. In his 'Perceptual symbol system hypothesis', Barsalou (1999) explains for example that representations that sustain concepts are grounded in the sensory-motor system; and that concepts are to be viewed as re-enactments of previous experiences. Stimulation of sensory-motor brain areas during perception in so-called on-line conditions; a form of situated cognition which takes place in the context of task-relevant inputs and outputs (see Wilson 2002) results in neural representations that endure beyond the period of stimulation. Riding your bicycle or sharing a conversation are both activities that depend on extensive perceptual processing of the environment. Off-line cognitive activities, such as daydreaming, remembering or planning take place irrespective of environmental input, and is therefore not situated. In the off-line situation, like when reading 'garlic' without the concomitant presentation of the relevant referent (here, a garlic), cognitive processing also involves perceptual and action systems that retain the perceptual qualities pertaining to previous encounters with a similar phenomenon (Pecher et al. 2011). Accordingly, the claim that a banana is yellow in the absence of bananas is associated with activity in the visual areas, whereas the claim that a banana is sweet is associated with activity in the gustatory areas of the brain (Pecher et al. 2011).

What are the neural mechanisms responsible for the sensomotoric anchoring of concepts?

Apparently, frequent co-activation of neurons strengthens their mutual connections. Thus, specific cortical links develop whenever experiences (for example the smell of garlic) correlate with particular language processes (the word 'garlic') (e.g., Pulvermüller 2005). The co-activity organises new neural assemblies that subsequently link representations of hitherto distinct phenomena such as the linguistic processes that produce the concept 'garlic' and the smell of garlic. And,

[3]According to Shapiro (2011), embodied cognition research has not yet matured to the level of an actual school, since most approaches diverge with respect to methodology, framework, and outspoken claims. However, embodied cognition approaches all agree to confront cognitivist claims. They object to a representationalist conception of cognition that neglects the inseparable co-determining of mental representations from bodily sources. Chemero (2011) on the other hand holds that cognitive science on the whole is immature and still caught in the 'preparadigmatic stage' as described by the Kuhnian terminology. For reviews on the fundamentals of the embodiment hypothesis, see for instance Meteyard et al. (2012), Pulvermüller (2013), and Wellsby and Pexman (2014).

importantly, as we will see later, even irrespective of whether the smell of garlic is phenomenally experienced.

If acquisition of the concept of garlic occurs as a result of actual exposures to garlic, sensomotoric processes are included in the conceptual representation. Following the neurophysiological understanding, neural representations established in previous direct experiences are significant to the character of the resulting verbal output and so-called linguistic knowledge, at least when subjects address concepts that refer to tangible objects.

To fully understand the implications of the embodied cognition position on linguistic knowledge, a more precise definition of what is meant by the expression 'concept' is appropriate. According to Barsalou et al. (2003), the common sense intuition about concepts is (p. 84): "knowledge about a particular category (e.g., *birds, eating, happiness*). Thus, knowledge about birds, represents the bodies, behaviours and origins of the respective entities". However, Barsalou et al. hesitate somewhat regarding the precise scientific understanding:

> Perhaps no discrete entity or event constitutes the concept. Perhaps conceptual functions emerge from a complex configuration of mechanisms in both the world and the brain. Thus knowledge of car objects per se resides in the car simulator[4] but much other relevant knowledge resides in associated simulators, such as those for road and travel (2003, p. 84).

Thus, in the embodied cognition perspective, sensomotoric activity contributes to conceptualising *because* of the re-enactment of the activity elicited during direct exposure. Surely, there are considerable difficulties associated with the embodied Barsalou-inspired take on concepts (e.g., Stjernfelt 2014). Some researchers advocate for the view of an embodiment continuum or "graded grounding", and distinguish embodiment theories on the basis of so-called strong and weak forms of the embodiment hypothesis (Crutch et al. 2013) to counteract risks of short circuiting understanding of cognition by radical embodiment theories (e.g., Chemero 2011). According to Chatterjee (2010), a reason to acquire the modest position is that theories of embodiment and grounded cognition have notorious difficulties in describing how children come to acquire abstract words.

As will soon be revealed, the central goal of this book is, on the grounds of embodied cognition, to explain how acquisition of abstract linguistic knowledge occurs and this implicates a significant deviation from an exclusive Barsalou-inspired take on concepts.

The question is then how to accommodate both perspectives; that knowledge is (partly) constituted by direct experiences, e.g., knowledge of garlic through smell and sight etc., but in some instances exclusively linguistically acquired, e.g., knowledge of the Ice Ages of which recent humans can have no direct experience and perceptually relevant activity. How is it possible to reconcile the neural data that suggest that knowledge is embodied with the everyday experience of widespread sharing of linguistic knowledge that often lacks the corroboration of direct experiences?

[4]'Simulator' refers to the neural correlate that sustains processes that refer to categories.

So far, following the biological perspective we may advance that cognition is an evolutionary product feeding on real interactions between the organism and its surroundings to optimise the negotiation of real objects, phenomena and events. As a result, the organism and the environment it negotiates must physically meet.

What, then, causes and characterises knowledge of phenomena and events we did not experience ourselves but know of only by language? Is the kind of conceptual knowledge that is not corroborated by direct experiences of a significantly different quality? Is scholastic knowledge obtained in education without the support of direct experience of a different kind? From a strict neuroscientific perspective, can non-perceptually grounded knowledge be considered knowledge?

1.3 Interactional and Contributory Knowledge

Recently, the existence and character of knowledge without direct experience has received increasing scientific interest. Within science and technology, that is studies on how social, political, and cultural values affect scientific research and technological innovation, the knowledge categories; 'contributory expertise' and 'interactional expertise', were introduced (Collins and Evans 2002; Collins 2004, 2007; Collins et al. 2006). Collins and Evans (2002) employ these terms to illuminate differences between various kinds of *expertise*. Interactional expertise is remarkable for its exclusive dependence on linguistic knowledge in the state of words and sentences uttered in conversation *without* the intervention of direct experiences of the phenomena, events or situations to which these words and sentences refer. The point is that expertise on, for instance, management of a science project that involves the ability to understand several sub-disciplines, is informed by linguistic exchanges on the subjects and *not* by hands-on experience in the sense of direct experience as conceived of in embodied cognition research (e.g., Collins and Sanders 2007).

Contributory expertise, on the other hand, refers to knowledge possessed by *practitioners* and therefore in addition to linguistic knowledge includes knowledge based on direct experiences. In contrast to interactional experts, who acquire knowledge purely by linguistic immersion which we will discuss in more detail in Chap. 2, contributory experts acquire their verbally expressible knowledge both by being practically and linguistically immersed.

Interactional expertise was introduced to explain and corroborate the validity of knowledge cooperation and exchanges in human professional trading zones (thus emphasis on expertise instead of knowledge, e.g., Collins et al. 2007), but to Collins and Evans (2007) it permeates almost any kind of human interaction; from division of knowledge in communities such as companies and professional societies to knowledge sharing in informal ordinary life. Though the concepts of interactional and contributory expertise were developed within the field of sociology, the

theoretical implications clearly pertain to general ideas about knowledge formation and foundation which renders the concepts highly relevant to the general discussion of knowledge pursued here (for instance, in the 2012 paper by Collins, in reference to the Dreyfus/Collins dispute, references are to the cuts of surgeons, the chess playing of chess masters, and expert sports commentators, and in the 2011 paper Collins states: 'Interactional expertise is not something possessed by odd characters such as social scientists and managers—the special interactional experts—it is everywhere: it is the 'glue' of human social life. That is why we are not bound to be social isolates, our comprehension narrowly restricted to our particular set of physical practices', p. 284).

From the biological perspective, what seems disturbing about interactional expertise and central to the discussion presented here, is its similarities to contributory knowledge with respect to linguistic competences. As noted by Collins, the interactional expert is not practically knowledgeable. However, of interest here is that linguistically interactional experts are insignificantly different from contributory experts. Whereas contributory expertise is founded and in that respect is neuroscientifically explainable in practical experiences, interactional expertise is acquired exclusively by extensive verbal exchanges with contributory experts. Thus, the phenomenon of interactional expertise challenges the neurophysiological and biological idea of direct experience as a constitutive source of knowledge (e.g., Pulvermüller 2013, for similar phenomenological objections to interactional knowledge, see Selinger et al. 2007).

The case of interactional expertise implies that, in principle, at the level of the individual, linguistic knowledge has no causal connection to or *immediate* grounding in external reality in the sense claimed by the embodied approach (though it certainly has at the level of language in general, i.e. Collins 2011). For example, a dentist has proficient knowledge about the pain of wisdom teeth even if he has never experienced similar pains himself. The male midwife legitimately knows about the experience associated with uterine contractions during labour even if his anatomy significantly differs to the extent that he can never experience this for himself (see Schilhab et al. 2010).

Without personal experiences, both the dentist and the male midwife know about teeth and contractions, respectively, from other sources. Most likely these sources are partly or fully linguistic[5].

According to Collins (2004), the quality of linguistic knowledge is comparable across interactional and contributory experts despite differences at the level of embodiment. In this understanding, private experiences and sensory perceptions though crucial to the practising of a practice, are insignificant to the formation of

[5]Please note that two aspects of expertise are at stake here. The argument concerns expertise at an individual level, in which knowledge of a particular sensation of pain or contraction is questioned. At the professional level, male midwives and dentists are all contributory experts with or without the direct experience supporting the conceptual knowledge.

specific linguistic knowledge in the individual (e.g., Collins 2011). The view acknowledges that for knowledge to be considered genuine knowledge originally someone has had to participate in physical practices and in this sense direct experience is still criterial for knowledge (see the 'social embodiment theory', Collins and Evans 2007, p. 79). Actually, Collins makes this statement when he argues that originally, any language emerges from interactions with the environment (2004). He claims, however, that once established, participation in the linguistic community does not presuppose that each individual is equally engaged with the environment to practise linguistically.

Of course, dentists are proficient practitioners of dentistry for them to count as professional dentists. However, they did not gain the majority of their knowledge from direct experiences with every bit of knowledge that defines the field of dentistry. Likewise, male midwives are fully equipped to maintain work as midwives without sharing the physical traits that characterise pregnant women. Male midwives are knowledgeable about pregnancy despite the fact that their bodies obviously lack the ability to become pregnant.

Within the concept of contributory and interactional expertise, long-lasting linguistic immersion is all it takes for novices to become proficient interactional experts who flawlessly verbally master the discipline in question.

One way to go about the tension between the bio-neuro-perspective that claims knowledge is grounded and the social perspective that knowledge occurs via linguistic immersion, is to posit that each position conceptualises knowledge idiosyncratically. Thus, knowledge in the sociological sense is entirely different from the biological sense. Though it could be argued that the conceptual understanding of knowledge in the biological and sociological perspective differs substantially, there need not be a complete congruence for the alleged tension to persist. After all, the idea of interactional expertise is conceived of in the context of contributory expertise which relates to knowledge obtained through direct experiences. Thus, it could be argued that the idea of interactional expertise employs a concept of knowledge that partly overlaps with that found in the bio/neuroperspective since both positions examine the implications of the physical interaction. The sociological claim is that linguistically, interactional expertise substitutes for contributory expertise. To reason linguistically about a discipline you need to be linguistically immersed.

To sustain the claim, Collins et al. (2006) have demonstrated the power of linguistic immersion in, for instance, colour-blind people (e.g., dichromats) who match any perceived colour with a mixture of only two spectral lights, and therefore might experience difficulties in distinguishing classes of items that differ only in colours. For example, colour blind people may find it difficult to distinguish a ripe from an unripe tomato. Some might also confuse the red and yellow of a traffic light without other clues (e.g., shape or location). However, according to the study by Collins et al. (2006), despite their (minor) handicap, colour-blind people are linguistically immersed in 'colour vision language' spoken by the majority of people

and therefore they are thoroughly acquainted with the language. Thus, accordingly, though partial colour blindness is likely to have a few mild behavioural consequences, those consequences seem to be non-verbal altogether (Schilhab et al. 2010). Just as for interactional experts in a specific field, any differences in experience will not show up in conversations or linguistic performances.

To sum up, from the above it becomes clear that the sociological conceptualization of knowledge has implications for discussions of knowledge and knowledge acquisition, since interactional expertise is relevant far beyond knowledge share between professionals. Principles guiding interactional knowledge compare with everyday observations of common information exchanges between neighbours, teachers and pupils, and parents and children. If in fact, most knowledge acquisition is not directly experienced at the individual level but rather by conceptualisations, interactional expertise may prove important to a reframed view on fundamental features of human knowledge. In the following, I will refer to knowledge that is acquired in senses relevantly similar to interactional expertise without being interactional expertise, as 'interactional expertise-like kind of knowledge'.

One of the reasons the tension between the sociological and neuroscience perspective on knowledge acquisition is fascinating is that these perspectives share the idea of language as placeholder of knowledge. When the interactional expert utters sentences that are insignificantly different from the sentences uttered by the contributory expert, the claim is that he uses the language in the exact same way. Thus, he demonstrates adequate and equivalent language proficiency.

Even more important to Collins (2011) it is the understanding of phenomena that we normally intuit is invoked perceptually which may be linguistically conveyed:

> it would, for example, be possible to come to understand tennis – to have a practical understanding of tennis – without ever having played tennis, held a tennis racket, bounced a tennis ball, or anything similar. To be clear about what is being argued, imagine a person who has been blind and confined to a wheelchair from birth. It is claimed that such a person could acquire a practical understanding of tennis solely from extended and intensive discussion of tennis in the company of tennis players. The claim is that such a person could, in principle, understand tennis as well as someone who had played it all their lives. They could become linguistically socialised in this way without paying tennis, seeing tennis, touching the apparatus of tennis, or stirring from their wheelchair (2001, p. 271).

When neuroscientists register which anatomical areas are active during linguistic tasks, they assume that the neural representation correlates to the knowledge mediated linguistically.

In a biological perspective we still need to explicate when and how linguistic knowledge can be transferred, what it means, and whether knowledge in the biological sense deteriorates during such linguistic exchanges. Therefore, in this account interactional expertise as concept instantiates the ancient scholastic position that knowledge is symbolic, which implies that it is transferable and independent of direct experiences in its acquisition. Accordingly, interactional expertise exemplifies the perspective on knowledge that suspends the bodily impact on linguistic knowledge as constitutive to seriously challenge biologically informed conceptions of knowledge formation as they appear in current neuropsychological research as

grounded in reality. Thus, the discussion does not hinge on whether interactional expertise actually exists in the form argued by Collins and Evans. Here, interactional expertise merely represents the position that linguistic knowledge is dissociated from embodiment.

1.4 Themes

Is it possible to reconcile the idea of interactional expertise as being grounded in the linguistic part of linguistic communities with contemporary neurobiological ideas of knowledge formation as grounded in reality? The analysis of and answer to that question is the objective of this book.

One way to embark on this enterprise is to scrutinise the implications of the sociological suggestion in an attempt to solve the following puzzle: Do linguistic knowledge of directly and non-directly experienced objects or events differ from each other to a significant extent not immediately revealed in normal discourse? In terms of interactional expertise, one may ask if, at some point, the cognitive processing of *concrete objects* based on direct experiences that naturally involve perceptual activity is significantly different from cognitive processing of *concepts* that refer to the very same concrete objects. Contrary to the concept of interactional knowledge and pro contemporary neuroscience, in the former case relevant perceptual experiences are actually included in the construction of knowledge. That is, the representation of the perceptual experience of concrete phenomena is included in the knowledge. In opposition, relevant perceptual experiences that pertain to linguistic knowledge are not involved when we acquire linguistic knowledge. Here, concrete phenomena of relevance to the linguistic concept are not immediately perceived—thus the representation concerns what I will refer to as 'non-crete' (abstract) knowledge. Thus, abstract knowledge is to be understood as knowledge of phenomena that are not directly experienced and in the present context, abstract is therefore defined in accordance with how it impacts neurally. This is a particular interpretation of the common understanding that 'abstract' means lacking in physical attributes (e.g., Vigliocco et al. 2013, see also Dove 2016). I do follow Borghi and Cimatti (2012) in that it makes little sense to posit a concrete-abstract dichotomy when it is rather a continuum. According to Borghi and Cimatti, it makes more sense to posit pure natural kind concepts like 'dog' at one end, followed by artifacts such as 'hammer' and 'trains', and social role categories such as 'teacher' increasing the complexity of the perceptual activities involved in the processing. At the other extreme we have concepts established by definition, like 'odd number'. Borghi's and Cimatti's continuum (2012) allows for abstract knowledge to contain experiential content (for a similar understanding see also Schilhab 2012).

The emphasis on the lack of experiential content as demarcation criterion of the abstract invoked in this book is somewhat connected to the idea of abstractions that are ripped from context as discussed by Barsalou (2009), insofar as the perceptual context as experienced is in fact missing.

This definition of abstract allows us to discuss whether differences in concrete and non-crete representations contribute significantly to the kind of knowledge that emerges.

Another important issue that follows from the question of the existence of, as well as representative characteristics of, interactional expertise is how interactional expertise is realised. If knowledge of concrete phenomena depends on exposure to real phenomena, events, and situations to some extent, what mechanisms (if not exposure to physical reality) are involved in case of the non-crete? How can we in principle make sense of the following claim by Collins (2012, p. 225)?

> The fallacy is this: while it is true that there could be no Lionese without zebra-ripping, not everyone who speaks Lionese with fluency has to be a zebra-ripper. Lionese is the collective property of lions and their `form-of-life' but that does not stop non-lions from acquiring it if they put enough effort into it. To acquire a language in this way is not a trivial accomplishment – which is why it remains true that if a lion could speak most of us would not understand him – but one or two of us who had put in the effort that it takes to become fluent in Lionese could understand him even though we have no claws or ripping-teeth.

In other words, is the non-crete knowledge different from concrete knowledge to an extent that biological conceptualisations of knowledge tend to ignore but which we ought to acknowledge?

1.4.1 On the Agenda

This book pivots around (a) the relation between concrete (direct experienced) and abstract/non-crete (without direct experience) cognitive representations, as they appear in interactional and contributory expertise of adult linguistic acquisition and (b) the biological conception of knowledge that emphasises the relation between linguistic knowledge, neural representations, and how we come to master large parts of language. A recurrent theme is therefore concerned with the *acquisition* of words for concrete phenomena which normally takes place in early childhood and the actual presence of the referents in question. When first acquiring the word for seagull, seagulls or at least pictures of seagulls would normally be present. However, with abstract (non-crete) phenomena in the sense implied, for instance 'space shuttle', the concrete referent is likely to be absent. In that case, linguistic descriptions are exclusive as stimuli that inform and corroborate the conceptual understanding. Although accompanying tacit body language is also likely to become associated to the conceptual understandings (e.g., Kontra et al. 2012; Schilhab 2012).

My aim is to explain how representations without direct experiences (as claimed of interactional expertise) are *representationally* possible in the neurobiological perspective and may give rise to interactional expertise in the absence of concurrent perceptual activity.

In this account, I assert that interactional expertise, though defined as exclusively about non-crete phenomena, is in fact a disguised form of embodied cognition.

I propose a mechanism—derived embodiment—to explicate under which circumstances the disguise is in effect.

So, one may ask why even bother, if my overall aim is to demonstrate that embodied cognition dissolves the concept of interactional expertise. In the following I list but a few reasons.

Obviously, human knowledge acquisition includes learning from indirect experiences[6] of which acquisition at the level of professional adults is persuasively framed by the concept of interactional expertise. The theory of interactional expertise is thus formulated and addresses a vast amount of knowledge which openly challenges neuroscience explanations of knowledge acquisition. Additionally, interactional expertise conceptualises our indisputable ability to stand on the shoulders of others to gain knowledge.

Thus when explaining knowledge acquisition it would be a fool's game to disregard the kind of knowledge that interactional expertise represents. Still, if humans preferentially acquire knowledge using their senses and this knowledge is anchored in concrete phenomena, yet in line with every day observations, the occurrence of interactional expertise seems almost insurmountable to explicate[7].

The agenda therefore is to explore the nature and realisation of the kind of knowledge that interactional expertise represents, that is the non-crete and how it relates to embodied knowledge.

In short, the present account is about how we, as children, may change from addressing concrete phenomena and in that process rely on perceptual experiences as adults to address phenomena we have no direct experiences with based on direct experiences in childhood.

Since the claim that knowledge acquisition without direct experiences appears indisputable, the aim is to leave the discussion of possibility to address the *mechanisms* in support of knowledge sharing. Though the level of description still aims at and refers to neural representations, and indirectly accentuates the individual, the impact of extensive social interactions on the representation is central. As we will see, the mechanisms sustaining acquisition of abstract knowledge are

[6]Intermediate varieties of learning that are neither direct nor indirect also exist. An example is so-called 'physical contiguity', which is a concept developed by Ribeiro (2007a, b). See also Schilhab (2007a) for a neuroscientific exposition based on mirror neuron studies. In Chap. 8 we return to that particular issue.

[7]How applicable is a sensorimotor explanation to linguistic meaning? Even researchers who agree on the relevance of re-enactment and simulation in language seem to differ on this issue. At the one extreme, some researchers hold that simulation is a constituent of all aspects of language (see Chemero 2011), whereas other researchers hold that both amodal and modal representations are involved. For instance, Barsalou et al. (2008) propose the Language and Situated Simulation (LASS) Theory, which posits that concepts are represented either in linguistically or in situated sensory-motor simulations. Whereas the linguistic system is associated with relatively shallow processing of language, the deeper conceptual processing elicits activity in the simulation system. Some researchers believe that concepts are primarily amodal (Mahon and Caramazza 2008, p. 10), however "sensory-motor information colors conceptual processing, enriches it and provides it with a relational context".

cognitively demanding. Thus I will assert that the cognitive load on the individual is possible exclusively as a result of knowledge sharing and conversational interactivity activities pinpointed by the concept of derived embodiment. Turning to the cognitive aspects emphasises the applicability of the theory of derived embodiment to the cultivation of the mind.

At the meta-level, the aim of this account is double while it contributes to the naturalising of man in the best Nietzschean sense (Welshon 2014). At the general level, the ambition is to 'translate man back into nature' (ibid., 2014, p. 22) using explanations at the level of biology and psychology. At the more specific level, the ambition is to explore the concrete neural mechanisms but from a perspective that is self-consciously humble with respect to what science has mandate to explain, which is why phenomenal experiences and conscious processes are central to the descriptions.

In both of these senses, the account has significant educational implications for what should be learned and how. Discussions about which direct experiences are preferable and why framed within contemporary neuroscience studies seem highly relevant. Are there such things as 'natural' experiences? And are there natural learning conditions that tap perceptual activity in optimal ways? The same goes with knowledge acquisition under interaction-like conditions. Based on the interpretation of concomitant neural activity, I will have much to say about the preferable settings and therefore also about the optimisation in a school context. When is language mediated knowledge acquisition preferable? What are the constraints, and are all pupils equally and sufficiently equipped for that kind of learning? The educational perspective pursued here therefore also contributes to fundamental issues in educational neuroscience.

1.4.2 Other Approaches

The notion that embodied experiences also inform language at an advanced linguistic level is not new neither philosophically nor psychologically (e.g., Lakoff and Johnson 1980), though it is well-known that abstract language seems to pose a special problem (Zwaan 2003; Barsalou 2008). Different approaches, however, attempt to explain the grounding of non-crete words and sentences in embodiment by focusing on either:

- metaphorical analogies, where image schemas obtained in a particular situation are applied in a new context (Lakoff and Johnson 1980; Williams et al. 2009; Hofstadter and Sander 2013)
- an action-based view in which motor responses are recruited showing the so-called action compatibility effect (ACE) (Glenberg et al. 2008)
- the relation between abstract words and internal references (as proposed by Barsalou and Wiemer-Hastings 2005; Vigliocco et al. 2013).

In these theories, emphasis is more on bridging the gap between the abstract and the concrete and less on the actual mechanisms and social realisation that in this account is proposed is crucial to the rendering the bridging probable. Williams et al. (2009) for example, introduce the concept of scaffolding as "a process through which humans readily integrate incoming information with extant knowledge structures". Scaffolding is then (ibid., p. 1257) "the passive, natural process through which new concepts are formed, especially in early childhood. Features of abstract or less understood concepts are mapped onto existing and well-understood concepts, such that the structure of the developmentally earlier, primary concept is retained in the newly constructed concept. This structure imbues the newer concept with meaning". The paper argues for some kind of 'metaphorical extension'. However the actual mechanism by which such scaffolding is accomplished is not clarified. Which processes are responsible for the mapping of abstract or less understood concepts onto existing and well-understood concepts? And in what sense is the process both passive and natural?

The WAT hypothesis (Words as Tools), however, may appear closer to the present discussion due to the inclusion of the social component (e.g., Borghi and Cimatti 2010) which emphasises that words are tools irrespective of their reference. Following the perspective of Wittgenstein Borghi and Cimatti (2012, p. 22) state that they "conceive words of a language as a set of tools that allow the user to perform a given activity". To Borghi and Cimatti, the tool perspective distinguishes between meaning of concrete and meaning of abstract words (MCW and MAW respectively, 2009) on the grounds that word meaning for concrete categories are grounded in quite constrained perception and action systems, whereas meaning for abstract categories depends on more complicated constellations of situations, objects and human decisions.

Hence, in this view MCW and MAW differ due to the differences in the situations in which words are used and, as we will see later, it is the differences in situations that decide to which category (concrete or non-crete) a certain referent belongs, which indirectly points to the quality of the referent in question.

Though WAT accentuates the significance of linguistic interaction, the WAT hypothesis is not explicit about which particular linguistic-cognitive mechanisms apply to either MCW or MAW situations, nor by what means linguistic exchanges in social interactions may be central to acquisition of abstract knowledge. This is central to the present account. However, the division is represented in other perspectives. According to some researchers, concrete words, here in the sense of words that refer to specific objects or events (West and Holcomb 2000) are acquired earlier, and are remembered and recognised more rapidly than abstract words because their eligibility to imagery provides an additional means through which they can be stored and retrieved (Altarriba and Bauer 2004). This effect has been termed the concreteness effect (Altarriba and Bauer 2004). There seems to be, however, some dispute over the generality of the effect. For example, the time subjects use to comprehend sentences is generally shorter when the sentence is

concrete rather than abstract and subjects tend to respond faster to concrete than to abstract sentences when they assess meaningfulness. However two major approaches, the dual-coding theory and contextual-availability model (see reviews by Paivio 1986; Schwanenflugel 1991), respectively, have contrasting views on why the concrete seems to improve memory and time of processing. Dual-coding theory claims that remembering concrete words (here, words that refer to visual objects and actions) differs from remembering abstract words, because concrete words like pictures of objects can be both verbally and visually coded, while abstract words can only be verbally coded (Kroll and Merves 1986). However, when there is adequate contextual information in the discourse, linguistic factors might mask the beneficial effect of the imagistic aspect of concrete words, because of faster or earlier processing (see West and Holcomb 2000).

According to the context-availability model, understanding (of both abstract and concrete words) is closely related to both (1) the information internally revealed in the preceding discourse and (2) prior knowledge of the subject. The dual-coding theory, on the other hand, claims that besides semantic processing, concrete words are processed further in a nonverbal 'imagistic' system "through referential connections" (West and Holcomb 2000, p. 1025). In a study using event related brain potentials (ERPs), subjects were requested to either make sensibility judgments or lexical decision tasks when exposed to concrete or abstract sentences (Kounios and Holcomb 1994). Here, concrete words typically elicited more negative ERPs than abstract words indicating that "concrete words were accessing a nonidentical set of cognitive and neural processing" (ibid.). Further studies making use of anomalous sentences by adding incongruent final words to the sentence context showed more profound activation in incongruous concrete sentences such as "Armed robbery implies that the thief used a rose" compared with "Armed robbery implies that the thief used a weapon". Subjects were either explicitly asked to imagine a target word (the end word) that occurred in a sentence which they were instructed to judge the truthfulness of. And the target word was either concrete (e.g., spider, violin, umbrella; e.g., it is easy to form a mental picture of an elephant) or abstract (e.g., greed, equality, chaos, it is difficult to form a mental picture of an aptitude). The authors concluded that (West and Holcomb 2000, p. 1034): "superior associative connections in a common linguistic semantic system and the use of mental imagery both contribute to cognitive processing advantages for concrete words over abstract words".

A study by Xiao et al. (2011) on event-related potential effect during retrieval of concrete versus abstract words corroborates the claim that concrete words show faster retrieval times because of availability of context. They write: "intentional rehearsal during the encoding phase contributed to the advantage of concrete words over abstract words by providing greater contextual information in the explicit retrieval phase". However, according to Altarriba and Bauer (2004), emotion words belong to still another category. These are less concrete but more imageable and easier to think of a context for than abstract words. Also, emotion words elicit more associations than abstract and concrete words when subjects are instructed to write

down the first word that comes to mind when presented with a stimulus word (Altarriba et al. 1999).

For other important however slightly different approaches on language and cognition, see Deacon (1997) and Fauconnier and Turner (2008).

1.4.3 Introducing 'Derived Embodiment'

In the account presented here, I emphasise the effect of conversations and assert that language acquisition is a scaffolded process. The point is that language in itself makes advanced linguistic knowledge (without direct experiences) possible by offering itself as a constructive tool. The argument is that early mastering of language mostly concerns direct experienced phenomena (the concrete stage) (see Schilhab 2011). This ultimately paves the way for mastering language concerned with non-directly experienced phenomena (the abstract stage). I suggest that the processes involved in our childhood acquisition of abstract language are largely comparable to the acquisition processes of interactional expertise in professional adult life (Collins 2011). As explored in details later the mechanisms that seem to govern interactional expertise acquisition are prominent during earlier stages of language acquisition also, which suggests that interactional expertise is to be understood merely as a sophistication of existing learning strategies associated with human interactions.

Thus, central to the understanding is the primacy of the concrete and its use as a springboard for abstract knowledge acquisition. As briefly discussed, to understand abstract knowledge as the result of some sort of scaffolding process is barely new. The same goes for the accentuation of early language comprehension as grounded. Therefore, my emphasis is in particular on the *mechanisms behind the scaffolding* and how exactly concrete language acquisition constitutes understanding of the abstract.

I have named the compilation of mechanisms 'derived embodiment' (Schilhab 2013a, b, 2015b) to emphasise the particular conditions and processes that lead to the acquisition of non-crete concepts. When language acquisition turns from concrete to abstract phenomena, the significance of perceptual processes changes. Derived embodiment is, in the absence of experiences of the actual (real) referents of the concepts, by proxy in conversation to flesh out mentally established constructs in the form of imagined concretisations. My claim is that the processes sustaining derived embodiment provide qualitatively similar linguistic competences when addressing abstract phenomena as when addressing concrete phenomena. In short, derived embodiment emerges when pure imaginings absorb, so to speak, and during that process become associated with representations of concrete items or phenomena. However, derived embodiment processes are by no means intuitive nor do they follow automatically from mastery of concrete language.

What is radical about derived embodiment is the accentuation of the social interaction. In most expositions on abstract knowledge acquisition, focus is on the

individual. It takes an individual mind to actively conceive of ideas that have no or very reminiscent physical realities. For very good reasons, intuitively the focus is on the individual as powering mental constructs, even when shared linguistically in conversation. Obviously, when we orient ourselves towards abstract ideas, the process has all the signs of an individual enterprise. However, what seems to be forgotten is that the powers that generate these ideas have a developmental history that is uniquely social. I will argue that it is by way of tedious, careful, and continuous social interactions that abstract linguistic acquisition is realised. The neglect is possible only because many of us eventually have become proficient thinkers who have trained extensively to internalise the work once shared. I will analyse how abstract thinking that which we think of as sacred to human cognition can be dissolved into socially mediated cognitive processes. Hence, I argue that what seems uniquely individual is in fact based on an elaborate mental activity of supportive fellow humans in particularly productive settings. Hence, I claim that the settings and procedures involved might be of considerable importance to both cultural development and the maturing of the individual. This is also why this book is not just another argument for embodied cognition. Rather it is an account aiming to explain how abstract thinking or more elaborate thinking seems to be rooted in both our neurocognitive processing and socio-linguistic interactions. Another reason why this account may prove particularly interesting for scholars in the humanities who generously embrace the social, but typically dismiss or even reject the individual cognitive processes in culture and learning.

Thus, advanced acquisition through derived embodiment presupposes the meeting of certain conditions:

(I) Linguistic skills have been established by addressing the concrete level
(II) Actual conversations involving an interlocutor
(III) Establishment of an intimate space produced by its participants.

(I) *Linguistic skills acquired to address the concrete level*

The first condition refers to the fact that the realisation of derived embodiment presupposes some degree of competent language use. For abstract language learners to participate in conversations about phenomena that (to them) have no physical attributions, they must know a number of rules that govern conversations. Among other things, these imply familiarity with the word-object paradigm or so-called ostensive learning in which "adults naming objects while the child focuses on and attends to them" (Pulvermüller 2011, p. 10) and which we will return to in more depth in Chap. 3.

When abstract knowledge acquisition occurs, learners already master competent language use in the concrete phase in which direct experiences of concrete phenomena, events, and objects, which have distinct perceptual qualities described in time and space, are linguistically adopted. The category of concrete phenomena, events, processes or occurrences include *tangible* objects such as dogs, cutlery, liquid, clothes, apples, and mosses, as well as sisters, the earth, universities, stars, and radio-broadcasts. From the perceptual point of view, the category which

appears unsystematically broad is nevertheless distinct. I argue that due to the concreteness (which implicates perceptibility) of such items, in direct experiences different language users have more or less equal access and therefore to a certain extent equal opportunities to acquire knowledge pertaining to the perception of these phenomena. Knowledge of phenomena, events, and objects such as 'democracy', 'desire' or 'discipline' are not concrete and therefore cannot, along similar lines of thinking, be localised in time and space. They do not present themselves to traditional forms of perception and therefore linguistic acquisition of such phenomena appears more variable.

In the later derived embodiment phase, however, intangible items become tangible because of their almost promiscuous borrowing of corporeality from direct experiences of objects. Knowledge of what has not been perceived is encoded by way of the perceptible and therefore becomes perceptible itself. Abstract knowledge that borrows the material structure from direct experiences is then upgraded to 'original' knowledge corroborated by perceptual experiences despite the absence of direct perceptual grounding. As a result of associations, derived embodiment helps us understand non-experienced experiences referred to by linguistic expressions and the leading process in knowledge exchanges such as interactional expertise that build almost exclusively on linguistic exchanges.

(II) *Actual conversations involving an interlocutor*

The second condition concerns conversations of a certain kind and not just any conversational exchange. Ordinary discourse, in which participants exchange information on the fly, may happen at a superficial level without substantial attentional investment on the part of the interlocutors. Everyday exchanges of words need not recruit focal thought to satisfy the purpose of a dialogue. For conversation to result in acquisition of abstract knowledge, on the other hand, both participants need to possess the 'right' (focal) state of mind (see Turkle 2015). Ideally, the expert (the more knowledgeable) must take responsibility to create mutual comprehensibility in the conversation by assessing the perspective of the learner and fill in the gaps to ensure coherence of the emerging conversation. Thus, evidently, derived embodiment is not automatically elicited as we exchange words about phenomena that are not perceptually accessible. The circumstances that facilitate the ability to concentrate are time consuming and vulnerable to external disturbances. In that sense, conversations that generate derived embodiment processes are luxurious and demanding and closely linked to well-developed intentions to learn. In adult life, this may happen professionally as described by the phenomenon of interactional expertise that depends on deep conversations (linguistic immersion). As exemplified by the conversation between a contributory expert and an interactional expert novice, ideally he or she is fully aware of the demands pertaining to him or her as full blown expert when he or she engages in a conversation with an apprentice. The learner on the other hand is motivated by his or her interest in developing an understanding of the issue in question. He or she will exert himself or herself to keep track and make sense of the explanations offered in conversation.

In children, however, derived embodiment processes are likely to surface in engaging class room teachings, in episodes of bed time stories, and in prolonged parental explanations. Thus, robust derived embodiment processes are more difficult to pursue than processes of concrete language acquisition.

This is because the acquisition of concrete language also depends on conversations and attention. Learning about abstract referents one has had no direct experience with places a different stress on the ability to sustain understanding. In concrete language acquisition, interlocutors merely point to the referent of the conversation, whereas in abstract language acquisition, the interlocutor points by using words.

Thus, the mechanisms that lead to understanding fundamentally change. I will argue that the mechanism crucially depends on both the individual's ability to grasp phenomenal aspects of imagination as well as the conversational partner (elaborated in the next paragraph). The cognitive efforts behind this process are comprehensive and advanced and include mastering an attentional switch from monitoring external stimulation to the internal 'stream of consciousness' (e.g., Dennett 1992 following the psychologist William James).

These cognitive processes depend on more general linguistic competences and are therefore likely to emerge relatively later in language acquisition. Moreover, for these abilities to fully develop it is crucial to have emphatic interlocutors. My assertion is that a subject's abilities to acquire abstract knowledge evolve through careful guidance and therefore may in fact vary noticeably as an effect of a 'master'. It is therefore not difficult to see how teachers may prove particularly useful or devastating for learning in this abstract phase.

Emphasis on conversation as the single mechanism by which to obtain abstract knowledge may seem unconvincingly narrow. On a daily basis we acquire knowledge about, for instance, historical places without ever being deliberately taught and engaged in the proposed derived embodiment mechanisms in the conversation, for example through written works. In literature, there is no *active* communication between the author and the reader. Yet, one could argue that often literary texts such as poetry elicit derived embodiment processes. Nevertheless, I suggest that the process of derived embodiment is particularly productive in acquiring abstract knowledge and distinctive of those instances that resemble training of interactional experts, narratives by story tellers, and even in the deleterious sustenance of 'gaslighting'—the therapeutic term for the attempt to distort reality in an effort to convince one's spouse that he or she is crazy, and that what he or she is perceiving is not happening (see Gass and Nichols 1988). I believe that reading texts that evoke derived embodiment processes piggybacks on processes refined in previous episodes of real life conversations. Thus, successful acquisition of abstract knowledge via reading seems highly dependent on familiarity with the processes characteristic of derived embodiment conversations.

(III) *Establishment of an intimate space produced by its participants*

As briefly touched upon, the mechanism of derived embodiment is neither passive nor 'naturally' occurring. First, the empathy of the conversational partner—the putative expert—is not a trivial precondition. I propose that the success of abstract knowledge acquisition crucially depends on the empathic skills of the interlocutor in the sense of tuning into the other person's thoughts and feelings. Why? Drawing upon 'grounded cognition' studies in contemporary neuroscience and cognitive psychology, my claim is that the linguistic explanations are primarily fuelled by mental imagery during conversation (e.g., Moulton and Kosslyn 2009) which unavoidably builds on the ability of the adult interlocutor to gauge the level of comprehensibility in the learner. His or her inevitable assignment in conversation is to appropriately monitor the linguistic maturity and level of understanding in the novice.

Second, for abstract knowledge to be conveyed, the interlocutor will need to establish metaphors or phrases that immediately capture the concrete meaning of the abstract knowledge. Just as the adult in ostensive learning furnishes the on-line world, for instance holding up a cup, pointing to the cup and exclaiming 'cup' (e.g., Pulvermüller 2011), the interlocutor furnishes the off-line world. He or she seeks mutual comprehensibility and makes mental tableaus that are thought to match the understanding of the child (or in case of adult learning, the novice).

Third, despite exchanges of questions and answers, the expert interlocutor takes on the leading role to attain mutual comprehensibility. In this endeavour, the interlocutor must refrain from the uncontrolled imposition of his or her own level of understanding on the listener. At the same time, he or she must sustain his or her own (expert) understanding while remaining sensitive to the level and quality of the imagination of the novice.

Such engagement of the conversational partner of course also exists in earlier stages. During early language acquisition, the continuous attention towards the activity of the child, the dedication to read the intensity of his or her gaze, and the compelling affinity towards his or her way of interpreting the world are some of the profound drivers behind 'shared intention' (e.g., Fasel et al. 2002; Gavrilov et al. 2012; Bard and Leavens 2008). The adult interlocutor is always engaged in repairing any lack of coherence or logic in the behaviour or interpreted 'train of thought' in the child. The interlocutor will adopt the attitude of continuously repairing any fragmentary conversation on the part of the language learner. He or she will engage in various interpretations of the inner world of the child, including his or her mood, current thoughts, expectations, and intentions based on the progress of the conversation.

At the abstract level, the role of the conversational partner becomes even more central in the development of the student/novice. The linguistic exchanges aim to establish the imagery and invite the conversational partner to furnish the world without the involvement of direct perception. In fact, the part played by the interlocutor is to *compensate* for the lack of perceptual corroboration in this advanced phase of language acquisition. Thus, for language acquisition of abstract

knowledge to succeed, the role of the interlocutor is to replace the perceptual cues provided by the real world at the concrete level. The task is challenging since the furnishing happens in a non-existent room created by the individual imaginations of the adult interlocutor and the language learner.

To summarise, I suggest that once concrete language (along with competent language use) has been established, much of our childhood acquisition of advanced (abstract) language is comparable with the acquisition coined by the idea of interactional expertise. Due to the imminent absence of the referents in question, I suggest that advanced language acquisition typically depends on discourses with conversational partners in a process that I have named derived embodiment. However, for linguistic stimuli to work proficiently, the language learner must be capable of establishing and maintaining the images referred to during conversation. Such cultivation of imaging depends on an ability to bring vague memories to the mind which again depends on the ability to maintain an inner focus.

1.5 Obvious Objections

1.5.1 Embodied Cognition and Representations

Let us get this right from the start. On the face of it, my rough claim about the two-phased language acquisition that deals with concrete and non-crete phenomena, respectively, is vulnerable to many obvious objections. At this point, it might be precautious and productive to address some of the most prominent doubts to pave the way for the argumentation that follows.

To begin with, there seems to be an immense tension between the explanation of abstract knowledge acquisition and hence interactional expertise from primarily an embodied and neuroscientific perspective on the one hand, and on the other hand by way of representations. According to Chemero (2011, 18):

> there are those who think the main business of cognition is what I sometimes call mental gymnastics, the construction, manipulation, and the use of representations of the world, and there are those who believe that the business of cognition is to do something else.

The latter are anti-representationalists, who emphasise the omnipresent interaction with the environment and with whom 'the embodied cognitivists' normally sympathise. Thus, the luring problem here is with the notion of representation chosen as the level to make sense of cognition.

The difficulty arises as a result of the function cognition, in the representational sense, serves in living organisms. Putatively, to emphasise representations is to impute statics to the mind. Deacon, however, emphasises the *process* as absolutely key to understanding organisms as well as their cognitive abilities (2012). According to Deacon, being alive is about changes and not composition. The same goes with our cognitive activities (ibid., p. 106):

> No one would seriously suggest that the process of thought could be explained solely in terms of neural structures or neurotransmitter molecules. Of course, these are critical to the account, but without understanding the processes that they are enmeshed within, we are merely doing anatomy. What matters is the process…

So, how can I possibly defend the idea of representations while grounding the explanation of abstract knowledge acquisition and the kind of knowledge that interactional expertise represents primarily on embodied cognitive approaches that would ultimately stress 'the process'?

First and foremost, I take the concept 'representations' to connote the impression that stimuli cognitively reflect. By impression, I stay more or less agnostic with respect to the causal mechanisms involved and I refrain from imposing strong opinions on the inevitability and character of the representational end results. This position is informed by the seeming difficulties of firm correlations between the phenomenal and neural aspects (e.g., Barrett 2006). Moreover, in recent years it has become increasingly clear that the resting state of the brain is co-determinant of the immediate neural representation (e.g., Raichle 2009; Callard and Magulies 2011). Thus impressions simply denote the neural imprint either empirically recorded or which we assume exist *correlated* to particular stimuli outside of or within the organism. In many cases, the notion of the 'neural correlate' is an abstraction inferred from the ongoing physical activity in question that leaves the actual interpretation and derived anticipatory predictions rather weak. In such cases the neural correlate is to be understood as a construct not empirically established, yet meaningfully ascribable (see for instance Anderson 2014). Moreover, the stimuli that occur outside (externally) or inside (internally) of the organisms are, though labelled in singular terms, most certainly composite in nature. It seems meaningless to assume that cognition can be described as the 'result' of a single input, though cognition (despite default network considerations) definitely implies action and reaction relations and therefore lend itself to images of selective input-output associations. Why emphasise the neural level, then? The accentuation of representation in the sense of imprint results from the wish to understand how biological organisms susceptible to external occurrences eventually cognitively manage phenomena of less concrete character. Since abstract learning as defined here depends on phenomena with no physical reality in the normal sense of the term, and at the same time should be related to knowledge acquisition of perceptible entities, investigation of such learning naturally invites the level of neural representations, even if the perspective balances on the brink of accusations of reductionist inclinations. Moreover, and of significant importance stressing the neural correlate allows for the inclusion of implicit processes, non-conscious actions, and automatic responses, abundant in human behaviours. With the neurally informed tool set we may come up with falsifiable suggestions about the nature and function of concepts as 'operational units' of thought and language as part of a causal chain, even if these suggestions are neither exhaustive nor complete. When we include the neural level, we zoom in on the processes that combine the individual with the social.

A more subtle objection addresses the claim that abstract learning is social in character, which apparently renders the focus on representations in the individual

irrelevant or at least insufficient as a level of explanation. I concur that any episode of language acquisition depends on social interactions. So also the mechanism of derived embodiment presupposes levels of explanations beyond the neural. In opposition to for instance so-called eliminative materialism (e.g., Churchland 1986), it is not the neural level per se that interests me, but how acquisition of abstract knowledge converts to neural activity because this level of description may disclose characteristics of knowledge to which we might otherwise be blind. Simultaneously, I acknowledge that for the activity to change, we take a number of different levels not neurally addressed for granted.

Other seemingly dubious dispositions in need of clarification include the notion of knowledge employed here. One could object to the impression that in a neural account (1) knowledge is 'just' the changed representation composed of previous and current neural activations that emerges when individuals are exposed to stimuli, which raises questions about the relation to language e.g.; (2) is the separation of concrete and abstract entities on the basis of presence and absence contrived and not applicable beyond the distinction used here?; and (3) does the implied assertion that the individual linguistic acquisition in general follows characteristic trajectories along the concrete abstract axis, as if concrete knowledge belongs to the childhood and abstract knowledge always belongs to more mature ages, hold? In the chapters to come, I address these questions more fully. Here, however, I will confine my preliminary considerations to three immediately recognisable problematic implications of my account: (I) language as knowledge; (II) the separation of concrete and abstract phenomena, and (III) the idea of stages in language acquisition.

1.5.2 Language as Representation

At what grounds might a linguistic representation, for instance words uttered, count as knowledge? Obviously, as we equate language with knowledge, we risk missing out on non-verbal means of knowledge, disregarding knowledge as also procedural, automatic, and non-conscious insofar as it emerges as a non-verbal behavioural response. The distinction between verbal and non-verbal knowledge is connected to that of explicit and implicit knowledge since it invokes similar ideas of conscious and non-conscious processes[8]. Though, I fully recognise implicit versions of

[8]Anatomical (Squire 2004, 2009) as well as neuropsychological research (e.g. Berry and Dienes 1993; Berry 1996; Underwood 1996; Weiskrantz 1997; Stadler and Frensch 1998) unambiguously supports the existence of at least two independent learning systems. However, disagreement on how theoretically to demarcate non-conscious, implicit from conscious, explicit learning has prevailed (e.g. Berry and Dienes 1993; Frensch 1998; Reber 1967, 1993). Moreover, distinctions in terms of consciousness have dominated explanatory attempts, i.e., the presence or absence of awareness, as manifested by the ability or inability to report with confidence on learned material, is crucial to most research paradigms (e.g. Berry and Dienes 1993; Berry 1996; Underwood 1996; Weiskrantz 1997; Stadler and Frensch 1998).

knowledge and in line with the biological conception of knowledge widely include non-conscious processes in most explanations presented here, as implied by the embodied cognition framework, the central question to be answered here concerns the neural activity of abstract linguistic knowledge.

I will, however, contend that this representation always also includes non-conscious processes (see Shusterman 2009). Therefore, when in this account focus is on linguistic knowledge it is in the sense endorsed by the idea of interactional expertise but, as will become clear, with an eye to embodiment of that knowledge. Thus, when addressing how non-crete knowledge acquisition is possible, I will certainly not claim that all knowledge is linguistic. The aim is instead to investigate how abstract linguistic knowledge is actually constituted by embodied knowledge.

I am, however, at this point undecided with regards to the nearby topic; that of the relation between *understanding* and knowledge, which is typically conceived as *linguistic* and the issue will eventually be discussed. Here, it suffices to accentuate that we do somehow use linguistic knowledge (to the extent that it differs from non-verbal knowledge, Schilhab 2007a) to bridge and acquire different perspectives to harmonise and exchange viewpoints (Prinz 2004) an achievement that seems to depend on understanding. It is the linguistic format that promotes dissemination of knowledge and which is commonly accepted as indicative of knowledge due to being verbally and therefore to some extent consciously accessible. Linguistic knowledge thus permits information transfer between subjects.

The question is then in an implicit though unspecified acknowledgment of the involvement of understanding: how does intersubjectively transferred knowledge, linguistic knowledge, make abstract knowledge acquisition possible?

More specifically, in what sense and how may linguistic knowledge be conceived of as placeholder for knowledge obtained in direct experiences? In principle, what permits linguistic knowledge to contain those elements that validate it as knowledge insignificantly different from directly experienced knowledge?

To answer these questions we will explore the nature of linguistic knowledge as it appears in non-crete knowledge; how it emerges, its constituents and how it relates to concrete and non-crete phenomena.

Another objection related to knowledge as linguistic is that such characterisations are far from exhaustive with respect to what language is. Language is much more than a labelling device used to symbolise the furniture of the world, as suggested by Tylén et al. (2010), amongst others. They argue that though language might be conceived of as representing knowledge, it has a number of interactive effects suggestive of its tool like nature. For instance, they list that language extends

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(Footnote 8 continued)

As commented upon by many observers, creating a distinction by subjective report might not be feasible in that the distinction is operationally unclear (e.g. Berry 1996; Frensch 1998). It is clearly impossible to show that lack of report is due to non-conscious awareness of learning. For a modified suggestion, see Butler and Berry (2001).

so-called 'interaction space' by 'enabling externalized and mediated forms of interaction that work over distances and times' (p. 4). Language is also extensively responsible for the precise summoning of the attention of others and the accomplishment of predicting the intention of others. Thus, language facilitates the sharing of plans and sustains cooperation.

In the present context, I will, however, focus on a very specific feature of linguistic functioning bearing in mind the multifaceted character of language function. Doubtless, the referencing of the world—the word to world match—is, though not exhaustive—archetypical of linguistic functioning in the contributory—interactional expert dialogue. As we shall see this particular aspect plays a considerable role in the acquisition of language. From early on, we request objects, attend to events, or seek particular emotional states, all of which are directly experienced and which we learn to denote by using language as 'labels'. Later, we request knowledge of phenomena, objects, or events to which we have no access. To claim that sometimes language functions as a labelling mechanism by no means implies that language as such works and can be fully understood in a one-to-one projection, in the sense that 'cat' refers to 'furry animal on carpet'. We will return to this issue in the next paragraph.

1.5.3 The Concrete and the Abstract

This leads me to the discussion of the second controversial distinction; the separation of concrete and abstract phenomena. One could object that this distinction does not carve the world at its joints, since what counts as either 'concrete' or 'abstract' is rather ambiguous.

So, to polarise phenomena, events, and objects into just two categories may appear unjustifiably crude and could obstruct the attempt to obtain any proper classification. The response, however, is that in line with the linguistic discussion also from a biological perspective that focuses on representations, apparently the mode of existence of the phenomenon to which knowledge refers, designates the character of the representation and therefore the formation of knowledge. Simply, and as we will return to in Chap. 3, concrete phenomena have the 'natural' capacity to influence and form knowledge involving somatosensory representations, while non-crete phenomena do not. To use perceptual influences as a decisive factor in categorisation permits us to, from a biological perspective, clarify what linguistic knowledge consists of and how it is constructed, since perceptual characteristics readily lend themselves to neural descriptions in the sense of neural correlates. Though the neural level description of knowledge is neither exclusive nor primary to other perspectives, the important point is that the neural description sits well with representational characterisations of knowledge.

Results in current neuroscience suggest that among other things, the division at the neural level is based on inclusion or exclusion of perceptual activities. Hence,

the representational character appears analytically relevant to the discussion of significant differences between concrete and non-crete knowledge.

Given that in the concrete case knowledge is constructed from perceptual activities, the neuroscientific approach makes it possible to address what is the relation between representations that arise from current external stimuli, previous knowledge, and on-going internal activity such as images, introspections, and interoceptive experiences. Likewise in the non-crete case, what characterises knowledge that is not corroborated by current external stimuli?

The representational differences at the neural level reflect and emphasise important aspects about knowledge that may advance our understanding of and the implication of knowledge.

Visualise that reading philosophy in an armchair involves continuous exchanges with the surroundings in the form of tactile sensations of the seat, olfactory bombardments by the strong cup of coffee at the table, the background sounds of doors being opened and closed, as well as haptic feelings connected to turning the pages of the book.

What if the philosophical text is about drinking coffee while doors are opened and closed in an opposite room? Obviously, in the neural representational perspective, some of the current perceptions might superimpose on and perhaps indeed facilitate the reading activity while others would be indifferent to the reading.

Hence, the need to distinguish conceptual knowledge that refers to online phenomena (in the above example drinking coffee in the presence of opening and closing of doors) from conceptual knowledge that refers to absent phenomena (e.g., dogs were mentioned in the text but absent in the surroundings). Given the continuous perceptual activity, apparently we ought to distinguish between perceptions that *sustain*, are *neutral* to, or *counter* conceptual knowledge formation (Kuzmičová 2015). One such first step is therefore to separate relevant from irrelevant experiences (the armchair experience seems irrelevant to conceptual knowledge of, for instance, chocolate), as well as actual and mere simulations of perceptions (in case of present versus absent referents, respectively). In the discussion of relevant perceptual activities, for example, we can think of chocolate in the sense of conceptual knowledge of chocolate while being relevantly perceptually supported by eating it. The problem is thus; does knowledge perceptually supported differ substantially from knowledge which is not? Is thinking of chocolate as in 'What is chocolate?' while factually eating it different from thinking about chocolate while imagining the activity of eating it and the sensation on the taste buds? And will certain ways of conceiving chocolate be more relevant than others, e.g., thinking about chocolate as in *how it tastes* is more likely to show differences compared with thinking about chocolate as a product based on cocoa-beans between eating and non-eating conditions (on the impact of particular mind sets while thinking see for instance, Dijksterhuis and Van Knippenberg 1998)?

On a diet, we would not hesitate with respect to which of the above situations (with or without eating) would prompt us to count the putative intake of calories. Thus, we might already have a pretty good idea of what separates experiences caused by actual entities from experiences based on imagining or memorising the

very same entity. In fact, normally we have no difficulties in distinguishing real from imaginary chocolate. However, what about perceptions that do not sustain conceptual knowledge, say irrelevant perceptual activities as when thinking about chocolate while eating strawberries?

The enigma brings on the issue of 'previous knowledge' to the discussion of how representations of concrete and non-crete phenomena differ. How did we in fact ever come to know of chocolate (the sweet tasty phenomenon) as 'chocolate'? Only by tasting, manipulating, smelling, and melting it in what I will refer to as a so-called 'linguification' process. Linguification is central to getting language use off the ground as a vehicle for knowledge exchange and therefore absolutely crucial to the understanding of how interactional expertise comes about, but also to how we came to conceive of chocolate as 'chocolate'. I define the process of linguification as the process in which neural representations are repeatedly associated to particular linguistically formulated concepts. The linguification process itself can be understood at the neural level as the connection between processes sustaining the labelling (linguistic concepts) and the perceptual understanding of the referent. Linguification is at stake when parents establish vocabulary in toddlers, when the teacher codifies abstract ideas by a few concepts, and when the contributory expert linguistically introduces the interactional novice to an imagined off-line version of his or her practices.

Thus, the reason why chocolate eating corroborates thinking of chocolate (for the relevant condition see Chap. 7) is because it enhances the associations which were already laid down. If we had acquired knowledge of chocolate while eating strawberries instead, strawberry eating would have been highly relevant and chocolate eating deemed irrelevant and counterproductive to the processing of chocolate knowledge. Evaluating the association between strawberries (the fruity, tasty food item) and the concept of chocolate as faulty and therefore strawberry eating irrelevant to remembrance of chocolate is thus exclusively the result of linguification. This is not to say that strawberries are no different from chocolate as a phenomenon. They certainly are. Our sensations systematically differ when eating soft and juicy lumps of strawberries as compared with hard, sweet and easily melting chocolate. Naturally, our experiences are somehow constrained by the actual qualities of the food items in question. However, as we will return to, the categories (as well as emotional responses) we opt for in these experiences could to some extent be randomly attributed and are therefore to some extent controlled by the linguistic community in which we take part.

However, when linguification has established the association between the labelling and the experience of the phenomenon, the link is profoundly resilient. Given that neural representations may differ as a result of whether knowledge refers to concrete or non-crete phenomena, the distinction may have important implications for elucidating the differences between concrete and abstract knowledge which is only revealed at the neural level. As we will return to in more depth differences between concrete and abstract knowledge may be remarkably noticeable in the composition of the linguification product.

1.5.4 Linguistic Stages[9]

Lastly, a serious objection against the concrete-abstract distinction is directed at the literal understanding of concrete linguistic knowledge as always preceding abstract knowledge. Is it correct that linguistic understanding in infants is aimed at and associated with direct experiences? Can we validate a developmentally defined separation of acquisition of language regarding concrete and abstract phenomena?

Analysed according to the above definition, phenomena such as 'love', 'solidarity', and 'imagination' are abstract, insofar as they are difficult to perceptually grasp. Given parental care, children are nevertheless (ideally) exposed to episodes of 'love' and probably also 'solidarity' from birth. Thus, we may have to rephrase the claim to bring about the desired interpretation. One way that fits well with the realistic position defended here is to focus on the notion of exposure. Can we agree, that infants are not 'taught' about love or solidarity even if they are immersed in such phenomena on a daily basis? (Intuitive imitation may serve as an example, e.g., Marshall and Meltzoff 2011; Van Gog et al. 2009; Buccino et al. 2006). This, however, is opposite to the overt tradition for 'disclosure' of concrete objects such as cups, socks, bananas, pacifiers, dogs, and parents. Here, infants are 'shown' objects almost as if belonging to a responsive audience. Parents or caregivers present parts of the world to this audience by ostensibly pointing to them and concurrently naming them, though in pre-schoolers the effect of pointing may not be as straightforward as suggested by the word-object paradigm (e.g., Troseth et al. 2007). Simultaneously, they offer 'the audience' (the child) concrete objects, insisting that the child perceptually attend while the linguistic baptizing occurs (in fact this defines the process of linguification as described earlier).

For the exposure to successfully work, some of the structure and mechanisms controlling a show is at play. Attention to the object and emerging perceptual 'reflection' seems crucially important for linguification to take place. As a result of the accentuation of certain phenomena at the expense of the context, the child associates a perceptually accessible phenomenon linguistically. He or she is brought in a particular mental condition (that of direct attention) which forces him or her to simultaneously flip between the individually obtained perceptual experience and the control of that experience as well as the linguistic 'handle' offered by the interlocutor (we will thoroughly address 'directed attention', control, and 'linguistic handle' in later chapters).

Though implicit, unreflected processes are abundant and, as we will discuss later, are of crucial importance to cognition, the reason for accentuating the primacy of the concrete is due to the parental *emphasis* on the exhibition of phenomena to promote *conscious* processing of that which has perceptual qualities. This also explains why concepts are never one-to-one projections. When children acquire a 'label', in one sense there is no 'natural' outline to which the label refers. Children may in fact 'label' different parts of the situation to which the linguification applies

[9]Sections of this chapter has been modified and extended with basis in my paper (Schilhab 2015b).

(when talking about 'weather' i.e. the temperature, the colour of the sky, the emotion, the tone of voice, and so on and so forth), though the perceptual concreteness may have the upper hand. We return to this aspect in Chaps. 3 and 8.

In the acquisition of non-crete knowledge, real 'exhibitions' are clearly out of the question. For children to grasp the non-crete, perceptual 'crutches' to attract and maintain attention have gone and now the child is left to access his or her private non-crete representational activities. That capability is likely to mature (often controlled through careful supervision by the interlocutor) with age (e.g., Wetzel et al. 2006). According to Vigliocco et al. (2013, p. 1), age of acquisition of given word categories differ:

> only 10% of 3-year-olds' vocabulary is abstract, rising to 25% in 5-year-olds. Acquisition of abstract concepts then increases steadily: > 60% of 11-year-olds' vocabulary is abstract.

The presentation of stages in linguistic acquisition that reflects the transition from concrete to more abstract understanding, though not meticulously reflecting developmental ages, nevertheless helps disentangle the processes involved in abstract knowledge acquisition and ultimately the emergence of the kind of knowledge interactional expertise represents.

Depicting the acquisition of linguistic knowledge as progressing in stages reveals why the basic part, the concrete step, of linguistic development applies to all children in general. Since concrete objects are available to us through perceptual and somatosensory processes the linguification process might be alleviated. To the contrary, processes corroborating abstract reasoning are more subtle, thus more variable and vulnerable. Partly as a result of the individual ontogenetic cognitive development, partly as a result of how proficient the interlocutor turns out to be. Therefore the exposition of derived embodiment as sustaining non-crete knowledge acquisition and interactional expertise-like knowledge should be viewed as an idealisation of how language realises the transfer of direct experiences between subjects and how experiences in one context might transfer to another in an as-if directly experienced form. Thus, it is worth noticing that reaching the advanced refined stage, of which interactional expertise may be exemplary on an individual basis, is far from inevitable. On the contrary, many language learners might be stopped prematurely, which makes it even less probable that the peak stage of qualified linguistic transfer is shared between all language users. The switch from one stage to the next includes many decisive factors such as the level of empathy and proficiency as conversational partner of the interlocutor, *the switch from external to internal attention in the learner; the amount of perceptual experiences and executive control while directly experiencing in the language learner*, the numbers of interlocutors, etc. Therefore, the full exploration of derived embodiment as presented here is to be understood as an idealisation most of us come to know of within particular knowledge domains, for instance in our professional lives. This does not imply that optimal development above derived embodiment in ordinary life is unattainable. What it means is that not all language learners are in a position to take full advantage of the capacity of language demonstrated by interactional expertise. In this presentation, in the exploration of the conditions characteristic of

derived embodiment, I point to factors relating to both interlocutor and language learner that, if taken into consideration, might improve learning in general. Thus, besides exploring how abstract knowledge acquisition may occur, this account also addresses cognitive cultivation with implications for education.

1.6 Content of the Book

Abstract knowledge acquisition inevitably challenges embodiment theories of knowledge. Interactional expertise-like knowledge, an expression I use to denote knowledge that resembles interactional expertise but obtained outside a professional discipline because of the applicability to natural language acquisition also accentuates the controversies any biologically inspired theory of linguistic knowledge is bound to meet. This tension is the driver that defines and ignites all discussions throughout this book. If conceptual knowledge consists of perceptual and motor-sensory activities as suggested by contemporary neuroscience results, the idea that knowledge is graspable by language and on that account might bypass direct experiences seems bold. To attempt reconciliation between the biological *bottom-up* and the social *top-down* activity, one approach is to unravel essential properties of language acquisition, the character of the knowledge involved, and especially the mechanisms that render interactional expertise-like knowledge possible. Traditionally, bottom-up cognition is viewed as involving automatic, unintentional and involuntary processes, in contrast with intentional cognition that is often individually or socially (linguistically) and, of importance here, consciously controlled. The implications of the contrasting approaches will be further developed in Chaps. 3 and 4.

Thus, Chap. 2 introduces the theory of contributory and interactional expertise to present an example of knowledge that challenges the explanations provided by embodiment theories. The sociological theory spells out in detail what must be addressed for a neurobiological perspective to be convincing. Emphasis is on the understanding of language as a vehicle for knowledge sharing and addresses questions such as "What is linguistic immersion?"; "What is the role of the body in linguistic competence?" and "Are similarities in contributory and interactional expertise at the conversation level generalizable when addressing, for instance, specific word classes?" From these considerations it is clear that interactional expertise-like knowledge is powerful in abstract knowledge acquisition and must be given a sincere neural interpretation. This is provided by the derived embodiment mechanism, which realises the integration of the individual and the social.

Chapter 3 gives a brief introduction to studies on embodied cognition specifically on the relation between perceptual and sensomotoric processes and linguistic conceptualisations from the neuroscientific perspective to demonstrate the depth and approach of the challenge presented by the interactional expertise theory. Both behavioural and neuroimaging studies reveal that linguistic activities are sustained by multimodal experiences. Thus, conceptualisations, detached from the

particularities of individual episodes, actually build on processes characteristic of particular incidences. In the chapter, technicalities on how neural correlates emerge and which processes are involved to establish conceptual representations are also discussed. To that end, the linguification process is introduced in detail. Special emphasis is on in what sense the biological origin of cognition pervades the cognitive as exemplified by tacit processes since these may prove especially important to abstract knowledge acquisition. Therefore, the chapter also touches upon the distinction between implicit and consciously controlled, phenomenally experienced knowledge. This dichotomy fits with and contrasts bottom-up and top-down processes, which will be given a lot more attention in later chapters. The idea, that bottom-up processes are often automatic and beyond control whereas top-down processes depend on directed attention often as a result of instruction by others is introduced.

Additionally, the concept of 'sub-activities', 'back doors' and 'linguistic handles' are presented to conceptualise the complexity of the neural correlate sustaining linguistic knowledge, as well as to conceptualise the process of accessing neural correlates by stimulating fragments of the assembly.

Together, these aspects open up a discussion on which sub-activities are consciously accessible after being loosely compiled into 'one' assembly in the neural correlate. Especially the issues of phenomenal re-experiences and linguistic handles are essential in the explanation of abstract knowledge acquisition.

Following the presentation of interactional expertise in Chap. 2 and embodied cognition in Chap. 3, it is time to become a bit more technical in the exploration of how we acquire abstract knowledge. I start Chap. 4 on the note that pre-linguistic categorisation is central to the furnishing of the world. Thus, linguification becomes central only after we are cognitively anchored in reality. (In Schilhab 2016, the anchoring was the main reason why I referred to us as *Homo concretus*). Hereafter, I address features central to language acquisition that I claim are crucial parameters in the explanation of abstract knowledge acquisition in derived embodiment processes. These address:

(1) The reality of the phenomenon, event, or object
(2) The attentional focus of the language learner
(3) The interlocutor.

Qualitative shifts in those components seem essential in the transfer from the first stage (concrete level) to the next stage (abstract level). Obviously, the reality of the referent of what one linguistically addresses changes from being immediately present (on-line) to absent (off-line) (Wilson 2002). The off-line condition imputes a challenge to the second parameter, the learner's imaginative abilities to which he or she must turn in order to understand to what language refers. When the referent is present, the understanding will get external support from perceptual processes. Contrariwise, in the off-line condition, the language learner relies on vicarious internal, self-sustained cues to attain understanding. Due to the inherent deficit of sufficient cues, the third feature we need to address is the fundamental providers of the material to be processed in abstract language acquisition.

The chapter deals primarily with the first parameter that leads to considerations about the imagination, the relation between imagination and re-enactments as well as the distribution of non-conscious and conscious processes preliminary dealt with in Chap. 3 and thus introduces the concept of first order linguification processes. Since phenomenally experienced imagery may play an important part in abstract language acquisition, space is devoted to further explorations of the question of the phenomenal qualities of re-enactments, which inevitably invites discussions on different notions of consciousness. The chapter closes with a presentation of different attention states and the moderating impact of the interlocutor.

Chapter 5 is dedicated to derived embodiment, the process that takes us from the perceptually informed to the imagined understanding and thus seems constitutive of interactional expertise-like knowledge. The chapter thus explains the notion of second order linguification processes. Though interactional expertise exemplifies the type of knowledge formation in which principles of derived embodiment can be found, I aim to show that the mechanism is abundant in ordinary knowledge acquisition. I claim that while environmental stimuli are central to acquisition of concrete language, intentionally or unintentionally the interlocutor takes over at the abstract level. Thus, children who were more or less at equal footing in the concrete phase may diverge strikingly from each other in the abstract phase due to the quality of the social conditions (the ability of the interlocutor). Hence, while the abilities of the biology are discussed in Chaps. 3 and 4, in Chap. 5 the abilities of the interlocutor are discussed to explore the anatomy of the social in abstract language acquisition. Focus is on by what means the interlocutor calls forth particular phenomenal experiences and how this contributes to abstract language acquisition by exemplifications to demonstrate derived embodiment mechanisms. Thus, the argument entails both instructed fear conditioning and a powerful and telling example of training of a shaman novice by a shaman master as well as the use of metaphors in teaching singers.

In Chap. 6, I focus on the characteristics of mind that may benefit from abstract knowledge acquisition. Which faculties and abilities are cultivated? How might abstract knowledge acquisition contribute to the development of differences in thinking abilities? Seemingly, if derived embodiment processes are corroborated by imagination, mental control, and re-enactment of previous phenomenal experiences, training through active discourse will gradually divide children into the more and less mentally cultivated.

The insistence of off-line cognising favours particular mental abilities. Metacognition and general executive functions such as working memory capacity, inhibitory control as well as the influence on mind-wandering are discussed. Tentative descriptions of the explorative search of the phenomenally experienced ‘inner landscape’ that appear essential to derived embodiment processes and in parallel partly responsible for the cultivation of the mind, are also presented. The fundamental argument however, centres on the crucial importance of the significant other, without whom later self-training seems unattainable. Thus, this chapter argues both that imminent to the construction of the individual mind is a somewhat

neglected malleability which if seized by responsible interlocutors may advance the individual to sophisticated cognition.

Chapter 7 brings the discussion about first order and second order (derived embodiment) linguistic processes into an educational setting but in recognition of the fact that the discussion is bound to be confounded by being highly speculative. Up until this chapter, the account has been agnostic with respect to operationalising the insight. Considering that concrete experiences are fundamental to language acquisition but at some point may work indirectly through derived embodiment, how does systematic exposure to concrete phenomena influence knowledge at the level of competent language use? At this later stage, will concrete experiences change the content of linguistic (conceptual) knowledge by adding experiential qualities? To address these questions depends on the notion of what understanding is employed. Throughout the account based on biological assumptions about cognition, the underlying contention has been that concrete phenomena, all else being equal, are perceptually more influential (and therefore conceived of as more real) than non-crete phenomena. Thus discussions about putative differences in understanding between direct experienced and linguistically acquired knowledge are in focus. The discussion pivots around the neural consequences relating to bottom-up and top-down approaches and the different degrees of tacit processes that go with these.

At the end the chapter points to the inclination of language users to use material crutches extensively. In this perspective, I return to the discussion of cognitive load pertaining to imagination and derived embodiment to sustain the strong inclination to make use of material crutches.

Finally, in Chap. 8 I turn to the implications of and obvious objections to the idea of derived embodiment. Throughout the account, I will have presented a number of examples to grant the idea probability. I will have implicitly endorsed the idea of the full-blown and somewhat ideal form of the derived embodiment mechanism to which interactional expertise-like knowledge applies to facilitate analysis. I have also maintained that as process in practice given the engaged involvement of an interlocutor, derived embodiment is somewhat demanding. Understanding interactions that only partly activate derived embodiment processes is still of relevance to explore kinds of knowledge exchange. Hence, I begin Chap. 8 by proposing instances that to some extent entail derived embodiment processes without completely matching the ideal description. In particular, I focus on the role of the interlocutor to stress how the lack of perceptual qualities in, for instance, acquiring a theory of mind depends on the verbal ostensive pointing via designation. The example substantiates the argument that language widely mixes embodied and social processes. It also shows that the social level is highly decisive with respect to interpretations of phenomena that are difficult to grasp by first order linguification processes.

The example concerned with acquisition of concepts for mental states is followed by a final discussion on the generality of derived embodiment. Is the

mechanism applicable to the acquisition of the concept of 'weather'? If not, what are the limiting conditions pertaining to the mechanism? In the last section, I focus on the sub-aggregates and back doors in the linguification product. I end by concluding that despite the usability of derived embodiment, the mechanism is chosen only when *Homo concretus* has turned down other options. The proposition remains however that derived embodiment mechanisms are significant to the concrete transgression of individual experiences distinctive of human cognition.

Chapter 2
Interactional Expertise

2.1 The Tacit Dimension

Is the linguistic knowledge acquired by individual A through immersion in purely linguistic contexts of a domain D different from the linguistic knowledge acquired by A's twin brother A^* through linguistic and bodily immersion in the same knowledge domain[1]? To make the introductory question intelligible in an everyday setting, if two experts on a topic, B and B^* both possess the ability to talk about the topic, while only B^* possesses practical experiences, would their talk, including their explicit knowledge, differ to a significant extent? Would B^* possess more propositionally accessible knowledge than B about the domain in question? For clarity, the question is not about whether A^* performs better than A within the practice of D. Surely a lack of practical knowledge would leave A behind. The puzzle touches upon the problem of how skill learning and theoretical knowledge interact. Analytically these phenomena are often split in contrasting pairs such as implicit-explicit, discursive and non-discursive, theory and practice and so on which result in the unintended side effect that we tend to forget that these knowledge phenomena cooperate in humans (and apparently also in animals, e.g., Wynne 1998).

The question is, instead, whether physical interaction with the environment adds to the kind of knowledge we can share with others (e.g., symbol-like knowledge of which language is a core example as well as any kind of knowledge that corroborates the linguistic practice to which A has access). Will direct experiences of phenomena or events specific to D add invaluable elements to the growing knowledge and eventually render A^*'s linguistic knowledge significantly different from A's? (Later in this chapter we will zoom in on what kind of practical knowledge D supposedly could add. And in Chap. 7 we return to the issue of understanding).

[1]The narrative of A and B and some parts of the chapter were originally published in Schilhab (2011).

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_2

Turning to sociology and the terms 'contributory' and 'interactional' expertise that specify the role of language in human knowledge exchanges may facilitate answers to these questions (see Collins 2004; Collins et al. 2006; Collins and Evans 2002, 2007). To grasp the implication of these answers we need to detail what is intuited about knowledge when applying the terms.

As briefly introduced in the last chapter, while contributory expertise is knowledge held by practitioners (the worlds' A^*s), and applies to both practices and symbol-like knowledge, interactional expertise is defined as purely linguistic knowledge (held by the worlds' As). And, according to Collins and Evans (2007), the latter permeates almost any kind of human interaction, from division of knowledge in confined communities, such as companies and professional societies, to informal life (see also Collins 2011). Such symbol-like knowledge has traditionally been thought of as explicit, accessible to awareness and preferentially recoverable as propositional, rational statements and conceptualisations (e.g., Berry and Dienes 1993). However, it is disputable what kind of knowledge pertains to linguistic knowledge. According to the theory by Collins and Evans, language does not exhaust knowledge (as also demonstrated in, for instance, studies on the relation of linguistic reportability and consciousness, see Chap. 4). Thus, to Collins and Evans emphasis on the kinds of knowledge that can be disseminated and shared among participants in a *linguistic* community does not reiterate the traditional view on knowledge. Rather, according to Collins 'interactional expertise' is a third kind of knowledge because it depends on 'linguistic socialisation' which involves wide acquisition of tacit and informal knowledge pertaining to the domain (2004, pp. 126–127).

Accordingly, possession of linguistic knowledge in the sense of interactional expertise entails far more than possession of mere propositional knowledge. To possess interactional expertise knowledge is also to possess tacit skills of how to use language.

That aspect is particularly important since the concepts of interactional and contributory expertise are framed in a response to contemporary conceptions of the relation between language and knowledge that apparently has ignored the tacit aspects of competent language skills. As posed by Collins (2011, p. 272):

> In some recent approaches language has been entirely ignored and practice alone has been taken to be what makes it possible to understand practice. Philosophers such as Merleau-Ponty and Heidegger emphasised the role of the body in understanding while others, such as Dreyfus, used these insights to criticise attempts to build machines which tried to use symbols to reproduce the full range of human capacities. As a consequence, language, seen as belonging to the domain of symbols, has been pushed to the margins.

Interactional expertise may therefore be viewed also as an attempt to introduce the tacit dimension of linguistic knowledge. Thus, interactional knowledge is similar to contributory knowledge except for the differences in physical interaction. It is acquired through immersion in linguistic communities and based on extensive verbal exchanges among contributory and interactional experts. In conversations, participants discuss misunderstandings, professional problems, and share experiences (Collins 2004). In communities, tacit and explicit, as well as formal and informal

rules control linguistic exchanges. This is the material accessible to the interactional and contributory expert alike, of which interactional expertise emerges, though only the latter expert is physically immersed in the sense of engaging direct experiences as well.

Collins provides a description of the 'education' of the interactional expert using the sociologist who investigates a new subject field as an example (2004, pp. 128–129):

> The sociologist of scientific knowledge entering a new domain initially understands neither the banter nor the technical terms pertaining to some new piece of science being investigated. After a painful period the inferences in others' conversations start to become clear and eventually it becomes possible to begin join in. One day a respondent might say in response to a technical query from the sociologist, 'I had not thought about that', and pause before giving an answer. When this stage is reached respondents will start to be happy to talk about the science and even respond generously and with consideration to critical comments.

The education is overtly processual and involves different levels of expertise. Collins continues (ibid.):

> Eventually the scientists will become interested in what you know, not as a scientist in your own right, but as a person who is able to convey the scientific thoughts and activities of others. If you have just come from visiting scientist X you may be able to tell scientist Y something of the science that X is doing, and tell it in a way that is convincing enough to enable Y to be sure they have learned something. What were once 'interviews' then become 'conversations.' In such a conversation the sociologist might occasionally anticipate a point, speeding the conversation along without needing detours where mutual understanding already exists. The sociologist might fill in technical niceties that might otherwise be forgotten.

Here, Collins describes how interactional expertise evolves because of prolonged immersion. Thus, the acquisition of linguistic knowledge is in the sense of how it is put into appropriate use more skill-like and less based on sudden insight. However, singular episodes in which the novice (for instance the sociologist) asks specific questions to obtain particular answers also occur.

To acquire the level of genuine interactional expertise requires years. At that time (2004, p. 129):

> The sociologist comes to recognise jokes, irony, and leg pulls (there is no expertise that makes it possible to recognise well-wrought lies). When the sociologist becomes really good at the work it becomes possible to take a devil's advocate position in respect of some scientific controversy and maintain it well enough to make the conversational partner think hard about the science. This asking of new questions that the scientists might not have thought about, conveying of information, embellished in a way that makes it clear to the recipient that it is reliable, and making the real-time creative moves that are needed to maintain a devil's advocate position in the face of determined opposition, are discursive skills, not a matter of selection from an assembly of discrete propositions.

Returning to our twins and following the understanding depicted by interactional and contributory expertise, if both A and A^* are equally exposed to conversations and linguistic exchanges of the community, then their linguistic competences will not diverge. Despite his or her embodied learning, practitioner A^* does not fare

better than non-practitioner A with respect to the amount of linguistic fluency including explicit knowledge he or she picks up. But how is this possible? Why would direct experiences of a domain D that gives rise to practical knowledge not transfuse the linguistic realm?

Since Collins and Evans aim to explain and corroborate the validity of knowledge cooperation and exchanges in human trading zones from sociological perspectives, elucidation of the cognitive mechanisms involved has not been a priority. This is however, our concern here. From the perspective of exposure, what are the cognitive processes connected to linguistic practices? By what processes is interactional expertise linked to contributory knowledge if physical immersion in the practices of the field appears irrelevant to the character of knowledge? What are the cognitive mechanisms associated with the development from novice to interactional expert? And above all, what characterises linguistic knowledge grounded in practice compared with linguistic knowledge grounded in language? Answers to these questions will be pursued throughout this account. But first we must address more fully why interactional expertise is a powerful challenge to general intuitions about linguistic content.

2.2 Red Herrings?

Based on everyday intuition, one could justly ask why we have to bother with twin brothers A and A^* and their knowledge acquisition at all. Why set up red herrings in a perfectly transparent case?

Since A only has access to the linguistic part of a knowledge domain D, while A^* has access to both linguistic and bodily experiences within the domain, it is obvious that A^* is simply better informed and therefore A and A^* cannot retain matching explicit knowledge. Conflicting perspectives on the matter is only of scholarly interest. The intuition fits well with the everyday experiences of those we consider true experts. When we seek advice, we appear to look up contributory experts hoping for a high degree of knowledgeability. We underscore the presence of practical knowledge because we infer that practical knowledge adds to the knowledge the expert can actually share even if the sharing is entirely linguistic in nature.[2] Exceptions exist however. We don't expect our dentist to have personal

[2]To Collins and Evans, contributory expertise is not considered a superior kind of knowledge due to contributory experts being bodily engaged in their practice, even if this is how people conceive of the superiority of contributory knowledge. Within society, recognition of expertises seems to some extent at least, to arise from the current sociological status the expertise provides the individual with. It includes the ability to apply for particular job positions and the time spent on their particular specialty (e.g. Collins, 2004). It is hardly surprising that the degree of expertise is correlated with the amount of time spent on activities reserved for experts, i.e. conversations, cognitive rationalisations and the like, with that particular expertise. However, there is no reason to assume that the quality of knowledge is defined by time spent on practising that knowledge.

experiences with the exact same syndrome for which we seek his or her advice. Neither do we believe policemen are better detectives if they have direct experiences with criminal acts.[3] Thus, common sense opinions on what makes a genuine expert may differ in relation to degree of bodily involvement in various disciplines. In some kinds of expertise we trust the expert based exclusively on his education and experience with costumers (an expert hairdresser and personal assistant of female celebrities may be male). In other trades, the trust depends on personal involvement and direct experiences with similar occurrences.

Despite exceptions, the common sense intuition that direct experience brings deeper understanding is widely shared. Are we actually validated in the assumption that, in general, physical interaction, in the sense of somatosensory activity, adds significantly to explicit knowledge? Are we validated in the assumption that linguistic immersion, which entails years spent with knowledgeable people, even bordering on interviewing to the extent of interrogation during conversations, could not in principle provide us with an equal amount of linguistic knowledge and deep understanding?

It is a fact that in most instances of life we don't engage in first hand experiences of the concepts we master to perfection. Who has ever had personal experiences with unicorns, the ice ages, or the Big Bang? Climate science writers, describing the ice drilling projects on the Greenland ice cap, will not need to have set foot on Greenland, still less do they need to see snow falling on the glaciers or have seen someone holding a 130,000 year old rod of ice extracted from three kilometres below the fresh snow. Not even the scientists who consider such phenomena as part of their professional inventory. But we don't have to come up with exotic scientific concepts to drive home the argument that represents the position of Collins and Evans. Which child is not requested every day to accept bacteria and viruses as the reason for keeping a high hygienic standard to the extent that they themselves linguistically teach other children about proper hand washing without ever having met such critters? We are surrounded by phenomena (or so it seems) which are denoted by particular metaphors or expressions of which we have no personal experiences what so ever. If we close in on the qualities of these putative 'non-realistic' phenomena, which 'come to life' because we name them, the close-up reveals considerable differences in relation to the way they evade personal acquaintance. Some concepts are elusive because they are derived theoretical idealisations without any known instantiation such as 'atoms' (e.g., Collin 1992). Some concepts are intangible because their instantiations are always only partly encountered such as 'democracy' and some concepts that refer to for instance colours and tastes are difficult to grasp because their use seems to depend on the interpretation of the individual to a larger extent. (We will elaborate on different characteristics of kinds of concepts in Chaps. 4 and 8). So, as proposed by Collins (2011) in many aspects of ordinary linguistic use we do indeed all seem to be interactional experts (see also Collins 2016a).

[3]Thanks to Professor Frederik Stjernfelt for providing this example.

To fluently speak a language that consists of abstract concepts, and refer to events and phenomena one has had no direct experience with, that is to be considered a competent language user, seems to depend on knowledge of which linguistic and social situations these abstract notions can be brought to use appropriately (Ribeiro 2007a, b). To be a competent language user does not assume the need to have personal experiences of all aspects covered by language. So, it seems that language itself carries the potential to convey information that is not self-experienced without loss or distortion of information.

But as briefly introduced in the first chapter, this assertion sits uncomfortably with the biological interpretation of the nature of knowledge. Are there any data to solicit the sociological perspective? In the following we will address the empirical approach offered by Collins et al. (2006) to draw up the 'battlelines' of the discussion even more effectively.

2.3 Empirical Results

Recently, Collins et al. (2006) demonstrated interactional expertise developed through linguistic interaction without full-scale practical immersion in a culture by the use of a test, the so-called imitation game. The imitation game tests the ability to "talk the walk" of a field, to evaluate whether direct experiences, i.e., first-person experiences of relevance to the domain, seem inconsequential to how one talks about a domain. In the original imitation game (Collins et al. 2006), a judge (a contributory expert within a particular field, D) posed written questions to two (to him unknown) respondents, one contributory and one interactional. The experiment consisted of two phases. In phase one, real-time experiments at the university involved real-time computer-based conversations between three participants. In phase two, complete real-time conversations were transcribed and sent to new judges by mail or email. Their judgments were statistically treated in the same way as the judgments obtained in phase one.

An imitation game as a simulation of real life conversations is of course questionable. For instance, the linguistic complexity of a dialogue in the imitation game, which attempts to reproduce everyday dialogues, may conceal irregularities in the use of language and blur the identity of the contributory expert. This could explain why colour-blind people (as we will see shortly), despite differing significantly from people with normal vision in their colour experiences, passed as interactional experts in the imitation game (Collins et al. 2006). Obviously, in real life interactional language perception and use also consists of a multiplicity of non-verbal communicative acts. However, in this context imitation games are *not* to be conceived of as meticulously simulating conversation. Collins suggests viewing imitation games as a kind of test (2004, p. 126):

> Informalists (I include myself) have tended to use as examples of the intractability of the informal some practical skill such as bicycle-riding, or car-driving or the use of stick by a blind man. We tend to argue that the way the rules of such activities follow as a matter of course can only be grasped by being skilled practitioners of the respective activities. We tend to believe that only those who, as we might be inclined to put it, 'share the form of life' of the relevant activity would be able to understand it fully. We then argue that if we were not accomplished practitioners, our lack of understanding could be revealed if it was subject to the right kind of test. If, say, we were placed in a Turing-Test-like situation, where our ability to hold a discussion in some domain in which we were a novice were tested against the ability of genuine practitioner in that domain, we would be correctly identified as a novice (if the judge, who must also be an accomplished practitioner in the domain, were to ask the right questions).

He continues:

> Informalists tend to think that those who believe otherwise have mistaken propositional knowledge—that which can be said about a domain—with real understanding. 'Those formalists' we say, "mistakenly think that you can strip knowledge out of experts' heads and encodify it in propositions." I now want to argue that this polar opposition is misleading. I think the Turing-like test could be passed by non-practitioners. It could be passed by those who were immersed, not in the entire form of life of some domain but only in the language-world of those who were immersed in the form of life proper.

Collins et al. (2006) categorise a conversation between a judge and two respondents as "chance" or "identify". In the "identify" condition, one of the respondents is ignorant about the jargon of the target field, whereas the other respondent is a contributory expert. Here, due to the one participant being linguistically ignorant about the jargon, the judge is able to spot the deceiver. However, in the chance condition, the respondents belong to the pool of either contributory or interactional experts who are both knowledgeable of the target jargon. Thus, for instance in the 'field' of colour vision, Collins et al. (2006) showed that colour-blind people are capable of deceiving judges with normal-colour vision (Collins and Evans 2007, p. 93):

> The idea of interactional expertise implies that, having been brought up in a color-perceiving society, the color blind will be fluent in color-perception language even though they cannot see the full range of colors—they will have acquired interactional expertise in color-perception language though they have no contributory expertise in color discrimination.

Despite their (minor) handicap, colour-blind people are linguistically immersed in 'colour vision language', spoken by the majority of people, and they are, therefore, thoroughly acquainted with the language. To Collins and Evans, the crux of imitation games is the demonstration of separate domains in which individuals acquire linguistic knowledge not shared by the surrounding society and then show how linguistic immersion overrides bodily preconditions or experiences with physical interactions. The passing of imitation games is therefore considered as proof of the concept.

Studies have also been pursued on the facility of perfect pitch (Collins and Evans 2007, p. 92).

> "Just as you see an apple and know it's red without thinking about it, I hear a note and know it's an E flat". That is a description of perfect pitch. In contrast to color-blindness the "disability" is the statistical norm. Therefore "pitch-blind" persons (nearly all of us) have not been socialized into the language of pitch-perception. The strong interactional hypothesis holds, then, that it should be easier to spot the pitch-blind pretending to be pitch perceivers in the imitation game that the color-blind pretending to be color-perceivers.[4]

Results obtained in the perfect-pitch experiment showed that those with perfect pitch are very good at passing as those without perfect pitch and thus confirmed the interpretation that (Collins and Evans 2007, p. 100):

> a lifetime's immersion in the discourse of a group with a certain contributory expertise enables a person without the contributory expertise to acquire the corresponding interactional expertise, at least as tested by the imitation game, to a very high level—the strong interactional hypothesis is demonstrated.

To summarise, the chance and identify studies suggest that participation in a linguistic community that linguistically target phenomena, events or situations which the individuals have no personal experience with, annihilates differences resulting from differences in direct experiences.

Originally inspired by his long-term scientific work as a sociologist within the field of tacit knowledge in gravitational wave physics, Collins has also allowed *himself* to take part in a slightly moderated version of the imitation test to demonstrate the effect of linguistic immersion (e.g., Collins 2004). The idea was that he might pass as an interactional expert when interviewed by a contributory expert in gravitation wave physics. The test consisted of sets of seven questions sent to contributory experts as well as Collins. Participants were asked to answer the questions off the top of their head and without consulting other sources. The answers provided by Collins and gravitational wave physicists respectively were then presented side-by-side to contributory judges. From these written discourses, the judges were asked to guess and then explain how they made their choices.

In bare figures, seven out of nine judges chose Collins as the gravitational wave physicist, one chose correctly, and one was indecisive. Accordingly, Collins managed to convince contributory gravitational wave physicists about his scientific knowledge. However, according to Collins and Evans (2007, p. 107):

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[4]Example of a conversation that leads a judge with perfect pitch to correctly guess the identities behind A and B (Collins and Evans 2007, p. 101).

"Question 3: How do you pick up a single voice in a crowded room?

Participant A: By hearing the individual pitch of the given person's voice, although it does depend on the volume of the individual voices as well.

Participant B: By trying to concentrate on that voice.

Question 4: Would you rather use a score to arrange a piece of music or dictate by ear?

Participant A: Dictate by ear.

Participant B: Use a score, probably".

Here A was the contributory expert.

> Some of the judges, and all of the judges in respect of some of the answers did not feel that technical content allowed them to make a judgment. In these cases they fell back on style and, in the main, Collins's style was preferred because his answers were shorter and thus bore the hallmarks of someone who was answering impatiently—this suggested a scientist to other scientists.

2.4 The Midwife Case[5]

In an attempt to validate the results obtained by the imitation game procedure, it becomes of importance to ensure that the proof of concept is not the result of the subject fields of blind-sight, perfect-pitch, and gravitational wave physics. An obvious objection is whether in these cases for various reasons the bodily impact on language is marginal in the sense that direct experiences may be more or less irrelevant to the linguistic practice. That could explain the fact that differences between interactional and contributory experts are insignificant.

To counter such objections, my colleagues and I conducted a series of imitation games with midwives, since the midwife profession targets expecting mothers during the pregnancy, delivery, and the post-pregnancy phases (Schilhab et al. 2010). Besides general health care issues, midwife practices concern bodily experiences connected to pregnancy and motherhood. Thus, the community is likely to employ a professional "jargon" concerned with bodily sensations related to pregnancy shared by all midwives, regardless of their direct experiences with pregnancy, delivery, and breastfeeding.

In view of the procedures of imitation games, conversations where mother midwives interview mother midwives and non-mother midwives about pregnancy, delivery, and breastfeeding belong to the chance condition, since both categories of midwives are genuine practitioners. All are linguistically immersed. Thus, if direct experiences of the problem field do not add significantly to how one refers to the field as conjectured by the theory of interactional expertise, we would expect mother midwives and non-mother midwives to express themselves similarly in these matters. Consequently, we would expect the distribution of judgments by mother midwives (who have knowledge of motherhood and midwifery) to be equal to those of lay mothers (who have knowledge of motherhood). Both in phase one, in which the judge herself was responsible for the questions asked, and in phase two in which the judge was exposed to ready-made material in the format of ready-made conversations, the distribution of judgments by the midwife group and the lay mother group differed significantly. When considering the proportion 'correct' for each of the midwife mothers as compared with each of the lay mothers, midwife mothers showed a greater proportion of correct answers as well as greater than chance. If bodily experiences are of no significance to how one talks about a domain, mother midwives should be unable to distinguish between mother midwives and non-mother

[5]This paragraph is elaborated from selected parts of the paper by Schilhab et al. (2010).

midwives. The findings suggested that mother midwives can see through the professional language and identify the mother midwife, whereas lay mothers apparently were deceived by the linguistic aptitude of non-mother midwives.

A number of possible objections could be raised, though. Most important, can we be sure that the professional language of midwives resembles the proposed jargon of motherhood? The study seems to balance on the supposition that midwifery provides participants with the language of breastfeeding, delivery, and the post-pregnancy phase. If the professional language shared by midwives does not apply to the talk of pregnancy, delivery, and breastfeeding, non-mother midwives could not possibly be acquainted with the jargon and would subsequently be exposed in a test. However, even if the overlap between motherhood jargon and the professional jargon of midwifery is not complete, the control condition seems to suggest that non-mother midwives are competent motherhood language users, at least enough to deceive lay mothers. And since lay mothers, more than anyone, are assumed to possess motherhood language, the fact that non-mother midwives can pass as mother midwives is intriguing. How do non-mother midwives conceal their identity before lay mothers but not before midwife mothers?

While it seems likely that lay mothers are misled by the professional jargon mastered by both the mother and non-mother midwife, mother midwives also possess features embedded in the answers. The question is what characterises these clues? How did direct experiences with breastfeeding, delivery, and the post-pregnancy phase become linguistically ready for midwife mothers to pick up? Apparently, embodied tacit experiences may have influenced the linguistic descriptions after all.

One possibility to take into consideration is that while delivery and the associated breastfeeding experience are bodily experiences they are also significant 'once in a life-time' experiences and in that respect differ distinctly from the bodily experience of perfect pitch and colour vision. We will return repeatedly to the impact of emotion on linguistic knowledge in later chapters.

2.5 The Role of the Body

Though Collins and Evans fully acknowledge the involvement of tacit knowledge, they do not assume tacitness to be bodily corroborated. Actually, the body seems *almost* insignificant to the establishing and maintenance of interactional expertise (2007, p. 78):

> humans can function well as natural language speakers under a variety of adverse circumstances in respect of their bodies. They can do this so long as their brains are still making sufficient connection with the embedding society to allow them to become and remain social beings. This, of course, does imply a minimal sensory apparatus, but the essential parts of the organisms turn out to be very few. The essential parts are those bits of the brain to do with language-processing and those bits of the body to do with language-learning and speaking: the ears, larynx, and the rest of the vocal apparatus.

The downsizing of the body as central to language is, however, a bit more nuanced than may appear from the above quote. For instance, Collins acknowledges (e.g., 2004) that the world as it renders itself available to our bodily practices is irreplaceably reflected in language. Actually, Collins introduces the 'social embodiment thesis' (e.g., 2004) to emphasise that language as a whole is affected by bodily form that dictates what can be done in the world. Collins and Evans state (2007, p. 79):

> We understand the family resemblance between various things which we call "chairs" because we can sit on them because our knees bend in a certain way. Thus the word "chair" appears in our language and can be more or less mutually understood. A community of speaking lions, on the other hand, would not have the equivalent of "chair" in their language because they do not sit down in the same way. Instead for lions, what we call a chair might be classed alongside whips and pointed sticks such as are used by "lion tamers" (assuming that the community of speaking lions still lived in circuses run by humans). Thus here, a difference in the physical joints of the lions corresponds nicely to a difference in the conceptual joints.

Clearly, language makes sense only in the context of bodies physically immersed. In large part, language reflects the way a community lives, and a community of speaking lions would contract of a language that fundamentally differed from that found with human societies due to the species-specific constitution of bodies. Languages reflect the real world including real phenomena as well as meaningful relations between language users and the world. Despite the fact that natural languages depend on bodies that talk for them to count as real languages, to Collins the individual might nevertheless dispense of the body and still count as a competent language user.

Insofar as interactional expertise depends on linguistic communities and language exchanges, one will also have to address the influence of another's bodily activity on the perceiver's bodily activity (e.g., Chartrand and Bargh 1999; Press et al. 2008; van Baaren et al. 2003) and ultimately linguistic knowledge (for the relation between movements and subsequent linguistic understanding, see Wilson and Gibbs 2007).

At the individual level, however, the necessity of bodily activity is reduced to a minimal body. Hence, direct bodily experiences cannot be a causal determinant of linguistic knowledge.[6]

In defence of that position, in the 'individual embodiment thesis' Collins (2004) discusses the case of Madeleine portrayed in Oliver Sacks book *The Man who Mistook His Wife for a Hat* (1985) (2004; Collins and Evans 2007). Sacks in his

[6]To some extent the reduced value of activating the individual body in the acquisition of language is possible only at the expense of increased importance of everyone else's body. For interactional expertise to appropriately function, everyone is part of a community of learning bodies, on which any individual member depends, and therefore every individual body is crucial to the learning of society as a whole (Schilhab et al. 2008). In the words of Collins (2004, p. 138): "One of the characteristics of interactional expertise, as opposed to contributory expertise, is that it cannot be passed on through the generations without continual linguistic refreshment from those with contributory expertise".

capacity as neuropsychologist studied Madeleine and describes her as congenitally blind and disabled to an extent that even kept her from acquiring reading braille. Collins notices (2004, p. 132):

> Nevertheless, Madeleine learned of the world from books read to her by others. Madeleine had a 'minimal' body with almost no ability to take part in the normal activities of the members of the surrounding society. Sack's triumph with Madeleine was to teach her how to use her hands for the first time; the fact that the real triumph is established by his stressing the extent to which Madeleine had been utterly inactive throughout her earlier life. The uselessness of Madeleine's hands, according to Sacks had come about precisely because she never did any moving in the world on her own.

To Collins, obviously, the absence of the faculty of sight or lack of manipulation experiences had no accountable effects on the linguistic knowledge produced by Madeleine (2004, p. 132):

> She has learned the language through immersion in the world or language alone rather than immersion in the full-blown activity which constitutes the form of life. The social embodiment thesis says, correctly, that the language has arisen from the full-blown form of life—that is, from the full range of activities of the full-blown members of the society—but an individual can get much of the corresponding understanding without much of a body.

Collins acknowledges that typically we tend to convey the kind of information we obtain by physical interactions. Why shouldn't we? The thing is that we rely on perceptual processes to guide the linguistic choices we make. As demonstrated by the case of Nunez the climber, who during one of his trips stumbles upon a valley inhabited by only blind people for fourteen generations, we may choose to withhold personal bodily processes from influencing our wording (Collins 2004). Nunez is sighted and quite contrary to his expectations of earning the respect of the natives on that account, is presented with a request which applies to all language users. He is asked to prevent his visual processing from affecting his linguistic expressions, for example to stop referring to stars, distances, and the sensation of observation, in order to reduce the estranging effect such language imposes on his hosts. The point Collins makes is that though commonly we seek assistance from our senses to inform language, Nunez has a choice (2007, p.81):

> Nunez could, if he wished, adapt, with a struggle, to the ways of thinking and doing of the natives; to adapt or to remain unique becomes a matter of principle for the explorer, not a matter of ability […] the fact that he had a choice, and that he might have succeeded in acquiring the new conceptual structure were he not so obstinately determined to preserve his old way of thinking and acting, can be read as an illustration of the power of linguistic socialization.

Using the story of Nunez, Collins suggests that language users hold in their power the ability to dismantle perceptual information and urges to report direct experiences. If we neglect particular bodily impressions and by extensive training 'pretend' to be blind even when actually being sighted, it follows that bodily experiences are causally determinants of language only in a very restricted sense (p. 85):

> insofar as a body is required to participate in a linguistic community, then it must include some physical structure that allows it to open itself to the social world of that community. In most cases this will mean the ability to hear and make sounds, but we know from experiences of the Deaf that even loss of the part of the body that normally has the responsibility for language acquisition can be circumvented and alternative linguistic communities, such as those involving sign, can grow.

Ultimately, we can do away with extremely reduced bodily resources and still retain linguistic competences.

2.6 The Body-Language Relation

As described in the previous paragraph, for Collins it is beyond discussion that the body in the physiological and banal sense as provider of oxygen and carbohydrate to the brain is mandatory to language. Obviously the toning down of the body is about toning down direct experiences as fundamental to understanding (see Collins 2016b). Direct experiences are not *constitutive* of linguistic states.

Collins specifies (2011, p. 284):

> If it is necessary to have made the cut in order to understand the cut, then the world of the heart surgeon becomes impenetrably different from the world of the orthopaedic surgeon, which would be impenetrably different from the world of the liver surgeon, the stomach surgeon, and so on. It may be true that each of these specialists would be reluctant to take on each others' jobs 'at the drop of a hat' but if their worlds were impenetrably closed to each other in terms of understanding how would the domain of surgery work? There would be no such thing as 'surgery'; there would be, at best, only 'heart surgery', 'orthopaedic surgery', 'liver surgery', and so on, each of which would be as incomprehensible to practitioners of the others as the Azande poison-oracle is to Westerners. At worst, there would be only 'this person who does things with a knife' and 'that person who does things with a knife'.

The quote is a reply to the on-going debate between the philosopher Hubert Dreyfus and Harry Collins that began with the publication of *What computers can't do* by Dreyfus, which addressed AI-issues, including the ability for computers to simulate language use. Throughout the years, Dreyfus has maintained that language use always presupposes bodily experiences (Dreyfus, in Selinger et al. 2007, p. 737):

> You may have mastered the way surgeons talk to each other but you don't understand surgery unless you can tell thousands of different cuts from each other and judge which is appropriate. In the domain of surgery no matter how well we can pass the word along we are just dumb. So is the sportscaster who can't tell a strike from a ball until the umpire has announced it.

While defenders of the embodiment position hold that the body contains the tacit knowledge necessary for attributing meaning to language, as we have seen, Collins and colleagues claim that language itself is an expertise that contains tacit knowledge. Accordingly, linguistic knowledge does not equal symbol knowledge expressed in rules, formulas, and facts to be encapsulated in computer programs and

the like. To the contrary, linguistic knowledge is ripe with tacit knowledge, so-called collective tacit knowledge (e.g., Collins 2010). It is a kind of knowledge which is located in human collectivities and therefore can never be the property of any one individual.

Crudely put, while embodiment theorists such as Dreyfus point to receptiveness towards the physical world as constitutive of language, Collins points to receptiveness towards the social world. In 2007 (p. 261) Collins puts it as this:

> In the case of somatic-limit tacit knowledge, humans struggle to acquire knowledge that belongs, as it were, to the physical domain […]. In the case of collective tacit knowledge, humans are, as it were, unique parasites specially fitted to take sustenance from a strange and alien species—social collectivities—in whose domain the knowledge resides.

Collective tacit knowledge is here opposed to so-called somatic tacit knowledge in virtue of dependence on the understanding of social conventions. These conventions are not fed by materiality in the normal sense. It seems almost impossible to point to a bottom-up causal chain of action though an overt sensibility is present which is beyond the capabilities of, in this case, machines.

Collins and Evans (2007, p. 111) demonstrate the subtlety of the sensibility and thus tacit knowledge found in humans towards the social collectivities by the concept of 'subediting':

> The most difficult thing for a computer to do in such a test would be to make sense of a badly typed or misspelled input. In other words, the really hard thing is subediting. Consider the following passage which is in need of subediting.
>
> Mary: The next thing I want you to do is spell a word that means a religious ceremony.
>
> John: You mean rite. Do you want me to spell it out loud?
>
> Mary, No, I want you to write it.
>
> John: I'm tired. All you ever want me to do is write, write, write.
>
> Mary: That's unfair, I just want you to write, write, write.
>
> John: OK; I'll write, write.
>
> Mary: Write.

And they continue (ibid. p. 111):

> We can do this in spite of the fact that what counts as an appropriate response—and there may be several possibilities—varies from place to place and time to time […] the ability to subedit reasonably successfully, then is a matter of not learning a set of rules but of being a member of a society.

Given that language use acquires or is closely connected to the linguistic community, linguistic usage is not controlled or determined by bodily experiences. To Collins, all it takes to acquire language is exposure to communities that speak, not to direct experiences.

To make the disconnection between direct experiences and linguistic knowledge complete, Collins presents the following scenario (2004, p. 138):

> One day the problems discussed here might find another application in space. Imagine a party of space explorers leaving the Earth for a 10-year space journey, perhaps to pass by one of the distant planets and return home. Imagine that one of the astronauts becomes pregnant early in the trip and gives birth, returning home with an eight-year-old infant—Wanda. That infant will never have experienced the pull of gravity and all there is associated with it. The claim made here is that the infant's language will not be detectably defective in virtue of that lack of experience; Weightless Wanda will be able to say everything about weight that is sayable.

Thus, experiences come second to linguistic knowledge. The body experience of the pull of gravity has no significant impact on the ability to talk about gravity.

This primacy of language applies even when we engage in bodily enabled experiences such as professional practices. Contrary to the common conception, to Collins people rely on linguistic competences and not on direct experiences (2011, p. 279):

> When investigating any practice-learning environment one should, then, act as though language is always the learning mechanism. Imagine a group that appears to learn entirely through deep immersion in physical practices; even in such a case the role of language should be treated, in the first instance, as central. In the first instance, physical immersion in practice should be thought of only as the condition for immersion in the practice language. In other words, all cases of human acquisition of expertise should be treated, as far as possible, as cases of the quintessential collective way of human learn-ing, rather than the 'human-as-animal', individual-encounter-with-the-physical, way.

Collins (2011) also downplays the experiential specificity of practical knowledge and claims that contributory experts have acquired practical knowledge of only a small fraction of their specialty language. Contributory experts in a field are then basically understood as unique units engaged in different practices which 'sustain' only a very small portion of what is covered by the whole language. Thus, every contributory expert has exceptional (individual) practical experiences, though the majority of his or her knowledge overlaps with that of others in his or her field, because all contributory experts are in principle interactional experts.

2.7 The Primacy of Language

In a sense, Collins turns the relation between interactional and contributory expertise upside down when describing how all experts (contributory and interactional alike) are informed by the language of interactional experts (Collins 2011, p. 277):

> But there are also arrows, not coming out of the specialists but going into them. These arrows go from the language to the 'hammerers' (i.e., contributory experts, my addition). These downward arrows represent the way language gives meaning to and shapes practice as individuals are inducted into the field. To repeat, each specialist, such as the bolded hammerer […] learns the language of GW physics while practising only a small part of the physical activities that comprise the entire practice's physical engagement with the world (italicised in the original work).

In this updated understanding, contributory experts belong to an exotic species crystallised from the common interactional expertise ground (2011, p. 279):

> a practice can never be learned from someone else in the absence of shared language; this must become the new default position. If there are said to be cases where no language is necessary, these need to be looked at again; existing descriptions of apprenticeship regimes that appear not to depend on language […] need careful reconsideration.

In 2011, Collins is thus in dire need of introducing new distinctions as a result of these new interpretations (p. 274):

> Another innovation is the changed relationship between contributory experts and interactional experts. Since, as will be argued, language dominates practice for the individual, we are all interactional experts, even those classed in earlier treatments as contributory experts. Contributory experts are, then, interactional experts, too—the two classes do not contrast; rather, the class of contributory experts is entirely included in the only very slightly larger class of interactional experts. […] This means that it is necessary to invent a new term for the special group of interac-tional experts who are not contributory experts; the obvious term is 'special interac-tional expert'.

To sum up, in the evolved position on contributory and interactional expertise, contributory experts are conceived of also in the sense of the interactional expert. Contributory expertise is 'reduced' to a specialist position and fed by the interactional expertise language. In this updated interpretation the causal impact of physical interaction with a field on linguistic knowledge is ultimately deemed superfluous.

2.8 Pretence and Lying

So far, we have learned that interactional expertise (and special interactional expertise)[7] is linguistic knowledge obtained by many years of linguistic socialisation. The knowledge, however, is established without direct experiences of the domain and as such does not imply any practical skills beyond language, as also acknowledged in the example of Weightless Wanda (Collins and Evans 2007, p. 86): "Learning the language of a domain is not a substitute for learning a whole form of life".

Thus, interactional experts are knowledgeable of how to carry out discourse to an extent that makes them inseparable from the rest of the community if tested linguistically.

Are there nevertheless significant differences between linguistically knowledgeable interactional and contributory experts, if tested linguistically beyond conversational skills in everyday life or institutionalised imitation games?

[7]Throughout this account, unless otherwise stated, I will stick to Collins and Evans original concept of interactional expertise and its connotations to avoid confusion.

To clarify, the question is not about differences of the practical skills of 'laser building' or 'hammer and anvil practices'. The question is concerned with to what extent direct experiences feed into linguistic processes to a degree that systematically changes these processes at a level not revealed at the conversation level. Obviously, the question pertains to the idea of *understanding* in so far as appropriate language use seems closely related to 'know how' as also vividly described by Collins. It takes more than 'parrot talk' (e.g., Crane 1993) for a girl in a wheelchair to *understand* what characterises tennis in order to talk meaningfully about the activity, even if she has never held a racket in her hand or watched a game.[8] We will return to the topic of understanding in later chapters (e.g., Chap. 3 and especially Chap. 7), here it suffices to notice that significant differences that could bear on the nature of understanding may be disclosed if we zoom in on conversational components of insignificant importance to the functioning of normal discourse.

As direct experiences with a topic are dispensable in acquiring interactional expertise, conversations may still seem coherent despite participants invoking meaning that lacks references to self-experienced real life situations.

If we scrutinise a level not targeted by the imitation games which the interactional experts normally do not abide by, will interactional experts continue to be insignificantly different from contributory experts? We may find tentative answers to the question in studies that aim to disclose the structural differences in natural language use in deception. These suggest that when being honest instead of deceptive, people seem to change the way they talk. This might indicate that the degree of self-experience is actually linguistically reflected. Especially three classes of word categories have been implicated in deception: pronoun use, emotion words, and markers of cognitive complexity (Pennebaker et al. 2003). Liars tend to use a lower rate of first-person singular pronouns such as 'I', 'me', and 'my' and refer less often to themselves in stories than truth-tellers either to dissociate themselves from their words or because they lack the sense of ownership.

In studies where subjects are made to be self-aware and truth seeking about personal matters, self-references increase, whereas individuals who employ self-deceptive strategies tend to linguistically distance themselves from their stories. Deceptive acts are morally problematic and might be associated with heightened discomfort which accompanies consistent elevations in the use of negative emotion words during deception compared with truth-tellers (Newman et al. 2003). Most

[8]In a quote from Pinker (1996), 14-year-old Denyse, who suffers from 'Williams Syndrome', demonstrates the intricate relation between eloquence and meaningful language use. Subjects suffering from the disease are gregarious, smiling people who enjoy talking but with IQs of about 50. Denyse refers eloquently to 'bank statements' and a 'joint bank account' that she shares with her boyfriend, even if she has no boyfriend and only a very peripheral understanding of the concept.

According to Pinker (ibid., p. 51), Denyse: "obviously had only the most tenuous grasp of the concept 'joint bank account' because she complained about the boyfriend taking money out of her side of the account".

intriguing is that markers of cognitive complexity seem to be associated with truth-telling. This applies to the word category, referred to as exclusive words, which is made up of prepositions and conjunctions such as 'but', 'except', 'without', and 'exclude'. Exclusive words require the speaker to distinguish what is in a category from what is not in a category. In these studies (for word analysis in deception, see Newman et al. 2003; Pennebaker et al. 2003), truth-tellers used far more exclusive words than did liars. "In the act of deception, it is far too complex to invent what was done versus what was not done" (Pennebaker et al., p. 564). Apparently, and of particular interest here, the lack of connections between expressions and concrete items and actions result in less complex natural language use, because as quoted 'it is far too complex to invent what was done'.

Why may these studies be of relevance here? As emphasised by Collins (2000), in a very narrow sense, the interactional expert has a certain likeness to a pretender—a liar. To lie is to make up stories of which one has no direct first-person experiences. It could be places one claims to have visited, physical activities one has engaged in, or jobs one has been doing. Common to fabricated stories is the absence of relevant actual perceptions connected to the linguistic description. However, where does the liar fall short? Obviously, and sustained by the above studies, he has to deliberately invent connections within the putative experiences he lies about. To be convincing, he will have to assess possible and plausible connections associated with his acclaimed memory. To stay persuasive in front of an audience, he will have to construct mentally a virtual world in which he consciously installs possible connections which are likely to have formed if his narrative was true. However, to make up connections depends on his recognition of them and this may prove to be quite a task (we return to why this may be so especially in Chap. 6).

What evidence speaks in favour of the liar being able to predict all possible connections? The question is all the more relevant, since many real-life connections tend to emerge and thus reveal themselves only as a result of the process progressing which more or less means something like 'the road is created while you walk it'. Typically, we come short of predicting real life events down to the last detail. Somewhat ironically, at the same time the unpredictability of life might in fact help the liar in his attempt to disguise his fabricated story.

In support of the alleged difficulties, research on credibility assessments of criminals suggests that deceptive reports may be less coherent or detailed than real memories (e.g., Porter et al. 1999), which could turn out to be 'the' crucial point of departure between liars and truth-tellers.

The confusion imposed by the manifold of opportunities or open-endedness may in fact be the very reason why we tend to emphasise direct experiences in expert knowledge. Cleeremans (2008, p. 24) describes how actual experiences may function as a specification of 'direction' according to which we may navigate:

> We often say of somebody who failed miserably at some challenging endeavor, such as completing a paper by the deadline, that the failure constitutes "a learning experience". What precisely do we mean by this? We mean that the person can now learn from her mistakes, that the experience of failure was sufficiently imbued with emotional value that it

> has registered in that person's brain. The experience hurt, it made one realize what was at stake, it made us think about it, in other words, it made us consciously aware of what failed and why.

In a sense, all events are uniquely composed and might be only fully experienced when lived through.

There are nevertheless two very distinct differences between interactional experts and liars which may eventually render the comparison untenable. First, interactional experts don't lie as part of conversation. Obviously, this is exactly the case with imitation games in which interactional experts are forced into a particular strand of thinking, though. However, under normal circumstances, interactional experts don't pretend. They talk as experts because they *are* experts.

Their knowledge is not interrogated and tested in a way similar to that of a false witness or fraud. Thus, they are not in similar mentally strenuous conditions and the bias in formulations (as demonstrated in liars) are therefore not shared. Second, in contrast to interactional experts, typically a liar may not lie about something of which he or she is particularly knowledgeable. Normally, liars would lie exactly because they *don't* have knowledge to provide them with the truth. If studies on the linguistic characteristics pertaining to liars should prove informative about interactional experts, we therefore had to select those cases where putative liars had a lot of linguistic knowledge about the chosen subject, since interactional expertise emerges from long lasting exposure to the language performed by contributory experts. Following the results from the linguistic studies, systematic biases in linguistic expressions between truth-tellers and liars are more likely to result from liars *not* being experts and therefore simply less knowledgeable.

Moreover, as briefly noted, to know the truth in case of particular events results from being more knowledgeable about specific and idiosyncratic details on a subject matter, say, when expounding on one's whereabouts when charged with accusations. In such cases and in contrast to the interactional expert, knowledge is related to particularities and not what holds about the world in general.

2.8.1 Misinformation Studies

If we want to investigate putative differences in the quality of the knowledge that makes up linguistic knowledge in conversations, studies on liars and pretense may actually be misleading. Fortunately, we might obtain help from so-called 'misinformation' studies that investigate the possibility and effect of planting entire memories of events that never happened, such as being lost in a shopping mall at the age of six and getting rescued by an elderly or an experience of participating in a hot air balloon riding (Loftus and Pickrell 1995; Wade et al. 2002). In misinformation studies, subjects are exposed to information that elicit so called 'rich false memories' but without actual perceptual support. These subjects believe that they acquired specific experiences, i.e., that they had seen or heard a stimulus that they

have not encountered, and verbally referred to the event in sensory detail that would make it (Loftus 2005, p. 363) "extremely difficult to take a single memory report and reliably classify it as real or unreal". Recent neuroimaging and electrophysiological studies that compare the brain activity related to true and false memories seem to suggest that systematic differences actually exist at the neural level.

For instance, Stark et al. (2010) have demonstrated that when true and false memories are compared, activity in early regions of the sensory cortex distinguishes the former condition from the latter, leaving true memories with 'sensory signatures' (e.g., Fabiani et al. 2000; Slotnick and Schachter 2004; Abe et al. 2008). It is worth noting that according to such studies, neurally we may find differences that suggest a different neural organisation as a result of real experiences whereas at the level of experience, there are no phenomenal differences (see Garry and Polascheck 2000, on the impact of imagination on memory and the so-called 'imagination inflation' effect). Accordingly, such studies seem to question a naïve conception that asserts that the phenomenal experience of direct experiences, the sensation that one has experienced a hot air balloon ride is causally derived from a quality of 'directness' exclusive to direct experiences. We may conclude that the sensory signatures at the neural level have no significant effect on the experience of truth and falseness of the memory at the phenomenal level. We will return to this particularity of the mind in more details in the following chapters since it may be especially important to the mechanisms of derived embodiment.

To sum up, the idea of interactional expertise by Collins and Evans holds that linguistic knowledge in the sense of competent language use may be acquired to an extent that makes it insignificantly different from the linguistic competences of contributory experts. Linguistic competences are skill-like and therefore depend on tacit knowledge. However, in contrast to dominant conceptions that relate tacit knowledge to the body, Collins and Evans emphasise the association to the social collectivities. Furthermore, the ability to talk competently about a particular domain is not causally dependent on direct experiences of the domain but obtained through linguistic immersion.

This downplays the role of the body substantially. Accordingly, individual experiences have insignificant impact on linguistic skills as exemplified by the so-called social embodiment thesis.

Collins et al. (2006) have conducted experiments in so-called imitation games to provide 'proof of concept'. These experiments may highlight the fact that the conversational level to which the claims about interactional expertise apply may not generalise to the level of single linguistic categories.

Of importance here though is the fact that most human interactions appear to presuppose the idea of linguistically conveyed information. Thus, the concept of interactional expertise forces us to recognise how we linguistically share an experience and are capable of neutralising the individual perceptions in the sharing even if interactional expertise in the narrow sense of the term among adult interlocutors is less frequent.

In the following, the term 'interactional expertise-like knowledge' is used exactly in the sense that many human interactions seem to involve linguistic sharing

in which direct experiences appear irrelevant. And it is in that sense that interactional expertise is of relevance to this account.

Interactional expertise-like knowledge is interesting because it implicitly suggests that linguistic knowledge as viewed from the perspective of conversations operates independently of biological processes and suggests instead that language is based on an individual's social collectivities. The contention is thus that language operates top-down. The suggestion is sustained by misinformation studies that seem to suggest the irrelevance of sensory signatures on the phenomenal experiences on which subjects seemingly rely when reporting on a hot air balloon ride or getting lost in a mall.

It is in that sense that interactional expertise-like knowledge challenges the embodied cognition approach that addresses linguistic knowledge as bottom up, to which we will now turn.

Chapter 3
Grounded Cognition

The notion of interactional expertise presupposes a minimal embrainment and embodiment platform, as exemplified by the case of Madeleine. Apart from the marginal physiological preconditions at the level of the individual, the structures constitutive of language as well as the use of language are not caused by particular bodily activities. Hence, while bodily idiosyncrasies such as 'uselessness of hands' at the level of the individual may influence the experience of the individual, they are not causal determinants of either the linguistic acquisition or the linguistic use at the conversational level. Mal—or non-functioning hands, as in the case of Madeleine (e.g., Collins 2004), do not exclude the speaker from talking meaningfully about manipulation or finger-related activities.

However, contemporary neuropsychological studies on the neural underpinning of linguistic knowledge defend the diametric opposite view especially within the research program of embodied cognition (see Barsalou 2010). Glenberg posits (2008, p. 355):

> The essence of embodied theories of cognition is that the body, particularly bodily systems that have evolved for perception, action, and emotion, contribute to "higher" cognitive processes. Many of these cognitive processes are important to education, such as language comprehension, reading, mathematics and scientific thinking.

In what follows, we will focus on a number of studies that apparently demonstrate a close relation between perception, action, emotion, and 'higher' cognitive processes that exemplify and fuel the embodiment perspective. In focus is the idea of simulation[1] and the neural mechanisms commonly suggested to corroborate the

Some of the ideas and arguments presented in this chapter have been covered in condensed form in Schilhab (2015c).

[1]In the scientific literature, simulation theory is found in two separate variants. Though partly connected, one is concerned with mind-reading abilities and points to our ability to simulate the mind and perspectives of others, for example by activity of mirror neuron systems (see also Chap. 8). The other variant claims that simulation of percepts grounds conceptual understanding. Thus, the former could be viewed as a special case, that of understanding other minds, of a general ability to make sense of the world by simulation.

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_3

embodiment claim. The aim of this section is to introduce contemporary views within neuroscience that challenge the idea of interactional expertise-like knowledge and non-crete linguistic acquisition and use. Thus, the exposition of results in this paragraph is by no means intended as an exhaustive review but merely serves the purpose of providing the contemporary line of reasoning about the impact of embodiment in grounded cognition studies.

3.1 Empirical Results

According to grounded cognition studies, when and how are bodily idiosyncrasies causally connected to linguistic processing? How would embodied cognition studies view the uselessness of Madeleine's hands with respect to understanding manipulation or concepts related to hands?

Some studies evidently point to the contribution of perceptual processes to the linguistic output. For example it has been demonstrated that simulation of perceptual experiences seems co-responsible in forming lexical decisions about sentences (e.g., Barsalou et al. 2003; Glenberg and Kashack 2002; Holt and Beilock 2006). In one such study by Zwaan et al. (2002), subjects had difficulties assessing the congruence of a target object in a sentence and a subsequent photograph if the circumstances defining the depicted situations were different. Thus, comprehension of a sentence such as "the ranger saw the eagle in the sky" was significantly slowed and thus response time (RT) increased if the depicting photograph was of an eagle in its nest. According to these researchers linguistic meaning emerges from dynamic processes that involve so-called perceptual representations.

Such perceptual representations, for example in the form or shape of 'objects', are termed 'perceptual symbols' and are conceived of as residues of perceptual experiences, "stored as patterns of activation in the brain" (Zwaan et al. 2002, p. 168). Thus, to attribute meaning to concepts in order to comprehend and assess congruence between an object in a photograph and an object in a sentence, is to excite the perceptual symbol (see also, Pulvermüller 2005). Following this account, to make sense of "the ranger saw the eagle in its nest" involves simulating the perception that relates to experiencing an eagle in its nest.

In this case the perceptual simulation obviously rests on the visual modality. Importantly, though, perceptual representations may encompass all senses and not exclusively the visual though there might be reasons to believe that vision is especially important to simulation. That all senses may potentially contribute is sustained for instance by a study by Goldberg and colleagues (2006) in which semantic decisions that index tactile, gustatory, auditory, and visual knowledge activated specific sensory brain regions. Participants were fMRI[2]scanned while

[2]Functional magnetic resonance imaging or functional MRI (fMRI) is a functional neuroimaging procedure using MRI technology that measures brain activity by detecting associated changes in blood flow.

asked to determine whether a concrete word item possessed a given property from one of four sensory modalities, including colour (green), sound (loud), touch (soft), or taste (sweet). Results were that sensory brain regions were activated by the perceptual semantic retrieval across the four sensory modalities. For example, knowledge of taste was associated with increased activity of the orbitofrontal cortex in contrast to the other sensory modalities and to pseudo words used as control.

The suggestion that linguistic knowledge is related to perceptual simulation aligns with interpretations of knowledge as re-enactment of neural assemblies previously activated as a result of direct experiences (e.g. Buccino et al. 2016). The interpretation has gained support in various RT studies, in which a subject's speed of reaction when engaged in sensibility judgments is measured and which test by directly tapping into the behavioural memory. For instance, in a study by Glenberg and Kashack (2002), subjects were asked to assess the sensibility of the sentence "close the drawer" and prompted to respond "yes" by *pulling* or *pushing* a handle that would result in a movement towards or away from their body. Thus, the sentence's implied action direction was either compatible or contrary to the direction of the response and RTs were significantly lower in the compatibility conditions than they were in the incompatibility conditions.

Apparently, to make sense of the sentence "close the drawer" recruits neural connections that underpin the execution of the actual movement. So, making sense of sentences that describe actions elicits reactivations of the neural correlate that would have been recruited in case of actually performing the described action. Please bear in mind though that since there is no actual performance, i.e., no physical activity, the 'simulation' is only partly congruent with the neural correlate that would be recruited during activation.

Involvement of motor programs in conceptual understanding was also found in a study by Glenberg et al. (2008) in which previously induced manipulation of motor plasticity influenced the RTs in so-called sensibility tasks later on. In the study, subjects were required to move 600 beans from one container to another one at a time. Subsequently, participants read sensible and nonsense sentences about the transfer of either concrete or abstract information towards or away from themselves. The time to assess both concrete and abstract sentences was measured and interaction between the direction of transfer of beans and the direction of described transfer in the sentences was found. According to the researchers, participants were slower to make the sensible judgment, which involved pressing a key on a keyboard with the right index finger, when sentences described transfer in a direction that matched the direction of previous bean practice.

The study is a challenge to Madeleine's 'uselessness of hands' since the researchers interpret the increased RT as evidence of a causal link between the motor system and the comprehension of both concrete and abstract language. After all, 20 min of repetitive actions fatigued the common neural underpinning and slowed down the response (for causal links between the motor system and the comprehension of language, see also Glenberg et al. 2008; Meteyard and Vigliocco 2008; for theories linking words and sensosomatic processing, see Myung et al. 2006). All else being equal, if the activity of hands co-determines understanding and use of

concepts related to manipulation, Madeleine's bodily historicity would result in different neural activities when processing sentences about manipulatory activity.

The results of the studies are not decisive with respect to the details of the simulation interpretation. In the study by Glenberg et al. (2008a) the motor system became exhausted. Sometimes, however, perceptual activation facilitates cognitive processing instead of delaying reactions as described in the above studies. A study by Pecher et al. (2003) on concepts as partly grounded in perceptual processes shows this effect (see also Boroditsky and Ramscar 2002; Markman and Brendl 2005). In these studies, subjects were exposed to concepts along with an associated property and asked to verify or reject the validity of the association. Afterwards, subjects were again exposed to the concept but now showed either a property of the same or another modality. For instance, 'apple' was accompanied by the visual property 'green' and subsequently 'shiny' (same modality) or 'tart' (other modality). If the second property belonged to the same modality, RTs were markedly reduced. Apparently, in this study the re-enactment of perceptual qualities that tapped into the same neural activations 'improved' concept understanding and therefore reduced reaction times (see also Marques 2006). It seems that the time component matters and the Glenberg et al. study aimed at exhausting the activity of the motor area.

According to Chersi et al. (2010), recruitment of perception and action mechanisms during linguistic processing has been confirmed by numerous studies (e.g. Buccino et al. 2017). Using EEG,[3]Pulvermüller et al. (2001), studied the processing of verbs that referred to actions performed with the face, the arm/hand, and the leg/foot. In a lexical decision task, different verbs (e.g., to "lick", to "pick", to "kick") ignited different areas of the brain (for a similar study on preschool children aged 4–6, see James and Maouene 2009). This study was later confirmed by fMRI (Hauk et al. 2004) which showed that reading words associated with mouth, hand, or foot actions would recruit areas that partly overlapped with areas activated when *making actions* with the mouth, hand, or foot (see also, Aziz-Zadeh 2013).

Thus, embodied cognition theories in cognitive neuroscience seem to suggest that there is no separation between so-called 'low' cognitive processes such as perception and action and 'higher' cognitive processes, such as language and thought. When we understand words, those sensorimotor areas we use for interacting with the objects and entities the words refer to are recruited (Jirak et al. 2010).

3.2 Biological Considerations[4]

What makes simulation of previous perceptual experiences central to linguistic processes? What are the mechanisms sustaining perceptual experiences that allow previous experiences to form part of the neural correlate corroborating conceptual

[3]Electroencephalography (EEG) is the recording of electrical activity along the scalp.

[4]Part of this subsection is a modified version of my paper (2013c) on why robots are not animals.

processing? The common explanation of the association between perceptual experiences and conceptual knowledge emphasises the synchronised presentation of referents and concepts that seem responsible for the association of somatosensory, motorsensory, and conceptual causes during the process of linguistic acquisition (Glenberg et al. 2008a).

This understanding covertly owes the explanatory power to the biological foundation of cognition. In that perspective, cognition evolved to and is functionally constrained by its sustenance of the abilities to maintain 'self' (e.g. Maturana and Varela 1998). According to Godfrey-Smith (2002) cognition is the biological set of tools we use to act appropriately in our environment.

Godfrey-Smith adds that the core elements of the toolkit (perception, internal representation of the world, memory, and learning) are not to be conceived of as describing a set of recognisable and distinct "modules" found in the same form in all cognitive systems that have them. The elements of the toolkit are to be viewed as a set of capacities realised in different ways in different organisms. They are capacities that shade into each other and off into other non-cognitive parts of the biological machinery (ibid.).[5]

The implicit claim is that analytic separation of cognitive features bears the risk of hypothesising that they can also be found in reality, a devastating mistake given that organic cognition is based on the complex cooperation of many different parts. In a discussion on the features constitutive of linguistic knowledge, where does the biological perspective fit in?

Of importance here, and in opposition to the interactional (sociological) perspective, the biological perspective seemingly approaches cognition as at least somewhat dependent on *bottom-up* processes. Traditionally, bottom-up cognition is viewed as involving automatic, unintentional and involuntary processes, in contrast with intentional cognition that is often individually or socially (linguistically) and, of importance here, consciously controlled (Nosek 2007).

In the present context, I use 'bottom-up' in a very specific sense. Among other things, life is a continuous biochemical process to sustain and maintain an appropriate constellation of crucial parameters that happens at a level we have no or only diminutive control over and/or awareness of. In this perspective, organisms are congregates of incessant dynamical exchanges and bottom-up processes that result from the immediate sensitivity that corroborates this continuous processing. To understand the term 'bottom-up' and the implication of bottom-up processes in the current context, this functional definition suffices for now. In later sections, we return to further discussions of, as well as implications of, bottom-up and top-down processing on cognitive processes in linguistic acquisition.

[5]Obviously, abilities that enable a particular organism to cognitively cope are not fixed across species but rely on the history and life conditions (phylogenetic characteristics) of specific species. Godfrey-Smith elaborates (ibid.): "As the term 'toolkit' suggests we need not to find some single set of tools across all the organisms with cognitive capacities; different organisms have different collections of behaviour control devices, according to their circumstances and history". See also Schilhab (2017a).

As described by Deacon (2012) and in line with the interpretation of core elements by Godfrey-Smith in the above quote (252):

> Brains are organs which evolved to support whole organism functions that are critical to persistence and reproduction. They are not arbitrary, general-purpose, information-processing devices. Everything about them grows out of, and is organized to work in, service of the organism and the teleodynamic processes that constitute it. Animal physiology is organized around the maintenance of certain core self-preservation functions on which all else depends. Critical variables—such as constant oxygenation, availability of nutrients, elimination of waste products, maintenance of body temperature within a certain range, and so forth—all must be maintained, or no other processes are possible. Sensory specializations, motor capabilities, basic drives, learning biases, emotional response patterns, and even the structure of our memories are ultimately organized with respect to how they support these critical core variables.

Hence, organisms are not sufficiently describable in mechanistic terms. Framing organisms in traditional mono causal explanations excludes features central to satisfactory descriptions of the operation and guiding principles. According to Deacon (2012), features such as function, purpose, representations and value are significant characteristics of organic organisations. Sheets-Johnstone (1998) interprets this life-preserving flux in terms of kinetics and argues that the significance of movement, which is crucial to proprioception and kinaesthesia, has been unwarrantedly neglected despite the fact that these phenomena permeate all living things. Movement, as the original demarcation of life, includes the unnoticed but life-preserving activation of cilia and flagella, which are organelles found in all eukaryotic cells. For instance, cilia are found in the lining of the trachea (windpipe), where they sweep mucus and dirt out of the lungs, and in female mammals the beating of the cilia moves the ovum from the ovary to the uterus (see Schilhab 2011). For Sheets-Johnstone, movement is a biological imperative in processes, tissues, and sensations alike. Maintenance of the appropriate flux of material is then coupled to a profound environmental sensitivity. Sheets-Johnstone (2011) describes how animate creatures display surface recognition that makes them aware of both movements and the environment.

Simultaneously this sensitivity reflects the volatility of the world (and which could be the single most important reason why liars face difficulties when addressing the particularities of phenomena). Sheets-Johnstone (1998, p. 290) posits:

> no matter what the particular world (Umwelt) in which an animal lives, it is not an unchanging world. Hence, whatever the animal, its movement cannot be absolutely programmed such that, for example, at all times its particular speed and direction of movement, its every impulse and stirring, its every pause and stillness, run automatically on something akin to a lifetime tape. Consider, for example, an earthworm, its body pressed against the earth as it crawls along, or a beetle walking along the ground. In each case, the immediate environment is tangibly inconsistent; it has topological and textural irregularities—bumps here, smoothness there, moisture here, hardness there, and so on. Both earthworm and beetle must adjust kinetically to what they find in the immediate moment.

Organisms deal with the volatility of the world by an inherent malleability reflected in plasticity and adaptations at all levels. This pervasive sensitivity is responsible for and grounds continuous bottom-up processing in the individual which is also

reflected neurally. It is worth noting that grounded cognition theories blatantly (often implicitly) use the biological perspective as an explanatory framework for tacit processes, situatedness, and context dependency in terms of bottom-up processes. Biologically, however, bottom-up processes make sense insofar as organisms are also top-down controlled, i.e., the perspective of the organism, linked to 'conscious' attention and control. Thus, from a biological perspective cognition is also a result of top-down processes caused by the perspective of the organism qua an autopoetic system (e.g., Maturana and Varela 1998; Deacon 2012).

To sum up, it is thus clear that bottom-up processing, as implied in the neurobiological explanation of simulation, is closely related to (and even probably constituted by) a general responsiveness to ongoing environmental stimulations that are subsequently retained as memories without our explicit recognition of them. Seemingly, sentence and concept comprehension are not processed separately from the situations to which they pertain or in which they take place.

It is also clear that though sensitivity to environmental stimuli may be described at the singular level in a kind of one-to-one correspondence—as in the case of the sensitivity of the active site in the bacterium *E. coli* to carbohydrates (the issue is further discussed in the following paragraph), at any given point in time, an organism is immersed in a multiplicity of stimuli and respond at a variety of levels. At any given time, the organism is both remembering and responding, which immediately impacts on any other interaction. Organisms are historical, anticipating, holistic, and complex systems consisting of numerous ongoing processes. The individuation and identification of particular stimulations that result in particular representations are therefore abstractions since each and every representation covers a conglomerate of processes.

Thus, this should always be kept in mind when discussing one-to-one correspondences between environmental stimuli and particular neural activations.

3.3 Links Between Language and Perception

The biological perspective accentuates the fact that copious susceptibility to the surroundings is inherent to organisms. Note that so far such sensitivity does not need to be linked to or in any way be subject to conscious processing in the sense that these processes are *accessible* to the organism, even if, as we will later see, they may be. Sensitivity in this general understanding may be as simple as recognition of the active site of a carbohydrate by bacteria as nutrition (e.g., Stjernfelt 2012). Why is the biological interpretation that emphasises the susceptibility aspect of cognition at issue in embodied explanations of how we come to understand and process linguistic knowledge?

As briefly discussed in the introduction to this chapter, to a certain extent, current neurophysiological studies show that the semantic content of language, for instance in reading, is corroborated by activity in a conglomerate of perceptual and sensomotoric neural systems. It is argued that this activity demonstrates that

linguistic understanding of, for instance "eagle in its nest", involves perceptual and sensomotoric simulations. As a consequence, at some point acquisition of language is linked to direct exposure to the environment, which engages perceptual and sensomotoric processes which, when put to linguistic use, are later 'simulated'.

Accordingly, Pulvermüller (2011) posits that studies on early language acquisition demonstrate language acquisition by pre-linguistic children almost exclusively in the one-word stage (e.g., Xu et al. 2005; Nomikou et al. 2014), although several components in language learning are launched before children actually produce words (e.g., Steger and Werker 1997) as well as the potential to socially interact (Tomasello et al. 2005; Fuchs and De Jaegher 2009). This one-word condition is central to the so-called word-object paradigm, which asserts that language is established through ostensive learning (Pulvermüller 2011, p.10); "adults naming objects while the child focuses on and attends to them". Similarly, Dromi (1999) claims that initially children acquire terms which label objects and actions that are commonly encountered in the immediate and familiar environment. Thus, acquisition of language centres on (and perceptually depends on) common objects and events. A study on the content of Danish first words by Wehberg et al. (2007, p. 377) confirms this general pattern:

> the children knew names for mother and father, affirmations 'yes' and prohibitions 'no', they used words linked to social interaction contexts such as greeting (hi) and playing (peekaboo), objects (presumably) close to a child's world (car and book) and they talked a lot—using Sound effects as well as Common nouns—about cats, dogs and the like, indicating that, very early on, Danish children are also fascinated by fellow animates.

Earliest language acquisition in children seems to result from bodily exposure to phenomena to which children are particularly sensitive; i.e., cats and dogs, father and mother, and welcome events as well as departures. When naming dogs, they are most likely exposed to dogs in direct experiences, in the street or in their homes. While acquiring the concept of greeting, they are directly engaged in the act of greeting as well as observing acts of greeting in others. Thus, it is the simultaneity of linguistic and perceptual experiences that links conceptual knowledge to non-symbolic processes (e.g., Barsalou 2008; Barsalou et al. 2003).

An important consequence of the word-object setting is that it teaches children that language might work as a stand in for 'reality' in a loose sense. For example Xu et al. (2005) describe how infants aged 12 months assume that a new word refers to a kind of object if the presentation of words without concurrent perception of the referents follows a series of word-object studies.

Through the word-object paradigm, children may then acquire the conception of language as a 'labelling' device and instrument for symbol use. Naturally, language use includes far more, probably even more frequently, than 'just' mastering of word-object relations (e.g., Hodges 2009; Hodges et al. 2014). For example, acquisition of language also involves the development of the 'habit' of using language, that is, the 'right' way to understand sentences. Glenberg et al. (2010, p. 425) exemplify this by saying:

> Consider for example how people understand a sentence such as "Art stood on the chair to change the bulb in the ceiling fixture". The first process is that words and phrases, such as Art and the chair are indexed. Thus, if the sentence were uttered while gesturing to a particular chair, the comprehender would index or map the phrase to that chair […] If the sentence were spoken outside of the context including the chair or if the sentence were read, the comprehender would index the word to a perceptual symbol.

However, the dominant word classes at the single word stage such as common nouns, verbs, and social interaction events seem suggestive of a bias towards ostensive learning in early language acquisition. In other words, a significant part of what infants learn when they begin acquiring their first language is to infer how 'things' are in reality from linguistic sources, even if they also pick up an immense amount of information of, for instance, social interactions and social 'forces' that may not in any sense boil down to single concrete stimulations. Such intangible abstract forces may be incredibly important to the development of children's understanding. However, as we will see in this context, the word-object relation is of particular importance to the understanding of later acquisition of abstract knowledge in the sense of interactional expertise-like knowledge. Therefore, it is in this sense that I will examine linguistic acquisition.

Apparently, early linguistic learning is (also) concerned with cracking that aspect of the linguistic code that concerns an understanding of how words point to (and may replace) concrete phenomena or objects. For this to happen, I suggest that children are enrolled into a process of *linguification*, a concept that I introduce here to accentuate how the simultaneously guided exposure to perceptual experiences and linguistic naming eventually lead to and sometimes even cause 'understanding' through 'labelling'. Before we turn to that we need to clarify in what sense understanding is involved.

As we encountered in embodied cognition studies, understanding of some sorts is involved, when subjects are requested to assess whether an object in a photograph was also referred to in a subsequent sentence. Likewise, for listeners to make sense of the story about Art on the chair they must understand in what respects the story relates to the reference implied. A successful outcome is assumed to depend on 'understanding', e.g., comprehension of inferences of the sentence. Thus, understanding the concept 'eagle' for instance involves deeper cognitive activity than 'superficial' recognition of 'eagle' as in reading the concept 'eagle' that may occur automatically (e.g., Gerlach et al. 2002). Thus while the former might result from conscious manipulation of information, the latter may depend more on tacit processing (e.g., Dehaene and Cohen 2011). As a first approximation, we may contend that the understanding needed to recognise similarities between objects described and objects visually presented depends on conscious awareness/controllability which I will refer to throughout this account as one sense of 'top-down' processing. However, the pervading sensitivity to stimulations makes it likely that neural parts of understanding occur also without conscious processing. Thus, understanding is based on both top-down and bottom-up processing. (I will address this in more detail later in this chapter as well as the issue of understanding in relation to educational implications in Chap. 7.)

3.3.1 Process of Linguification[6]

In the linguification process that will be detailed at the neural level in the following, the connection between the label (the reference or concept) and understanding in the sense defined above is established. By 'understanding' (as when understanding 'eagle') I mean both what is *consciously* perceived by the individual—the sensation associated with particular somatosensory and sensomotoric experiences, and the emotional evaluation—as well as the *non-conscious* cognitive processes that work bottom-up. Thus, understanding is sustained by the neural conglomerate of what systematically occurs at any given occasion categorised by the concept (in the next section we address the neural mechanisms involved). Apparently, understanding may be interpreted from a number of perspectives. Thus, 'understanding' refers both to the explicit recognition of a particular state of affair, to the relevant future actions implied by the conceptual information and specifically in the neural perspective as demonstrated by the grounded cognition studies, the collection of sensations, associations and phenomenal experiences corroborated by the neural correlate that provides subjects with the ability to assess the meaning of sentence. For the sake of analysis we may distinguish between the state of the facts (what systematically occurs nonverbally) and the verbal part (the systematic activity that produces the uttering as well as the utterance). It is noticeable, though not surprising, that the verbal part in the sense of linguistic categorisation (the conceptual part of the linguification process) is determined by a linguistic community. From early on, the linguistic community is represented to the individual by caregivers, family members, friends, neighbours, and other individuals close to the language learner. But also television programmes and books that carry verbal information will participate.

At this early point in life, as described by Wehberg and colleagues (2007), part of understanding language is to repeat and 're-enact' (e.g., simulate) an episode (loosely defined) categorised by a unique reference existing in public. Although, the processes that facilitate the re-enactment may change when mechanisms behind the ability to overview and control elements of experiences are introduced, language studies on iconicity between linguistic form (sound) and human experience suggest that in early language acquisition we may need help to concentrate on the task of connecting concepts to objects (Imai et al. 2008; Thompson et al. 2012). When a parent for instance smiles and greets the child, the utterance 'Hello' is linked to the act of greeting. When the caregiver utters: 'This is teddy', 'Oh, where is teddy' or 'Is teddy nice?', the child is seemingly *nudged* to either refer to the actual teddy or simulate the experience of the exact teddy bear. In these early stages, the function of language is primarily to point to or simulate the acts and doings in a 'real' world furnished with concrete phenomena. However, it is members of the linguistic community that 'decide' which phenomena or acts should become labelled.

[6]The ideas developed in the following paragraphs on 'linguification' have been introduced in preliminary form in Schilhab (2013a; 2015a; b; c).

Linguification is central to getting language use off the ground as a vehicle for knowledge exchange and sharing in interactional expertise-like conditions. At the neural level, I define the process of linguification as the process in which neural representations of non-verbal state of affairs are repeatedly associated to neural representations of verbal state of affairs, i.e., particular linguistically formulated concepts. The concept of linguification is inspired by the concept of situated conceptualisation introduced by Barsalou (e.g., 2003, 2009, see also 2016) as (2005, s. 620): "a multimodal simulation that supports one specific course of situated action with a particular category instance". The concept of linguification picks out those cases of situated conceptualisation in which linguistic concepts become part of the neural correlate of the 'particular category instance'. Well-established linguification processes may then offer themselves as 'handles' that, with proper use by the interlocutor, may re-enact previous experiences. Thus, linguification is at stake when parents nudge the emergence of the word for 'Teddy' or 'Dog' but also for the expanding vocabulary in toddlers (i.e., introduction of 'unicorn' and 'flying saucer'); when the teacher codifies abstract ideas by a few concepts (i.e., the binding of the sun's energy by 'photosynthesis') and when the contributory expert linguistically introduces the interactional novice to an imagined off-line version of his practices (i.e., the practice of TEA laser-building or change of brake cables in a racing bicycle).

Linguification denotes the neural aggregation of hitherto isolated cognitive processes, so all language acquisition seems describable in terms of linguification. However, in this context, linguification refers to language acquisition in which the perceptual component is constitutive of the neural correlate (In Chap. 5, I introduce the concept of 'second order linguification processes' to clarify the connection between derived embodiment processes and linguification).

Thus, early acquisition of a notion for a noun, say apple, which often happens simultaneously with the first taste and tactile experiences of the fruit (e.g., Glenberg 2008; Glenberg et al. 2008b), is an example of the process of linguification. In early linguification processes, the acquisition of the concept forms over several sessions with simultaneous exposure to the naming procedures and the presentation of actual objects to facilitate the association of the linguistic 'label' and sensomotoric experiences. As a consequence of the primacy of the concrete at this early stage of life, children 'acquire terms which label objects and actions that are commonly encountered in the immediate and familiar environment' (as asserted in the Wehberg quote). Thus, the aggregate of non-verbal perceptual stimuli, actions, and processes related to the naming (verbal stimuli) is often temporarily linked, although repeatedly activated several times. What comes out of these neurally represented repetitions has been formulated by Scorolli and Borghi (2008, p. 11):

> The word 'glass' should reactivate the experiences of our previous interactions with glasses. So it leads to the activation of auditory, visual, and tactile information, for example the smoothness of a glass of wine, its sound banging into the dish, its shape and size, that surprisingly do affect the smell and the taste of the wine. The same word re-activates also proprioceptive and kinesthetic information, for example hand/arm feedback, whereas bringing a glass to our mouth as well as information on its affordance.

If the act of eating apples is commonly connected to the state of being seated, an aggregate that connects the 'eating of apples' with 'while *seated*' will gradually form. Note, however, that the neural activity sustaining linguistic processing of 'apple-eating', which entails the processing of the spoken sound of 'apple' as well as the physiological and muscular activity that sustains articulation of the word 'apple', is also likely to participate in the co-active aggregate.[7]

3.4 Fire Together, Wire Together

Obviously, the repetitive multi-modal (and multi-perceptual) exposure central to the linguification process in the word-object setting, results in lasting neural correlations.[8] Commonly, these are the focus of embodied cognition studies. According to Barsalou (2009, p. 1281):

> When an entity or event is experienced, it activates feature detectors in the relevant neural systems. During visual processing of a bicycle, for example, neurons fire for edges and surfaces, whereas others fire for colour, configural properties and motion. The overall pattern of activation across this hierarchically organized distributed system represents the entity in vision. Analogous patterns of activation in other sensory modalities represent how the bicycle might sound and feel. Activations in the motor system represent actions on the bicycle. Activations in the amygdale and orbitofrontal areas represent affective reactions.

The concurrent stimulations and causally related (often conscious) experiences of objects and concepts pave the way for the process of 'neurons that fire together wire together' (FTWT).[9] This process combines and maintains previously unrelated

[7]In the technical formulation of Pulvermüller (2011), when a word form is articulated neural activity is sparked in the lower motor cortex. However, the resulting speech also sparks activity in the separate auditory area. The co-activation leads to strengthening of the neuronal links (p. 6):

"As the inferior-frontal and superior-temporal neuron populations—which, before learning, had either been controlling articulation movements or had specifically responded to the acoustic features—are being linked together by the learning process, the resulting connected assembly can be considered an action-perception-circuit, or APC, in which action-related and perceptual information is being merged or mixed".For a neural study on the early linking of language perception and speech in infants, see for instance Imada et al. (2006).

[8]Correlates (or aggregates) refer to concurrent stimulations which couple linguistic, perceptual, and motor processing and which eventually integrate into a neural ensemble. Pulvermüller (2011) lists a number of descriptions for this phenomenon such as 'cell assemblies', 'reverberatory synfire chains', 'cognits', 'large-scale neurocognitive networks', and 'neuronal assemblies'. Following Pulvermüller, I will use these notions interchangeably unless otherwise stated.

[9]The neural mechanism is known as Hebbian learning and involves repeated presynaptic activation that leads to increased postsynaptic activity that improves the synaptic strength between the implied cells (for relevance of Hebbian learning to complex neurophysiological mechanisms, see Garagnani et al., 2008; see also Meyer and Damasio (2009), for elaboration on the neural architecture corroborating re-experiences during recall).

events to an extent that may persuade observers to believe that neurons are dedicated to particular functions and results in activities that cannot be traced back to the activity of an isolated event.

3.4.1 What Correlates to the Correlate?

Now, by way of the concept of linguification we have established how and why ubiquitous sensitivity to the surroundings connects to conceptual understanding at the neural level. An important aspect to bear in mind is that pervasive sensitivity persists throughout life and is not confined to the acquisition of language. According to Sheckley and Bell (2006) most connections between neurons form in response to experiences of objects, events or situations that stimulate changes in the state of the body. It could be the eating of an ice-cream or handling of keys while locking the door. They name this a 'change-of-a-body-state' (COBS) experience. The COBS-*experience* intuits what we touched upon earlier, that episodes of conscious experiences are key to the categorization (p. 43):

> The more repetitions we have of a change-of-a-body-state (COBS) experience and the more intense the COBS experience, the more likely the brain is to form a durable, fired-together-wired-together (FTWT) circuit to "remember" the experience.

Here, Sheckley and Bell (2006) seem to suggest that the awareness of COBS is criterial to the strength of the FTWT assembly, which on the other hand may be criterial of the ability to grasp a concept. The experience of actual phenomena results in COBS experiences which 'suffuse' the understanding of the concept, so to speak. In the grounded cognition tradition, the conceptual understanding of ensembles or neural correlates underspecifies the relation (i.e., do not explicitly distinguish) between conscious and non-conscious correlates. To this account, however, in the attempt to explain the mechanism that sustains abstract language acquisition, the differences between conscious and non-conscious representations may prove highly important. Hence we pursue this issue in later sections.

Apparently, COBS experiences make up our daily life. Sheckley and Bell nicely exemplify this in the following quote (ibid., pp. 43–44):

> For example, when you sip a cup of coffee you are conscious of a COBS as a rapid shift in the temperature of your mouth. If drinking coffee is part of your regular routine, the neurons involved would fire together many times.

Through repetition, a durable FTWT circuit of the COBS episode would be formed. Note, however, that ensembles of neurons coupled tightly together may also have been established as an aggregate on the basis of one marked COBS experience. According to Sheckley and Bell (ibid., p. 44):

> What if you grabbed a cup of coffee that was scalding hot and unwittingly took a long pulp? The pain of your mouth burning would lead to an extreme COBS. Even if you never drank coffee again, the magnitude of the neural impulses involved would be sufficient to create a durable FTWT circuit or memory of the event.

Thus, activity in neural ensembles formed in response to experiences of coffee drinking (or, to emphasise the generality of the mechanism, ice cream eating) accompanied by actual naming of the activities, is the neural basis of meaningful language units.

Does the idea of COBS experience aid in understanding what is meant by 'the meaningful language unit' and thus with what the neural correlate correlates? So far the conceptualisation of FTWT (neural correlates) or linguification processes as related to meaning, pointing to the activity of particular neuronal ensembles during a cognitive task amounts to no more than recognition of which neurons are actively involved in the cognitive task.

What is claimed is that the relation between the task picked out and the neural activity appears stable to an extent that allows for systematization. The neural correlate is also referred to as the 'representation'. This is an abstraction for those neurons actively corroborating the behaviour, mental content, and/or phenomenal experience in question. In most instances studies are agnostic with respect to the 'identity' of those neurons (Barrett 2009). Carried by the susceptibility of neurons, representations may be metaphorically depicted as that part of a water surface disturbed by the skipping of a stone though it should be emphasised that the neural default activity is co-determinant of such representations. It follows that whereas the resonance is viewed as a patterning that 'represents' the transient presence of the stone, the body of water is crucial to the exact wave pattern. Hence, on-going processes in the form of neural activities are co-determinant of the representation.

Representations in the neural sense are therefore pretty underdetermined with respect to 'content'. A representation is likely to embrace implicit and explicit processes that may or may not be accessible to conscious control. However, since the neuroscientist is seldom capable of capturing the full neural ensemble that sustains particular cognitive activities of interest or to pinpoint any causal connections between particular sub-processes and the cognitive level, the indeterminacy is inherent to 'representation' (see Greenfield 2014). Moreover, representations are abstractions in so far as they are not fixed over time. A representation is likely to 'pulsate' in the sense that new neurons may be recruited while others, hitherto active and corroborating the aggregate, may become silent. The representation is then the set of neurons active at a particular point in time (e.g., Anderson 2014).

From this information, it is not possible to pinpoint to what extent the individual is aware of any particular subcomponent making up the aggregate. Eating ice cream may at some point be connected to the concept 'ice cream' through the word-object relation experienced in early linguification processes. Later on, however, 'ice cream' may also become associated with 'advanced experiences of shame due to the seeming lack of self-constraints' or even to 'moral issues of refraining from superfluous calorie intake in the face of world-wide scarcity of food'.

To what extent are subjects aware of sub-processes, such as sensomotoric, perceptual or emotional processes, connected to the linguistic conceptualisations? The answers to these questions seem connected to puzzles regarding what linguistic understanding amounts to, and I will attempt shortly a provisional answer in the

discussions on bottom-up and top-down activity. In the next section, I will give an example of how neural aggregates (the concept token seems appropriate here) may relate to categorisations.

3.4.2 Neural Aggregates and Categories—An Example

Obviously, systematically connecting particular (categorical) experiences such as 'car', 'cat', 'the oak tree in my garden' to particular neural tokens for concepts is not exclusive to linguification. That is, that the category is nominated linguistically is not decisive for neural aggregates to sustain particular categories (as also implied by the 'bicycle' quote from Barsalou 2009). For instance, from a neural perspective, Goldberg (2013) elaborates on the case of face recognition, an ability of fundamental value to most mammals and humans with respect to the emergence and sustenance of social networking. Apparently, the human face consists of universal features, e.g., the same basic configural appearance such as two eyes in the upper part, a nose in the middle, and a mouth below. However, individual faces are distinguished by relational information about these universal features. Goldberg argues that a particular neural correlate relates uniquely to a particular face. The important marker is named MAS (ibid., p. 576): "Of crucial importance for biomarker identification is the existence of a '*micro-anatomical structural level* (MAS)' in which every iris and face is morphologically unique". Following Damasio, Goldberg explains that face recognition abilities in the perceiver depend on two separate processes (p. 578):

> it is possible that when a viewer sees a familiar face the viewer has essentially immediate knowledge of the history of its previous encounters with the person behind the face being viewed. For this to occur the viewer must, "within approximately the same time window", not only perceive the unique MAS pattern of the face, but must also recall "information that pertains uniquely to that face".

Of importance to the present discussion is the association of the face 'token' to a unique memory about previous interactions. Goldberg explains (p. 579):

> The model holds that representations or percepts of the face-pattern in the primary visual sensory system are established in a perceiver through learning enabled by the face-pattern's being repeatedly presented which results in reinforcement of the strength of the synaptic connections that hold together the unique set of neurons that form the percepts or brain-objects. After familiarity has been established, when the perceiver sees a familiar face the representation or percept is activated, and then, within a period of approximately 200 ms, the appropriate memory store in the rostral temporal cortices is accessed.

Thus, face recognition is sustained by individual configurative subtleties of faces and the unique association to a memory trace of prior interactions (p. 577):

> A crucial factor in the use of face-patterns as unique identifiers is the structural stability of the MAS. It is obvious that if the face MAS patterns were structurally unstable then face recognition would not be a useful biomarker method of identification.

Of importance here is to recognise the similarity in mechanisms sustaining the neural codification in face recognition and linguification. Though MAS is actually superior as an individuating principle, i.e., only one 'face' is connected to a unique memory, the fact that the percept of a specific MAS by repetition may be associated to a particular store of memories bears resemblance to the phenomenon of associating a particular concept (in early language acquisition—within the word-object paradigm) to systematically elicited memories. In time, the concept automatically codes for a set of environmental facts in much the same way as a face (MAS) may code for a unique set of interactions. In case of linguification, the selected set of occurrences is elicited by mere repetition and the difference between each occurrence may be somewhat blurred. In the case of face recognition on the other hand, to Goldberg the selected set of memories appears individually distinct, an effect not unlikely to follow from an elevated emotional impact of faces as compared with concepts.[10]

As described here, linguification emerges either gradually and 'undramatically', without sensational feelings involved as a result of numerous naming events, or it emerges as an individual episode as in the case of imbibing a scalding hot drink that pertains to a single but emotionally strong experience. In both cases the neural associations are constructs based on 'individual' neural correlates that become associated in contingent 'reverberatory synfire chains'.

3.5 Bottom-Up and Top-Down

So far, on the grounds of the word-object paradigm, implicitly assumed in grounded cognition theories, we have discussed the linguification process as one linking concurrent neural activities while acquiring language. Thus, the presupposition is that language acquisition occurs predominantly as a result of stimuli impinging on the individual. However, the process of linguification may proceed *either* in a bottom-up or a top-down direction (in reality, it is seldom either or). As a first approximation, bottom-up activation happens automatically when external stimuli are responsible for driving and constraining the learning process, whereas top-down linguification is consciously controlled. Borghi and Cimatti (2012) make a similar observation referring to Gentner and Boroditsky (2001), who propose a distinction between 'cognitive' and 'linguistic' dominance that resembles the bottom-up and top-down control presented in this account. Cognitive dominance occurs in cases where concepts are informed by sensorimotor activities and only later language is

[10]However, it is not unlikely that several interactions with someone eventually leads to characterising that person based on pattern recognition and implicit theories about the personality instead of particular behaviours associated with each singular incidence. When interacting abundantly with an individual, it becomes increasingly difficult to separate singular episodes unless they are particularly memorable.

involved. Linguistic dominance occurs, when language defines which perceptions are relevant to the concept.

In continuation, Borghi and Cimatti refer to experiments that demonstrate a linguistic difference relating to cultural parameters between bottom-up and top-down processing (p. 27):

> Malt et al. showed participants novel kinds of containers and asked them to perform a naming and a sorting task. They found the sorting task was not heavily influenced by linguistic diversity. In the same vein, Malt et al. (2003) investigated the influence of perceptual and linguistic-cultural aspects on 60 categories of common containers in Chinese, Spanish, and English. They found a complex pattern, indicating that languages share linguistic categories when the stimulus space is rather structured, but where it is not then the different languages partition the stimulus space in different ways.

Borghi and Cimatti conclude that when non-linguistic tasks such as the sorting task involve concrete nouns, there is less effect of linguistic differences. In tasks involving abstract domains, the effect is comparatively larger. The reason is that with concrete concepts the world structure provides more constraints on how categories are assigned than with abstract concepts.

As implicated by Borghi and Cimatti, to some extent the concurrent exposure to both concrete objects and verbal identification works because of our innate sensitivity to environmental stimuli in a bottom-up fashion (see also Borghi and Binkofski 2014). It is the abundant sensitivity to concrete phenomena that picks out particular constraints of the bottom-up approach in a sense comparable to the MAS in face recognition.

The emotionally laden linguification process aside (we return to it in Chap. 4), the precondition for the disambiguation of word-object relationships is that it occurs over several learning events as a result of the filtering of what is constant and contingent to the particular learning event (see Byrne 2012 for an interesting and similar account of the bottom-up categorisation in gorilla language; Pulvermüller 2011). According to Pulvermüller (2005, p. 576):

> Taking into account well-known facts about the cortical basis of learning—namely that frequently co-activated neurons strengthen their mutual connections—it is likely that the cortical systems for language and action develop specific links between each other whenever actions correlate with specific language processes. From this we can predict that whenever language and action information processing correlate with each other in the different cortical areas, distributed functional systems are being established that allow for fast, interactive processing of multimodal information across cortical areas.

3.5.1 Zooming in on Selection

Apparently, bottom-up conceptual learning depends on and takes place in rich perceptual environments with countless, thus potential, stimulations. A word of caution may be in place here. Is it a satisfactory explanation of early language acquisition to emphasise that reality consists in embedded patterns revealed in

non-conscious cognitive processes? How then does the cognitive system select what part of the pattern to include in the assembly? How is the aggregate of multi-perceptual experiences determined? In situations in which "adults are naming objects while the child focuses on and attends to them", for instance using bananas, there is no apparent way in which the child understands that 'banana' refers to the whole fruit and not just the peel or the stalk. To learn about the world by so-called ostensive definition, poses the problem of how we find out the aspect of the world to which the naming refers.

Seemingly, from one incidence to the next our cognitive system filters between what is constant and contingent to the particular learning event and the concurrent multimodal stimulation forms functional units or cell assemblies. For such circuits to become stable, concurrent presentation of stimuli to activate functionally different neurons is obligatory and determines what stimuli become part of particular correlates.

After being firmly established, however, concurrent stimulation might be less important to the maintenance of the cell assembly, since triggering stimuli are very likely to start a cascade of neural activity that *simultaneously constitutes and confirms* the reverberating circuit (i.e., the re-enactment) (Hesslow 2002, 2012).

Hence after the firm establishing of contingencies of particular stimuli, the correlate itself, once established, is partly supportive of further activity. Along similar lines, Barsalou describes how strong neural connections give rise to perceptual predictions (2009, p. 1284):

> The perception of something familiar in the environment, body or introspection activates a simulation or situated conceptualisation that contains it. Components of the simulation or situated conceptualization not yet experienced constitute predictions about events likely to occur, actions likely to be effective and introspections likely to result.

One important implication of this is that stimulations which are slightly different from the stimulations that gave rise to the particular functional unit are neurally treated as if they were actually similar. To exemplify, bananas might differ in colour, smell, weight, and circumstances in which they appear, likewise the voice and accent by which the word 'banana' is presented to the child might be idiosyncratic to the person speaking. However, due to the constitutive function of the assembly, the visual and auditory 'irregularities' (as compared with the 'average' stimulation that participates in the foundation of the assembly in the first place) could be relatively easily levelled out.

To sum up, the capacity for associating neural *sub-activities* into larger ensembles normally depends on repetition of concurrent stimuli.[11] Following

[11]I use the term 'sub-activity' for the different 'classes' of neural underpinnings that are recruited and eventually united by the linguification system. In the following bicycle-example of Barsalou (2009) the visual processing of a bicycle involves, for example, neurons that fire for edges and surfaces, whereas other neurons fire for colour, configural properties and motion. Analytically, neurons with similar functional characteristics belong to a particular class or 'sub-activity', whereas all classes or sub-activities represent the bicycle in vision. Sub-activities may be conceived of as components in the concrete manifestation of simulations.

Barsalou (2009), continuous bottom-up activity corroborates the emergence of conceptual knowledge, as for instance 'bicycle' (2009, p. 1282):

> After experiencing a category's instances over time, a distributed multi-modal system develops to represent a category as a whole… consider a simulator that represents the concept of bicycle. Across encounters with different instances, visual information about how bicycles look becomes integrated in the simulator, along with auditory information about how they sound, somatosensory information about how they feel, motor sequences for interacting with them, affective responses to experiencing them and so forth. The result is a distributed system throughout the brain's feature and association areas that accumulates and integrates modal content processes for the category.[12]

Concrete phenomena or events pose more constraints on the character of the neural sub-activities, which result in relatively more coherent correlates. When associations have been established, different sub-activities may become elicited without the presence of the original stimulation 'setting fire' to the entire correlate. That situation is referred to as 'anticipatory'.

3.6 Implicit Processes in Linguification

Normally, bottom-up linguification depends on co-activation of a multiplicity of perceptual activations (sub-activations) that gradually become associated when conceptual knowledge forms. The complexity and identity of each and every 'unit' of the constellation is beyond comprehension by the individual. Actually, the individual is only partly aware of particular parts that make up an assembly. Thus, neural correlates consist of unconscious parts that are inaccessible to the individual as demonstrated in studies on priming and implicit learning (e.g., Jiang and Chun 2001) and (in a slightly different perspective) as briefly mentioned in connection to false memories in Chap. 2, that may exemplify how parts of the linguification process relate to consciousness.

For instance, studies on incidental haptic sensations that seemingly influence unrelated conscious assessments of social relations demonstrate such involuntary and tacit, stable connections between perceptions and conceptual processing. In a series of experiments by Ackerman et al. (2010), physical interactions involving palpation and touch influenced significantly decisions about people and events. Despite being entirely unrelated, experiences of heaviness (induced by the use of heavy clipboards compared with light) produced impressions of 'importance' and 'seriousness' in evaluations of job candidates. Similarly, touching rough or soft surfaces of the pieces in completing simple puzzles (with rough pieces covered in rough sandpaper) significantly influenced subsequent assessment of social coordination in other people. Participants primed with rough pieces were more inclined to

[12]Barsalou et al. (2003) distinguish between simulators and simulations as a relation between type and token.

promote compensatory behaviours. In this study, even passive experiences of touch, by seating experimental subjects in either hard wooden or soft cushioned chairs, influenced the assessments of employees in the observed conversation. In contrast to soft experiences, hardness primed participants to perceive others as less emotional, more stable, and with decreased negotiation flexibility (for elaboration on the complexities governing haptic influences, see also Fay and Maner 2014).

In another study by Glenberg and colleagues (2005), associations between muscular activity, emotional state, and reading time were explored. It was demonstrated that congruence between the emotional states of the reader and the emotional content of written sentences on a computer screen reduced reading time. The emotional states of the subjects were manipulated by holding a pen either between the teeth or the lips. Pen holding by lips produces facial grimaces such as frowning and unpleasantness, while pen-holding by teeth is associated with smiling and pleasantness. Subjects holding a pen either with their teeth or lips were urged to read sentences that expressed either a pleasant or an unpleasant sentence (For the original study see Strack et al. 1988). When smiling, pen between teeth, pleasant sentences were read significantly faster than unpleasant sentences (the study has apparent similarities to that of Glenberg and Kashack 2002). When subjects were holding the pen with their lips, however, unpleasant sentences were read significantly faster (see also Havas et al. 2007).

The obvious explanation for such results is that activated bodily states interact with cognition by tapping into the neural underpinnings that are recruited (sub-activities) while either consciously assessing social situations or reading. As explained by the word-object paradigm and the bottom-up linguification process, the corroborating neural correlate apparently sustains (and/or unites) both perceptual experiences (degree of softness) and conceptual processing. According to Ackerman et al. (2010):

> Given that established associative links between sensorimotor events and scaffolded concepts do not evaporate over time, touching objects may simultaneously cue the processing of physical sensation and touch-related conceptual processing. Accordingly, feeling the rough bark of an oak tree sensitizes us to rough textures and may also make accessible concepts relevant to metaphorical roughness.

Hence, the neurophysiological explanation is that of linguification as a result of contiguous presentations of physical actions, sensations, and the linguistic concept.

To the same effect, irrelevant perceptual influences on apparent rational thinking have even been demonstrated in studies on moral judgments. The feeling of disgust, which is a basic emotion apparently explainable in terms of adaptational benefits (Curtis et al. 2004) is provoked by a wide range of stimuli such as vomit, wounds, rotting meat, slime, and maggots, which all share the connotation of infectious diseases and is shared worldwide.

In studies where the feeling of disgust has been provoked by applying an appalling odour not noticeable to the participants, it proves transferable to areas of moral judgments (Schnall et al. 2008). More specifically, the research has been interpreted as demonstrating that moral judgments might depend on disgust in the sense of being a regular bottom-up gut feeling.

Another example of the association between perceptual and conceptual processes as in linguification is the tight connection between emotions and sensosomatic activations as described in a study by Li et al. (2010) in which the physical act of enclosing an emotionally laden stimulus (in this case into an envelope) reduced the associated perception of the negative emotion. In the first of three experiments subjects were asked to recall a recent decision they regretted, and a sub sample of subjects were asked to write the memorised event on a piece of paper and place it in an envelope which they sealed afterwards. In a second experiment, subjects were exposed to a tragic story and answered questions related to the story to measure their focus whilst reading. Again a sub group of participants enclosed the answers together with the story. In the third experiment, the researchers distinguished between self-rating on sadness in relation to the story in the first experiment and compared subjects who enclosed the negatively laden recall in an envelope with those who used paperclips to attach the two surveys. In all experimental settings the effect of enclosing the story associated with negative emotions alleviated the emotional experience of the association. The general conclusion is that systematic exposure to experimental stimuli will elicit relevant neuronal activity and ultimately associate the perception with concurrent activities.

3.6.1 What About Accessibility?

Doubtless, for the most part repetition of perceptual stimulations accompanying the early linguistic achievements in the linguification process occurs subliminally, whereas part of the perceptual stimulation, which we attend to and focus on, occurs supraliminally. In the examples on the influence of implicit processing on overtly separate tasks such as subliminally experienced odours on rational judgments, subjects were not aware of the influences of irrelevant perceptual stimuli. The co-activity of sub—and supraliminal processes has also been demonstrated in the processing of angry faces, which was accompanied by considerable amygdaloidal activity without perceptual awareness of the stimulus.

In a study by Morris et al. (1998), subjects trained in a conditioned response paradigm were shown pictures of two angry faces, one which was paired with an unconditioned stimulus (a 100-db burst of white noise) and one which was not. In the following PET study, when subjects were exposed to the conditioned angry face for 40 ms followed by a neutral mask, subjects were consciously unaware of the target stimulus as demonstrated by systematically controlled verbal reports in the debriefing. However, enhanced amygdala activity showed that the subliminal exposure to the fear-conditioned angry faces resulted in unconscious processing (see also Reddy et al. 2006).

Thus, from such studies, the relation between different neural sub-activations and to what extent they are simultaneously processed seems to happen outside the awareness of the subjects involved.

In some conditions, unattended stimuli may be processed (e.g., odour) irrespective of the processing demand of the secondary task (moral judgments).

For example Chun and Turk-Browne (2007) reported that in a study involving a highly demanding working-memory task and dependent on conscious processing of facial stimuli (we return to that ability in Chap. 6), there was no effect on the responsiveness of a particular neural area (parahippocampal place area (PPA)) to task-irrelevant background scenes. However, repetition of background scenes correlated with robust repetition attenuation. Therefore, the scenes were processed and at least briefly retained in perceptual memory (otherwise repetition attenuation would not have been observed). However, this repetition attenuation was eliminated when the perceptual difficulty of the working-memory task was increased. The conclusion is that the extent to which processing is automatic or conscious is variable and depends on the overlap between the processing demands of the secondary and primary task (the discussion is also related to the connection between perceptual awareness and consciousness, e.g., Cohen et al. 2012; Prinz 2007).

On the issue of what consciously enters into memory, Chun and Turk-Browne continue:

> Just because you have the resources does not mean that you can do everything at once. You still have to choose what to do. Likewise, the availability of attentional resources is not sufficient for memory encoding. For example, when faces and scenes are combined into fully overlapping composite stimuli […] subjects can only remember what they selectively attend to. Not even implicit measures of memory such as repetition attenuation are preserved for ignored stimuli […] even when repeated 15 times in a 30 s block […]. Thus, stimuli that are to be learned must be selected, whether the task is explicit or implicit […]. One interesting exception to this case is the demonstration of low-level perceptual learning from subthreshold stimuli […]. However, even such cases of visual perceptual learning without perception are not fully passive, but require reinforcement from an independent, concurrent task.

Thus, from this quote we may conclude that neural sensitivity to regularities in the environment is far from exhausting what may then pertain in neural aggregates. Moreover, what determines the relation between implicit and explicit processes and to what extent implicit processes are in fact implicit is unresolved. However, as discussed in relation to the abundant sensitivity that grounds linguification, learning appears to cover a much wider number of phenomena than selected attention allows for. Barsalou recognises this and argues that (2009, p. 1283):

> At any given moment in perception, people perceive the immediate space around them, including agents, objects and events present. Even when people focus attention on a particular entity or event in perception, they continue to perceive the background situation—the situation does not disappear. If perceptual experience takes the form of a situation, and if a conceptual representation simulates perceptual experience, then the form of a conceptual representation would take the form of a perceived situation.

Why is it important to disentangle the contribution of conscious and non-conscious processes when discussing linguification processes in relation to grounded cognition? A consequence of the mixing of subliminal and supraliminal processes may be that the re-enacted perceptual and sensomotoric activity that accompanies linguistic

tasks are not necessarily fully recognised by the subject. And if phenomenal experiences are indeed involved in the 'perceived situation' (which it is highly likely that they are), then the level at which they appear after linguification, that is to what extent phenomenal experiences are re-enacted, when using words, as well as the particular content may be difficult to articulate and control for the individual. If for instance 'bicycle' is associated to happiness, or fear, it may not be obvious to the subject uttering the term. The comprehensive network of sub-activities associated in the linguification process may represent disparate phenomenal experiences of similar dimensions. Sheckley and Bell (2006) show the comprehensiveness of any situation and putative segregating that may attract conscious processing by dissecting how COBS experiences are associated with drinking coffee, for instance, which involves multidimensionality of conscious states (p. 45):

> Though consciousness as a unitary phenomenon cannot be separated into constituent parts, for ease of explanation we discuss it here as if it had separate dimensions. One of them would be immediate COBS events—the smell of the coffee, its temperature, the taste of the beverage, and the setting (home or coffee shop)—and your state of mind (late for work, meeting a friend for a chat, or enjoying a vacation, and so on). Second would be the dimension of all past coffee-drinking events: the scalding experience you had with your first cup of coffee, the robust espresso served at the French Bistro, and. . . and. . . and. . . all coffee-drinking experiences stored in your memory. Third would be the dimension that includes all the COBS implicit within your coffee-drinking experiences: the nuances in smell and the subtleties of taste and the social rituals of drinking coffee and. . . and. . . and so on. Your consciousness also includes the amazing ability of the brain to "extend" consciousness into the future […]. In this dimension, consciousness involves imagined future scenarios such as possibly being alert at an upcoming meeting, and possibly feeling jittery two hours from now, and possibly experiencing a let-down when the caffeine wears off. Even though they are virtual, these imagined projections can be experienced "as if" they were actually occurring.

Apparently, in this understanding any conscious experience is layered and might even involve correlated processes outside the control of awareness.

At the level of the correlate and the involved sub-activities, what may we conclude with respect to the co-activity of conscious and implicit processing in the linguification process and their later accessibility? This is the topic of the next paragraph.

3.6.2 Entering the Correlate Using 'Back Doors'

When a child engages in the linguification process of 'apples', she or he might be fully aware of the apple taste, but not the colour or the smell and even less that apples might often be found in bowls and not refrigerators or on the floor. Nevertheless, at a subliminal level, if these features (colour, smell, storing locality) are characteristic of the perceived situation in which apples are met and therefore to some extent demarcates apples, they may become part of the neural correlate that sustains 'apple'. Consequently, when subjects name objects in conceptual tasks

(e.g., reading the concept and subsequently re-enacting sensomotoric areas), the experiences normally related to these neural activations, which may cover a number of phenomenal aspects, are not necessarily consciously accessible all at the same time.

Likewise, it seems highly unlikely that to recall objects or events in itself results in re-enacting subjective feelings accompanying the perceptual experiences that were fundamental to the original linguification process. It is long gone.

As we peripherally touched upon in relation to the face recognition mechanism, every phenomenal instantiation of a concept that contributed to a specific linguification process is unique. Being weak, any insignificant deviation from one instance to the next is likely to become 'overruled', so to speak. If transparent connections between perceptual experiences and the concept were neurally indexed in the sense that re-enactments involved the full packet, we might have difficulties using language in the symbol-like way we do (this was also the point pressed in relation to the face and sentence primes by Landau et al. 2010). The essence of language is to go from particularities to generalities (e.g., Ohlsson and Lehtinen 1997).

This clearly demonstrates a separation of that part of the neural correlate that concerns the symbolic knowledge, and the part of the correlate that concerns the experienced content of the concept (see Meyer and Damasio 2009 on the concept of convergence divergence zones which stresses that re-enactment is not revival of the originating activity).

On the other hand, the semi-stable aggregate that emerges from numerous occurrences of co-activity suggests that we might be able to trigger and often indeed activate the aggregate using different 'back-doors' in the sense that part of the aggregate, the sub-activities, might serve also as individual 'entries' to activate the entire correlate (in the sense of a dynamic entity that has no specific end form but gravitates around a subset of neural connections). For instance, the neural aggregate forming the concept 'apple' might be accessible through 'William Tell', 'law of gravitation', the word 'apple', 'Isaac Newton', the experience of apple flavour, taste, textures, and the like. As phrased by Pecher et al. (2011, p. 219):

> For example, a concert pianist may form different simulations of piano in various contexts. When thinking about an upcoming performance, the simulation might include the piano's sound, along with the fine hand movements involved in playing the instrument. When planning to move the piano into a new apartment, however, the simulation might include the shape, size, and the weight of the piano, along with the gross movements necessary for lifting and moving it. Furthermore, different instances of a category can be instantiated from one simulation to another.

In other words, the same concept may be subdivided into a number of connotations. Any specific interpretation (and actualised re-enactment) is dictated by the context. As a result, when concepts are in use some representations for interpretations are dormant (in the 'apple-example', potential 'backdoors' might be taste, the sound when crunched by teeth, apple leaves, New York etc.) while others are actualised.

Barsalou (2009) describes how categories are made up of simulations that may be active beyond conscious knowledge and may consist in different exemplars that are activated in different contexts. For example, the bicycle category contains different versions of bicycles like mountainbikes and racing bikes that are likely to become activated on different occasions.

What is entailed with respect to the ability to re-enact experiences, that ensembles cutting the world slightly different are tightly connected? By entering one back door, is it possible for us to trigger any of the other neural connections in the hub, so to speak, and thus consciously access experiences of which we were not immediately aware and which were maybe irrelevant to the situation? In other words, will processing the expression 'cinnamon', for instance caused by reading, implicitly activate those perceptual and phenomenal memories which have been associated through repetitive activity during linguification? And, more to the point, could this automatic chain reaction qua the simultaneity in the linguification process lead to *phenomenal* reviving of experiences that form part of the aggregate but not in the situation themselves activated by on-line stimuli? The implicit cognition studies on moral judgments and the perception of others as a result of haptic experiences seem to suggest exactly that.

The question is, then, could non-conscious phenomena neurally represented in an ensemble as sub-activities become explicit because of the re-enactment of the representation through the link it forms to other entries? To exemplify, could the conscious remembrance of the taste of cinnamon lead to the one-off conscious remembrance of the sight of Santa Claus during childhood through re-enactments of Christmas trees? One suggestion is that the neural connection formed between implicit and explicit parts of the correlate in case of excitation might lower the threshold for conscious activation so that the implicit processing may turn explicit. In practice, what seems to happen is that to consciously recall an object or event is to be able to gain access to the perceptual information associated with the entry e.g., 'handle' established through the linguification process. I suggest the notion 'linguistic handle' to refer to the symbol part (the 'concept' which may be uttered in sentences) of the linguification ensemble whereas I refer to non-verbal entry points as 'back-doors' (see also the next section in which linguistic handles define top-down). When the linguification is established, that is when a concept is acquired in the word-object paradigm, the linguistic handle is a very popular and efficient entry to activate the corroborating ensemble. The important point is that the handle may be used for activation by every competent language user.

It seems as if previous concurrent activities that entailed exposure to the environment, which involved perceptual experiences and phenomenal feelings, exist as a semi-stable hub because of several repetitions. In this condition the sub-activities that define the hub may be accessed by for instance controlled introspection.

Do we find evidence for the fact that activation of neural associations through linguistic handles lowers the threshold for conscious accessibility? We return to this question and attempt some answers in the next chapter.

3.7 Attention and Top-Down Processing

To sum up, the early linguification process taking place in the word-object scenario (as well as any linguification process later on) seems to involve both implicit and explicit processes. However, it is unclear to what extent awareness and attention are obligatory to the process. Are the explicit processes the result of, or the precondition for the linguification process? Does the child who acquires names for objects apprehend *because* of attentional processes, and are we able to specify the nature of the focus with this function? Must attention be directed at particular aspects, say the object as perceived, for the perception to be memorised in a form which is later accessible? In the case of the concert pianist who may form different simulations of piano in various contexts, both thinking about an upcoming performance that includes the piano's sound, along with the fine hand movements involved in playing the instrument and when planning to move the piano into a new apartment, that might include the shape, size, and the weight of the piano, could be argued to originally rely on the involvement of attention.

In addition, as briefly discussed, the application of attention may not guarantee the 'right' selection of stimuli in the sense of what counts as correct following conventions, which calls for a specification of the generality of the word-object paradigm and differentiation of selection processes at work.

For instance, it remains debatable to what extent linguistic naming of, for instance, colours is congruent with bottom-up perceptual experiences. To grasp the notion 'red', perceiving red flowers, red bicycles, or red pacifiers depends on the ability to acknowledge that obviously very different stimuli converge on sharing the red colour (Mirolli and Parisi 2011). Under such circumstances, the linguistic acquisition depends on the individual to intentionally exclude some perceptual impingements and actively include what is relevant. As discussed in relation to 'constraints' imposed by the world, when grasping the concept of 'teddy', a variety of senses may corroborate to extract the phenomenon.

In case of colour perception, to the contrary the visual perception of the phenomenon cannot systematically link to form, texture, or smell. Therefore, one might argue that the mental task of grasping instances of 'red' in objects is harder than to grasp instances of 'teddy'. Such mental demands may retard the successful grasping compared with basic concrete phenomena that operate on the senses in a more straightforward (and homogenous) way.

If so, acquisition of colour names seems comparably more dependent on convention and linguistic processes than perceptually driven bottom-up activities (as discussed in relation to containers in Sect. 3.5). Studies on colour perception and categorisation suggest that language in the sense of mono-lexemic terms indeed affects objective colour discrimination performance. For instance, according to Roberson and Hanley (2007), speakers of Himba, a Bantu language of Gabon, fail to show categorical perception at boundaries that they do not distinguish linguistically, such as that between green and blue. Similarly, Russian speakers show categorical perception between lighter blue colours ('goluboy') and darker blues

('siniy') that is unique to the Russian language and not found in, for example, English (Winawer et al. 2007). The semantic distinction significantly improves the performance in a non-linguistic colour discrimination task. Russian-speaking subjects were faster at discriminating colours that fell into different categories (one 'siniy' and the other 'goluboy') than when they belonged to the same category (both 'siniy' or both 'goluboy'). Apparently, discriminative improvements provided by linguistic categorisations were receptive to concurrent verbal but not spatial dual tasks suggesting that linguistic representations were involved online in the colour judgment.

Findings suggesting that new verbal discrimination of concrete phenomena influences perceptual processes are also reported by Kwok et al. (2011). In their study, subjects were taught to map new nonsense terms (meaningless Mandarin syllables: áng, sòng, duan, and ken) to newly created colour categories (two shades of blue and two shades of green). Training, which lasted two hours, simulated the 'fast-mapping' phenomenon in which children (and adults) learn new word-objects associations (according to the researcher all subtasks of the experiment in fact simulated language acquisition tasks in the naturally occurring word-object paradigm). The colours were visually but not lexically distinguishable. Subjects were exposed to three different tasks during training. In 'listening' they listened to the new name while watching the appropriate colour. In 'naming', they were required to name the presented colour while receiving feedback. The 'matching' task required subjects to decide if the sound they heard was actually the new name for the colour presented on the screen. After 1 h and 48 min spread over three days, grey matter difference in the area of V2/3 known to be involved in colour perception was significant.

Of specific interest to this account is the putative dependence on linguistic support to perceptually categorise new hues. Apparently, individuals exploit the linguistic handle of the developing assembly in the 'artificially' induced linguification process. In this experiment, it seems safe to claim that the two shades of blue and green are already there in the sense of being perceptually distinguishable and therefore already operating bottom-up. It is likely, however, that the association of the linguistic label facilitates the recognition of the shade, that is, top-down. In the beginning of the experiment, the shades may appear blurred to the subjects experiencing them. As the linguification process proceeds, an association between particular bottom-up processes (how the colours phenomenally appear) and linguistic processes is formed. Late in the experiment, exposure to the shades facilitates the naming, through the newly formed link. However, activating the link by the naming procedure top-down may facilitate the experience of the shades in return and thus improve the activity of the assembly and therefore also the phenomenal experience of the colour in question.

In the words of Barsalou (2009, p. 1286):

> When a perceptual stimulus activates a similar perceptual memory, the perceptual memory runs as a simulation of the stimulus and speeds it's processing by activating relevant processing areas with the simulation perhaps fusing with the stimulus information.

In that respect, language could be argued to help categorise top-down by facilitating the activity of the neural aggregate correlated with the experience and thereby lowering the threshold for conscious experience (for a study that seems to corroborate this interpretation, see Shepard and Cooper 1992). One might wonder whether the colour-example differs markedly from acquisition of the concept of 'teddy'. Initially, there might be a difference between acquisition of 'teddy' and 'red', as 'teddy' is easier to grasp perceptually through a number of senses than 'red'. Later, however, the facilitatory effect of language in the two cases seems to converge.

3.8 Summing up Linguification Processes, Back Doors, and Linguistic Handles

In this chapter we have addressed how the linguification process may enable the neural connection of a number of different sub-activities that now possess the potential to re-enact each other. Hence, it is likely that concepts in the sense of spoken words are capable of eliciting the activity in the entire (however dynamically changing) assembly and thereby lower the threshold for perceptual stimuli to elicit responses (as exemplified by the acquisition of new colour categories). If a perceived car has the potential to prompt the activity of the car simulator including multiple subsets, it is likely that the specific label 'car', which neurally is merely just another entry in the ensemble of neurons in the simulator in question, is similarly potent (Barsalou et al. 2003).

Thus, language may act as a handle to whatever sensation or perceived situation has been promoted during linguification. Here, emphasis has been on how language interacts with and modulates particular perceptual processes. However, keep in mind that language works as part of culture and may not be disentangled from culture as both work co-operatively and therefore affect perception co-operatively. Thus, the use of an abacus in Japan is associated with 'abacus-talk' and results in lasting neural effects studied anthropologically (e.g., Kitayama and Jiyoung 2010). The culture could also be more 'local' e.g., idiosyncratic in origin. Take the case of the mother who introduces the word 'spider' while sharing the experience of the eight-legged arthropod with her child. If she behaves with all signs of fear, i.e., her facial expressions advertise sheer disgust, then her offspring will certainly come to associate the concept 'spider' with the bottom-up experience of the organism 'spider' and the bottom-up experience of 'unpleasantness'. Future exposures to the concept of 'spider' will elicit the feeling of unpleasantness (e.g., Niedenthal 2007). The converse situation emerges in the case of ice cream (and to the beer-consuming population when referring to 'beer'). Though both ice cream and beer are unpleasant first hand experiences [ice cream is an unusually cold food item to digest and the taste of beer is an acquired taste (Dennett 1992)] the *social circumstances* counteract the horridness of the direct sensations. Thus, the 'original' attempt of

avoidance associated with the primary bottom-up experience is overturned by the pleasurable experience and expectations associated with the social context.

For linguistic handles to take full effect, the language user may need to be closer to a minimal linguistic competence than experiences allow for in the early language acquisition stage discussed here. In the word-object stage, the linguistic handle, as when the interlocutor utters 'teddy' or 'spider', may 'just' elicit the dominant emotion or immediate image directly associated with the concept. In the abstract stage, as we will turn to in the next chapter, when language learners are capable of representing absent phenomena, the linguistic handle may be far more useful, as we will see in Chaps. 4 and 5. In reading texts and constructing plots from narratives, it is the linguistic handle that opens into and re-enacts otherwise dormant sub-activities.

To sum up, embodied cognition presupposes the biological perspective on cognition which entails a pervasive sensitivity to environmental stimuli. The on-going dependence on exchanges with the environment grounds conceptual learning in neural assemblies that consist of multiple sub-activities.

Moreover, due to the perceptual dominance of concrete phenomena, early language acquisition is dominated by the word-object paradigm in which a concept is connected to a concrete phenomenon, i.e., entity, event, or emotion. The repeated co-activity of perceptual experiences and language processes is associated to form a new aggregate. The association of this neural correlate of the conceptual understanding is established in a so-called linguification process (first-order). Here, multiple sub-activities, most if not all elicited automatically and some beyond consciousness and thus bottom-up, are associated. These sub-activities are clustered in a somewhat dynamical new correlate that may be 'lit up' by a number of specific 'back door' entries, as when the smell of cinnamon activates the entire correlate that refers to 'cinnamon'. Surely, some of the former sub-activities may be consciously inaccessible both during acquisition and later re-enactment processes. Via the 'linguistic handle', which consists of the publicly accessible symbol or 'concept', for instance the concept uttered by someone or read by the individual, several of the sub-activities may be accessible even consciously in re-enaction. This feature may prove especially important to acquisition of abstract linguistic knowledge in derived embodiment processes.

In later acquisition states, as when acquiring names for colours, linguistic handles may work top-down to determine as well as define the relevance of particular perceptions in the developing correlate.

Chapter 4
Concrete and 'Abstract' Knowledge

So far, we have discussed how embodied cognition theories explain most linguistic conceptual knowledge as developing from—and to some extent consisting in—perceptual and motor activity ignited by stimulations of concrete objects, phenomena, and events (e.g. Pulvermüller 2013). Thus, the conceptual knowledge of 'banana' is, at least in part, neurally grounded in the same sensomotor areas as those active during the actual perception of a banana. As emphasised by the concept of linguification through the continuous synchronisation of different perceptual activities in multiple episodes, an assembly of neurons is formed whose activity correlates with the conceptual knowledge. Eventually, large parts of the entire assembly may be triggered by only a small fraction of the original stimulations. This means that experiences of taste, manipulation, smell, sight, sound, and words may act as individual triggers (the back doors introduced in the last chapter).[1] The latter includes activation related to word production such as auditory stimulation, facial muscle activation, and activation of supporting tissue of the oral cavity, neck, and vocal cord (e.g. Watkins et al. 2003; Sato et al. 2010, 2011). As discussed earlier, the power of stimuli that originally activated maybe one of the sub-activities in isolation to activate the entire aggregate has been illustrated by the studies related to implicit knowledge. Though language may be of extraordinary value as back door for dif-

[1]The relative stability of the neural constructs that result from repeated co-activation may be illustrated by the continuous firing of amputated limbs in amputees. Even after the external stimulation in the form of touch to the removed limb is rendered oblivious, Hurley and Noë (2003, p. 133) refer to the stability as 'cortical dominance':

> "Cortical dominance is illustrated by phantom limb cases in which there appears to be no change in the normal qualitative expression of activation of a given area of cortex, despite change in the source of input. Normally, tactile inputs from arm and face map onto adjacent cortical areas. After amputation of part of an arm, tactile inputs from the face appear to invade deafferented cortex whose normal qualitative expression is a feeling as of an arm being touched. When this area of cortex is activated from its new source, the face, it retains its normal qualitative expression, the touch-to-arm feeling".

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_4

ferent reasons (and in that case operates as a linguistic handle), the ability to 'open the door' to parts of the entire aggregate is not exclusive of language.

Likewise, despite the fact that language is of prime consideration to the present discussion, surely an important conceptualisation of the world occurs without any involvement of language as a result of mere exposure to environmental stimuli. As described by Barsalou (2009), the conceptualisation of the world depends on what we attend to. We are likely to conceptualise *bicycle* if we attend repeatedly to that kind of object in experience. Similarly, if we repeatedly attend to an activity *pedaling* or an introspective sentiment of well-being *happiness* conceptualisations will develop.

From this suggestion, and as already briefly discussed in the previous chapter, it follows that at least some instances of categorisation seem to be intimately related to attention and awareness despite the lack of linguistic references. Along similar lines, language also belongs to this 'environmental pattern'. Obviously, particular words may certainly co-occur with non-verbal stimuli which could be interpreted as a sense of 'form' and not as in the sense of semantic meaning. Normally, however, emphasis is on the symbolic property of words and it seems therefore often feasible to maintain a distinction between verbal and non-verbal stimuli.

When we are aware of particular experiences (whether those occurring externally like thunder or smoke, or internally like stomach pain or muscle fatigue), the neural activity that corroborates these experiences is significant and re-enactments appear experientially distinct. Obviously in this sense infants are already agile categorisers in the pre-linguistic phase. It is highly likely that children might in fact establish numerous concepts based on non-verbal experiences in the pre-linguistic phase. The ability is also fundamental to non-humans (e.g. Dehaene et al. 1998; Nieder et al. 2002) and maybe even robots (De La Cruz et al. 2014). However, in all these cases it remains unclear to what extent awareness is part of the categorisation (see however, Dukas 2009).

What examples are there that support this claim? Gibbs (2005) points to the bodily accommodation (and the concept of body schemas, see Holmes and Spence 2004; Maralusa and Macavita 2010) as a way in which to categorise the result of exposure to stimuli (and without linguistic concepts) (p. 69):

> 'image schemas' emerge throughout sensorimotor activity as we manipulate objects, orient ourselves spatially and temporally, and direct our perceptual focus for various purposes.

As expected, similar to the description pertaining to linguification processes, the particular neural underpinning of the physical activity categorised in 'image-schemas' is established through repeated exposures. Gibbs continues:

> image schemas are imaginative, nonpropositional structures that organize experience at the level of bodily perception and movement […]. Balancing is such a pervasive part of our bodily experience that we are seldom aware of its presence in everyday life. We come to know the meaning of balance through the closely related experiences of bodily equilibrium or loss of equilibrium. Each of us has experienced occasions when we have trouble standing, have too much acid in our stomachs, when our hands get cold, our heads feel too hot, our bladders feel distended, our sinuses become swollen, and our mouths feel dry. In these and numerous other ways we learn the meanings of lack of balance and equilibrium.

Here, the exposure-elicited activity exemplifies the bottom-up processes we discussed in Chap. 3 (e.g. Jin et al. 2015, Sakreida et al. 2016). However, these may to some extent still work *because* of the involvement of attentive processes. An example of how the environment constraints and forms our categorisations non-verbally and probably without us consciously recognising the connection, is the emergence of an association between caregivers and warmth which infants seem to automatically acquire. According to Fay and Maner (2012, p. 1369):

> From the first moments of life, infants experience physical warmth emanating from the body of their mother. Bowlby (1969) suggested that infants require physical contact with caregivers, which, among other things, involves the experience of bodily warmth. Indeed, an important element of the experience of physical warmth is that warmth is spatially limited. For example human bodies are warm, but one must be close to a body to feel its warmth. That is, warmth implies spatial proximity to the heat source. As such, people may employ perceptions of warmth as a means of interpreting abstract concepts like social closeness or intimacy.

Apparently, the simultaneous bottom-up exposure to warmth and closeness to other people may later become linguistically codified, as expressed in the metaphor a 'warm friendship' to an extent in which incidental (on-line) physical experiences of ambient temperature influence judgments about the personality of fictive individuals (Williams and Bargh 2008). However, as in most cases concerned with bottom-up activity, top-down conscious processing may be involved too, especially in cases where warmth is absent and appears as a lack of warmth to the freezing mind.

The existence of an association of warmth to social closeness is also supported by studies on the rejection by others, an 'advanced' psychological experience, which seemingly induces an actual feeling of coldness (Zhong and Leonardelli 2008). Furthermore, studies on how subjects who suffer from chronic loneliness tend to self-regulate feelings of social warmth through applications of physical warmth apparently without explicit awareness of doing so, corroborate the findings (Bargh and Zalev 2011).

In neural terms, and of interest here, activation of the ensemble that encodes warmth and closeness to other people may have partially overlapped across instances in early childhood, irrespective of the intention of the individual to perceive (Watanabe et al. 2001). However, the existence of some sort of awareness cannot be excluded.

4.1 World Constraints on Concrete Knowledge

As discussed in Chap. 3 in relation to the linguification process and argued here with respect to general categorisations without language, the environment stimulates in a constrained and thus systematic and automatic bottom-up manner. In neural terms, is it possible to explicate the effect in detail? First, the similarity of concrete phenomena across instances contributes to *stabilise* the resulting neural construct, which is reflected in more stable internal connections between the

individual sub-activities as compared with the connections the individual sub-activities form with other more contingent correlates. In the warmth-social closeness association, it is the constancy of the temperature of caregivers as compared with the colder environment and the spontaneous sensing of warmth in babies that grounds the association.

How are we to conceive of the worlds' constraints, when discussing bottom-up selection processes? Consider the eating of, say, a piece of chocolate. The chewing will ignite particular sensomotoric mechanisms which are specific to chocolate eating experiences in general. The similarity of stimulation associated with the chewing over time and the systematic matching of continued activity of one modality with coherent activity of other modalities gives the impression of a concrete object. This is not to say that the chewing behaviour does not change from the first to the last moment of chewing, but rather that the particular pattern associated with the first and last chewing of a piece of chocolate is characteristic of chocolate *because* of the particular composition of chocolate and inevitable decomposing of chocolate as it melts. The uniformity of the continued stimulation makes concrete phenomena stand out in comparison with more unstable phenomena. For instance, the particular activity of taste buds associated with the perception of chocolate is very unlikely to suddenly change towards the activity characteristic of the taste of strawberries (or cheese). Likewise, the disintegration of chocolate during the act of eating does not all of a sudden stop and reverse, first melt then solidify. Of course, to conceive of specific experiences (percepts) in isolation from thinking and acting is impossible, in view of the influence of previous experiences on any percept by for example implicit learning. So the idea of us getting to naked 'raw feels' is an abstraction. Despite being only analytically possible, the point is to explore what makes us believe that something is concrete i.e. solid, irrespective of the impact of former experiences as this is reflected in the character of the neural correlate.

Cleeremans (2008) proposes that some neural representations—'explicit representations'—possess the feature of 'directly representing the relevant information' (p. 22), which means that no further computation is required to gain access to the information. Cleeremans suggests that such representations might emerge from a neural assembly that fire whenever a specific condition holds. It could be when particular stimuli are present in the environment, when the body is in a particular state when for instance being in pain or hungry. To Cleeremans, such "explicit" representations are not necessarily conscious (ibid., p. 22): "Instead, they are merely good candidates to enter conscious awareness in virtue of features such as their stability, strength, or distinctiveness".[2]

[2]According to Cleeremans, for such 'direct' representations to be conscious they must be themselves the target of other representations (ibid. p. 22):

"such representations are 'first-order' representations to the extent that they are representations in the system rather than representations for the system that is, such representations are not accessible to the network as representations".

Apparently, studies in developmental psychology point to candidates for explicit representations, characterised by stability, strength, or distinctiveness. These may play a distinctive role in consciously furnishing our world and perhaps even ground early language acquisition.

At birth we assign solidity to concrete objects on the basis of their ability to simultaneously impinge on our perceptual system in a characteristic multimodal way. In the very first attempts to make sense of external stimuli, children seem to be guided by intersensory redundancy (also known as amodal information, that is information which is not specific to one modality) when learning about the furniture of the world (Bahrick et al. 2004). This applies to hand clapping in which rate and rhythm is conveyed both visually and acoustically.[3] However, after the emergence of learning-induced stable connections, unimodal input is sufficient for recognition of the phenomenon (e.g. Bahrick and Lickliter 2012). The stirring of one modality, say, when hearing a ball jumping behind a curtain, ignites the rest of the neural underpinning of 'ball' by prediction or simulation (e.g. Hesslow 2012) elicited by perceptions of concrete objects in previous experiences.

The intersensory studies suggest that our perceptual system is predominantly adapted to 'catch' or 'construe' constraints in the world that may elicit particularly strong representations which on the other hand may representationally appear with characteristic stability, strength, and/or distinctiveness. Imagine as a newborn that your perceptive abilities and senses have not as yet been overly 'polluted' and formed into 'habits'. The structured surroundings and the multimodal immediate responsiveness syndicate to sort multidimensional perceptions into a pattern as exemplified by, for instance, ambient temperature which predicts social closeness. So, from very early on the dynamics of the neural correlate are sensitive to simultaneous activations along different modalities, to turn originally uninformative, unimodal stimulation into a sign for a larger pattern.

It is worth pausing a bit on the note of children's learning through constraints in the world. We are in a very real sense born helpless.[4] From the very beginning we must learn the most elementary parts of life such as 'what is danger?', 'what is food?', 'where is home?' and 'who is my friend?' We may have preformed categories relating to danger or food such as feeling pain and hunger, but we need to experience particular instances, As a result newborns depend heavily on social bonds and empathy from relatives to ameliorate our life conditions while teaching us how to gradually sustain out own lives.

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[3]Time windows exist in Hebbian learning, the neural mechanism behind concurrent stimulation of more neurons leading to sustained neural activity, which means that only if neurons are co-activated within a certain time span will their individual contributions significantly add up and multiply the original signal (see Keysers and Gazzola 2014 for an updated introduction to the neurophysiological basis of Hebbian learning). Crudely put, if stimulations from sight, for instance movement, resonates with stimulations from sound, i.e. tapping, and both neural paths feed into a common field, mutually they will have greater impact than either one alone. Though time limits exist, the redundancy strategy enhances and thus stabilises the pattern.

[4]The following paragraphs were originally published in Schilhab (2011).

All of us meet the world in such an imperfect or immature condition. And the amount of learning we have to greet welcome is astronomic. Try to remember at what age you actually learnt to run, stand on one leg with your eyes closed, balance a cup full of milk, draw a circle, jump landing on both feet from high up, or swallow a pill rather than having to get a ground-up version on a spoon with sugar?

To put it bluntly, these basic emotions seem to be the driving force of the increasing understanding of the world. In early infancy, parents will monitor a child's internal struggles and satisfy its needs. When hungry, the child will be fed, and the association between the sensation of hunger and its highly concrete remedy, food, to dull the sense, furnishes the child's immediate world. Crudely put, how much time can one spent on non-physiological activities if hungry? Or if tired? Therefore, the child is first and foremost directed at concrete items motivated (in a non-specific sense of motivation) by physiological cravings in order to survive. Immediate survival is linked to basic life conditions such as food, shelter, and ambient temperature, which have a concrete manifestation accessible by all of our senses. As a result, the introduction to and reception of the surroundings in infancy is exclusively directed at the concrete, because it is only concrete entities which manifest themselves by addressing our senses in concert that will fulfil our needs.

Thus the world's constraints, especially in the 'actual furnishing of the world', could be interpreted as the result of the interplay between the sensitivity of our senses developed phylogenetically and 'attractors' in the world's landscape, which stand for increased density of information. The exploited mechanism situates *Homo sapiens* in reality and transforms us into *Homo concretus*.

The fact that constraints in the world exist to which adaptation of our senses pertain is revealed by studies based on the tactile-vision substitution system (TVSS) in which blind subjects receive stimulations on their tongue, back, or thigh from a camera mounted on their shoulder, which transmits the visual input to vibrators (Sampaio et al. 2001). In the beginning, subjects have to adapt to the stimulation but very soon after they start to report image-like experiences which are 'non-tactile' and 'quasi-visual' (Hurley and Noë 2003). Intriguingly, if the subject is passively receiving whatever visual stimulations the camera mediates, the felt sensation is more on the tactile side, whereas the more active control the subject takes over the camera, the more 'visual' the experience.

Apparently, the way visual stimulation is acquired and the arrangement of the world perceived visually seem significantly different compared with other modalities. Accordingly, subjects list effects of the experiences typical of visual sensations such as perspective, parallax, zooming, depth effects and the illusion of the waterfall (i.e., 2003). In sight, objects are located in space which means that units being in front, closer to the observer, will normally occlude the sight of units behind. Further, visual information is obtainable only from the side of the item which is visually accessible. To get more information about its dimensions one has to move.

To sum up, it is the exposure to a heterogeneous assembly of concrete stimuli that results in 'image schemas', the category of bananas and the association of heat to social closeness. However, as briefly discussed in Chap. 3 and as we will

develop further in this chapter, when language (as 'pointer' to specific sections of the set of environmental stimuli) participates in the on-line categorisation through linguification processes, it may eventually enhance and thus facilitate or 'define' certain parts of what is perceived. Apparently, when linguistic concepts are neurally included, they assist in a similar switch from multimodal to unimodal activity as observed in early development. Thus, just as hearing the ball triggers the multimodal simulation of ball, the expression 'ball' may trigger the simulation. The elicitation of activation by environmental stimuli that happens bottom-up turn into neural representations which may simulate the original activation even if activated by only a fragment of the set of stimuli. Such a fragment may take the form of a spoken (or written) word (as 'linguistic handle'). As briefly touched upon in the last part of Chap. 3, I will argue in the following that when words activate the process of simulation, the process is very likely to proceed top-down. During ontogenetic development a significant restructuring of the relation between bottom-up and top-down processes occurs.

So far, it is worth setting straight two considerations. First, the early 'furnishing of the world' is not accidentally accomplished. In the perspective of neural representations, the 'sorting principle' that seems to be at stake and which emphasises multimodal representations also accentuates the concrete at the expense of the abstract. It is from this mechanism that *Homo concretus* emerges.

Second, the sorting principle is efficient immediately, which means that linguistic acquisition emerges noticeably later and more importantly only after the first crude segregation and categorisation of the world has happened even if infants are always linguistically immersed. Hence, as we will see, language may add some very delicate 'icing on the cake' in the sense of abstract learning, and the refinement is a mere addition to the concrete framework which predominates most human interactions (we return to this issue in Chap. 6).

4.2 The Switch from Bottom-Up to Top-Down

As argued in the previous paragraph, in the early language stages major parts of language acquisition may be carried predominantly automatically and in a bottom-up direction since substantial parts of the individual linguification process is determined by external stimuli.[5] The 'real' teddy and the 'real' cup are actually present and perceptually acquired.

However, with language acquisition we gradually manage to address phenomena which are omitted from our perceptual vicinity (see Fig. 4.1). Children turn from referring to this particular teddy in sight, to the perceptually absent teddy belonging

[5]It is likely that the maturation (and control) of awareness during ontogenetic development is a co-determining factor (e.g. Kuhn 2000). Attentive processes in infants may be concerned more with external stimuli (exogenous attention see also later in this chapter).

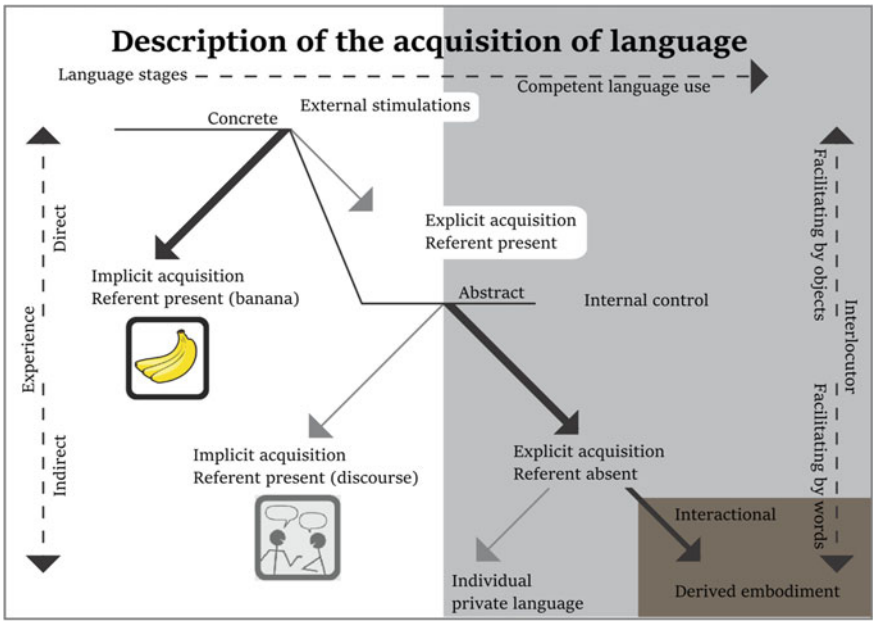

Fig. 4.1 Schematic representation of some of the crucial parameters discussed. Language acquisition proceeds from the concrete to the abstract, and may occur either *bottom-up* or *top-down*. The conditions and situations not discussed in detail are toned grey. Graphics by Niels Hansen

to a sibling or friend or the long gone teddy of a parent. Similarly, historical events, geographical, biological or anthropological descriptions of distant places and cultures, personal stories by friends or literary fictions or scientific expositions are likely to drag on knowledge of which the learner has had no direct experience. Language acquisition, in the absence of systematic perceptions to corroborate understanding, therefore depends on structures of a different kind. Here, linguistic acquisition occurs as a result of top-down processes that balance on the focal attention of the individual. However, focal attention will only bring the individual so far. When external stimuli are of limited importance (teddy is not visually accessible, and neither his 'sleeping bag' nor scarf), I argue that language acquisition increasingly depends on a *significant other* to continuously 'nurse' and help cultivate cognitive processes to compensate for the lack of facilitative bottom-up processes present in the on-line condition. The significant other, be it a competent language user (such as a friend, neighbour, author (in case of written material) or in the advanced stage of language acquisition the contributory expert), provides material for the learner's attention to work on. He or she may be more or less aware of his or her inherently powerful influence as provider of knowledge. It may be of importance to note that is not my contention that the learning of abstract linguistic knowledge is fully explained by the ability of 'directed attention' and the presence

of a 'significant other'. But the top-down control mediated by the interlocutor seems to be extremely important for understanding how our abstract understanding may be rooted in our social interactions.

We seldom notice that other people direct our attention to particular aspects of our minds especially through their choice of words.

In Chap. 3 and in the introduction to this chapter, we discussed the power of bottom-up categorisation in the pre-linguistic phase and as part of the linguification process in the word-object paradigm and the resulting capacity for simulation. In what follows, we will focus on the characteristic changes in the social and cognitive processes of language acquisition which encourage learners to switch from acquiring concrete to non-crete knowledge. The aim is to explicate the mental and neural changes that sustain the switch from concrete to abstract knowledge acquisition. As we progress, it will hopefully become clear both that the mechanisms involved may explain the realisation of interactional expertise-like knowledge and that these mechanisms explain the extent of the impact of certain social activities on the individual mind.[6] What I show is that when the individual mind has less opportunities to anchor its understanding in the concrete, for good or for worse it becomes highly susceptible to the impact of other people's choices.

Therefore three parameters seem especially important:

(I) The state of the referent as present or absent to the subject since the perceptual and experiential qualities and subsequently knowledge seem to vary accordingly.
(II) The ability of the individual to maintain internal representations in an off-line environment.
(III) The mediating role of the interlocutor.

We begin by addressing specific characteristics of on-line and off-line representations with respect to concrete and non-crete phenomena (parameter I) since this clarification is highly productive for the characterisations of the remaining parameters.

4.3 The Concrete and the Abstract

Early linguification processes are mainly directed at 'on-line' phenomena or events that easily trigger concurrent perceptual processes to contribute to the neural underpinning of that particular knowledge construct. However, beyond the one word stage in the on-line situation, an integral part of acquiring language is to be

[6]As discussed in the previous paragraph, this switch has clear phylogenetic and developmental components. However, my focus is in principle on what characterises the neural underpinning of knowledge of concrete and non-crete phenomena, and what mechanisms may endorse the switch. Thus, developmental considerations related to age of acquisition, individual differences, and so forth are beyond the scope of this account.

able to speak meaningfully about one word phenomena and events also in their absence.

Developmentally, to switch from speaking about what is perceptually present to what is absent involves a qualitative shift in the mental mechanisms involved and the accompanying neural underpinnings. Why is that? When children shift from attending to external stimulations (the banana at the table) to internal representations (the banana eaten yesterday), prompted by the words uttered by the conversational partner, they abandon the dependence on perceptual corroboration of on-line concrete stimuli (Wilson 2002). Thus, of utmost interest here is how these representations differ and what cognitive manipulations they imply.

In the off-line condition, language learners rely on internal sources to process language. Hence, learners seem to rely on the maintenance of their internal representation (involving the memory of among other things that particular banana referred to as well as of the concepts of 'banana', of 'yesterday', and of 'eating'). Just to reiterate, from the grounded cognition studies and their interpretations endorsed here one may infer that the banana on the table exists both as a collection of immediate perceptual qualities that appear in direct experiences and as a representation accumulated and stabilised from several previous experiences and naming events. To the child (both at a pre-linguistic age and after the achievement of concrete concepts) who currently observes the banana, part of the neural representation of the banana arises from the actual banana perceptually present and part of the representation arises from previous experiences with bananas. The mere thought of the banana as a concept is likely to elicit the representation established in the linguification process.

For the switch to occur, say to process information about bananas without immediate perceptual support, two conditions must apparently be met. First, the switch may only be realised when direct experiences are in place, resulting in the linguistic manipulation changing from processing *with* external support to processing *without* external support. This does no entail that previous encounters with a referent always precondition linguistic references to absent phenomena. That would render understanding of linguistic references to phenomena one has never encountered impossible in the sense that language could be 'empty'. Clearly, we may come to understand by extrapolation or abductive reasoning. That kind of understanding has a different perceptual corroboration. My point is, though, that during the early learning phases, infants predominantly experience the presence and absence of phenomena with which they have had direct experience. Thus, in early linguistic acquisition in which infants are familiarised with language as a communicative tool, the dialectical presence/absence modus is especially influential. My claim is that the first ontogenetic encounter with abstract understanding depends on a particular historicity of the mind that entails direct contact with an item which, due to this contact, can be easily simulated when absent. So, I don't attempt to rule out the possibility that humans in principle could acquire conceptual knowledge without bodily knowledge. However, the point is that our environmental

sensitivity is constitutive of the cognitive system to an extent that makes it almost a 'natural law' for humans to learn by direct experience. Due to this natural law, we cannot be certain whether sensitivity causes conceptual understanding since we have no parallel world in which to test the inevitability of the contingency.

As described by Pecher et al. (2011, p. 220):

> When a person thinks about an object such as a banana, the neural patterns in sensory-motor brain areas that have formed during earlier experiences with bananas are reactivated. This reinstatement of neural activation results in a sensory-motor simulation. The visual system simulates seeing a banana, the motor system simulates the acts of grasping, peeling, and eating a banana, and the olfactory and gustatory system simulate the smell and the taste of the banana. In other words, when thinking about a banana, the brain acts partially as if the person is actually perceiving and interacting with the banana.

Of importance here is that when bananas are absent, language users maintain and access the internal representation of 'banana' that becomes active as part of addressing the object (by name) in conversation (as well as in thinking) without immediate relevant perceptual support. It is the linguification mechanism in rewind (or anticipation), as already discussed in Chap. 3, which sustains the as-if experience of bananas even when such entities are only reminiscent in memory.

Simultaneously, attention also changes radically. Without external support, the language learner must direct his or her attention exclusively to the internal representation in order to maintain the representation. In this account, I name this particular representation t-representations (top-down controlled) in order to distinguish them from the b-representation (bottom-up controlled).[7]

4.3.1 Four Neural Modes of Existence

Understanding conceptualisation in terms of the neural underpinning that either involves or is disengaged from immediate relevant perception allows us to distinguish four conditions in language acquisition. These conditions grasp to what extent the learning may be considered to work bottom-up in the world to word direction. Apparently, the neural correlate systematically differs both as a result of whether the referent *exists* and whether the referent of the concept is or has been actually *present*. Thus, the neural correlate is to a significant extent influenced by the

[7]Since the b-representation feeds into the t-representation [for instance, when odours in the environment grow strong to an extent where it is consciously recognised (Schnall et al. 2008)] there seems to be an overlap between b-representations and t-representations. As discussed in Chap. 3, the overlap is incomplete, however, and during development children also learn to 'reality monitor' (e.g. Marham et al. 1999), to detect differences between imagination and direct experiences. To clarify the effect of historicity and to analytically separate new from familiar activation, it may be necessary to apply a related distinction between b-re-enactment and t-re-enactment to distinguish between the acquisition phase (representation) and the employment of the representation (re-enactment) when it has been firmly established.

ontological status (exists in this world or not)[8] of the referent (mode of existence[9]) as well as its developmental (mode of historical presence[10]) and spatial nearness (mode of actual presence[11]) when being linguistically addressed. Note that this distinction adopts a realistic stance in the sense that it stresses the ease by which neural activity is elicited in so far as the concrete and non-crete are as viewed through the prism of sensitivity to stimulation. The realistic perspective seems appropriate when the objective is to distinguish between knowledge of directly and indirectly experienced phenomena within the neurobiological framework. However, other approaches might downplay the impact of reality and knowledge as representation. For instance, the WAT approach (the Words as tools hypothesis mentioned in Chap. 1) emphasises the action part played by words. In this sense, words are tools we use. Just as words for real concrete objects are helpful markers for actions, words can be similarly used as tools in social contexts, though actions performed by words are more relevant for abstract words. 'Physician' is more abstract because of the difficulty we experience in nailing down what perceptual criteria must be met for an object to count as 'physician' (Borghi et al. 2011). Thus, words such as 'physician' that refer to social roles might be more abstract than words referring to single objects (e.g. 'bottle') but less abstract than purely definitional words (e.g. 'odd number'). What differs is the context in which children acquire language.

The 'representational' point of view that I endorse here does not contradict the WAT hypothesis in any major way, since the contention of words as tools may still be construed along ideas of sensitivity and linguification processes. What may differ between the WAT-proposal and the view presented here, is what is considered as the prime mover behind the acquisition of knowledge, the tacit bottom-up processes or the social/internally controlled top-down and the mediating role of the interlocutor.

During language acquisition, the neural correlate of a particular phenomenon, event, act, etc. can be viewed as a product of the mode of existence, mode of historical presence, and mode of spatial presence.

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[8]In this context, I am not concerned with distinctions that assess the property of phenomena to abide by the natural laws. Thus, in dissociating concrete from abstract knowledge from the rather narrow perspective of interactional expertise-like knowledge, I acknowledge the non-existing category (mode of existence) just for the sake of argument. After all, interactional expertise-like knowledge concerns real phenomena and events abiding by natural laws. In other words, phenomena and events which somebody has actually experienced.

[9]Refers to the sense in which the referent relates to our senses phylogenetically. This condition presupposes the development of appropriate sense organs. Humans cannot sense in the spectrum of the ultra-red or perceive by echolocation. Thus, when we address ideas about 'ultra-red' perceptual corroboration is not uniformly linked to the actual phenomenon. Therefore the perceptual corroboration is idiosyncratic to the individual.

[10]Refers to the sense in which the referent relates to our senses ontogenetically, thus the historicity of individual encounters. This condition presupposes the modus of existence.

[11]Refers to the sense in which the referent is momentarily present or absent.

As such, it could be claimed about the referent that it:

(1) Exists/is present. Thus, it exists and is present to inform you sensomotorically through direct experience (for instance the banana in front of you)[12];
(2) Exists/has been experienced/is absent. You have experienced it because it was previously present and accessible to your senses. A memory (i.e. representation) has been formed which can be used during simulation (the sweets eaten on Christmas Eve)[13];
(3) Exists/has not been experienced by you. The referent may be inaccessible due to it being an 'exotica' (distant or unreachable as for example places you never visited; belongs to a community you are not a member of, or relates to historic events you never witnessed)[14];
(4) Non-exists (the green blue) and therefore non-existent.[15]

The third category refers to linguistic acquisition of abstract (non-crete) phenomena as opposed to the concrete phenomena of categories 1 and 2.[16] In case of conceptual knowledge of truly abstract phenomena (category 4) with no concrete realisation such as 'round squares' or 'multi-dimensional greenness', embodiment seems of minor help. In such cases, the 'realisation' is closely tied to the mental representation and here the neural corroboration may involve activation of perceptual areas in a significantly different way.

Obviously, abstractness in that sense is then related to absence, never experienced by anyone. Abstract phenomena in that sense will have to borrow physicality even if just in the mind, through objects and events comprehensible to the senses.[17]

In this context, the kind of knowledge acquisition of interest is perceptual. Hence, to categorise at the neural level aids to distinguish between different

[12]Exists phylogenetically and is both ontogenetically and spatially present in terms of the notation of modus of existence, modus of historical presence, and modus of spatial presence (+, +, +).

[13]Exists phylogenetically and is ontogenetically present, but spatially absent. Condition 1 and 2 denote on-line and off-line cognition respectively (+, +, −).

[14]Exists phylogenetically but is both ontogenetically and spatially absent (+, −, −).

[15]Does not phylogenetically exist and is both ontogenetically and spatially absent. This category is concerned with phenomena, we have no perceptual qualifications for (−, −, −). Please note that the condition denoted by (+, −, +) is absurd, since no referent is both ontogenetically absent and spatially present.

[16]In Schilhab (2007b), in addition to the categories presented here, I included a category to which fabulous monsters such as unicorns and dragons belong. Such objects seem to be caught between two of the categories presented here. They come into existence in fairy tales, wallpaper, and children's toys. In that form they materialise to a kind of 'as if' existence that physically instantiates the concept and materialises to a form accessible to the senses. I return to this in Chap. 8.

[17]As discussed above in relation to 'as-if extensions', the ability to assign, to the unrealistic conceptual material, some kind of substance as in the case of painted chimeras found in prehistoric caves that borrows reality by partial resemblance to real things, is to transform the unreal that would be completely inaccessible to the senses because of its non-existence to something real and perceivable. This process may have certain similarities to hypostasis and reification, see also Chap. 8.

perceptual instances. Thus, by using the neural taxonomy adopted here, we obtain a detailed overview that allows for new categorisations when associated with the 'internal control' of the individual (parameter 2) and the linguistic mediator (parameter 3), both of which will be briefly introduced at the end of this chapter.

In what follows, I will discuss the neural characterisations of categories 1 and 2 (on-line and off-line representations). If off-line representations simulate on-line representations, what happens to the quality of the experiences? Thus, emphasis is on to what extent the phenomenal quality characteristic of on-line experience *is accessible* in representations of absent phenomena in the off-line condition, a question I approached but never closed in Chap. 3. The question becomes then, when and how are perceptions simulated. Given that the linguistic handle may access fragments or even entire simulations, what controls whether the phenomenal feel is re-experienced? Answers to this question are of utmost importance to the idea of derived embodiment. To illuminate the issue, I will therefore have to return to the difference between automatic (bottom-up) and voluntary (top-down) representations as well as the relation between non-conscious and conscious processes as discussed in Chap. 3. In Chap. 5, the neural features of category 3 are more thoroughly discussed, while category 4 is peripheral to the present discussion and therefore only briefly addressed in Chap. 6.

4.3.2 Differences in on-Line and off-Line Representations?

To recapitulate, significant parts of the perceptions caused by concrete objects (in categories 1 and 2) emerge as bottom-up activities due to the sensitivity of our perceptual system to particular occurrences in the environment. It is worth noting, however, that none of the categories are found in their pure form in real experiences. Expectations, prior knowledge, and tacit knowledge always co-constitute the neural correlate. The categories are analytical abstractions with the objective to operationalise different experiences from the neural perspective.

So, how is it possible to distinguish between category 1 and 2 at the neural level? As a first approximation, contrary to the activity elicited by memories, on-line experiences seem to activate primary cortical areas dedicated to the processing of incoming sensory signals (Kosslyn et al. 1995; Kreamer et al. 2005; however, see also Harrison and Tong 2009, and Chap. 2 on false memories).

Consider conceptual knowledge of chocolate for example, corroborated by perceptual activity as in on-line cognition typical of category 1. The knowledge is sustained by neural activity in particular sensory and motor areas. To the contrary, when we contemplate chocolate in its absence (category 2), there is no chocolate activity of taste buds which probably results in less secretion of saliva. The *lack* of primary sensory impressions is systematically coupled with the *absence* of the phenomenon and might help us differentiate between factual and imagined experiences (e.g. Slotnick and Schachter 2004; Abe et al. 2008).

Thus, while the b-representation is externally controlled due to the continuous stimulation (category 1), this is not true for the t-representation[18] (category 2). Accordingly, the absence of external stimulation and constraints may render the internal representation more fragile in terms of stability, strength, or distinctiveness (e.g. Cleeremans 2008). Here, the maintenance of activity depends on controlled activity as a result of *direct attention*, which we will address more fully later in this chapter. Consider what happens when a subject imagines that she carries for instance an egg but is then distracted. Maintenance of the representation is a wilful act that depends on the ability to retain the goal in your mind's eye. If the representation is not mentally fed, the experience stops. In comparison, if, for instance, attention to an actual egg carried by hand is momentarily diverted, the subject is still haptically informed about its presence.[19] Though the attention of the subject is disrupted, the resulting distraction does not turn off the continuous perceptual stimulation and the egg is still safely guarded. Naturally, the (often) subliminal stimulation that arises from direct exposure might not benefit 'concrete objects' we access exclusively unimodally, as for instance perception of stars or distant mountain peaks. If we close our eyes, the stars and the b-representation of stars is fragile in a way comparable with the conditions pertaining to thoughts [see Jonas 2001(1966)]. The problem being that unimodally perceived objects may be only marginally related to archetypical concrete phenomena. Yet, unimodally perceived phenomena are still radically different from thoughts. Fundamentally, unimodal phenomena *are* concrete and immersed in a concrete world that imposes constraints. Their stable associations to phenomena we *are* capable of perceiving, for instance through conditioning, add to our ability to access them through direct attention even after closing our eyes. For instance stars are always located above our heads and physically we always need to stretch the neck to see them. Moreover, as opposed to pure imagination, the representation of on-line visual phenomena resides in short-term memory. After looking at stars, the perceptual impact on short-term memory may result in relative stronger activations than pure imagination (Pearson et al. 2013).

[18]If following the strict interpretation of the introduced vocabulary the correct term would be; 't-reenactment' as I infer that the representation has been established on-line and is now re-activated (see also the note on the distinction between the linguification process and the linguification product). In that sense, t-representations may be used only in case of linguistically mediated knowledge that is category 3.

[19]The representation elicited by carrying the egg may rely on previously acquired balancing expertise but the involved sensory modalities also contribute. However, Kim et al. (2011) offer an explanation as to why the motor system works despite mind wandering while walking down the street, which might also pertain to the egg example (p. 465): "motor systems can continue to accurately respond to current environmental contingencies when we are apparently attenuating the sensory inputs critical for these visually guided actions". According to the researchers, processing of stimuli presented to the lower visual field (LVF) (p. 469): "may specifically resist tuning out so that our bodies can respond to current environmental contingencies regardless of where in time and space our mind may have wandered".

Thus, the crucial difference between categories 1 and 2 is that while external stimulation works also subliminally, internal stimulation exclusively depends on conscious effort. The internal representation is caused and controlled by the individual who, while contemplating absent phenomena, is left without external 'help' and may turn to voluntary re-enacting of the representation (for comparisons between the neural correlate in perceptual and imagining object processing, see Cichy et al. 2012; Lee et al. 2012). On the other hand, when conceptual knowledge is about entities or events that one has never personally experienced (category 3), such as the summit of Mount Everest or the French Revolution, at the face of it knowledge (about unknown phenomena) is not and cannot be sustained by personal experiences. Therefore, it cannot be sustained by relevant perceptual activity in sensorimotor areas and is differently corroborated.

4.4 The Phenomenal Feel in Linguification

The transgression from the actual experience of concrete phenomena, such as bananas, chocolate or stars, to the off-line mastering of notions of 'banana', 'chocolate', and 'stars' as 't-re-enactments' depends on the neural ability to re-enact.[20] To what extent is off-line re-enactment a simulation of previous experiences? Phenomenally, what are the consequences of switching from predominant external to internal support, from externally caused representation to internally caused representation (from bottom-up to top-down processing)?

When we address concrete concepts in the absence of relevant external support, imaging technique studies have shown that stored perceptual memories applicable to the phenomena in question are reactivated. Thus, reading about 'cinnamon' elicits neural activity in areas related to perceptual processing of cinnamon. Likewise, when we process information about absent phenomena, for instance when we imagine the bicycle in the shed, the neural re-enactment substitutes for the external stimulation, i.e. the perceptual stimulations that would occur when experiencing the real bicycle, as well as the information associated with riding a bicycle and any associations connected to bicycling as a cultural value, a childhood

[20]I use the notation of b-reenactments and t-reenactments about the neural correlates activated in category 2, in which focus is on the established representation, since there is reason to distinguish between the *process* of linguification and the *product* of linguification. When addressing the accessibility of the perceptual feel that originally (in)formed the undercurrents of linguification, the emphasis is on the *product* in the sense of processes that sustain the well-established concept. Thus, we must distinguish between representations in the developing linguification product and the re-enactment, which is more related to an already established representation. Since representations are always in a process of development, the distinction is disputable. In this context, however, it is important to make these analytical distinctions. Moreover, apparently, we may also need to distinguish between different phases in the linguification process insofar as repetition of experiences may induce implicit processes that function at an automatic level.

memory, etc. To what extent are these representations also phenomenally experienced?

Studies on the formation of mental images of the future show a dependence on consciously accessible perceptual images that subjects voluntarily pursue. For instance, when instructed to project imagined events of the future, apparently subjects tend to depend on first-person experiences in the past (Szpunar et al. 2007). That imagination is sustained by conscious access to previous experiences is supported by a study in which patients with memory impairments as a result of hippocampal damage were asked to expand on imagined *novel experiences.* These were significantly reduced in richness and content compared with those of controls (Hassabis et al. 2007). This suggestion is further corroborated by studies that show that brain regions traditionally involved in memory functions (i.e. the remembrance of past events) are similarly engaged when people imagine future events. According to Schachter et al. (2007), the "simulation of future episodes draws on relational processes that flexibly recombine details from past events into novel scenarios" (p. 658). Hassabis and Maguire (2009) describe how mental scene construction in which perceptual experiences obtained in one context, by expropriation, eventually corroborate images that require the flexible association and integration of many scene elements. They claim:

> Scene construction is a specific example of "associative construction" which involves visual imagery, binding and also disparate multimodal elements that, when bound together (re)create an event as a whole. This includes contextual details such as sounds and smells in addition to visual inputs, people, objects, entities and their actions. (p. 1267)

Thus, conscious recollection in mental images of the future is likely to involve phenomenal simulations as well. This is sustained by Barsalou, who states (2009, p. 1281): "When re-enactments reach awareness, they can be viewed as constituting mental imagery, given that imagery is typically assumed to be conscious".[21]

The question therefore, is whether conscious recollection of previous experiences and thus phenomenal qualities are always at stake in imagery?

The familiarity of (and possibly habituation to) language use related to every day conversations may cloud our sensitivity to the specific dynamics involved. For instance, we may not be aware of to what extent conscious experiences are

[21]What characterises imagery in the *neural* literature? According to Pearson, Deeprose, Wallace-Hadrill, Heyes, and Holmes (2013, p. 6), there are two distinct routes by which mental imagery is created (Pearson 2007): "First of all an image can be created directly from immediate perceptual information. For example, someone can look at a picture of a horse, create a mental image of the picture in their mind, and then maintain this mental image as they look away or close their eyes. Second, an image can be created entirely from previously stored information held in long-term memory. For example, someone can hear the word 'horse' and then create mental imagery based on their previous experience of what a horse looks like". Please note that 'imagery' refers to perceptual impressions in general and is not dedicated exclusively to the visual modality.

According to Hall (2002, p. 467): "mental imagery shares neural networks with major cognitive functions such as language, memory, and movement depending on the nature of the imagery task. Hence, there is no unique mental imagery neural network".

involved. Thus, everyday neural activations may not necessarily be consciously accessible, but if they reach awareness, Barsalou suggests that imagery is inevitable.

Also, as we will see later, the circumstances eliciting the imagery may prove important. It is likely that everyday discourse on bicycles in sheds, for instance, happens at a conscious-wise superficial level compared with the level of consciousness associated with reading tasks in empirical experiments of singular concepts such as 'cinnamon'. The seriousness of the latter condition and potentially the effect of processing singular words versus sentences or entire conversations may significantly change the mental activity.

If simulations reach awareness as in the studies on mental imagery of the future, the question is then in what sense is imagery assumed to be conscious? Are the perceptual experiences corroborating memories of cinnamon or bicycles consciously accessible in the sense that they are subject to mental control through the process of imaging (Pearson et al. 2013)? This seems to be the position defended by Barsalou (2009, p. 1286):

> Mental imagery can be viewed as the conscious and explicit manipulation of simulations in the working memory to predict future events. When imagining a rotating object, for example, a person attempts to predict the object's future orientation.

Alternatively, when reading 'cinnamon', is the perceptual neural activity significant at the conscious level in the sense that the phenomenon is perceptually experienced as if *actually* tasting or smelling cinnamon? In other words, to what extent are we consciously aware of or have access to the *phenomenal* content of the simulation when we attempt to make sense out of semantic information? Do we actually experience the smell when merely reading about cinnamon or tense up the muscles as if pedalling when merely talking about the bicycle in the shed? Before embarking on the idea of derived embodiment, these questions must be addressed more fully.

Moulton and Kosslyn (2009) introduce the concept of mental emulation for those re-enactments that equal explicit imagination (p. 1278):

> in order to qualify as simulation, and thereby serve as an epistemic device, a simulation must feed into processes used in working memory. Even if an implicit process were to operate via sequential analogy, it would not qualify as an emulation unless it produces consciously accessible information.

Why enter into a discussion on the state of consciousness in the linguification process and re-enaction here? The reason is to clarify to what extent the phenomenal quality of direct experiences is a constituent of off-line semantic knowledge about the referent of the original experiences. For instance does it *feel like something* to read about concrete concepts, say a cup of coffee, as a result of the phenomenally experienced components (taste of coffee, the sensation of scalding hot, the haptic sensation of the handle of the cup) that initially grounded the linguification (acquisition) processes?

If imagery is conscious in the perceptually felt sense, is it possible to intensify the feeling in your mind's eye by, for example, addressing particular aspects

(neurally speaking sub-activities that sustain the feeling) using a kind of zoom-function of attention similar to the effect of the novel linguistic concept that seemed to reinforce the perception of colour discussed in Chap. 3? The answers are of importance to understand to what extent and how linguistic handles (for instance concepts used as metaphors) may be used to re-enact the phenomenal content of experiences as discussed in Chap. 5.

Some studies may be interpreted to support the conception that phenomenal perceptions are inherent to re-enactments (e.g. Kosslyn et al. 1995). According to Damasio and Damasio (1998, p. 20), an overlap in anatomical location of direct experience and imagination has important implications for the ability to experience phenomenally both on-line and off-line if damaged:

> After damage in cortical areas V2 and V4 for instance, color is neither perceivable nor recallable in imagination. No consciousness of color is possible even if other aspects of vision can be appreciated and even if one can note the absence of the color experience. The fact that perception and recall are compromised by damage at the same site and the fact that no other known site of damage produces such a defect, suggest that early sensory cortices are the critical bases for processes of image-making.

When the shared neural underpinning of direct perceptual processes is harmed, conscious experiences of the recall vanish as well ('blindsight' may be another example of this effect; see Cowie and Stoerig 1995).[22]

Given that re-enactment involves phenomenal re-experiences, the next question is, are phenomenal experiences equally associated to b-reenactments and t-reenactments? In other words, will *any* linguification process, be it bottom-up (e.g. bicycle) or top-down controlled (e.g. the colour red), result in later re-enactments equally associated with phenomenal feelings? If we are always perceptually or emotionally tuned, that is it feels like something at any given moment, naturally the

[22]The close association between on-line representation and imagination is also corroborated by the study by Stokes, Thompson, Cusack, and Duncan (2009) in which top-down mechanisms for visual imagery accessed the same distributed representations within the visual cortex that also underline visual perception. Similar findings are also reported in studies that demonstrate that imagining a visual scene activates the visual cortex (Kosslyn et al. 1995).

Obviously, the overlap between on-line and off-line networks is not confined to the visual modality. An fMRI-study on reactivation of previous experiences observed in auditory imagination seems to suggest that perceptual activity is true to modality. In the study, subjects were presented with both familiar and unfamiliar music that either included lyrics (as in 'Satisfaction' by Rolling Stones) or not (as in the theme of the 'Pink Panther'). In the experiment, subjects listened to an excerpt that was followed without warning by a short interval of silence. In the familiar case, subjects showed increased activity in perceptual areas during the continuation of the song in imagination (Kraemer et al. 2005).

Despite these studies that demonstrate that the neural correlate of on-line experiencing and imagining overlap, the characterisations by Cleeremans (stability, strength, or distinctiveness) may still pertain more to on-line representations than re-enactments (see also Meyer and Damasio 2009; Prinz 2010).

Thus, it could be the direct control of the imagination that forced the re-enactment into consciousness and via this switch now in the possession of features such as stability, strength, or distinctiveness.

During acquisition	Bottom-up	Top-down
Phenomenal *With experiential content*	**b-representation** Example: Identification of particular experiences by subject, e.g. tasting of ice-cream	**t-representation** Example: Identification of particular experiences by instruction, e.g. watching of specific colours in rainbow
Automatic *Without experiential content*	**b-representation** Example: No identification of specific experiences, e.g. walking from a to b	

Fig. 4.2 A systematisation of the combinations available during language acquisition with respect to experiential content and possible examples to illustrate the specific conditions pertaining in each category. Please note that a relation between the particular feel during acquisition and subsequent re-enaction is assumed.

perceptual tuning may contribute to the linguification product by way of the sub-activities sustaining the feeling. Furthermore, it means that any knowledge acquired is always associated with a particular 'stimmung' (e.g. Chalmers 1996).

When phenomenal experiences are constitutive of re-enactments, let us name the off-line conditions 'phenomenal' and thus the re-enactments phenomenal re-enactments (see Fig. 4.2).

It is, if however seldom in reality, analytically likely that sometimes linguification processes proceed without concomitant experiential associations and thus no phenomenal feels are accessible when re-enacted. For the sake of the argument, let us name these automatic re-enactments.

4.4.1 Emotion Words

Though it remains unclear to what extent phenomenal experiences (and in that sense conscious processes) are constitutive of both acquisition and later re-enactments, some concepts seem to show stronger phenomenal re-enactments than others. For instance, according to Altarriba and Bauer (2004), emotion words are less concrete but more imageable and easier to think of a context for than abstract words. When we process 'emotional' words such as 'attack' or 'murder', the phenomenal sensation appears strong. Emotion words such as 'smile' even induce motor resonance in facial muscles comparable with that demonstrated in the case of the specific emotion (Foroni and Semin 2009).

According to Citron (2012, p. 212): "emotion words might be characterised by higher perceptual salience, a wider network of semantic connections, and stronger memory circuits". In corroboration, emotion words elicit more associations than

abstract and concrete words when subjects are instructed to write down the first word that comes to mind when presented with a stimulus word (Altarriba et al. 1999).

If the emotional response is strong during linguification, obviously the neural activations that sustain the sensation will become similarly represented in the neural correlate, which heightens the probability that the re-enactment ignites the phenomenal aspect during recollections. Moreover, in emotionally enhanced linguification scenarios, the language learner devotes attention to salient elements of the acquisition due to the aroused state which enhances the neural activity (Kousta et al. 2009).

As a probable side effect, it may be that notions that refer to the family dog, the teddy bear, or the summer location where several childhood vacations were spent may be especially emotional and satisfactory to initially master, which would explain the predominance of such concepts in early language use (see, Sharot et al. 2001; Phelps et al. 2006). In such cases, conscious processing may play an important part in the neural construct, corroborating the concept. However, part of the assembly will of course also involve subconscious activity (e.g. Kissler et al. 2009, see also Jończyk 2016).

It is worth noting that according to Kousta et al. (2011), when controlling for context availability, familiarity, and acquisition (not normally controlled for), the time it takes to process abstract words such as 'heresy' is reduced compared with concrete words such as 'artichoke', which somewhat modifies what would normally be considered emotionally engaging. As we will discuss further in Chap. 8, the reason for this may be that while concrete concepts are primarily grounded in sensory-motor experience, affective experience is crucial in the grounding of abstract concepts (Vigliocco et al. 2013).

To sum up, there seems to be neural differences between on-line and off-line representations. On-line representations may be characterised by more stability, strength, and distinctiveness. We may however access off-line re-enactments in imagination. The accessibility is demonstrated in embodied cognition studies such as when reading 'cinnamon', which sustains the idea that when processing concepts off-line we simulate previous experiences. The question is, however, whether re-enactments also simulate the phenomenal experiences of the original direct experience, and the extent to which the phenomenal feel of individual sub-activities in the linguification product is accessible. I will address these issues in more detail in the following paragraphs.

4.4.2 A-Consciousness Versus P-Consciousness

The distinction between memories in the sense of simulations that access perceptual experiences as controllable episodes but without experiential content and memories that also revive the phenomenal qualities of the experiences, relates to the separation of access-consciousness (A-consciousness) from phenomenal consciousness (P-consciousness) proposed by the philosopher Block (e.g. 1995). According to Block (1995, p. 234):

> A perceptual state is access-conscious roughly speaking if its content — what is represented by the perceptual state — is processed via that information processing function, that is, if its content gets to the Executive system, whereby it can be used to control reasoning and behavior.

P-consciousness, on the other hand, is defined by the particular feeling accompanying being in that state. Thus, if perceptual experiences of cinnamon are constitutive of the concept 'cinnamon' and therefore also evoked by mere reading in the sense of P-consciousness and not A-consciousness, it feels like something to think of 'cinnamon', informed for instance by taste, smell, touch or sight. Accordingly, to imagine 'cinnamon' is also to re-enact the experiences of cinnamon fully phenomenally laden in the sense that it feels like something to think of cinnamon.

For the purpose pursued in this account, besides A- and P-consciousness, there seems to be important mental states which are not experientially salient, that is they are neither non-P nor voluntarily accessible, thus also non-A. These constitute mental states that *may become* A-, P-conscious, or both in the right circumstances. Alternatively, they may change other states into becoming A-, P-conscious, or both (for example by way of the back door 'command line' described in Chap. 3). Normally, this kind of mental state is just characterised as non-conscious or subliminal, so why take particular notice of this kind of mental state in the present context?

As described in Chap. 3, a number of studies demonstrating embodied cognition suggest that simulations may engage perceptual states of which the individual is unaware, which nevertheless participate in the constitution of the mental states studied.

For instance, carrying a hot cup of coffee or a glass of cold water while temporarily resting in an escalator prior to the experiment, was significantly correlated to judgments of personality traits in a fictive individual (Williams and Bargh 2008). However, subjects were unaware of the connection, which suggests that they were unaware of any *phenomenal feel* related to the staged incident of holding either hot or cold drinks previous to the actual experiment despite the fact that it was exactly the phenomenal feel that was secretly 'transferred'. A probable interpretation is that the experience in the escalator is in fact consciously experienced. Because of the insignificance of the event, that is coffee tend to be hot, whereas cold drinks are normally cold, subjects do not take notice and therefore are unaware of the transference of the phenomenally relevant but, situationally speaking, irrelevant experience.

Though subjects surely were aware of the haptic manipulation and could report on the incident (thus were in fact either A- or P-conscious), they were unaware of any connection between the episode in the escalator and the task performed subsequently.

Obviously, the ability of the hot/cold haptic experience to influence later seemingly unrelated judgments, suggests that time for the process to develop is crucial. Whereas A-, and P-consciousness are static snapshots, the experimentally demonstrated impact of perceptions on seemingly unrelated mental states emphasise the interaction between sub-activities. In corroboration of the importance of

such mechanisms, Goldman and Shanton (2010) refer to major findings in recent cognitive science that suggest that the unconscious mind executes a large number of tasks previously thought to be the exclusive preserve of the conscious mind.

Despite the breach with the common (static) classification of mental states, of interest here is what decides the 'quality' of consciousness, that is whether a state is A- or P-conscious or neither of them and how they come to *change* states. Seemingly, experimenters may unintentionally manipulate subjects *above* the P-consciousness threshold as demonstrated in the study by Schnall et al. (2008, p. 14):

> As a disgust manipulation, we asked participants to immerse one hand in a gooey substance mixed from creamed corn, collard greens and chocolate pudding. Immediately afterward, participants made morality ratings. This very concrete disgust experience, which was not otherwise involving in the way that films are, did not influence moral judgments (compared to those who put their hands in a bucket of water), presumably because the unusual nature of the experience and its obvious relation to disgust remained highly salient as participants made their moral judgments. In retrospect, it seems likely that any disgust elicited by the moral dilemmas was likely to be attributed to the feeling of the gooey substance, rather than the other way around.

Remarkably, when the experimental setup drew subjects' attention to the sensation of disgust (p-consciousness) influences on moral judgments failed to appear, probably due to the mental control elicited by the highly salient sensation. This effect has also been demonstrated in studies on moderating influences of implicit–explicit attitude relations (e.g. Nosek 2007).

In the current framework, one very tentative way to make sense of this modifiability is for individual sub-activities to fluctuate between unconscious and conscious states as a result of the neural strength which might also be controlled by the solidity of the connection to the aggregate (for instance linguification product) of which it is a part.

Winkielman and Schooler (2011) address the relation between unconscious and conscious mental states along similar lines though without allusions to the neural corroboration. They propose a tripartite model to distinguish between unconscious (mental states of which we are genuinely unaware), conscious (aware, but lack meta-awareness—and therefore similar to P-consciousness), and meta-conscious states (internally articulated as states of the perceiver, similar to A-consciousness) (see also Schooler et al. 2011). To Winkielman and Schooler, the transition from awareness to meta-awareness is facilitated by several factors (p. 6):

> One is the strength and clarity of the internal state. Fast, weak, fuzzy experiences (e.g., a flash in the visual periphery, hum of a distant plane, subtle scent of a perfume) may first be unconscious, and then remain on the "fringe of consciousness" (Mangan 2001). Such experiences become noticed and articulated in meta-awareness only when they become stronger and clearer, either via their bottom-up strength, or via amplification by attention.

Prinz (2010), however, accentuates the availability of mental states to working memory and claims (p. 322): "As emphasized earlier, conscious states need not be encoded. When there is no encoding, there can be conscious states, but we are not conscious of those states". For the discussion of many concepts of consciousness, see Lycan (1996).

Re-enactment	Non-conscious		Conscious (A & P)	
	(I)	**Tacit, subliminal**	(II)	**Strong emotionally felt**
Automatic *Bottom-up b-re-enactment*		Ex. When you due to carrying the cold glass judge the personality of a described person differently		Ex.'Gooey substance' - when they attract attention
Voluntary *Top-down t-re-enactment*	(III)	**Associations**	(IV)	**Direct attention**
		Ex.May only exist as 'second-order' ripples that will not surface		Ex.Controlled by the subject. Birthday cake

Fig. 4.3 A systematisation of the combinations available during re-enactments with respect to non-conscious and conscious content and possible examples to illustrate the specific conditions pertaining in each category. Please note that A- and P-consciousness for convenience are collapsed into one category, although they will have significantly different implications in re-enacted memories.

4.4.3 b- and t-Re-enactments Reconsidered

Why is access consciousness and phenomenal consciousness of importance to the present account? The character of imagined states with respect to the phenomenal feel may be of importance to the quality and usability of the imagination in understanding new concepts and the consciousness state may therefore be crucial to the mechanism of derived embodiment discussed in Chap. 5. Above I have briefly touched what characterises different kinds of conscious states and suggested that in terms of the neural perspective, we need to take the volatility of processes into consideration. As we will see, we may crystallise a number of re-enactment categories along a number of dimensions (that follow the taxonomy discussed in relation to the nature of representations see Fig. 4.3). The horizontal dimension compares conscious (A- and P-conscious states) and non-conscious re-enactments, whereas the vertical dimension compares automatically and voluntarily triggered re-enactments (bottom-up and top-down activity).

Consider a conversation in which perceptual processes may be automatically elicited (bottom-up) below the conscious level; for instance, the perceptual activation associated with reading 'cinnamon' since mere reading activates perceptual neural representations. If not consciously associated or phenomenally experienced, the activation is below the conscious threshold (condition I).[23] On the other hand,

[23]Since A- and P-conscious states differ, merging them as one category may seem confusing. However, to avoid unnessecary complexity, they are contrasted only with non-conscious states and not with each other. Moreover, in this context the overarching focus is on a comparison between direct experiences and the *re-enacment* of experiences. Hence, it is the phenomenal aspect of the phenomenon that is of particular interest here.

automatic bottom-up elicitation of perceptual experiences might also occur at a supraliminal level (condition II). In that case, mere reading elicits strong perceptual memories the subject easily acknowledges (evokes attention; Prinz 2010). An example is moral judgments in which the individual allows for the 'gut feeling' to help navigate and assess the moral sentiment. In contrast, phenomenal experiences may also be voluntarily activated; for instance, when actively remembering the taste of a specific birthday cake. In this case, the phenomenal feel is central to the activation top-down and is always above the conscious level (condition IV).

Many cognitive operations are known to exploit our ability to deliberately control imagery (condition IV). Among surgeons for example, mental imagery is commonly used as a teaching technique in addition to 'hands on' physical practice with operations. According to Sanders et al. (2004), the performance of second-year medical students who had participated in one session of physical practice involving suturing a pig's foot and two sessions of mental imagery rehearsal were statistically equal to participants with three sessions of physical practice when performing surgery on a live rabbit. As a control, instructor-induced mental imagery rehearsal of incision and suturing procedures improved performance in an actual surgery compared with studying textbook descriptions of the same procedures (see also Hall 2002).

In the attempt to explicate the relation between the inclination to imagine and the automatic elicitation of perceptual experiences through linguification (i.e. the 'cinnamon' case), the results seem interesting. In the cited study, it seems that the inclination to perform mental imagery during the reading of words significantly differs from actual (verbal) instructions since it causes dissimilar training effects. Whereas imagery *instruction* (live) may exemplify condition IV (as the instructor facilitates direct attention, see also Chap. 5), mere reading may appear less insistent. We will return to this difference in Chap. 6, where we will expand on the attentional mechanisms involved in instructions and in reading.

The remaining category (III) concerns voluntary activation of perceptual experiences but is coupled with subliminal processing. Examples may entail voluntary focus on phenomenal properties of a concept, without the successful remembrance of the perceptual feel (see for instance the difference between convergent and divergent thinking, e.g. Colzato et al. 2013). That (failed?) kind of activation may in fact be crucial to the discussion developed here, a consideration we will briefly touch upon in the next chapter. However, category III is also likely to cover situations in which re-enactments by associative overlap activate subconscious processes that will never surface, but may still be efficient as facilitating or inhibiting associated correlates (as a result of the interaction process characteristic of the underlying neural assembly).

4.4.4 Automatic or Voluntary Activation of Imagery?

Is the difference between bottom-up and top-down activation as clear cut as one might be led to assume from the categorisation into these four distinct cases? Can

we pin down in any meaningful way when processes of imagination are triggered by bottom-up or top-down activation (apart from the fact that it is already problematic to assume that imagination may be perceived as isolated 'one-shot' activities)? Is it a feasible interpretation of the 'cinnamon' study and the like, that individuals imagine because words (other sources may have similar effects) automatically elicit imaginations or because subjects are instructed and therefore direct their attention in a mentally effortful summoning of the imagination? Seemingly, the previously mentioned surgery training study involving veterinary students suggested that the quality of imagination depends on whether it was induced by instruction, by reading or by the trainer. Thus, since in both conditions students were instructed, the study suggests that words written or spoken differ with respect to their efficiency as triggers of imagination in a putative b-re-enactment process.

That the efficiency of words to elicit imagination may depend on whether individuals are exposed to words through reading or instruction is corroborated by a study in which subjects were *explicitly encouraged* (instructed live) to imagine autobiographical memories of episodes which could not have taken place, such as having a nurse remove a skin sample from the little finger. When this condition was compared with the effect of mere exposure to written descriptions of such events, the live instruction condition created significantly stronger memories of the incidents (Mazzoni and Menon 2003). Thus in the case of purely fictitious stories, when subjects through instruction immerse themselves into vivid imagination, the construction of memories seems far more effective than exposure to written language, even when assumed to elicit similar imaginary scenes. The result seems to suggest that written descriptions of events that involve the removal of skin from the little finger (or in comparison, reading of 'cinnamon') were not as powerful as tools in establishing fictitious memories as when paired with overt instructions to imagine.

There may be good reasons for the reported difference. To the individual it might be more feasible to indulge in phenomenal experiences on selected occasions. Automatic elicitation of strong phenomenal feelings in the wake of incidental words could be counterproductive if one attempts to attend mentally to specific end goals.

Ostensibly, instructions by others may facilitate the subject's ability to control the focus inwards and the mental content in question. Under these particular conditions, such operations could ultimately result in facilitating memory. In Chap. 5 we will discuss the effect of the significant other on the conscious control of the mental in the individual in much more detail.

An objection to the suggestion that instructions always facilitate imagery while written texts are less successful is also found in reading studies in which reading texts might spontaneously lead to vivid imagery. For instance, according to Sadoski et al., reading may be associated with a strong inclination to imagine (1990). They point to the many spontaneous imaginative responses associated with understanding and experiences of living through literature. When we imagine while reading we seem to reproduce images from memory which can be used to animate the text (ibid., p. 56, see also Burke et al. 2016).

Though the study intended to explore deep understanding such as meaningful semantic analysis as different from surface level graphemic processing, though

exposing students to differently paraphrased written instructions that emphasised either surface or deep reading, all participants seemed to engage in mental imagery when reading the 2100-word typical adolescent adventure story. Thus, the researchers concluded (ibid., p. 69):

> Regardless of processing instructions and text manipulation, readers appear to have been absorbed in an imaginative, "lived through" experience. They formed powerful visual and affective images that were generally consistent with the text, and elaborated and synthesized portions of it, but also constructed images involving importations from other experiences. Their images tended to be somewhat related to the structure of the story, particularly the climax.

4.5 Rumination Studies: When Words Are Imageless

Similarly, it is possible to find examples of conditions in which imagery *is not* automatically elicited by words (i.e. bottom-up). Or put differently, in certain situations the straightforward opportunity to imagine is *suppressed*. Examples exist of mental states in which words, though referring to concrete phenomena, are in fact imageless.

According to a number of worry and rumination studies (Stöber 1998; Watkins and Moulds 2005), worry is conceived as a defence mechanism shielding the individual from emotional arousal associated with arousing stimulus material such as imagery. As a result, worry is connected to less imaging than normal thought processes by suppression of aversive imagery to avoid the undesirable cardiovascular fear responses normally connected to imagery of worrisome scenarios. In worry, thoughts are therefore preferably maintained as *image-free* representations. Such conditions are sustained by different neural correlates as demonstrated in an EEG study using a no-input, no-task, and no-response paradigm. In the study, experiences of thoughts (without imagination) and visual imagery were preceded by activity in different neural assemblies (Lehmann et al. 1998).

In studies that measure worry and the associated imagery, researchers presented subjects with a Worry Domains Questionnaire that lists a number of everyday problems, such as 'the impression of being unattractive', 'facing personal financial crisis', and 'making mistakes at work' (Stöber and Borkovec 2002). Participants were asked to select a number of problems and rate them according to degree of worry. Furthermore, participants were asked to write down potential antecedents and potential consequences. For instance, in case of choosing 'I make mistakes at work', subjects might list potential antecedent risks such as 'I could not sleep all night' or 'I have a noisy office environment' and potential negative consequences such as 'My boss will yell at me' or 'My colleagues will look down on me' (Stöber 1998). Independent judges would then assess the degree of concreteness in the elaborations associated with problems with different degrees of worry.

The researchers found a clear correspondence between worry and absence of concreteness. These studies point to an interesting correlation between imagery and concreteness as well as the simplification of 'problems' as those confronting worried subjects (We will later introduce the concept of 'material anchoring' especially in relation to pedagogical implications, see also Chap. 7). According to Stöber (following Schönpflug 1989) (1998, pp. 752–753):

> Problem elaborations with a high degree of concreteness contain risks and consequences that are detailed and specific, thus making it easier to find potential solutions to the problem (Schönpflug 1989). Moreover, through concreteness, anticipations of future events and actions gain some of the probative force and self-explanatory power of perceptions. They can serve as internal task models…for which action plans can be developed (p. 248). In sum, concrete problem elaborations may not only motivate the individual to counteract the perceived risks (prevention) or to prepare for the expected negative consequences (anticipatory coping), but may also show ways to tackle the problem.

Apparently, subjects who ruminate will worry more because their thoughts are less concrete (and as a consequence less arousing), and therefore solutions to their problems appear less imaginable. The 'normal' straightforward ability to imagine, which was the first parameter to be discussed in an attempt to explain how linguistic acquisition of abstract knowledge is possible, might be moderated when individuals worry. Possibly, without conscious acknowledgment ruminators inhibit the potential of the worrying concept to trip images.

In the perspective distilled in this framework, the ability to suppress imagery while maintaining words demonstrates that accessibility to different elements of the combined aggregate that sustained the conceptual learning during the linguification process may vary and putative causal links between words and imagery are indeed modifiable. The learned ability to suppress the inclination of words to elicit concretising images suggests that subjects may turn the control upside down and in fact learn also to increase the access to images, as will be discussed in Chap. 6.

To sum up, we have discussed the neural implications of linguistic representations and re-enactments when the referent changes from being present (online) to absent (off-line). To account for neural differences as a result of on-line and off-line processing and the degree of mental control involved, the distinction between b-representations and t-representations was introduced. Furthermore, we discussed to what extent the phenomenal feel of representations is accessible in the re-enactments which led to the brief discussion of A- and P-conscious states. Examples of b- and t-representations as well as b- and t-re-enactments were presented to demonstrate neural categories distinguished on the basis of automatic or voluntary activations, and we touched upon the unresolved issue of mental states oscillating between being not conscious, A-conscious, or P-conscious and in connection also the volatility as being constituted by the process nature of the neural correlate.

These considerations will prove important when the mechanism of derived embodiment is discussed. To bring the discussion of re-enactments back on the track concerned with words as linguistic handles, we have addressed under which conditions words may or may not elicit vivid imagination. In some studies oral instructions appear more successful than written words. The digression to rumination

studies exemplifies that in certain conditions individuals may actually successfully suppress image formation in an attempt to inhibit stressful re-enactments.

In the next section, we will leave the discussion of representations and re-enactments to turn to the second parameter initially introduced that influences our ability to linguistically acquire abstract knowledge. We will here explore the mental mechanisms that allow subjects to focus inwards which we have implicitly counted on throughout this account.

4.6 The Switch from External Perception to Internal Representation

Studies on rumination and worrying point to the modulating impact of cognitive control in the individual. The mechanism behind the generation of imagery in off-line conditions somehow involves attention and awareness. Therefore, we now turn to the second parameter; the switch from external perception to internal representation in an attempt to explore significant changes in the mechanisms responsible when we move from acquisition of concrete to acquisition of abstract language. The rationale is to prepare the ground for uncovering the mechanisms that render abstract knowledge acquisition possible.

As already briefly discussed, cognitive processing of abstract phenomena (in the off-line condition) relies on the ability to represent stimuli irrespective of their actual presence. Though we tend to pose the ability to represent in memory as a demarcation criterion, non-human animals are not entirely incapable of such mental work. An example is the dog that finds itself inside its house but represents the ball in the front yard and therefore gives the sign for the door to be opened. Another example is the laboratory rat that in the traditional T-maze study remembers which arm of the maze it has already visited to obtain a reward (Squire 2004; Wynne 1998). Or mangabeys behaving like meteorologists, since they are more likely to revisit a fig tree following a period of warm and sunny days compared with cool and cloudy days (Janmaat et al. 2006).

The task calls for continuous sustenance of imagery. Hence, in the off-line condition the cognitive load on the mind seems to dramatically increase.

Following traditional terminology, representations that arise from perception of external stimuli depend on attentive processes directed at external stimuli (exogenous), whereas representations that arise in the absence of external stimuli are said to depend on internal attentive processes (endogenous). According to Chun et al. (2011, p. 76) and following William James, there is a significant difference between external and internal attention as demonstrated by how the mind handles working load in the two domains:

> William James eloquently distinguishes the possession of the mind by 'objects' which we interpret as external attention, or 'trains of thought' what we call internal attention. As empirical support, increasing the load of perceptual input has different effects than increasing the load of working memory.

The character of attention might also be separated on the basis of what controls it. On the external attention, Chun et al. (2011, p. 76) posit:

> The distinction between exogenous and endogenous attention is especially important for understanding attentional deployment when there are multiple objects and events in the visual field. When attention is focused on a certain location, what are the mechanisms involved in shifting attention to a new location or a new object? Attention may be voluntarily moved to a different location in a goal-directed manner. Or attention may be 'captured' by an object or event occurring in a different, unattended location in a stimulus-driven manner.

The distinction has been corroborated by neuroimaging studies in which cortical systems that mediate conscious awareness are subdivided into an extrinsic system encompassing lateral fronto-parietal areas and an intrinsic system which encompasses medial brain areas (Vanhaudenhuyse et al. 2010). According to the researchers, the extrinsic system relates to external awareness in the sense of conscious perception through the sensory modalities (e.g. visual, auditory, somaesthetic, or olfactory perception) whereas the intrinsic system encompasses mental processes that do not require the mediation of external stimuli (e.g. mind wandering, daydreaming, inner speech, and mental imagery).

Attention controlled by exogenous stimuli (the extrinsic system): "permits the detection and evaluation of potentially important, but task-irrelevant stimuli (e.g. when we get distracted by a horn, while crossing a street and talking with a colleague)" (Wetzel et al. 2006, p. 2191). In such cases, attention is thus bottom-up controlled. On the other hand, endogenously controlled (the intrinsic system) attention is voluntary and thus top-down controlled (ibid.): "[it] allows us to perform a task successfully, without interruptions caused by disturbing stimuli".

Though attention comes in two versions, endogenous versus exogenous (i.e. internal versus external or voluntary versus stimulus-driven), and may be further differentiated in bottom-up and top-down versions, the mutual cognitive function is to select among the many potential, alternative representations that offer themselves to us (Kaplan and Berman 2010).

Following Chun et al. (2011, p. 82):

> To the extent that there are limitations in the number of alternatives that can be considered at any given time – and the even broader set of responses and choices that can be made to these alternatives – cognitive control is intrinsically attentional. Thus it would be useful to understand selective processes in executive/cognitive control, while seeing what's common and different in comparison to those in perceptual selection – external attention.

To sum up, though internal and external attention is understood as varieties of the same general cognitive device referring to a selectivity of response, the representations they administer differ in origin. External attention is directed at perceptual referents caused by external activity of which subjects have no control (even if they may attend both bottom-up and top-down), whereas internal attention is directed at representations that are maintained independently of external stimuli.

In the external condition, factors beyond the control of the individual (i.e., occurrence of external stimuli) instigate attentive processes. To the contrary, in the internal condition, in most cases attention seems to rely on the executive control of the subject (I will shortly return to exceptions to this).

4.6.1 Cognitive Load

Apparently, the mental act of referring to absent phenomena or events without sustenance by external stimuli is mentally strenuous as compared with on-line cognitive processes that are perceptually sustained. To access and maintain the simulation of a referent to manipulate the imagery depends on many vulnerable sub-processes (some of which are embraced by the concept 'metacognition', cognition that reflects on, monitors, or regulates so-called first-order (perceptual) cognition, e.g. Kuhn 2000). Thus, subjects pursue strategies to relieve the stress by cognitive load. Hesslow (2012) points out that when subjects are asked to memorise a scene they have experienced including a number of items, and are asked to recall it while looking at a blank screen, the eyes tend to move as if subjects were consecutively scanning each item as in real life. Likewise, if subjects are asked to imagine a novel scene based on a spoken description, eye movements seem to reflect the position of objects. This strategy facilitates a number of processes that may lead to the desired memory enhancement. According to Johansson et al. (2006, p. 1076) we use the gaze both to support our memory of objects and the object name production.

In general, gazing helps off-loading cognition to the surroundings (e.g. Johansson and Johansson 2014). Following Hutchins, individuals off-load cognition to the surroundings, and 'concretise' by seeking perceptual help in material structures, because (2005, p. 1574):

> [t]he fact that some of the task relevant structure is crystallized in a material artifact may reduce the demands on memory. Computing on complex mental images that have material anchors permits people to substitute robust and fast perceptual processes for slow and vulnerable conceptual processes. Since conceptual models work by embodying constraints among conceptual elements, both memory and processing loads can be reduced if the constraints of the task can be built into the physical structure of a material device.

That material artefacts may help off-loading mental work suggests that 'conceptual models' are costly.

The limits to the complexity one can keep track of mentally point to similar conclusions. Kirsh points to the difficulties of keeping a set of twenty separate pieces in one's mind and then checking if the twenty-first will fit. "The twenty-first piece may be the last straw, total overload, causing the whole mental structure to lose integrity." (2010, p. 447):

However, as always, the opposite might also be true. When discussing the ability to do mental work, Kirsh compares mentally rotating a tetrazoid in Tetris with

rotating it in the world and finds that real world rotations sometimes incur costs to the task solving because of over rotation. We return to mental costs of internal representations in Chap. 6.

4.6.2 The Internal State

So far, in the discussion of perceptual experiences in relation to concrete and abstract phenomena, except for the remarks on phenomenal experiences and emotions, focus has stressed representations (A- and P-states) elicited by external stimulations. At this point in the account, when introducing mental control, it may be feasible also to emphasise the role of 'perception' concerned with internally located stimuli. This is what I take to be framed by Borghi and Cimatti (2010), who emphasise that when children learn about contingencies, they can 'feel' their bodies without being involved in external actions: "When we dance, we might 'feel' our body even when no real interaction with external objects or entities take place" (p. 764).

As we will see, there appears to be important connections between mental control mechanisms that direct attention in imagination and internal states, since internal stimuli seem closer to thoughts and imagination (see also Chap. 8).

As discussed in relation to the phenomenal feel associated with the neural assembly, as associated with 'spider' for instance, the perceptual feel in any given moment is potentially equally likely to originate in the activity 'from within'. According to Barrett (2009, p. 330):

> Every moment of waking life, the human brain realizes mental states and actions by combining three sources of stimulation: sensory stimulation made available by and captured from the world outside the skin (the exteroceptive sensory array of light, vibrations, chemicals, etc.), sensory signals captured from within the body that holds the brain (somatovisceral stimulation, also called the interoceptive sensory array or the internal milieu), and prior experience that the brain makes available by the reactivation and reinhibition of sensory and motor neurons (i.e., memory). These three sources—sensations from the world, sensations from the body, and prior experience—are continually available, and they form three of the fundamental aspects of all mental life.

Obviously, representations that take stimuli emerging internally in the individual as the prominent material may be of equal importance to linguification processes (see discussion on emotion words in Chap. 8). Internal stimuli encompass experiences of hunger pangs, back pains, headaches, feelings of pleasure or tiredness, and the like, sometimes referred to as basic physiological sensations that suddenly occur, and in that sense compare with external stimuli as outside the control of the subject.

For example, tactile and proprioceptive information about our bodies is continuously integrated with visual information in an intermodal integration to an extent that when non-ambiguous action cues are unavailable, bodily cues contribute to self-recognition, for example (Knoblich 2002). Thus, body-representation in this sense is a necessary precondition for self-recognition. Tsakiris and Fotopoulou

(2008) describe how diverse cognitive tasks such as attention, multisensory integration, agency, perspective-taking, mentalising, and understanding of other people's minds seem to rely on the efficient distinction between events that may or may not relate to oneself, so body-representations may instead be the first level at which the distinction between oneself and other subjects and objects takes place.

Some use the concept 'interoception' to refer to the *monitoring* of the internal condition. Others refer to interoception as internal sensations. Fogel (2011, p. 184) takes 'Embodied Self-Awareness' (ESA) to refer to: "Sensing of one's internal condition with full awareness and without the need for verbal articulation". ESA consists of two components: interoception and body schema. The former transfers information from ergoreceptors (internal state conditions that include temperature, pressure, vibration, and movement) with afferent nerves in the body. Some of these project directly to efferent pathways to assist in regulatory processes like heart rate, blood flow, respiration, digestion, and movement. Other neurons project to limbic structures such as the hypothalamus and amygdala to participate in hormonal control and the autonomic nervous system, thus regulating sexuality, metabolism, and body temperature.

On the other hand, the body schema, according to Fogel (ibid.), starts at the point of proprioceptors that include touch, muscle, tendon stretch, and balance and bases the sense of movement and balance, our sensation of belonging to our body, our knowledge of size and extent. The body schema is part of a network which includes the premotor area of the motor cortex, the cerebellum, posterior parietal cortex, the ventrolateral thalamus, and the somatosensory cortex.

Why are internal stimuli in the sense of interoception and body schema (to use Fogel's conception) important to the present context?

In itself, monitoring of the internal state is helpful as a back door (acting like language in the linguification process) that may ignite the entire assembly of which it forms a part. Thus, internal stimuli may act as signs of a pattern in the same sense as external stimuli and may participate on equal foot in neural correlates of particular events such as drinking coffee.

The philosopher Loar addresses how internal monitoring may help us compartmentalise the world (and thus approach the understanding of the world and the activity of the neural assembly from the interoceptive part in the linguification process) (1997, p. 597):

> We introspectively discriminate our own experiences and thereby form conceptions of their qualities, both salient and subtle. These discriminations are of various degrees of generality, from small differences in tactual and colour experiences to broad differences of sensory modality, for example those among smell, hearing and pain. What we apparently discern are ways experiences differ and resemble each other with respect to what it is like to have them. Following common usage, I will call these experiential resemblances phenomenal qualities and the conceptions we have of them, phenomenal concepts. Phenomenal concepts are formed "from one's own case". They are type-demonstratives that derive their reference from first-person perspectives: "that type of sensation", "that feature of visual experience". And so third-person ascriptions of phenomenal qualities are projective ascriptions of what one has grasped in one's own case: "she has an experience of that type".

Loar's claim might have important implications for the current discussion since it seems to suggest that internal states are fully comprehensible without linguistic handles (see Chap. 3) and may even act in similar ways to them. To claim that at some level we are able to sense and distinguish different phenomenal feelings without the labelling use of language is compatible with the studies suggested by Bahrick et al. (2012), but I will detail the specificities by pointing to the acquisition of theory of mind (ToM) in Chap. 8.[24]

In opposition to external stimuli, since the individual might be in a better position to catch putative regularities of cause and effect, such as stomach pains and bad food, internal stimuli might appear more controllable in the sense of capturing and conceptualising when they occur (see also Herbert and Pollatos 2012). Occurrences of headaches might seem arbitrary on the surface, and in that sense relevantly similar to external stimuli. Still, the experience of internal cues that emerge before and eventually signal the felt sensation of a headache might be facilitated simply by being better available to monitoring. Thus, internal subliminal stimulations are probably in a better position to gain at some stage in stability, strength, and distinctiveness in order to become consciously available.

According to Wilson, the interoceptive capacity may also be the key to central human characteristics (2008, p. 382). She posits that we have achieved an unprecedented degree of control over our bodies. Wilson argues that it is voluntary control of the body, i.e. the distinguishing of internal sensations and eventually also the control of these sensations that paved the way for the formation of imagery (ibid):

> In order to take embodied cognition off-line, it is necessary to decouple our bodily actions (or mental representation of those actions) from the demands of the immediate situation. We need to be able not only to walk, jump, turn, point, move objects, smile at people, and speak words, but also to perform or think about performing those actions at will when they are not necessarily appropriate to the situation but can assist us in our cogitations. Escaping stimulus-driven activation of our motor skills is a necessity for off-line embodied cognition. (See also, Wilson 2010).

Shusterman is even sharper when formulating the productiveness of making at least some part of body consciousness explicit in the sense of meta-awareness (2009, p. 139, see also Sutton et al. 2011):

[24]Apparently the position is not without problematic implications. According to Kirsh (2010, p. 447):

"How can a subject be sure that the mental image in mind at time t1 is the same as the one at t0? And how can a subject know whether the addition of another mental image, or a simple rotation of a mental image, has not changed the original image? The only reliable test is whether the image is caused by the same external structure on both occasions. If that structure is not present, there is no objective touchstone to decide sameness. There is just subjective belief. For Wittgenstein (1953), this was a source of scepticism concerning the possibility of knowing one's mental state without outside referents to ground it. No inner state or inner process without outer criterion. Hence, without external support, there might be no way of knowing whether one has the same thought on two occasions".

> Keen to insist on the efficacy of a universal and unchanging primordial body consciousness, Merleau-Ponty describes our spontaneous performance as being marvelously effective. While I share Merleau-Ponty's appreciation of our inexplicit, unreflective somatic perception, I think we should also recognize that it is often painfully inaccurate and dysfunctional. I may think I am keeping my head down when swinging a golf club, though an observer will easily see I do not. […] Bringing unreflective habits into more explicit consciousness is useful not only for correcting bad habits but also for providing opportunities for unlearning problematic patterns of behavior and for stimulating new thinking that more generally increases the mind's flexibility and creativity, even in terms of enhancing the plasticity and efficiency of the brain's neural networks. The value of explicit, critical, and even reflective somatic awareness seems undeniable both for the stages of learning skills and for continuing efforts of extending and refining them and of reforming inadequate habits.

Thus, in conclusion the ability to make internal sensations the object of representation (and thus embark on the conscious accessibility of these internal states) may have important consequences for abilities to imagine (for an example that may prove this point, see Moser et al. 2015). This internal activity may prove particularly important when comprehending phenomena that are not concrete and therefore do not stimulate through external mechanisms (as addressed in Chap. 8 in relation to theories of minds).

4.7 The Role of the Conversational Partner

In the previous paragraphs we have discussed the status of the referent being on-line and off-line as well as differences in attention in relation to whether perception is externally or internally (normally referred to as interoception) driven. Also, we have emphasised the putative impact of interoception on the neural correlate. In this section, focus is on the role of the conversational partner.

The role of the interlocutor changes considerably, when ostensive pointing to concrete phenomena is abandoned at the expense of acquisition of knowledge exclusively by way of language. The following description of the interlocutor as linguistic expert and the orchestration of learning scenes, conceptualises some of the principles that ideally underpin language acquisition at the advanced stage. In practice, conversations may not meet the criteria that pertain to the complete package. However, from an analytic perspective the principles are still interesting to investigate as if every conversation exemplifies the ideal.

When the referent to which knowledge applies changes from the concrete to the abstract stage, say, when conversations turn from concrete on-line phenomena to absent and therefore off-line phenomena, the function of the conversational partner also changes. As already discussed in Chap. 3, early on in the concrete phase, the conversational partner is basically responsible for the concurrent presentation of objects, scenarios, and concepts to support the association of sensory and conceptual representations in the language learner. In the pre-linguistic phase, joint attention and like exchanges predominate, though the child is still linguistically immersed (for characteristics in eye-gaze, see Bethell et al. 2007).

Studies on early language acquisition in infants strongly advocate for the necessity of interlocutors for acquisition of language to occur. For instance, Kuhl and her colleagues (2003) have shown that when nine-month-old infants were exposed to the same foreign-language speakers and materials via audio-visual or audio-only recordings, those exposed to recorded Mandarin, by watching and listening, or simply listening, to studio-quality DVDs of foreign-language material without interpersonal interaction, showed no phonetic learning, even though infants of the same age learned from a live person. Therefore, we may conjecture that the conversational partner arranges the scene of conversation physically in a sense that is revealed only by direct contact. It may involve affection and trust. It may also depend on the fact that the interlocutor uses material 'cues' to catch the interest of the child (i.e. direction of gaze) to organise a scene believed to lead to acquisition of knowledge. Scenes of learning are to some extent orchestrated, and the success of the linguistic exchange between the language learner and the conversational partner thus lies predominantly in the hands of the interlocutor, who in this case, is considered to be the linguistic expert (in the beginning most likely the parent, professional caregiver or older sibling as well as in group interactions where 'the interlocutor role' may be shared among more subjects). He or she furnishes the concrete world to pave the way for the language learner to easily acquire word-object relations (see Pulvermüller 2011). If the child points to the family dog, the expert decodes this interest and establishes a scene by interacting with the dog, calling its name, patting its head, or pointing in its direction. Dealings with the real world involve practical arrangements and overt preparations of the location for the conversation, such as the positioning of objects in connection with other objects, saliency in the behavioural response in the form of overt gestures (Thompson et al. 2012), and amplified articulation of phrases. The repetitive presentation of on-line objects, scenarios, and expressions gradually prepares the language learner to accomplish language skills at the concrete stage. Other ways of acquiring language are not ruled out but may work only when the basic training is sufficiently established.

As discussed in relation to cognitive load, there may be multiple reasons for the construction of early language acquisition to depend on on-line presentation of objects, events, or scenes accompanied by a linguistic expert. One reason is that acquisition of language and especially the ability to retain the learning may depend critically on the involvement of the perceptual incentives in the form of direct experiences with objects. It might be incomparably easier to remember the word 'chocolate' if one has had access to taste, texture, and appearance which may easily catch the attention (see also Chap. 7). The linguistic experts mediate perceptual stimulations, direct the learner's attention, and reiterate phrases to ensure language acquisition. One could argue that when undertaking such scene-construction, conversational partners make use of material anchors, since they might alleviate the cognitive task of the individual in acquisition of language (Hutchins 2005; see also Wilson 2002).

The continuous attention to the activity of the child, the intensity of his or her gaze, and the compelling affinity towards his or her way of interpreting the world is

a profound driver that allows for 'shared intention' (Bard and Leavens 2008). However, the tight relation does not emerge as a result of language acquisition but has already formed in the pre-linguistic phase. According to Reddy (2003), the ability to participate in shared attention evolves alongside being the object of others' attention. Reddy emphasises that by the age of two months, infants react to attention to self by a variety of emotional reactions, such as smiling more when adults make eye contact and less when adults look away; they become elaborately expressive in response to attention and show distress when being unable to disengage from another's gaze. By the middle of the first year, awareness of aspects of the self, such as the actions of the infant, is demonstrated by variation in action routines as a consequence of for instance gaining attention. Reddy takes such evidence as indicating that the infant is emotionally aware of others from very early on, stating that "what appears to be developing is an awareness of the objects to which others' attention can be directed: the first of these is the self, followed by what the self does, then what the self perceives, and then what the self remembers." (p. 399). Doubtless, the amount of devotion by which parents attend infants has both cultural and sociological roots. Parents who on a daily basis struggle to provide for their children may lack the time for carefully orchestrated linguistic interactions. Thus, optimal language acquisition might very well be an utopian luxury to families that are less fortunate than what seems to be the norm in the Western world. These important considerations should be kept in mind when discussing learning in a general perspective.

4.7.1 Repair in Conversation

Though the infant is actively participating in the interaction, obviously the 'dialogue' between language learner and interlocutor is asymmetric. Hence, ideally the (often adult) interlocutor is always engaged in repairing any lack of coherence or logic in the behaviour or train of thought of the child, which is a reason to classify this kind of conversation as different from those occurring among peers.

What is 'repair' in this context? As stated in Ribeiro and Collins (2007, p. 1430—see also the concept of 'repair' in Collins 2010; Collins and Kusch 1998):

> Machines and pieces of 'explicit' knowledge, such as instruction manuals and books, are deceptive. Their meaning seems to be carried within them but actually provided by us. Their potential lies in the tacit knowledge and social understanding brought to their use by both their producers and their users.

Here, Ribeiro and Collins explicitly address the active contribution of receivers of text material. In the context of an asymmetric dialogue between a knowledgeable interlocutor and a child learner the process is relatively more challenging as the child is likely to be less coherent and break more conventional language rules than the instruction manual. The interlocutor will adopt a continuous repair of fragmentary conversation on the part of the language learner. He or she will become

engaged in creating various interpretations of the inner world of the child, including his or her mood, current thoughts, expectations, and intentions. The success of the repair seems to rest on the creativity of the adult. It is no easy task to figure out the state of mind of others (see also Chap. 8) or to go by the flow in the moment to optimise the result of the interaction. This is not to say that in shared attention the contribution of the child does not involve some sort of understanding of theory of mind and attempts to interpret the mind of the adult interlocutor. However, in terms of sharing, undoubtedly, and for very good reasons too, since he or she possesses the skills and is aware of the responsibility, the adult interlocutor is making the most investment to make the sharing functional.[25]

While gathering data from current behaviour, gaze direction, previous conversations, and experiences, the interlocutor attempts to find the inner logic to assemble the mind and thoughts of his or her conversational partner. In these attempts, the adult repeats procedures and utterances, stressing certain expressions and willingly accepts the sometimes rather opaque directions of the conversation taken by the language learner, who might be more whimsical and abrupt in the train of thought. The ability to control the train of thought, to keep particular representations in mind and to follow them all the way down to some sort of closure, takes years of training.

In respect of the 'guessing game' (the attribution of meaning), the child is much better off, since the relation between the different pieces of information to be put together to form a consistent interpretation of the mind of the interlocutor is better marked. What we as competent language users gradually learn is among other things to more or less deliberately provide the interlocutor with clues that facilitate his or her attempt to successfully attribute meaning to our utterances and actions. Thus, the word-object game and the first phase of language acquisition largely depend on the willingness (and skilfulness) of the adult interlocutor to second-guess the mind of the child and to simultaneously retract his or her own inclination to control the conversation. Meanwhile, in the attempt to interpret, the interlocutor will have to find the right balance between his or her own interpretations as they would appear to him or her, and the representations of the world as they will appear to the child. The interlocutor will have to downplay and take a step outside his or her own understanding of the world, in order to get a glimpse of that of the child (as we will see in Chap. 5 similar techniques apply to abstract learning acquisition as well).

[25]Given that interlocutors are decisive with respect to the actual linguification result of especially derived embodiment processes as we attend to soon, one may wonder what informs the interlocutor. What makes him or her capable of assessing which direction to direct the conscious focus of the language learner? What controls his or her performance? It is outside the scope of this book to address this issue in further detail. However, it seems clear that to some extent interlocutors are inspired by private experiences. It is likely that varied experiences of derived embodiment conversations in childhood facilitate the ability to engage in derived embodiment conversations and thus pass on the 'tradition' (see also Chap. 8 and the acquisition of ToM).

Why is the role of the interlocutor important to consider in an account on abstract language acquisition? Apparently, when direct experiences are absent, the phenomenal experiences inherent to perceptual experiences are absent too. Thus, in the off-line condition the means by which to grasp and remember are significantly reduced. To counter this and to facilitate understanding, the interlocutor may help the learner to access phenomenal experiences pending in the re-enaction.[26] In the next chapter, I address this more fully in the introduction to the derived embodiment mechanism.

[26]See Anderson (2014) for an elaborate discussion of how particular words in conversations may elicit full simulations in the sense of 'Phenotypic reorganizations'.

Chapter 5
Derived Embodiment and Interactional Expertise

Once language acquisition begins, language prepares for its own further development, particularly the category of linguistic knowledge referred to here as interactional expertise-like knowledge. From early on, well-established language is used as a stepping stone to grasp the meaning of new expressions perceived exclusively linguistically. The mechanism responsible for this reflects (and repeats) central aspects of language as a word to world match device and is especially salient when children are introduced to metaphorical expressions in which language concretises to facilitate meaning attribution or emphasises particular concrete aspects of the world.

Glucksberg (2003) refers to the following episode:

> In a class exercise for my psycholinguistics course, one of my students explained to her three-year-old daughter, Stephanie, that 'spilling the beans' meant telling a secret. Later that day, Stephanie cautioned her father: 'don't throw the beans to Allison, she's not supposed to know!'

Stephanie may not have fully understood the sense of the expression as demonstrated by her 'translation' of the metaphor to 'real-life' actions and practices[1]. Her use reveals that she has concretised the meaning in an attempt to grasp what happens when subjects are 'spilling the beans'.

What does it mean to concretise? In the case of Stephanie, concretisation amounts to deciphering 'what would be the conditions of the world, if the sentence was true' and this expectation about how language often relates to the world is established in language acquisition. As we introduced in Chap. 3 and further developed in Chap. 4, the linguification process provides the child with the ability to refer to referents that are absent. The linguistic handle 'opens' into previous

[1]'Metaphor' derives from the Latin *metaphora* "carrying over". To understand metaphors involves the recognition of circumstances characteristic of metaphor use. According to Rapp et al. (2004, p. 395) metaphors in speech and writing are used to help us in understanding: "When we hear someone state that 'hard work is a ladder' or that 'life is a journey', we instantly realise that these sentences are not meant to be taken literally but refer to a metaphoric meaning. Verbal metaphors are used for conceptualizing and making expressible relevant parts of our lives that are otherwise difficult to explain".

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_5

perceptual experiences and may amplify the activity of the neural underpinning to make it burst into a phenomenally experienced activity. This is not to say that we gain access to memories only by use of language which is why back door entries seem so important. However, language as it turns out is particularly useful as re-enacting experiences that we may wish to investigate further.

Since words elicit particular sensations, for instance 'friendship' is associated with warmth and social closeness described in Chap. 4, it is likely that the mechanism in itself contributes significantly to the conception of the word to world match.

Evidently, on-line linguification processes by which children acquire everyday concepts pave the way for off-line cognition. The scope of hitherto isolated episodes that may become neurally associated during linguification is wide. Food items, basic tools, artificial and natural objects, as well as everyday phrases for requests, greetings, and even subjective experiences as pain or sorrow may all become neurally associated in a representation corroborated by the same neural construct if they repeatedly co-occur.

5.1 Particular Neural Correlates as Handles

Thus, the linguification process results in a heterogeneous neural correlate, in part consciously accessible, that assembles and encodes the perceptual (and interoceptive) particularities of those situations in which the concept may often be used. These include the spoken sound of the concept, the sight of the concept in writing (relevant to literary subjects), the physical referent to which the concept refers, the situation in which the referent belongs, the internal state of the individual, etc.[2] Striking any singular 'particularity' like the sound (to which the neural pendant was named 'sub-activity'), may potentially activate the correlate sustaining the perception of the lettering of the concept due to the FTWT activity. Consider for instance the sensation of a cup. The handle of a cup initiates a complex pattern of neural activity (Cashman 2008, p. 51):

> When I hold a cup of hot coffee in my hand, my finger pads are physically made to curve in an iconic match to the curvature of the cup. Certain nerve endings embedded in the finger pads are triggered by this change of shape in the pads. At the same time, the skin of these finger pads is warming up because of the transfer of the heat (speed of molecules) from the porcelain cup to the fingers. Other specific neurons, that are unaffected by shape, are sensitive to changes of heat in the fingers. They are triggered to fire by the warming of the

[2]Studies with transcranial magnetic stimulation (Watkins et al. 2003) applied to the face area to evoke motor-evoked potentials of the lips showed that *listening* to and *observing* speech enhanced the size of the motor-evoked potentials. The results suggest that exposure to different aspects of speech activities, as when for instance the interlocutor talks about 'teddy', are included in the resultant neural underpinnings of linguistic activity.

> fingers. If, in addition, I squeeze the hand on the cup, still other neurons in the finger pads and in the joints of the hand are triggered in response to the increased pressure.

Different groups of neurons fire simultaneously and form integrated parts of a pattern. With experience, the full activity may be ignited from activation of only a fragment of the pattern (Hesslow 2012). In the words of Barrett and Bar (2009, p. 1325):

> When the brain receives new sensory input from the world in the present, it generates a hypothesis based on what it knows from the past to guide recognition and action in the immediate future. This is how people learn that the sounds of a voice come from moving lips on a face, that the red and green blotches on a round Macintosh apple are associated with certain tartness of taste, and that the snowy white petals of an English rose have a velvety texture and hold a certain fragrance.

Thus, as discussed when introducing the notion of 'linguistic handles', different 'particularities' (in case of the 'cup'-activity, for example 'nerves triggered by the change of shape in the pads') act as 'handles' that have access to and in that sense 'control' associated neural patches (for example, 'specific neurons that are unaffected by shape, but sensitive to changes of heat in the fingers'). Here, it is important to remember that these particularities may be addressed both in the sense of neural correlate (typically bottom-up) and in the sense of experiential content (typically top-down). As argued in relation to implicit knowledge, it is unresolved to what extent the experiential content is present. To recapitulate, in some conditions, elicitation of a sub-activity *has no* experiential content. When stimuli occur subliminally, the response is neural activity without accompanying experience. However, often the particularities may be viewed both as neural (sub-activity) and as experiential content. Thus, it is in either of these senses, neural correlate including the experiential content, and neural correlate without experiential content, that words, sounds, odours, sights, haptic sensations and so on, may be matchless as 'handles' (or back doors, as I named them in Chap. 3).

Some word categories are uniquely efficient as handles opening into full simulations (see for instance the effects of concepts that refer to ageing in Bargh et al. 1996). As briefly discussed in Chap. 4, emotionally laden words that result from the linguification of strongly felt emotions may induce phenomenally stronger simulations, while neutral words may be less efficient as simulation-inducers of phenomenal experiences (in case of emotions the interoceptive 'particularity' of the neural assembly may weigh extraordinarily, thus it is not the word that is responsible for the efficiency but the situation that renders the particular emotion word adequate). Since in abstract knowledge acquisition direct experiences are absent, the phenomenal experiences inherent to perceptual experiences are absent too. Though the language learner, as always, is perceptually immersed, the actual perceptions in comparison with the direct experiences are less relevant (Schilhab 2012). In effect, in the off-line condition the means by which to grasp and remember the knowledge of importance is significantly reduced. To counter this and to facilitate understanding, the interlocutor may help the learner to access phenomenal experiences pending in the re-enaction. To that end, interlocutors may *exploit* for

instance emotional words to trigger particular phenomenal sensations in the conversational partner.

In the following, I argue that interlocutors use words as handles to activate phenomenally laden simulations based on mere exchanges of words in for instance conversation, which is decisive for the ability to learn about abstract phenomena without concurrent perception.

5.2 Words as Perceptual Inducers

The specific use of words to bring forth a particular imagery accompanied by a particular simulated sensation is well-known in therapies such as guided imagery (e.g. Garry and Polascheck 2000). For instance therapies with an imagery component are among the most efficacious treatments for posttraumatic stress disorder. The strategy used to relieve subjects of their mental suffering has remarkable similarities to interactional expertise conversations, though of course the former aims at treating mentally malfunctioning subjects who may differ significantly from mentally healthy subjects. The therapeutic linguistic exchanges are off-line and exploit the attention of the subjects to strategically chosen sensory experiences. To aid traumatised subjects, the therapist decides the themes and actions of the imagined event and takes great care to choose the efficient wordings to create scenarios that are desirable with respect to a successful treatment (Kealy and Arbuthnott 2003).

In pursuit of rehabilitation, therapists frequently draw clients' attention to sensory details in order to deepen their experience of the imagined event, allowing greater involvement of emotional processes which facilitate psychotherapeutic change[3]. According to Kealy and Arbuthnott (2003), Mary Goulding (putatively a renowned therapist) for instance frequently uses guided imagery to illustrate for patients their typical and idiosyncratic reactions to events (p. 803):

> Pretend that you are driving your car. You are driving a few miles over the speed limit. The car ahead of you stops suddenly without signaling and you apply your brakes immediately. Your car hits the car ahead and you are not hurt. Sit in your car a moment. What do you feel?! What do you say inside your head?

In such therapies patients might benefit from imagining experiences they have never had to practise.

To accentuate, Kealy and Arbuthnott (2003) cite Greenberg et al. (1993, p. 41): "The direct expression of experience is viewed as more productive than a

[3]The ability to introduce phenomenally strong images in conversation is corroborated by studies on implanted memories using guided imagery procedures, see also Chap. 2 (e.g. Hyman and Pentland 1996; Porter et al. 1999).

description of the experience. Expression increases the sense of identification with, and owning of, the experience"[4].

For the therapy to work and for imagined experiences to relevantly simulate real experiences, the simulation must be phenomenally powerful as demonstrated by studies on the similarities of phenomenal characteristics associated with perceived memories and guided imagery events (Arbuthnott et al. 2002). Here, participants recalled a memory of an actual perceived event, a natural imagined event, and an entirely imagined event and rated the phenomenal characteristics of each of these memories. Before the perceived memory theme was presented, participants were told that they would be asked to recall a specific event from the past. The participants were instructed to think of a recent time they spent in a library or a recent time they visited the doctor or dentist.

Prior to the natural imagery theme, participants were requested to recall something that they had imagined in the past, and prior to the guided imagery theme, participants were told to make up or imagine something on the spot. In the latter condition, for instance, participants were told to imagine shaking hands with the prime minister[5].

In this study, subjects reviewed their memories and guided imagery creations in silence, that is, without ongoing conversation between experimenter and participant. Thus, subjects relied on their individual ability to construct images, when the experimenter read a description of the setting and initial details of the event and participants were given approximately one minute to form a complete mental image (Arbuthnott et al. 2002; Heaps and Nash 2001).

Following the 'conversation' for each condition, participants completed a 39-item Memory Characteristics Questionnaire in which they rated the phenomenal characteristics of each memory. Items included memory clarity, complexity, sensory details, and memory for related events.

The researchers found that phenomenal ratings of guided imagery experiences were lower than both perceived and natural imagery memories for thoughts and feelings. Guided imagery ratings, however, indicated more contextual detail than

[4]Kealy and Arbuthnott (2003, p. 803) write further on the use of guided imagery: "Such explicit direction to focus on sensory experience is typical of the use of imagery to intensify current experience, and is present in both co-created and guided imagery. Intensifying current experience is commonly thought to improve the efficacy of psychotherapeutic conversations […]. 'Change will occur most effectively when the emotion scheme is accessed in the session and reflected on. […] Use of imagery and metaphoric language as well as empathetic conjectures that move beyond the surface, closer to underlying feelings, are helpful in evoking emotions' (Greenberg and Paivio 1997, pp. 116–117)".

[5]Arbuthnott et al. (2002, p. 526) state: "Setting: Imagine that you are at the legislative building. You notice a crowd of excited people, so you go over to see what is going on. The prime minister of Canada just happens to be visiting. One of his aides tells everyone that if they get into a line, the prime minister will shake their hands. You decide to wait in line (Question: Where were you in the line?).

Action: As you wait, you watch the prime minister shake the hands of the people ahead of you in line. The prime minister finally gets to you. (Question: What happens next?)"

natural imagery memories, probably due to context factors being specified in each of the guided imagery scripts.

It is interesting that participants were supposed to establish certain imaginations exclusively based on written descriptions. To test for the impact of the particular presentation style of words on the quality of imaginations during conversation, the researchers conducted another study on so-called co-guided imagery (Kealy and Arbuthnott 2003). Here, the development of imagery more closely resembles interactional expertise-like conversations, since the subject imagines an event in response to details provided by the therapist on-line. During the conversations in this experiment, participants' attention was directed to the sensory characteristics of their memories during both recall and guided imagery generation, which seemed to reduce the phenomenal sensory differences found in the former study.

On both studies Kealy and Arbuthnott (2003, p. 813) conclude (and in line with the results pertaining to implanted memories discussed in Chap. 2):

> When memories and guided images were considered silently by participants, sensory characteristics of perceived events were consistently rated higher than those of guided imagery, and reflective characteristics of guided imagery were weaker than those of either natural imagery or perceived memories (Arbuthnott et al. 2002). In the present experiment, when conversation occurred, ratings for sensory details were similar across event types, and ratings of reflective characteristics were higher for perceived events. These results suggest that if conversation has occurred about any type of memory, perceived or imagined, then the presence of vivid sensory information or reflective details may not necessarily be diagnostic of whether or not the event actually occurred.

Hence, to sum up, when the 'direction' of imagination on episodes the individual has never experienced is controlled by real-life conversational exchanges, the vividness of sensory details resembles that of actual memories. In the following, I will relate this particular feature to the mechanism that sustains the development of interactional expertise-like kind of knowledge.

5.2.1 The Virtual Room

Though the actual room is irrelevant as a contributor to perceptual stimulations in off-line cognition, e.g. conversations about shaking hands with the prime minister, a virtual room seems appropriate. I conjecture that this virtual room is predominately built by words in conversations. How is this possible? As previously discussed, during early linguification, when the subject's processing of words reaches certain proficiency, the ability to construct images from verbal information emerges. As posited by Denis (2002, p. 223):

> [N]ot only can the brain process verbal information (which is obviously not a subject of debate), but, more important, it can translate it into nonverbal representations whose properties are similar to those of visual images derived from perception.

In everyday conversations, exploration of the imagery part may not be very important. However, as soon as fluency in understanding is disrupted, as in asymmetric conversations in which one of the participants is in need of elaborate explanations, the ability to 'turn on' imagery appears strategically feasible.

In conversations between the language learner and the interlocutor, unknown expressions, supposed or desired to be understood, are impediments to normal understanding. Typically, one pauses and ponders about such expressions and seeks help from explanations to crack them open. As discussed in Chaps. 3 and 4, in the concrete phase the interlocutor prompts understanding by actively involving materials in the surroundings to act as material anchors.

However, in case of adult/adult interactions in interactional expertise, the linguistically competent learner relies on imagery and repeatedly poses questions to improve 'the simulation' he or she 'builds'. He or she will probably also ask the contributory expert to refine (or simplify) his or her explanation to facilitate understanding (Schilhab 2011). Why? When one exerts oneself to understand, simplifications that may be imagined serve as concretisation pumps, as the earlier example of Stephanie and 'spilling the beans' suggests.

In linguistic exchanges about absent phenomena in the interactional expertise-like knowledge situation, imagery readily prepares and solicits the conversational partner in furnishing the linguistic world even if that world is without the involvement of on-line items. In fact, the part played by the interlocutor, as in the case of the therapist, is to compensate for the lack of perceptual corroboration in the unfolding of the conversation. As noted, interactional expertise-like knowledge conversations are non-material in the sense that they cannot offer abundant relevant perceptual stimulations apart from those associated with linguistic activity (i.e. facial activations, tone of voice, non-verbal behaviour, linguistic rule-following, etc.; see for example Kontra et al. 2012). The interlocutor may implicitly or explicitly corroborate his or her explanations with non-verbal behaviours to facilitate comprehension and in normal settings, as we will discuss in Chap. 7, observations may actively be employed. However, counter to on-line conversations, interactional expertise-like knowledge acquisition is perceptually sort of off-line.

However, as guided imagery procedures demonstrate, for language acquisition of abstract concepts to succeed, ideally the interlocutor may replace the perceptual cues provided by the real world at the concrete level with linguistic descriptions. Also, descriptions ideally should elicit comprehensibility by activating vivid imagination in the learner. Naturally, the mental abilities of the learner are important. For imagery to be exploited in conversation and thus contribute to understanding, accessibility (the switch from no imagery to imagery) and maintenance (the ability to direct attention to imagery over time) seem central and will be discussed in more detail in the following paragraph. We will resume the discussion of the capabilities from the perspective of attention and executive functions in the learner in Chap. 6.

The task is challenging since the furnishing happens in a non-existent room created only by the individual imaginations of the interlocutor and the language learner. Such virtual spaces might be sparsely decorated compared with the space in

real life (the living room, the kitchen, the landscape). Moreover, the existence of the imaginative space is fed entirely by the linguistic web spawned in the conversation by the interlocutor and the language learner, hence the construction seems fragile.

To counter that, what generates the virtual space and what enables its continued existence? As already addressed, the imaginative space emerges as a result of deliberate use of expressions by the conversational partner, implicitly taking advantage of previous linguification processes.

Though experienced interlocutors may constantly nudge the emerging image in the learner, as discussed below, its continued existence to a significant extent depends on the ability to monitor the internal representation elicited by the descriptions offered. This task widely depends on the attentional capacity of the learner (see discussion later in this chapter). Also, the *capacities for imagery* are important. Subjects with high scores on a visual-spatial task (The Minnesota Paper Form Board) were significantly better at 'mental scanning' tasks after verbal instructions than subjects with low scores. Chronometric characteristics indicated that images produced by the latter group lacked consistent structural properties with the same amount of learning (Denis 2002). We will return to this issue in Chap. 6.

First, we will address the role of the interlocutor and some of the necessary tricks he or she masters for the abstract language acquisition to be optimal. To that end we will distinguish between the interlocutor's use of top-down and bottom-up processes to actively elicit imagery and phenomenal experiences in the learner.

5.3 Interlocutor Tricks of the Trade

A precondition for the elicitation of imagery during conversation, is for the interlocutor to gauge the level of comprehensibility in the language learner to match the level and maximise the efficiency of the interaction.

For abstract understanding to occur, the interlocutor will need to establish metaphors[6] that capitalise on our inclination to simulate the concrete meaning of an unknown expression. Just as the adult furnishes the on-line world, for instance holds up a cup, points to the cup, and exclaims 'cup', the adult now also furnishes the off-line world. When probing for the level of understanding, he or she seeks mutual comprehensibility and makes mental tableaus that are thought to match the

[6]Gibbs (2013) distinguishes between traditional metaphor scholars who study "A is B" statements, or 'resemblance' metaphors, such as "My job is a jail", "The man is a wolf", and "My surgeon is a butcher" and cognitive linguists who study 'correlation' metaphors that reflect recurring correlations in bodily experiences, such as "life is a journey", or "knowing is seeing". I do not intend a particular understanding of metaphor use. There may or may not be actual metaphors involved, but for simplicity when I use the expressions 'metaphor' or 'metaphorical expressions' I am referring to linguistic tools that readily recruit imagery in the perceiver to elicit sensations and associations when one struggles to understand.

As we returned to in the last part of this chapter, the metaphors of interest here are characterised by being novel in the sense that they possess the capacity to elicit conscious reflection.

understanding of the child. If the metaphors or concretisations do not efficiently transform to re-enactments, the interlocutor should address the subject by using alternative exemplifications. Thus, simultaneously, and especially if immediate explanations fail, the conversational partner follows multiple lines of thought to create the mental room in which the learner is supposed to make progress.

His or her ideal assignment is during the conversation to continuously and appropriately monitor the linguistic familiarity on the part of the learner. To obtain this goal the interlocutor may choose different linguistic tools distinguished on the basis of the resultant effects.

At the general level, the interlocutor may *use words as a guide* when he or she *instructs* the learner to imagine. He or she may of course use words as a tool to *enhance* (and simultaneously reduce) specific elements of imagery, either *top-down* by explicitly addressing and thereby enhancing particular attentional activities or *bottom-up* by use of particularly powerful imagery-generating expressions which are more or less automatically elicited.

The former case is involved when urging the language learner to concentrate on particular aspects of the virtual room, whereas use of metaphorical expressions exemplifies the latter strategy in so far as it is the words themselves and not the instruction that trigger particular images and phenomenal feels. In the latter case, words may play the part of material anchors in the sense that the mechanism of anchoring the acquisition of abstract knowledge to phenomenal experiences simulates the linguification of concrete phenomena (but see also Hutchins 2005).

5.3.1 *Instructions, Top-Down and Bottom-Up Linguistic Tools*

At the general level, at which the impact of the interlocutor is top-down controlled, subjects are guided by instructions to imagine. We addressed this briefly in Chap. 4. According to Babin and Burns (1997, p. 35):

> Imagery processing can be encouraged through verbal or written commands. In typical manipulations of this strategy, the experimenter gives instructions to the recipient to form mental images. Subjects are told to "form a mental picture…" or to "picture your-self in the situation." Giving individuals instructions to imagine, such as instructions to use mental imagery to aid memory, results in greater recall than giving them other verbal instructions, such as instructions to use repetition to aid memory, or no instructions.

In support, the use of imagery instructions to elicit imagery results in a greater number of evoked scenes and a greater number of inferred attributes (McGill and Anand 1989).

However, interlocutors may also ask detailed questions about certain aspects of the imagery to induce particular understandings. When manipulating the imagery, on the basis of descriptions provided by the learner, the interlocutor might direct the awareness of the learner to augment parts of his or her impressions on the expense

of other parts. Noll (1985) describes how 'imaginal response training' or stimulus training is an essential aspect of the training of the novice shaman by the master shamans and refers to Reichel-Dolmatoff's (1975: 79) account of the mental imagery enhancement training of a Tukano shaman (see Noll and Shi 2004 for a description of how the last Shaman of the Oroqen people of Northeast China was recruited to become a master shaman through extensive imitation training in the sense of 'the second spirit' (who assisted the master shaman) and three classic 'initiatory illnesses' and three healings):

> The quest for these power objects is difficult and slow. For nights on end the men will sit and chant, asking thunder to favor them with his power. Until, in their trance, they will see a tree, a piece of wood, or a stone and will suddenly know: this is mine, this is what thunder sent me! The drugged apprentice will mumble and groan in his trance. Close by, the paye is sitting. "What do you see? Tell me, what do you see?" he will ask insistently, and the apprentice will then find the words to describe his visions. "There is the bend in the river. .. a black rock… I can hear the water rushing…." "Go on, go on!" the paye will insist, his ear close to the other's mouth. "There are birds, red birds, sitting on the lower branches of the tree…." "Are they sitting on your left or on your right?" the paye will ask. And so they continue, haltingly, at times in deep silence, until the older man knows what kind of images and voices his pupil is perceiving and can now begin to interpret for him.[7]

In this example, the interlocutor, the shaman, stretches his mental power to vicariously, and through the use of words, manipulate the image perceived by the novice almost to a physical extent. Though imagery in this case has occurred bottom-up, aided by sleep deprivation and drugs, the maintenance of this virtual world is corroborated by the questions raised by the shaman, who actively enhances parts of the imagery while downplaying other parts. While asking for specifications of particular aspects of the reported image, the novice is implicitly nursed to maintain, attend to, and thereby augment the neural correlate sustaining that element. In this citation, the apprentice would probably have neglected the actual location of the red birds. Due to the shaman's emphasis, both the birds and their spatial coordinates are stressed and it is likely that the linguification process initiated by the apprentice is in fact consolidated by the linguistic interaction with the shaman.

Though particularly overt in the transformation from apprentice to professional shaman, actual mental training in which control of words to elicit particular images is practised is not reserved for shamanist novices but may also occur as a result of voluntary (or automatic) strategies performed by the interlocutor in common conversations. In a study by Lang (1979), the impact of conditioned responses experimentally manipulated by the interlocutor on the experience of the learner was investigated (p. 503):

> Subjects were presented with sample scripts, containing response propositions, and asked to imagine the scenes suggested by the text. Following each imagining, the experimenter asked them to report what they had actually imagined. The trainer reacted to these

[7]This example is from Noll (1985) who refers to Reichel-Dolmatoff (1975). *The shaman and the Jaguar*. Philadelphia, PA: Temple University Press.

> descriptions by systematically reinforcing all statements which indicated that the subject experienced himself behaving during imagery. Typical reinforced responses were "my muscles were tense" "I felt myself running", "my heart was racing" "I was gasping for breath" etc. Stimulus description was ignored by the trainer. Over trials subjects progressively increased reports of responding in their imagery and in the reported vividness of an imagined behavioural experience.

Obviously, the interlocutor may direct the subject's attention by deliberate appraisal or negligence of particular elements in the report. Hence, stimulus descriptions were downplayed while behavioural experiences (or descriptions of behavioural experiences) were reinforced. Note that the interlocutor made use of yet another linguistic tool. In the study, the interlocutor first overtly and thus top-down instructed the subject to imagine, but upon receiving reports changed strategy to covert bottom-up stimulation by making use of reinforcement strategies. This manipulation is then somewhat different to that pursued by the shaman master, although they may have the same end result. In the Lang study, particular aspects of the imagination are reinforced but these aspects are expressed. Lang continues (p. 503):

> We also developed a second training program based on the counter hypothesis, that vivid imagery is characterized by the number, clarity, and specificity of stimulus elements in the image. In this "mind's eye" training, subjects were reinforced for reports of the color, form, and pictorial vividness of things apprehended. The trainer pressed for more and more detailed content, while he ignored any reports of subject behavior in the scenes. These subjects also progressed under training, and soon came to report rich tapestries of sense impression during imagery.

Following Lang, it is then possible to control direct attention in conversational partners by tacitly nudging them to focus on specific aspects of their mind's eye. Obviously, when ignoring particular perspectives in the imagination, such as stimulus descriptions and instead respond to the vividness of behavioural experiences, the interlocutor shapes the verbal behaviour of the subject, i.e. what he finds socially acceptable to report. This may be no different from what Nunez the climber confronts in Collins' example of 'the valley of the blind'. Nunez is forced to neglect particular parts of his language. While we may not know for certain if the experiences referred to by 'forbidden' words will fade, from the current case at least, it seems that the interlocutor also exerts his influence on which phenomenal experiences will predominate the conscious space of the learner. Here, by reinforcement of reports of particular experiences, the interlocutor facilitates specific perspectives on the expense of alternative perspectives. The result might very well be inhibition of attending those experiences that are less acceptable. Compared with the method employed by the shaman master, the content of the imagery in the Lang study may be open to more variation.

To what extent attentional resources and concomitant phenomenal experiences are controlled during this delicate interaction is, however, difficult to assess. Given that the report is a 'particularity', in the sense of being co-active with the attentional processes in the aggregate, memory for the conceptualised parts of the imagery may be facilitated. A suggestion is that a precondition for verbal reports on particular aspects of the imagery is that subjects must consciously focus on them (Prinz 2007).

Consequently, as interlocutors overtly (as in the case of shaman novices) or covertly (as in the conditioned response) urge the conversational partner to give experiential reports, concomitantly they modulate particular neuronal correlates, since apparently attention strengthens the activity of the neural correlate probably by improving the neuronal signalling (Womelsdorf et al. 2006; Dehaene and Changeux 2011).

A word of caution seems appropriate with respect to the state of control by the interlocutor. Though interlocutors are also influential on perceptual experiences in on-line conversations, as discussed in Chaps. 3 and 4, the impact appears less extensive. At the concrete level, along with re-enactments generated by the expressions chosen by the adult interlocutor, the language learner (and the interlocutor) relies on his or her individual perceptual experiences to form appropriate interpretations and associations (a point we return to in Chap. 8). For instance, the fact that the cake is actually in the refrigerator as observed in an earlier encounter helps the child make sense of a sentence that refers to the cake later on. Direct experiences may here supersede the interpretation provided by the linguistically prompted re-enactment. Koening et al. (2004, p. 694) pose:

> when young children have well-established knowledge of a given fact—for example, they know what an object is called, they know what color it is, or they know the properties of the class to which it belongs—they do not accept statements that contradict those known facts. They correct speakers who make false statements and refuse these statements as bases for subsequent reasoning.

However, in case of phenomena such as 'future events', 'digestion', or 'God', of which children have no obvious direct experience (as is also the case with adults), they seem to depend on information from other people. In such situations, pre-school children don't know about the properties and therefore only have the choice of treating the accuracy of previous labelling as relevant to the informant's current reliability. This makes them more likely to learn new words from previously accurate than from previously inaccurate informants (see however, Hodges et al. 2014).

To sum up, the associations used to corroborate the emerging understanding of new concepts in abstract learning may to a large extent depend on the choices made by the adult interlocutor. Denis (2002) claims:

> the structure of information in descriptions greatly constrains processing. A listener has no other choice than to adopt the sequence that has been selected by the speaker, which may have serious consequences if the sequence does not fit in with the listener's expectations. (p. 217)

Likewise, though maybe not directed at the transfer of knowledge, the construed conversational experiments as described by Lang, or the shaman endorsement described by Noll, demonstrate how interlocutors may endorse particular takes on the imagination of the learner using either top-down or bottom-up mechanisms. It is not unlikely that therapists might use similar tools in guided imagery conversations for healing purposes.

5.4 Conversations Are Cooperative Constructs

For now, let us leave meticulously planned conversations, as exemplified by shaman training and the reinforcement experiments, and turn to what happens in more common conversations aiming at acquisition of interactional expertise-like knowledge. In such open conversations, I argue the basic 'material' of the conversation is more in the hands of the interlocutor. This makes the responsibility for the conversation asymmetric but also provides the interlocutor with the power to 'manipulate' the mind of the learner.

As argued above, to optimise the success of understanding in practice, the interlocutor must then tentatively assess at which level expressions are meaningful to the learner to calibrate his or her imagistic explanations.

Since children in particular differ in personal experiences and level of linguistic understanding of significance to their linguistic abilities, conversations vary in relation to which images should be sustained during conversations. To grasp abstract or never experienced concepts, the child could be aided to mentally recombine details from past events to construct meaningful novel scenes, as discussed in relation to experiments on imagining a future birthday.

Clearly, to probe the level of understanding and to expose the learner to comprehensible conversation relies on sensitivity and the ability to take on the viewpoint of the other. However, this also calls for co-operative features in the learner and the ability to adjust to the level of the conversational partner (Bohannon and Marquis 1977).

Why are learners co-determining the adjustment abilities of the interlocutor? Apparently, for the listener to follow linguistic explanations or narratives that may not unfold bottom-up, he or she has to simultaneously represent to keep track of the descriptions that are unfolded. Seemingly, from the perspective of the learner the representations emerge as a result of both *bottom-up* (the words used) and *top-down* (the voluntary control of attention) processes. On the one hand, comprehension of sentences during conversation automatically triggers the perceptual activity in the mind of the learner (tacit or consciously). On the other hand, there may be no immediate understanding ready. Due to the difficulty of decoding the conversation, the learner becomes alert and compensatory activities seem likely. For instance, subjects may attempt to focus on particular aspects of the imaginary representation. If too many of the variables (words for objects, actions, or events) are unknown to the language learner, the ability to form representations is reduced and focus is lost.

Let me sum up issues with the asymmetry and responsibility for information in the interactional expertise-like conversation on the part of the interlocutor with an example. Well-known to practitioners of giving speeches and lectures is the ominous threat of losing the attention of the audience. The project of constructing an understanding based on the explanations of the interlocutor is fragile in the sense that it is held together entirely by the listener's ability to maintain the growing representation. The listener is also cognitively loaded since he or she must keep more alternative 'drafts' in his or her minds' eye and sustain several tracks in

parallel (ghost-copies) while adjusting the interpretation according to the unfolding narrative. Thus, the mental work seems highly vulnerable to external disturbances (external stimuli or irrelevant thoughts and emotions) that interfere. The demand on the representational ability is extraordinarily high (relevant external stimuli to sustain the representation would ease the strain on concentration). In a sense, conversational progress mitigates the effort by allowing supplementary questions to shed light. Questions highlight uncertainties and their answers help to prune and shape the temporary edition of the representation. However, if much of the description is difficult to represent, the maintenance of the representation is destabilised and understanding is lost. Therefore, the interlocutor aiming at mutual comprehensibility will manipulate his or her descriptions and choices of expression to let the learner in on the shared experience.

Despite exchanges of questions and answers, and that the conversation is a co-construct, the conversation is asymmetric. Since the adult interlocutor is expert, he or she takes the responsibility for the construction of shared mental space and for the successful reaching of mutual comprehensibility. In this endeavour, the interlocutor must refrain from imposing his or her own level of understanding on the listener. The reason is that his or her own (expert) level probably is inaccessible to the learner. The asymmetry instantiates the differences in knowledge level. Therefore, at the same time he or she must maintain and sustain his or her own (expert) understanding and raise his or her sensitivity to the level and quality of the representations of the listener. The enterprise is rather demanding. To quote Kierkegaard[8]:

> If one is truly to succeed in leading a person to a specific place, one must first and foremost take care to find him where he is and begin there. This is the secret in the entire art of helping.
>
> Anyone who cannot do this is himself under a delusion if he thinks he is able to help someone else. In order truly to help someone else, I must understand more than he–but certainly first and foremost understand what he understands.
>
> If I do not do that, then my greater understanding does not help him at all. If I nevertheless want to assert my greater understanding, then it is because I am vain or proud, then basically instead of benefiting him I really want to be admired by him. But all true helping begins with a humbling.
>
> The helper must first humble himself under the person he wants to help and thereby understand that to help is not to dominate but to serve, that to help is not to be the most dominating but the most patient, that to help is a willingness for the time being to put up with being in the wrong and not understanding what the other understands.

However, sometimes conversations don't allow for perspective taking. For instance, when teachers teach, they normally address a larger number of pupils and therefore are forced to address issues at a general level. Better understanding is accomplished by the serial unfolding of scenarios in conversation, designed to match the

[8]The opening paragraph to Chapter A2 from Kierkegaard's Writings, 'the point of view' Volume 22 translated by Howard V. Hong and Edna H. Hong. Princeton: Princeton University Press, 1998.

understanding of the individual. Therefore, naturally, learning under circumstances where clues cannot meet the criterion of being individually adapted, may disintegrate. In such conditions, as discussed in Chap. 6, students may fall into day dreaming and mind wandering and therefore miss critical information to succeed in sustaining the abstract construct. To grasp information at the abstract level is thus highly vulnerable and dependent on the commitment of the interlocutor to the needs of the individual. Obviously, the teacher challenged by class education cannot examine the response level or mind the historicity of the individual student. As a result, subjects familiar and receptive to the level at which he or she chooses to convey information, the wordings and metaphors he or she uses, might profit the most.

5.4.1 *Varying Levels of the Interlocutor*

One may ask if the role attributed to the interlocutor is sufficiently warranted since it seems to presuppose a higher level of awareness of the impact of language that we experience on a daily basis.

Though individual differences definitely exist, Antaki (1985) describes how adults normally adapt their conversational profile to the circumstances:

> In ordinary displays of socially competent discourse, explainers may be expected to orient the parameters of explanation by their *choice* of *description* of *the event* under discussion. […]This choice will be determined by the nature of the interaction and the shared assumptions of the interactants. In some cases (e.g. the case of a stranger being informed of local customs), little may be assumed to be shared and the description may be thoroughgoing. In others, much is assumed to be shared and the description may be elliptical. In some cases, the description itself is sufficient as an explanation, and in some cases the description strongly predisposes one set of explanations.

It may not be farfetched to claim that as competent language users have been trained for years to master the language, simultaneously they have trained for years in the role of conversation partners in numerous conversations with numerous interlocutors. Thus, most adult speakers have quite remarkable skills when it comes to actively 'repairing' conversational asymmetries.

As indicated by Antaki, for instance, conversations between native and non-native speakers concerned with the underlying goal of mutual comprehensibility demonstrate such sensitivity. In conversation, native speakers tend to adjust their linguistic outputs (they talk so-called foreigner talk). Such features include slower speech rate, simpler and shorter sentences, less use of contractions, fewer pronouns, and a vocabulary that is restricted to high-frequency words (Zuengler 1991). Thus, mutual comprehensibility is achieved by simplifications and common denominators, which are likely to depend on already well-known entities and concepts. Thus conversations between natives and foreigners somewhat imitate first order linguification processes because for speech to be understood the interlocutor actively seeks help in the environment by gestures and ostensive pointing to secure

mutual comprehensibility. When natives speak more clearly and in shorter sentences implicitly, they attempt to enhance the comprehensibility through perceptual accessibility.

To sum up, so far we have discussed how interactional expertise-like knowledge, that is off-line knowledge with which the learner has no prior experience, widely depends on the skills of the interlocutor. We have also briefly touched upon the tricks used by the interlocutor to sustain the attention of the learner.

The interlocutor takes the lead in the interaction, since he or she must compensate for the lack of direct perceptual cues. By use of metaphorical expressions, strategically chosen based on the level of comprehension, the interlocutor seeks to create a virtual room in which the learner may build his or her growing understanding. I have argued and exemplified that the interlocutor may develop quite advanced tools to direct the attention of the learner even to the extent of overt manipulation towards parts of his or her imagination. I have also pointed to the dependency on mental abilities in the learner, a topic we will deal with more thoroughly in the next chapter. In the following paragraph, we turn to the anatomy of the emerging knowledge. Here I address what the new understanding consists of, and elaborate on the mechanism which I have referred to as 'derived embodiment'.

5.5 Derived Embodiment[9]

In the previous paragraphs, we have discussed which circumstances need to be met for *derived embodiment* to occur, such as probing for comprehension and emphatic skills in conversations. We have discussed how interlocutors may cultivate particular sensations by reinforcing or devaluing particular responses either top-down by the use of instructions or bottom-up by strategic use of 'sensation-loaded' words or even reinforcement strategies. When used in derived embodiment processes, these sensations have been elicited off-line as a consequence of the use of metaphorical expressions as a linguistic handle. Now we may elaborate in detail on the specific mechanisms that underlie derived embodiment, that is, understanding without direct perception, to render abstract knowledge such as interactional expertise-like knowledge possible.

In conversations, when the interlocutor locates the right expressions to induce understanding of a new topic or when reading a text, and linguistic processing elicits vivid phenomenally experienced scenarios, derived embodiment is in function (the conditions when conversing and reading are not congruent, an issue we address in more detail at the end of this chapter).

When a child is told about an exotic fruit named X and told to imagine the taste of X as a mix of mango and pear, and the texture of X as that of an apple, the

[9]I have discussed some of the thoughts and examples on derived embodiment appearing in this chapter in Schilhab (2015c).

understanding of X and the acquisition of the concept X is then accomplished as a derived experience. Though perceptually this is undeniably many times weaker in the sense of stability, strength, and distinctiveness than what would be accomplished in direct experiences, X becomes embodied nevertheless.

Hence, derived embodiment is the mental mechanism that turns knowledge of phenomena not directly experienced into 'as-if' directly experienced knowledge by associating phenomenal feels, which are characteristic of direct experiences, with linguistically presented concepts. In derived embodiment, subjects actively associate phenomenal feels obtained in one context with verbal descriptions of phenomena or events they did not experience in order to grasp the concept. In derived embodiment, intangible phenomena become as-if tangible as a result of their almost promiscuous borrowing of corporeality from well-known experiences of real objects. In short, when pure imaginings absorb, so to speak, and during that process become associated with representations of concrete events or phenomena to improve understanding, derived embodiment is at work.

As demonstrated by the shaman training and reinforcement experiments, imaginative abilities render manipulation and control of the elicited image possible by for instance accentuating parts that may then attract the attentional focus.

Subjects enrolled in derived embodiment processes are capable of simultaneously establishing and maintaining imagination instigated by external communicative sources and experiencing the represented perceptual feel. In a scaffolding process, the revival of experiences renders them open to redirection in support of phenomena which are not directly experienced but only verbally described.

The similarity to the linguification process characteristic of the word-object paradigm is apparent. Central to derived embodiment is, in the absence of experiences of the actual (real) referents of the concepts, the fleshing out, by proxy, of mentally established constructs. This occurs in the form of imagined concretisations that involve phenomenal sensations which now, in a second order linguification process, become associated with the new concept. In this way, derived embodiment (as a second order linguification process) provides qualitatively similar linguistic competences that pervade embodied cognition when addressing abstract phenomena.

Second order linguification processes are fuelled by the re-enactment (likely to encompass both top-down and bottom-up versions) of direct experiences. Therefore, though in a significantly weaker version, the neural complexity of the linguification product is likely to apply also to the second order linguification. Moreover, as discussed in Chap. 7, the top-down control of the representation may facilitate some of the sub-activities in a way that places the weight of the activity significantly different from that of the activity in the original assembly.

5.5.1 Example 1: Aversive Fear Conditioning

In short, derived embodiment emerges when pure imaginings absorb, so to speak, and during that process become associated with representations of concrete items or

phenomena. The crux of the mechanisms is whether the phenomenal feel associated with the direct experience may transfer to the new concept.

Such associative mechanisms are not unknown to studies in, for instance, aversive fear conditioning that explore the extent of fear conditioning using instruction (verbal learning) only.

In the normal fear-conditioning paradigm, subjects must have direct experience with an aversive event. Typically, the subject is exposed to a neutral stimulus, such as a blue square, which is temporally paired with an aversive stimulus, such as a mild shock to the wrist (Phelps 2005). The shock elicits physiological responses characteristic of aversive stimuli.

Phelps writes (p. 64):

> For instance, autonomic nervous system arousal occurs as part of a fear response, one measure of which would be an increase in the skin conductance response (SCR), an indicator of the mild sweating that occurs with arousal. After a few trials of pairing the blue square and shock, the blue square begins to elicit an SCR when presented alone. This conditioned response indicates that the previously neutral blue square has acquired aversive properties.

People with lesioned amygdala, a subcortical brain structure more or less specialised for contributing to the corroboration of emotional responses, fail to acquire this conditioned response, which suggests that the amygdala is necessary for the acquisition and expression of a conditioned response.

According to Phelps (2005, p. 66), humans can learn about aversive stimuli *without actual experiencing* them in conditions that rely exclusively on instruction and verbal communication.

> Humans can learn through verbal instruction. For example, you might fear a neighborhood dog because the dog once bit you. However, you might also fear a neighborhood dog because your neighbor mentioned in conversation that it is a mean dog that might bite you. In the second scenario, there is no direct experience with the dog and an aversive event; rather, there is awareness and understanding of the aversive properties of the dog. When simply being told that the dog is unfriendly and could be dangerous, it is unlikely you would experience an emotional response. However, if you encounter the dog, you would likely have an emotional reaction.

So, without the direct experience of receiving a real shock, can cognitive awareness of emotional properties of a stimulus due to verbal instruction influence or involve the amygdala?

To explore this question, in an "instructed fear" study a blue square was paired with a shock. However, instead of subjects directly experiencing the blue square and shock, they were *told* that a shock would occur to their wrist when exposed to the blue square. All participants indicated that they believed the instructions although they never directly experienced getting the shock in connection to experiencing the square. When measuring skin conductance response (SCR) while presenting the blue square, subjects showed increased arousal levels.

This indicates that expectations about mild shocks to the wrist based on verbal instructions only (without direct perceptual experiences) result in significant physiological responses. As in the case of the comment on a fierce dog, the verbal

pointing to shock experiences elicits 'as-if' experiences of shock in subjects. The derived embodiment 'learning' occurs when subjects focus on the experiential content of the concept 'shock', and associate the experience with the previously neutral condition, the concept of 'the blue square'. Despite the lack of direct experience, in case of arousal levels, the verbal description is of such power as to stand in for the experience of a real shock.

That direct fear conditioning (normal paradigm) and instructed fear conditioning (only linguistic) neurally differ, is revealed in imaging studies on the associated amygdala activity. Phelps et al. (2001) write:

> In fear conditioning, this correlation was carried by the right amygdala. In the present study, activation of the left amygdala was predominant and more strongly correlated with the fear response.
>
> What might account for these differences in laterality in conditioned versus instructed fear? In the instructed fear task, subjects are aware of the aversive nature of the stimulus before scanning. A previous study has suggested that the left amygdala responds when subjects are aware of the aversive nature of the stimulus, whereas the right amygdala responds when subjects are unaware of this contingence.

Phelps et al. (2001, 440) also suggest that the modality of the stimulus is responsible for the laterality in amygdala activity. When the aversive stimulus is visual, the right amygdala is most likely to modulate the fear response:

> Visually aversive stimuli elicit an immediate, negative representation that is not dependent on elaboration by subjects. When the aversive nature of the stimulus is learned verbally, the subjects must generate a mental representation of the aversive event because it does not exist in the immediate environment. The difference in laterality of amygdala activation may reflect the extent to which the representation elicited by fearful stimulus depends on elaboration and interpretation of the subjects.

Accordingly, imaging studies on instructed fear, a prominent example of derived embodiment, show anatomical differences that involves different amygdala activity but also different insular cortical activity. This seems especially important since the insula, according to Phelps et al. (2001), has been suggested to be involved in conveying information about the aversive nature of stimuli to the amygdala. Instructed fear conditioning (in the sense of a derived embodiment process) depends on the imagined discomfort of receiving a shock that was never experienced. According to Phelps et al. (2001), it follows that: imagined and anticipated discomfort results in a cortical representation of fear, which may be relayed to the amygdala via the insula.

To sum up, the studies on instructed fear conditioning are interesting both in the sense that they seem to corroborate the claim that verbal instructions are indeed capable of eliciting images in the listener sustained by previous experiences (here of fear induced by the imagined pain from shock). This may ultimately be associated with a hitherto unknown neutral concept in a derived embodiment mechanism. Moreover, to the researchers the laterality of amygdala activation is related to bottom-up and top-down activation of the fear. When perception of fear occurs visually and thus bottom-up, the fear is immediate and implicit (and the source

external to the subject). However, when fear is verbally induced, the fear is activated top-down by way of imagery as an explicitly controlled activity (and the source of the fear internal to the subject).

Though Phelps notes that verbal reference to the putative meanness in the neighbour dog is unlikely to elicit emotional responses, emotional memories as emotionally salient content might be particularly suitable to sustain the derived embodiment mechanism. According to Cuthbert et al. (2003):

> Emotional networks include three classes of information (or types of representations): information about the physical stimulus context in which the event occurred, interpretive associations that elaborate the event's meaning, and most importantly for the current investigation, procedural representations of the efferent reflexes - visceral and somatic - that define expressed emotion. Given the presence of procedural representations (and assuming high strength of association among network elements), retrieval of an emotional memory is expected to prompt actual activation of the represented muscles and glands, albeit generally below the threshold of overt action.

If such procedural representations are included in verbal instructions, as predicted by ordinary linguification processes and the idea of interactive volatile sub-activities, previous experiences associated with ideas of, for instance, an 'electric shock' are re-enacted almost as if experienced on-line despite the lack of explicit experience. One could hypothesise that this is exactly why the aversive properties of the dog are understood (we return to the concept of understanding in Chap. 7).

5.5.2 *Example 2: Metaphorical Expressions in Singer Education*

As claimed throughout this account, derived embodiment might be especially potent in relation to grasping interactional expertise-like knowledge and we should expect the mechanism to flourish in asymmetric conversations that deal with the transfer of knowledge. The sensitivity to the level of the learner and the emphasis of concrete images to furnish the virtual room may be salient features of the conversation. In the teaching of singers, some interlocutors develop techniques that seem to exploit linguistic exchanges exemplary of derived embodiment mechanisms (Åberg 2013, p. 3):

> Many teachers develop a refined way of using metaphors and figures of speech. They address a problem, not with instructions, but by trying to change the mindset connected to a situation in which the problem arises. This use of metaphor is always connected with the specific situation in which teacher and student find themselves.

Thus, by metaphor use teachers attempt to establish particular sensations or a particular embodiment feeling to ease the student's ability to grasp what is conveyed. Therefore, some teachers of singers refine the use of metaphors in accordance with the personality of the individual student (Åberg 2013, p. 44):

> To reach a student with a metaphor, I must be convinced that we mean the same thing. And how do I know that? This is where dialogue comes in. "Do you understand what I mean when I say … ?" To teach a singing student a soft attack I sometimes refer to clutch control in a car, and use the expression "find the holding point", but only with people who can drive a car. They understand what I mean at once, while a person who has never driven a car will just look very confused. In my teaching I often use images from every day (?) events. To find the flow, for example: "surf the air" or "go skating". The difficulty for a song teacher is that the student's tensions, which are so clearly heard, are very often not visible. As a teacher I must then create a state or condition that can really help dissipate this tension. If you know the student fairly well you can use his/her everyday life and interests as a basis on which to build a metaphorical language that will work.

However, to some students, making sense of metaphors works less well than talking in a very concrete sense. The teacher continues (ibid.):

> Yet there are, I have noticed, students whose best response by far is to explanations that are straight to the point, such as "lower your larynx", "widen your pharynx" and so on. Flowery language is too muddled for them. You have to proceed with caution, pussyfoot forward here. Perhaps these are students for whom the concrete is the most important and readily accessible path forward? Or it may be that these students are not very imaginative, and may therefore not be so successful as musicians … For me it would be extremely difficult to teach if I could not use metaphors. They help when you want to tackle a particular problem. But I must be sure that the student has the same, or similar, associations as I do if the image is to be easy to understand. And metaphors must be used with discernment. An image that suits one person may be completely incomprehensible to another.

Hence, idiosyncratic preconditions must be taken into account in metaphor use. Students may be classified as concrete thinkers who may fare better with concrete communication[10]:

> Knowing that a student is a concrete thinker, communication partners, including teachers and parents, should adjust their language accordingly. They should either avoid the use of language that is at too high a level of abstraction, or link abstract language with its concrete equivalent. For example, in encouraging a student to study hard, a parent might say, "You've got to give it your best shot – study real hard." "Give it your best shot" is a metaphor that might be too abstract; "study real hard" is a literal or concrete equivalent.

Apparently, the use of concrete words may be more efficient and constrained triggers of images as already discussed in connection to rumination studies in Chap. 4, which demonstrates that metaphorical expressions may differ with respect to degree of constraints. The inclination to concretise words in 'concrete thinkers' appears to be related to a reduction in degrees of interpretive freedom. This reduction is related to a smooth and straight conversion from concept to re-enaction, as demonstrated by the use of action words (for instance 'smile') that induce stronger muscular activity than adjectives ('funny') (see Foroni and Semin 2009).

[10](http://www.projectlearnet.org/tutorials/concrete_vs_abstract_thinking.html. Accessed 22nd February, 2014).

5.6 Metaphors in Neural Terms

From the singers' education and the brief discussion of concrete thinkers, one may wonder if the use of metaphorical speech is always an efficient remedy. Apparently, this also questions the generality of derived embodiment processes in turn. Though metaphors elicit powerful imagery by exploiting the concrete that entails deep phenomenal experiences in particular circumstances, metaphor use might have different linguistic purposes. For example and most notably, not all metaphor use is directed at improved understanding. In fact, in metaphor use such as "I am the good shepherd, […] and I lay down my life for the sheep. *The Bible, John 10:14–15*", the listener is intended to immediately grasp what is meant, and not to associate the animal and the affiliated caretaker. On the other hand, in derived embodiment conversations, e.g. in education of singers, the continuous asking and answering of questions by use of metaphors makes the cognitive process different. When comparing the situations, an obvious difference in the unfolding of the process is revealed. In derived embodiment conversations, the ability to take turns, the focused attention, and the active involvement of the interlocutor contributes in a qualitatively different way to the process of understanding.

The co-activation of interlocutor and learner may enhance focusing (and activate top-down as in instructed fear conditioning), which may ultimately lead to stronger phenomenal experiences.

Neurophysiological studies on the acquisition of novel metaphors seem to sustain that attention and awareness make a difference to processing. Novel metaphors are crucial in eliciting concrete thinking as demonstrated in studies in which the first time one runs across a novel figurative expression, the implied actions and nouns are likely to be understood in a literal sense (Raposo et al. 2009, as well as Stephanie at the beginning of this chapter). For instance, the first encounter with the expression "kicking the bucket" activates the neural correlate of the literal understanding of a bucket, which might also encode action-related understanding (see also Aziz-Zadeh et al. 2006; Mashal et al. 2008). Thus, when meeting new linguistic descriptions, either in sentences or in whole paragraphs, familiarity with some of the concepts will ease the process of meaning attribution. Such findings sustain the claim that we automatically use our well-established linguistic competences to grasp new concepts by veritably building on top of existing representations.

However, other factors independent of first-person experiences, such as the saliency of concepts, seem to be important as well. For example, the general linguistic theory Graded Saliency Hypothesis posits that a meaning is salient because of factors such as conventionality, frequency, familiarity, and prototypicality. The salient meanings of expressions are always far more accessible than the non-salient meanings, irrespective of literality or non-literality, since to decode non-salient meanings requires inferential processes (e.g. Giora 2002). The idiomatic expression "he is out in the left field" (which means "he is actually quite lost") is salient because it does not derive its meaning from the individual words in the sentence.

The meaning is listed as a whole. In its literal sense, the meaning arises from the combined contributions from the individual words and is therefore compositional and more costly to decode.

Aziz-Zadeh and Damasio (2008) make the following observation:

> Highly familiar meanings that are represented in the mental lexicon are accessed more readily. According to this model, conventional metaphors, such as "grasp the situation", the metaphorical meaning (to understand) is more salient than the literal meaning (a grasping action). Thus it is the figurative meaning that would be activated first, without needing to access the less salient literal meaning […]. Because the metaphorical meaning of novel metaphors are not salient – that is, they are not yet stored in the mental lexicon – these representations would not be activated first. Instead, for novel metaphors, the literal meaning would be more salient and accessed most readily.

When particular metaphors are commonly used, metaphorical use of action words, which in the literal sense are connected to movements of limbs such as 'kicking the bucket' or 'grasping the situation', seem to have a different neural underpinning compared with those associated to the literal meaning of the involved action verbs as described in fMRI studies (Mashal et al. 2008).

Apparently, literal understanding of metaphoric expressions will gradually diminish as the metaphoric interpretation prevails. According to Lacey et al. (2012, p. 416), some researchers suggest that: "conventional metaphors, such as time/space mappings […], are merely overlearned idiomatic associations and that lexicalization of such metaphors results in separate stored meanings." Accordingly, fMRI studies in pursuit of the contiguous activation of sensory-motor cortices and linguistic areas seem to emphasise so-called semantic flexibility. This means that "semantic context determines the degree to which alternative senses and features are processed when a word is heard" (Raposo et al. 2009, p. 394). In this study, subjects were presented with action verbs in isolation, such as 'kick' or 'trample', and significant motor activation was found to result. But if action verbs were embedded in metaphoric expressions, then motor activation was insignificant. The inability of metaphoric phrase reading to activate neural areas corroborating the motor activity of certain effectors, say hands or feet, is also found in Aziz-Zadeh et al. (2006).

Seemingly, due to comparisons of the phenomenon that is in need of explanation to concrete features and actual sceneries, at the same time literal and idiomatic meanings are imbued. Context will eventually decide which meaning is the more plausible. So, brain activation patterns differ when semantic meaning is coupled either to factual incidences or to familiar idiomatic expressions[11].

[11]Studies on right and left hemisphere activation show further complexity with respect to the representations of metaphors. Thus, the right and left hemisphere (RH and LH) seem to encode idiomatic meanings differently. Priming studies that test the effect of different interstimulus intervals have revealed that LH predominantly selects a single interpretation on the cost of alternatives, whereas RH activates diffuse semantic fields and by that keeps alternative interpretations open in time. The result is the ability to solve putative ambiguous idioms and expressions and retain the ability to revise first interpretations in light of additional stimuli piling up. So, while RH is busy keeping many alternative routes to understanding expressions open at a time, LH settles on one interpretation.

5.6.1 Single Use and Common Metaphors

In the context of derived embodiment it might seem feasible then to distinguish between single event metaphorical expressions and metaphors in common linguistic usage. When metaphors are used by teachers to make singers understand a new approach to singing, the teachers intend for a new insight to arise (Åberg 2010. p. 41):

> The dressage rider who, apparently without effort, proudly, with a smile and in a top hat makes the horse perform quite remarkable feats. The singer is both horse and rider. […]The raggare, the Swedish greaser, cruises slowly through the town streets in his souped-up American car, acutely aware of what he has under the hood. The singer is both car and driver.

However, metaphors in common linguistic usage may not necessarily serve the same purpose.

According to Chatterjee (2010, p. 100), metaphors are characterised by the disregard for sensual properties:

> Thus verbs used literally describe manners of motion, and in the sentential context perhaps the paths and locations of these manners of motion. The conceptual attributes of verbs have to do with notions of source, goals or changes of states. When verbs are used metaphorically, the sensory attributes are attenuated and the conceptual attributes carry the bulk of the meaning. Thus *the man falling under a spell*, does not describe physical motion, but does describe arrival at a new state.

Consequently, the neural correlate of figurative sentences is not likely to accommodate the perceptual activity that sustains understanding in the literal and sentential sense[12]. An fMRI study (Chen et al. 2008) contrasted spatial metaphors such as in the sentence *the man fell under a spell* with literal metaphors such as in *the child fell under a slide* and found greater activation in the left lateral temporal lobe and left inferior frontal cortex in the latter case.

The suggestion is that though the temporal cortex processes aspects of motion, the more abstract the interpretation the farther removed from posterior perceptual networks is the neural circuitry (Chatterjee 2010, see also Desai et al. 2011).

However, some studies make opposite claims. Based on experiments involving both behavioural and trans-cranial magnetic stimulations (TMS), Glenberg et al. (2008) showed that metaphorical expressions have the same likelihood of engaging

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(Footnote 11 continued)

Openness to different interpretations as demonstrated by RH activation in metaphor studies might actually reflect a kind of creativity which opposes the rigidity of the LH activation (Mashalet al. 2007).

[12]Chen et al. (2008) distinguish between so-called nominal and predicate metaphors. While nominal metaphors semantically align distinct nouns, predicate metaphors use motion terms figuratively. Chen et al. emphasise that it is far from obvious that results obtained with nominal metaphors generalise to predicate metaphors. At issue in predicate metaphor comprehension is the fact that the level of abstraction in action event and verb processing plays an important role and may be reflected in the anatomical organisation.

the neural correlate of concrete experiences such as perceptual and sensomotoric areas as literal expressions.

In the behavioural study, subjects were exposed to both literal and figurative action sentences, such as 'you carry the pizza to Andrea' and 'Arturo presents the arguments to you', as well as nonsense sentences and instructions to judge the sensibility of the material. By manipulating the location of the response button, the experimenters could test the so-called ACE interaction (ACE refers to 'action sentence compatibility effect'—which expresses that judgments are faster when the action implied by the sentence matches the action required to make the response).

They conclude (p. 912):

> [W]hen judging a sentence describing action toward the reader, judgments are faster when the response is made literally moving the hand toward the reader, whereas when judging a sentence describing action away from the reader, judgments are faster when the response is made by literally moving the hand away from the reader. Importantly, the size of the ACE interaction was not statistically affected by the concreteness factor.

In the TMS study, new subjects were exposed to both concrete and abstract transfer and no transfer sentences and concurrent TMS-pulses to the hand motor cortex, while Motor Evoked Potentials (MEPs) were measured from hand muscles. Both concrete and abstract transfer sentences elicited MEPS in the hand muscles, while no-transfer sentences did not. The contradictory results may actually be explainable within the context of linguification processes. If metaphors refer to a particular perceptual activity or concrete activity which is rarely physically experienced, then over time the neural correlate that sustains the metaphor is activated relatively more through the conceptual handle and relatively less through the perceptual handle and the perceptual activity will diminish. In comparison, those metaphors that refer to perceptual or physical activities commonly encountered are still activated through perceptual handles which therefore are continuously maintained.

To sum up, for derived embodiment to work, i.e. for an understanding of phenomena, events, or acts of which one has no direct experiences to be improved, metaphors may have the capacity to form new scenarios that involve concretisation and inferred phenomenal states. This capacity seems to be linked to the ability to attract attention. Old metaphors which have been used numerously are likely to be subliminally processed and therefore also outside conscious focus.

Thus, so far I have proposed the mechanism of derived embodiment to account for acquisition of interactional expertise-like knowledge. If linguistic immersion amounts to abundant conversations with knowledgeable and skilful interlocutors who deliberately emphasise with the comprehension level of the language learner in mind, abstract knowledge may be acquired in a second order linguification process. In this process the experiential content of previous perception is actively associated with new concepts. The instructed fear paradigm instantiates the mechanisms behind the transfer of phenomenal experiences to new concepts and conversations between teachers and singers, exemplifying how the proficient interlocutor intentionally plans conversations to facilitate derived embodiment processes.

Metaphors are particularly productive conversational components to get derived embodiment processes launched. However, novel metaphors that attract the attention of the learner seem especially successful because they seem to force the learner to imagine and phenomenally re-enact perceptual experiences.

In that sense the derived embodiment process is similar to the first order linguification normally in focus in embodied cognition studies. One may claim that the cognitive system exploits mechanisms we are biologically inclined to employ, when we associate the perceptual feeling from previous direct experiences to concepts we did not simultaneously experience directly. The trick is, though, to simultaneously exploit the mental capacity of a significant other for the derived embodiment process to unfold its full potential.

Chapter 6
Mental Applications

Although we set out to explore and discuss interactional expertise-like knowledge as a particular kind of knowledge in Chap. 2, when discussing the background mechanisms it turns out that, with minor variations, this particular linguistic acquisition appears to be quite common. Linguistic interactions that focus on absent or never experienced phenomena are typical of many conversations. Derived embodiment processes contribute to understanding, when recommending the conversational partner to visit particular restaurants and tourist attractions on a holiday trip he or she has not yet been to, or instructing him or her as to how to fix a mechanical problem in a bicycle. Professional interactional expertise conversations that aim at focusing on abstract phenomena in specific disciplines are then the extreme variant of abstract knowledge acquisition.

Hence, the mechanism of derived embodiment that sustains re-enactments through elaborate use of linguistic handles installed by the linguification process to compensate for the lack of concrete anchoring when abstract language is acquired, is widely used in later phases of linguistic exchanges in succession to the word-object stage. Therefore, elucidation of the derived embodiment mechanism is equally important to the charting of, for example, informal learning contexts, understanding how narratives operate, the anatomy of discourse, as well as acquisition of interactional expertise-like knowledge.

As discussed in relation to the shaman example in Sect. 5.3, abstract learning presupposes that to a certain extent subjects must be simultaneously capable of increased control of direct attention and mental manipulation of imagery processes (note, however, that it is not mere imaging in itself that results in better control, see for instance Holmes et al. 2008 on extensive imaging in bipolar disorder).

It follows that the mental mechanisms that sustain linguistic exchanges on abstract themes may also be cultivated during the interactions. As abstract knowledge acquisition proceeds, in the learner the mental functions related to the realisation of the control of the imagination are trained.

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_6

Voluntary control of images in an attempt to recombine and reconstruct, to maintain an abstract from irrelevant impressions, depends on extensive manipulations in your mind's eye. Among other things, practising as a shaman novice entails explorations of 'being open to' and absorbing continuous linguistic inputs from the master shaman while being in a trance and instantiating the imaginings. As an effect of the master shaman's overt guidance of attention, the novice shaman simultaneously yet unconsciously adopted and improved control of his imagery. Phenomenal experiences that were previously tacit (or on the fringe of consciousness such as the location of the red birds) were intensified by the intervention and in more mundane conditions as a result of the improved control, these experiences would now be ready to become engaged in new second order linguification processes, i.e. in derived embodiment. Without the shaman master directing the novice's attention to the location of the birds, this feature in the imagery would have gone into oblivion.

Though everyday conversations during development are probably less pronounced with respect to learning 'transfer' in the shaman sense, it is likely that linguistically nurtured children may show relatively more improved mental capacities. My assertion is that frequent exercise of mental capacities that support abstract knowledge acquisition matures mental abilities in general. Thus, abstract linguistic exchanges in childhood serve a double function. Besides enhancing children's grasp of vocabulary and acquisition of conceptual knowledge without direct experiences in second order linguification processes, the mental mechanisms employed are simultaneously facilitated.

As demonstrated, conditions sustaining abstract knowledge acquisition, thus adding to the training effect of mental capacities, are diverse and the specific circumstances that facilitate the learning, e.g. the level of comprehension, the mental abilities of the learner, and the emphatic skills of the interlocutor may vary from one case to another. Therefore, simple recipes to enhance abstract knowledge acquisition may not apply. However, parents who, for instance, accept the task of reading aloud, welcome deep questions or attempt to enlarge on words that are unfamiliar to the child by creating a virtual world that these words refer to, contributing to the expansion of the vocabulary of the child (e.g. Lauricella et al. 2014), to his or her imagination (Feuerstein 2000), and to improved cognitive control of direct attention especially in introspection. From the relation between derived embodiment processes (that depend extensively on the involvement of a significant other) and imagination we may conclude that advanced cognition in opposition to common sense conceptions about the mind of the individual, in the sense of flexible imaginative capabilities of children, may be malleable and prone to extensive social influences.

In the following, I enlarge on the critical effects on cognitive content, already touched upon in Sect. 5.5 when discussing derived embodiment, and cognitive functioning that may follow from facilitation of derived embodiment procedures in the learning mind of the child.

6.1 Effects on Cognitive Content and Functioning

Can we specify which mental activities are particularly facilitated when derived embodiment mechanisms are employed in abstract knowledge acquisition?

On the initiative of the parent or caregiver, due to their use of explanations (i.e. metaphorical expressions), the child is invited (and sometimes requested through instructions as discussed in Sect. 5.3) to recruit and subsequently revive particular aspects of his or her knowledge base. However, the specific processes involved in the selection process may be distinguished with respect to *mental content* and the *mental processes* employed. For example, '*the what*' of the selection process that leads to particular imageries may be automatically prompted or voluntarily controlled by the language used (e.g. Barsalou 2013). To recapitulate, either metaphorical expressions work bottom-up as for instance due to strongly emotional sensations, which seem especially effective as initiators of imagery, or top-down as due to deliberate associations. Mere participation in a conversation that aims at furnishing new perspectives on phenomena, events, or entities not already experienced may be categorised as an unusual and unexpected experience that rules out the use of commonplace metaphors discussed in Chap. 5, and which attracts direct attention and therefore contributes to the 'massage' of cognitive processing. According to Ritter et al. (2012, p. 961): "any unusual and unexpected experience in itself, not necessarily related to cultural experiences or personal identity can enhance flexible and creative thinking".

'*The how*' of the selection process is influenced by the continuous verbal encouraging on the part of the engaged parent (or the shaman master). Through linguistic exchanges the interlocutor sustains the child's inner scenario and his or her utterances work as an external control on direct attention that opposes the learner's own inclination to let go of direct attention under distractive conditions (e.g. Tylén et al. 2010). Continuous linguistic exchanges, for example by use of words as linguistic handles (or tone of voice etc.), attract attention to the task at hand and compel the learner to maintain attention to his or her 'stream of consciousness'. In that process, the interlocutor acts as an instant external reminder that intensifies the introspective practice. Simultaneously, the parent solicits specific content and numerous specific mental abilities such as the associative mental skills in the child, abilities to understand other minds (see also Chap. 8), as well as his or her abilities to visualise using the mind's eye.

6.1.1 Cultivation of Phenomenal Processes[1]

Invitation and guidance of the child to envision particular objects or scenarios, and facilitation of the search for a common denominator to obtain mutual

[1]Parts of the following account have been published in Schilhab (2015b) in condensed form.

comprehensibility implicitly orient the child towards his or her own first-person experiences as well as the closely related interoceptive sensations. He or she is prompted to re-enact previous experiences and match them to the perceived images intended by the interlocutor. Due to the insistence of the interlocutor on mutual understanding, the intentionally sustained mental universe, simultaneously held in memory as an inner landscape and nourished by continuous verbal exchanges with the interlocutor, is now available to be phenomenally and conceptually 'tagged' Ideally this scenario does not necessarily have to meticulously follow the constraints of the outside world, as the fabulous animals of Lascaux and Altamira also suggest, but must however meet the criterion of providing useable products, such as a productive reconstruction of reality to manage environmental encounters, which may have been the ultimate goal. I use the expression 'inner landscape' to connote a slightly different perspective on what is normally 'the stream of consciousness' (e.g. Dennett 1992). Here, the 'inner landscape' refers to imagery and emphasises that the imagery is 'biologically diverse' and offers natural features such as three-dimensionality—an example is the naturalistic case of the red birds in the tree, but the landscape may not be reduced to naturalistic features (see also the discussion on advanced cognition). Moreover, inner *landscapes* are characterised by immensity that generates an abundance of blind spots at a distance, which in the mind's eye, close up however, become accessible to a multiplicity of senses. Note, however, that imagery does not favour visual sceneries, although vision is often involved.

Thus, it is the sustenance of the landscape and the potential to extract the phenomenal feel of whatever the learner directs his or her attention to or plain senses the interlocutor uses when he or she nudges the associations between particular felt sensations and the concept in question in the second order linguification process (the derived embodiment process).

Thus, in 'the what' phase, the phenomenal content must 'materialise' into conscious experiences for associations to become established. The mental manoeuver of repeatedly attending the stream of memorised perceptions to search for the feel of only weakly felt (intuited?) sensations is likely to increase introspective competences and the 'tagging' of interoceptive sensations. Mind that the search for some kind of phenomenal 'tag' is fuelled by a continuous interference and feedback on the part of the interlocutor. In the shaman case, the novice may not be aware of on which perch the red birds rested or whether they were at his right or left side, but the verbalisation of the shaman master aided the novice to discover (or construct) the suggested location in the image by reinforcement, and as the novice accomplished the task an associated sensation may have become ready to be explored.

To meditate on how something feels, without perceptual input from material anchors, depends on the ability to direct attention to more or less subtle cues in the inner landscape/conscious stream. According to Strick et al. (2012), such abilities differ between individuals (see also Crawley et al. 2002 for studies on so-called

'transliminality')[2] and may be more prevalent in individuals experienced in meditative techniques. The suggestion is that meditation facilitates improved access to the inner mental world as suggested by a study using subliminally primed words in Zen practitioners who did or did not meditate at the time of the intervention (Crawley et al. 2002). Consequently, performance and end result may vary from individual to individual with respect to level of clarity and control of the re-enactment (facilitated by meditative techniques). The mental movement from being mentally 'open' to remembrance bottom-up (elicited by the efficacious phrasing selected by the interlocutor) supplied by voluntary recalling top-down is a skill that is likely to improve during practice. To 're-enact phenomenally', bottom-up involves 'surrender' to the phenomenal feel invigorated from the re-enactment process. The process is that of being appropriated by the experience to an extent that approximates an actual experience. Whereas the trick seems to be to 'apply' the senses that must have been at work in the original perceptions to the inner landscape, the material for the senses has already been processed and the work is to get hold of the phenomenal feel accompanying these processes. The 'movement' in the inner landscape is less constrained than movement in a real landscape and surely the phenomenal feel is therefore less temperate and disproportionate as compared with real experiences. For instance, attention to the red birds draws attention away from the black river and makes it vanish, just like an imagined egg (in opposition to a real one) disappears the moment attention slips the imagined hands.

Mind that the correlate established in the linguification process is a conglomerate of incomprehensible dimensions that may consist of the particular neural aggregate that processed external stimuli, previous experiences associated with the one in question, and interoceptive sensations. Thus, the material most likely to be enhanced by the avid but distanced search has a systematic connection to the linguification product. In the process, the learner is unknowingly taught to develop a sensitivity to his or her inner landscape. The skill involves measuring from afar the contours of the rolling hills, the meadows and the patches of trees without sensing the details revealed at close range. The naturalistic scenery is a consequence of the 'inner landscape' targeting derived embodiment mechanisms that are at work when abstract knowledge refers to 'real' phenomena. Conversations in which the interlocutor points to surreal phenomena for the learner to imagine may be better described by for instance expressionistic paintings.

In the distanced observation of the landscape, there is an acknowledgment of the autonomic activity of the stream of consciousness. In the introspective activity, the

[2]According to Crawley et al. (2002, p. 887) and following Thalbourne (2000, p. 31): "'transliminality' is a hypothesized tendency for psychological material to cross the threshold into or out of consciousness […] 'Psychological material' is according to Thalbourne (personal communication), intended to cover a wide range of territory including perception, imagery, ideation, and affect". In a paper by Thalbourne and Maltby (2008, p. 1618) appears the following definition: "Transliminality has most recently been defined as a hypersensitivity to psychological material originating in (a) the unconscious, and/or (b) the external environment. 'Psychological material' is taken to cover ideation, imagery, affect and perception, and thus is a rather broad concept".

learner is taught an implicit willingness not to force particular sub-phenomena into being, but to let the landscape activities either gain in strength or dissolve on their own. Thus, the sub-phenomena are allowed to follow their inner dynamics to decide if they should attract particular attention.

In opposition, the active selection of relevant experiences involves controlled top-down activity, where the learner decides to which sub-phenomena he or she should attend. In that process the mere decision is co-responsible for the gain in strength and subsequent appropriation of the mind. The top-down control has an extremely important role to reassure that the' voluptuous' landscape is constrained and to structure the mind so it is only momentarily appropriated by the phenomenal feel. The immersion in the inner landscape and the sustained findings must be coherently associated with reality. Thus, top-down control contributes also to the necessary reality check of the inner sensations,[3] as does the interlocutor (see next section).

When interlocutors cultivate particular images in the learner and invite them to inspect their perceptual character, they cultivate the learner's mind. To accomplish such tasks depends on abilities that at the same time allow the distanced acceptance of sub-phenomenal occurrences and sustain attempts to attend to particular perceptions phenomenally, but also to re-experience them and simultaneously generalise away from particularities. Such processes improve the mental control and phenomenal accessibility of memories. When skilled, the individual might simultaneously be capable of introspecting his or her re-enactments while reporting on them from a distanced, non-phenomenal position.

6.1.2 Degrees of Freedom

What does the proposed reality check provided by the interlocutor amount to? Obviously, linguistically imposed re-enactments in normal subjects are more fragile instigators of experiences than online environmental stimuli (we return to that also in Chap. 7). The required 'verification' of the phenomenal experiences seems to result

[3]It is noteworthy that in subjects considered transliminally efficient (Thalbourne and Delin, p. 45) "there exists a common thread underlying creative personality, mystical experience, psychopathology (both schizotypal and manic-depressive), and belief in the paranormal. This common factor […] transliminality […] was tentatively defined as a largely involuntary susceptibility to, and awareness of, large volumes of inwardly generated psychological phenomena of an ideational and affective kind". Therefore, it could be argued that though transliminal features may be important to the cultivation of the mind, and may be prevalent in for instance artists and religious subjects, they cannot be at the expense of top-down activity, which is an absolute necessity to keep the imagination in check.

Likewise it could be argued that the 'opening' towards the inner landscape may be accomplished privately and without the help of an interlocutor. However, acquiring a routine that involves a frequent reality check of the phenomenal 'blossoming' seems to a large extent to depend on the interaction with an interlocutor.

from the reduced constraints associated to top-down control and to the way derived embodiment products are formed. For example, in the case of shaman novices' training sessions, the online (thus temporal) unfolding process of conversing provides the interlocutor with the opportunity to continuously contribute to the mental state of the learner. In addition, the shaman expert manipulates the attentional weight by which the subject turns to particular parts of his 'inner landscape'. In general, the interlocutor's choice of strategic words provides the novice with 'as-if' material anchors. However, compared with online *concrete* phenomena that influence through direct (bottom-up) processes (the real versus the virtual egg) and thus are accompanied by somewhat constrained perceptions, due to the strains on 'real phenomena' perceptual experiences elicited by words involve more degrees of freedom. By degrees of freedom in re-enactment, I attempt to emphasise the differences between representations elicited by real phenomena and representations elicited top-down by the act of will (or by the 'autonomic' sub-phenomena gaining in strength in their own pace). To exemplify, the perception of a straw online is always the perception of a straw defined by the contextualisation. Hence, the orientation of the wind defines the orientation of the straw. The time of day and number of clouds defines the definition of the shadow cast. The history of the straw is reflected as a particularity which makes the straw uniquely different from any other straw.

In comparison, the representation of an off-line straw combines features that could be shared by all (or no) straws (Prinz 2010 claims that neurobiologically, to consciously perceive a phenomenon happens at an intermediate level of processing that abstract away location, visual size and to some extent also viewing angle). The individual constraints that connect the features of a particular straw are absent, which makes the internal components of the representation less tightly coupled. Moreover, the imagery is mentally controlled and therefore simpler. As we will return to in the following sections, mental control has limited capacity which also explains why the imagined representation may appear more perceptually 'hollow' in the sense of diversity.

Thus, due to a higher degree of freedom when dealing with the inner landscape, less sharply defined interpretations are possible. Obviously, the representation process is slower in so far as it emerges from conversation and thus occurs mostly top-down, although language processing may involve automaticity (see statistical linguistic approach, e.g. Louwerse and Connell 2011), compared with the on-line bottom-up situation in which the referent is immediate. Therefore, during the further development and search of the inner landscape, the child might need to hold and keep track of multiple scenarios. Of course, to some children this challenge might prevent them from participating and thus improving their skills, especially children suffering from low working memory functioning (e.g. Gathercole et al. 2006; Holmes et al. 2009). When the child fares badly with one projection (hypothesis) about the state of the world based on his or her imagination, he or she is much better off by immediately switching to another internally consistent hypothesis. Here, the interlocutor appears to be extremely helpful in trimming images to more adequate versions. My recurrent claim that the 'landscape' that emerges as a result of the words chosen by the interlocutor substitutes the real landscape, should

be taken quite literally. When reasoning illogically in the real world, actual harmful encounters will teach the individual about real world connections in a trial and error condition. In the conversation, the interlocutor takes on the role of a testing board to correct misrepresentations. Bear in mind, however, that in so far as the abstract knowledge acquisition refers to interactional expertise-like knowledge and therefore aims at understanding 'as-if' based on real experiences, the interlocutor is led by a narrow understanding of what images will work. For instance, if the individually developed mental image slips or seems inadequate, as demonstrated by illogical arguments or contradictory suggestions, the interlocutor (i.e. parent or teacher) may lead the mind of the child back on track by his or her use of expressions as external reminders. The necessary distancing of previously generated images when discarding one at the expense of another is a matter of training.

Concomitantly, the interlocutor presents the learner with reasoning techniques to sustain coherence and examples of the constraints of logic, for instance by prompting orderly and temporal organisation of the interior of the virtual world and make the child aware of the manipulation criteria to be met. The logical rules and the insistence on the relation to reality act as constraints on the inner landscape. In tandem, they reduce the degree of freedom in thought.

Of course, to obtain this flexibility of mind, many resources, apart from the ability to create a virtual construct of the world and to let it pulsate in the mind over time, sometimes at a distance, sometimes close-up, are necessary. In addition, the learner must cultivate an ability to assess the relevant parameters of a situation that defines the conversation. Hence, besides the content, the conversational situation consists of cues that determine the interpretation of the conversation and outline what parts of the landscape should evolve. Obviously, directing the attention to the emerging internal landscape seems to presuppose paying attention to external, involuntary cues offered by the interlocutor. Given the circumstances, the ability to assess the probability of the interpretation being adequate, and to remain perceptually tuned towards the inner landscape depends on metacognition (e.g. Veenman et al. 2006). The latter is crucial since it paves the way for the ability to later hold the original goal of the construction in mind and actually choose among differently imagined scenarios. As we will see, to manage this kind of cognitive load normally depends on maturation of the working memory capacity.

6.2 Cognitive Changes

As discussed above, the mechanisms that enhance the ability to re-enact previous experiences have the potential to upgrade a number of related mental activities and functions considered central to mental flexibility.

Below is a summary of some of the important cognitive changes to the internal landscape that are likely to emerge in the child as a result of ideal linguistic exchanges.

- Cognitive content ('the what'):
  - Enhancement of particular aspects of the 'landscape' by directing attention to this in conversation. When exploring re-enactments, the mind pulsates. Particular features may temporally form and eventually appear with more clarity.
  - Expansion of vocabulary (through derived embodiment) and relation to the internal landscape that includes enhanced associations of particular aspects of knowledge and specific topographical 'locations'.
  - Saliency of the phenomenal feel of previous experiences manifest as part of the features in the landscape.
  - Improved long-term memory (due to repetition).[4]
- Cognitive function ('the how')[5]:
  - Improved control and maintenance of a particular imagery
  - Sustenance of many alternate imageries by increased working memory capacity in divergent thinking
  - Improved ability to access and desist perceptual experiences
  - Improved sense of self
  - Improved sense of external stimuli—perceptual agility
  - Improved ToM
  - Metacognition in the sense of monitoring the learning

To sum up, when enrolled in derived embodiment processes, the cognitive content of the learner is likely to change. Interlocutors import new objects to the virtual universe of the learner by drawing his or her attention to aspects of existing experiences held in the private archive and help them develop new facets of the landscape that may not have been directly or consciously experienced. The mechanisms that sustain derived embodiment are fundamentally social, since they feed widely on continuous contributions by the interlocutor and, needless to say,

[4]As discussed in 3.7 on the functioning of linguistic handles, due to WTFT associations, the uttering of a word may activate the full neural correlate. Thus, to some extent a word, like 'cinnamon' is actually practising the memory of cinnamon as a phenomenon (e.g. Simmons et al. 2005). It is probable that sheer verbalisation that forces the subject to re-enact may facilitate retention of these experiences in long-term memory as a side effect.

[5]Hassabis and Maguire (2007) list a number of cognitive functions that all crucially rely on *scene construction* as a common core process, which might account for a large proportion of the overlapping networks found in the neuroimaging studies of these functions. They include (p. 301):

- Episodic memory recall, episodic future thinking,
- Navigation (route planning and 'wayfinding'),
- Imagination (richly imagining and visualising a new fictitious experience that is not explicitly temporal in nature and is not necessarily self-relevant, plausible, or even possible),
- Default network, activated when no overt task is assigned,
- Viewer replay—the replay of an episodic-like memory but without a specific temporal time tag. This could be the recollection of an old TV series,
- Vivid dreaming—REM sleep, and
- Theory of mind—modelling the intentions of others.

language. Furthermore, the interlocutor controls in part the mental processing of the individual by his or her use of specific expressions that reinstate particular experiences; partly bottom-up by re-enactment of situated conceptualisations (Barsalou 2013) established through previous linguification processes and partly top-down by instructions that work in indirect ways. In the bottom-up case, the interlocutor controls the imagination of the learner as if he or she was playing an instrument (or more pretentiously expressed, operating a robot). The focus is on the malleability and claylike resonance of developing minds when carefully nursed (and nudged). As part of the experience/word product, the words activate certain 'sensed' scenarios bottom-up (by wide help from the learner) to elicit phenomenal re-enactments which would have remained dormant if not for the active involvement of the interlocutor. In that sense, acquisition of abstract knowledge seems entirely defined by dynamical mutual exchanges founded in social processes. Ultimately, the immediate outcome of these selective re-enactments of the learner's experiences consists of *enlarged* content. The world of the learner has increased in the sense that nuances not consciously experienced may become accessible, because of the extended individually adapted guidance. Moreover, in parallel, the cooperative dynamical enaction seems to add or at least deepen dimensions to the cognitive *function* of the individual, such as improved working memory capacities and elaborate introspective mechanisms.

In the following, I elaborate on what these changes in working memory capacity may entail in order to demonstrate how derived embodiment mechanisms have lasting effects on both cognitive content and functioning.

6.3 Increasing Working Memory Capacity

Mechanisms that sustain derived embodiment processes influence cognitive functioning, for instance the ability to keep in mind several alternative cohesive but mutually inconsistent scenarios.

Such operations are mentally strenuous since they seem to burden what some researchers refer to as working memory functioning, that is, the capability to attend, control, and execute mentally (e.g. Engle 2002). When engaged in derived embodiment processing, in which the control of linguistically elicited imagination and simultaneous 'scanning' of the representation with respect to re-enactment of phenomenal experiences occur, working memory as part of an assembly of executive functions (EFs) is involved. EFs refer to an assembly of functions in use when we concentrate and think. The core functions are *inhibition*, *working memory*, and *cognitive flexibility* and form the basis for 'higher-order' EFs such as reasoning, problem solving, and planning (Diamond and Lee 2011). Inhibition refers to control of behaviour as when inhibiting habitual responses and resisting short-sighted temptations such as leaving a task unsolved or incomplete. Inhibition is exercised in attention regulation to corroborate focused and directed attention and in emotional self-control.

Working memory is the function that holds back information in mind to be manipulated. It is involved in making sense of linguistic information, to derive a general principle, and acknowledge novel relations among old ideas (Diamond and Lee 2011).

On the other hand, cognitive flexibility manages perspective change, for instance switching between different aspects, thinking outside the box, and understanding the perspective of other people.

According to Ritter et al. (2012, p. 961) cognitive flexibility consists of the ability to: "break old cognitive patterns, overcome functional fixedness and make novel (creative) associations between concepts".

Overall, EFs have been linked to better academic skills, better quality of life, and improved self-assessment and are (as I assert here) to some extent trainable. EF interventions in the form of computer-based working memory training, for instance, have been shown to improve EF performance in different age groups (Klingberg 2010, 2012; Diamond and Lee 2011; Brehmer et al. 2012).

Specific improvements of EFs are not always associated with abstract knowledge acquisition in conversations. The control of multiple internal representations in a way similar to derived embodiment scenarios taps into a variety of EFs, and is demonstrated for instance by a grandmaster of chess giving blindfold simultaneous displays in which the exhibitor does not look at any of the boards. Thus, he or she is bound to retain all the moves of the games in his or her head since the moves of the opponents are communicated verbally to the exhibitor by an intermediary. The chess master must be able to memorise and switch between different games and keep in mind the objective of each particular match.

Shusterman (2009) describes how Japanese Noh dancers are accomplished masters of voluntary maintenance of simultaneous representations, which in the Noh tradition are associated with an expanded self-image to excel as a dancer (Shusterman, p. 141):

> If the actor thus needs enhanced critical self-consciousness and self-monitoring to achieve true excellence, how does he achieve it? How does one acquire the extraordinary skill to be attentively conscious of the bodily action one performs, one's inner feeling or image as one performs it, the reaction of the audience, and also the image one's audience has of one performing that includes the appearance of how one looks from the back and other dimensions of one's appearance that one cannot logically see (say, the expression of one's own eyes)? Zeami answers, of course, that this requires assiduous training. But what precisely constitutes the nature, basis, or direction of such training?

In contrast with the chess master, who is challenged by a multiplicity of somewhat similar scenarios, the Japanese Noh dancers must include representations from a variety of perspectives, including self-representations and representations of scenarios never experienced in a direct sense (i.e. 'the appearance of how one looks from the back').

Apparently, the Noh dancer must excel in maintaining a number of unique representations; bodily action, inner feeling or image of on-going performance, reaction of audience, etc. to guide and control his or her dance, most of which

happen at the periphery of attention. His or her performance seems to depend on the ability to maintain (in the sense of monitor and administer) multiple scenarios simultaneously.

The general control mechanism that maintains attention to representations, to on-line perceptions, and controls the recovering of information normally 'outside' of conscious focus is closely related to the working memory capacity.[6]

The skill of the chess master and the Noh dancer, and by comparison the skill trained in derived embodiment processes, places the cognitive burden on working memory. In the laboratory, the working memory capacity (also named WMC and referring to the maximum number of items we can transiently store in working memory, e.g. Edin et al. 2009) may be assessed using a complex span task in which subjects are presented with short lists of stimuli to remember in sequential order in alteration with a secondary task (Kane et al. 2007).

In the following I expand on my conjecture that concrete effects occur if the interlocutor indirectly trains the working memory functioning (and other EFs) of the subject during successful participation in derived embodiment processing.

Some effects are suggested by studies in which subjects who, low in working memory capacity, have difficulties in keeping goals consistently active and accessible. According to Kane et al. (2007, p. 615): "Low-WMC subjects seem to periodically lose focus on their goals, or 'zone out', when executive control is challenged". [When off-task experiences are recognised by subjects, the phenomenon of mind wandering is known as tuning out, whereas off-task mind-wandering episodes not recognised by the subject are referred to as episodes of zoning out (e.g. Smallwood et al. 2008)]. Moreover, in laboratory tests, low-WMC subjects make frequent errors apparently related to the collapse of attention (Smallwood et al. 2008). According to Kane et al. (2007, p. 619): "they have a deficit in metaconsciousness, whereby they fail to realize when their thoughts drift from their primary activities".

The drifting of the mind is reflected in an inclination of lower-WMC subjects to mind wander and indulge in off-task thinking during demanding tasks (Kane and McVay 2012). Kane and McVay report that during activities that were stated to be challenging and required concentration, lower-WMC subjects experienced more interruptions from task-unrelated thoughts and less on-task thinking than higher-WMC subjects. However, people's minds wander frequently (e.g. Mason et al. 2007), regardless of the character of their primary task.

In line with the suggested 'pulsating of the inner landscape' that oscillates between bottom-up and top-down activity, when the learner attempts to build a productive imagery, mind wandering might in fact sometimes be adaptive. People find it desirable to let their thoughts flow freely. In support of this view, Christoff (2012, p. 57) states:

[6]In the section on 'Degrees of freedom' I addressed the issue of forcing implicit processes into explicit focus. However, what it takes to gain access to vaguely accessible or primarily tacit dimensions of bodily activity remains underdetermined.

> this decade may well end up marking a paradigm shift within the cognitive neuroscience of thought, from viewing thought from within the prism of task based, goal-oriented cognition, to broadening our view to include the more nebulous and yet ubiquitous phenomenon of the drifting mind. After all, such mental drift occupies an enormous part of our daily lives. Instead of viewing the mind's drifting quality as a negative, useless, and even harmful aspect of our internal mental lives that we should resist and feel guilty about, such a paradigm shift may help us accept our drifting mind as a normal, even necessary, part of our mental existence—and may even enable us to try to take advantage of it in some creative, enjoyable way.

Positive aspects of mind wandering are also accentuated in a quote by Kane and McVay (2012, p. 348):

> Mentally fleeing the confines of present circumstances may help people persevere through tedious and unpleasant tasks and may allow them to simulate solutions to personal problems, unrealized goals or creative projects.

Perhaps surprisingly this seeming default mode of operation of the brain is related to people being less happy when mind wandering than when they were not (Killingsworth and Gilbert 2010).

In the laboratory, however, lower-WMC subjects may show occasional failure to act according to current goals, instead responding according to long-standing habits (Kane and McVay 2012).

For instance, when tested in the Stroop test, despite verbal encouragement to name the font colour of the word instead of reading the word, lower-WMC subjects show deficits in critical trials when colour names and font colours are incongruent. In light of derived embodiment processes, lower-WMC subjects may have difficulties when invited to explore the pulsation of their inner landscape. The cognitive load of holding more internally coherent scenarios in mind for further comparison, for instance, may seem overwhelming. Ultimately, they may possess fewer phenomenally rich abstract concepts and less verbal tools to address facets of the inner landscape, because it has been less charted.

To summarise, though mind wandering might be healthy in cases where mental contemplation of remote issues from the here and now is appropriate, when mind wandering draws us away from the task we perform, it has substantial downsides as it might lead to impaired task-performance (Fell 2012). Derived embodiment processes, in which the interlocutor aids goal sustenance and thus sharpens volitional attention, implicitly launch multiple perspectives to become manipulated in order to acquire the goal, thus appearing to improve executive functioning in the learner.

However, a point of caution to consider is the dichotomy between being in the present while simultaneously being at a distance. The conflict is between being sensorially open to acquiring as much information bottom-up as possible from environmental and internal stimuli, and consciously focusing on that information top-down to store the memory as bits and pieces from which new memories can become constructed.

In addition, the adaptive interpretation of mind wandering seems to suggest that too much mental control may have some unhealthy aspects. What does this imply

with respect to our ability to acquire knowledge? If our instantaneous understanding of the moment depends on previous experiences, we are at risk of missing important and unique information pertaining to the moment and which has not yet been encountered. Thus, we may need to be in harmony and open-minded to resist the superficial "pollution" of already established memories to acquire information about the current situation. To relax and actively keep an open mind seems optimal for learning and knowledge acquisition. A consequence of expanding this open-mindedness is partly the reduction of priming by already established memories to overflow the mind with preformed "interpretations" (or thought structures), and partly the maintenance of unimpeded switching from one piece of information to the next to allow minimal amounts of constraints on the information flow. In this context, interpretation might not be all that appropriate an expression. The interpretation need not be intended but might arise from implicit cognitive structures established in early childhood. Much of our thinking is likely to be by rote and not deliberate. Open-mindedness thus allows a greater sensitivity to the source of information impeding both automatic thinking routines and actual preformed trains of thought and reactions. In particular, the ability to relate and rewire to make new relations an integrative part of working memory seems suggestive of empowered imaginary abilities.

6.4 What Meditation Says About Mind Training

Obviously, the sensitivity to the pulsating mind and the inner landscape as well as the co-operation of bottom-up and top-down activity seems central to meditative practices and has actually been coupled with EF-training (e.g. Diamond and Lee 2011). Tang and Posner (2009) differentiate between attention training and attention state training in a discussion about the training of executive functions. While attention training refers to exercise of concrete neural assemblies thought to corroborate particular functions (e.g. Klingberg 2010; Diamond 2012), attention state training is directed at self-regulatory practices typical of religious traditions such as Buddhism and so-called integrative body mind techniques (e.g. Tang and Posner 2009; Tang et al. 2012).

According to Fell (2012): "The practice of mindfulness meditation aims at reducing the prevalence of uncontrolled thought chains by increasing meta-awareness of ongoing mental activities". Compared with meditation-naïve controls, in studies exploring the neural activity experienced meditators show less mind wandering during meditation periods, and more co-activation in brain areas normally active during self-monitoring and cognitive control.[7]

[7]Note, however, that meditative techniques may be very different and therefore render comparisons difficult.

Tomasino et al. (2013, p. 1) establish:

Mental training techniques have lasting structural effects as demonstrated in a study on the relation between increased executive function, cortical thickness, and attentional absorption. Thus, meditative training seems to alter attention and executive control networks both functionally and structurally and thereby improves performance on tasks which engage these regions (Grant et al. 2013).

In a study by Pagnoni et al. (2008), experienced meditators and naïve controls were required to assess whether presented stimuli were non-words with plausible reading but without semantic value, or real English words. Throughout the test they were supposed to also attend to their breathing. Since words are likely to trigger a variety of associations, researchers prompted subjects to immediately re-focus on their breathing after responding to stimuli to test for the duration of semantic processing effects. The meditation practitioners showed significant reduction in processing time compared with controls, suggesting an improved ability to disengage from mind wandering. Thus, in subjects experienced in mental contemplation, execution and control of mental operations including the ability to disengage were more improved than in novices.

Meditation may immediately modify executive attention that is the ability to direct inward focus (Graig 2004) as demonstrated in a study by Tang et al. (2007). Here, 5 days of 20 min integrative training (including mindfulness techniques) was showed to significantly improve a subject's executive attention, as compared with a control group conducting relaxation training.

The immediate effect of mindful attention achieved by mindfulness techniques on executive control was sustained by a study by Papies et al. (2012). Here, non-trained subjects were briefly introduced to a mindfulness practice described as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding experience moment by moment" (Kabat-Zinn 2003, p. 145). In that study, the mindfulness technique taught participants to observe their reactions to external stimuli as transient mental events as opposed to subjectively felt real experiences. In the subsequent task, subjects were exposed to pictures of highly attractive or neutral food items. When pictures were presented inside a blue frame, participants were instructed to press a key to 'move toward the picture'. When a picture was inside a purple frame, participants were to press an arrow key to 'move away from the picture'. The RT of control subjects who were told to 'completely experience' and 'get immersed' in the pictures was significantly lower than that of participants who received a brief mindfulness procedure. The results suggest that control subjects tend to understand external stimulations as denoting real phenomena and since attractive food items are

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(Footnote 7 continued)

"There are many types of meditation practices eliciting different cognitive processes (e.g., silence, attention to own body, sense of joy, mantras, etc.). It is very possible that different practices of meditation are subserved by largely, if not entirely, disparate brain networks. Whether the cognitive state induced by the different meditation forms is the same is not known (Tang et al. 2012). Therefore, it is difficult to describe a meditation-related activation pattern independent of the practices needed to reach it".

profitable to react towards, they react faster. In opposition, participants who had trained their ability to perceive external stimuli as transient mental events were inclined to dismiss external stimuli as action-eliciting. As a first approximation the study seems to suggest that experienced meditators focus on the representational part (in the sense of just being present) of the external stimulation while the inexperienced participants focused on the 'phenomenal' part.

Papies et al. write (p. 296):

> In contrast to earlier work on the limitations of conscious reflection, our studies speak to the benefits of conscious thought and introspection for regulating behavior […]. Crucially, however, mindfulness addresses the nature of one's thoughts, rather than their conceptual content.

Despite potential idiosyncratic features of individual techniques that are of interest to this context, meditation seems to improve mental control in senses implicitly embarked on in derived embodiment procedures.

Shapiro et al. (2006) propose a model of mindfulness that explains some of the positive effects of that particular meditation method. Accordingly, mindfulness entails a shift in perspective, termed 'reperceiving'.

This process involves the ability to dis-identify from the contents of consciousness (i.e. thoughts) and the view of his or her moment-to-moment experience with greater clarity and objectivity. They write (2006, p. 6):

> To the extent that we are able to observe the contents of consciousness, we are no longer completely embedded in or fused with such content. For example, if we are able to see *it*, then we are no longer merely *it*; i.e., we must be *more* than *it*. Whether the *it* is pain, depression, or fear, reperceiving allows one to dis-identify from thoughts, emotions, and body sensations as they arise, and simply be with them instead of being defined (i.e., controlled, conditioned, determined) by them.

Here the top-down control is applied to impose a distance to objects in the stream of consciousness/inner landscape to avoid uncontrolled absorption, a precondition for the pulsation activity also present in the derived embodiment process.

To bring the issue of meditation into the perspective of derived embodiment processes, the results seem to suggest that children exposed to abstract learning episodes and through that become familiar with derived embodiment processes both learn to decrease their inclination to mind wander through tedious and unpleasant tasks (as demonstrated in lower WMC-subjects) and increase their abilities to handle internal scenarios in a distanced view (e.g. Colzato et al. 2012; Baas et al. 2014). The latter entails an ability to disengage from particular representations to enhance another set as the interlocutor provides more information or if the emerging perspective seems increasingly fallible.

Moreover, reperceiving may facilitate flexible responding to the environment. Shapiro et al. pose (2006, p. 9):

> If we are able to see a situation and our own internal reactions to it with greater clarity, we will be able to respond with greater freedom of choice (i.e., in less conditioned, automatic ways). As Borkovec points out, research from cognitive and social psychology demonstrates, "existing expectations or beliefs can distort the processing of newly available information".

Learning to see clearly (and insight learning in general) depends on the ability to dis-identify from prior patterns and beliefs. Reperceiving facilitates this capacity to observe one's mental commentary about the experiences encountered in life. It enables us to see the present situation as it is in this moment and to respond accordingly, instead of with reactionary thoughts, emotions, and behaviours triggered by prior habit, conditioning, and experience. Reperceiving affords a different place from which to view the present moment (according to Diamond 2013, this EF-component is likely to belong to the category of cognitive flexibility).[8] In that context, the ability to adopt a self-distanced perspective when processing negative emotions and experiences (distanced why strategy) enables "cool", reflective processing of emotions, in which individuals can focus on their experience without reactivating excessive "hot" negative effects (e.g. Kross et al. 2005; Kross and Ayduk 2009).

6.5 Perceptual Agility

As already discussed, enhanced executive control reduces mind wandering. However, maintenance of sensitivity to external stimuli is likely to add to this reduction in the amount of stray-thoughts. Following Shapiro et al., sensitivity to external stimuli might even arise from a mindful approach to *mental* processes (2006, p. 7):

> Reperceiving can easily be confused with an attempt to detach from one's experience, distancing to the point of apathy or numbness. However, this is in sharp contrast with the actual experience of reperceiving, which engenders a deep knowing and intimacy with whatever arises moment by moment. Reperceiving does indeed facilitate greater distance in terms of clarity. And yet, this does not translate as disconnection or dissociation. Instead, reperceiving simply allows one to deeply experience each event of the mind and body without identifying with or clinging to it, allowing for "a deep, penetrative nonconceptual seeing into the nature of mind and world" (Kabat-Zinn 2003, 146). Through this process we are actually able to connect more intimately with our moment-to-moment experience, allowing it to rise and fall naturally with a sense of non-attachment. We experience what *is* instead of a commentary or story about what is. Therefore, reperceiving, in this hypothesized model, does not create apathy or indifference, but instead allows one to experience greater richness, texture, and depth, moment by moment, what Peters refers to as "intimate detachment".

[8]Note that in this context my intention is to emphasise that meditation as a technique seems to be an ancient practice to improve WMC and in this sense may shed light on what happens mentally when executive control improves. Likewise, the meditation results suggest that the pulsating ability potential of derived embodiment mechanisms is prevalent in meditative techniques and aids maintenance of self-control and distancing from bad thoughts. I need to emphasise, however, that I do not intend to claim that abstract thinking automatically trains subjects meditatively in so far as meditation cultivates immensely beyond mere executive power.

One might hypothesise that the technique facilitating 'intimate detachment' might also help grasping otherwise vaguely felt experiences. If the skilled meditator reperceives re-enacted experiences, he or she might render these more phenomenal. Thus, to be skilled at intimate detachment might improve the ability of the individual to sense perceptually. Such mechanisms thus work in the direction from mind to sensory experiences, sort of top-down but in the sense of bottom-up.
A study by Slagter et al. (2007) on how mental training may influence the 'attentional blink' phenomenon makes a similar suggestion. Bear in mind, however, that subjects in this study focus on solving a task exclusively in their mind's eye, which ultimately seems to facilitate their ability to attend to external stimuli.

According to Slagter et al. (p. 1233):

> Green and Bavelier [10] reported that intensive action video-game playing can improve attention skills, as reflected by enhanced performance on new cognitive tasks, including the attentional-blink task. Here, we show that improvements in performance of a novel, external task may also be achieved by *pure mental training* (Italicised by me).

Along similar lines, mind wandering which is more prevalent in low WMC-subjects seems to reflect a mental decoupling from external stimuli that high WMC-subjects and experienced meditators do not experience. According to Christoff (2012, p. 56):

> mind wandering entails a mental decoupling from the immediate external perceptual environment […] and could help explain why during episodes of mind wandering people can be oblivious to even salient perceptual events in their external sensory environment.

Like effects are also observed in Barron et al. (2011, p. 597) who suggest that task unrelated thought (TUT) depends on perceptual decoupling to "insulate an internal train of thought from the distracting influence of external perceptual information".

Hence, training of perspective-taking and intimate detachment may as a side-effect corroborate a heightened attention to external stimuli. It is therefore likely that increased perceptual awareness increases responsiveness to external stimuli in general.

This conjecture seems to be sustained by a study by Kam et al. (2011) in which subjects performed a simple visual discrimination task as the ERPs of task irrelevant probes were recorded, suggesting that task-relevant attention influences processing of irrelevant stimuli as well. Here, it was demonstrated that task-related attention can indeed bias the initial sensory-level processing of visual stimuli, since sensory-evoked responses to the probes (which were task-irrelevant) were significantly attenuated during off-task relative to on-task states.

So, increased perceptual awareness as well as reduced mind wandering might be the direct results of the intentional training of control of mental operations, and by analogy similar effects might occur when children acquire abstract knowledge. However, in conversation there could be other indirect ways to train perception that may in fact predominate, since perceptual sensitivity per se seems important to linguistic exchanges. The continuous alternation between paying attention to the verbal descriptions and instructions by the interlocutor and the growing internal

scenario, implicitly forces the learner to stay perceptually alert. Attention is directed both at external stimulations (i.e., particular wordings used and non-verbal signals that may contextually frame the utterance) and internal representations (built from bottom-up and top-down processes and resulting in more or less clarity at the phenomenal level).

6.6 Reading as Exemplification of WMC

In Chap. 4, studies that compared the ability of words to induce imagery either by reading or by instructions showed instruction to be more successful. A plausible explanation of these results was that instructions are more demanding as enquiry inducers. In other words, when students are instructed the interlocutor acts as an on-line crutch for attention. The interlocutor offers abundant information by intended gestures and non-verbal communication. Moreover, the interlocutor may insist on watching the individual and demand that the individual apply him or herself. In reading, the motivation all falls back on the individual.

However, abstract knowledge acquisition is not necessarily tied to conversations that occur on-line. Often, higher education novices will have to cope with written descriptions of abstract concepts (with no reference to direct experiences) in attempts to acquire the knowledge of specific fields. Likewise, in ordinary life we are confronted with abstract descriptions that we will have to decipher on our own, such as in written prescriptions, directions for use, fictions, and poetry.

How does written versus oral (live) presentation of abstract knowledge in derived embodiment-like conversations compare? An argument against the postulate that a lot of abstract acquisition happens by written explanations is to challenge the claim of the written acquisition as comparable with acquisition via conversation. If we exclude from discussion those instances of on-line conversations of low quality, which of course also exist, apparently online interaction seems more versatile and results in understanding of higher quality than understanding from mere text. Firstly, the text is static. Obviously it offers fewer coherent interpretations, since nothing new enters into the text apart from what develops out of the mental work in the reader. In comparison, the live conversation is dynamical and might offer several interpretations of the abstract concept. The conversational partner probes for the comprehension level of the language learner and consequently adapts his description to promote a better understanding. Undoubtedly, the dialectical movement between conversational partner and the language learner facilitates the internal cohesion of the representation encircling the abstract concept as well as the ability to associate satellite concepts that are partly relevant to the representation in question.

Consequently, reading to acquire abstract knowledge may take its toll on EF abilities and therefore, all else being equal, instruction seems more effective.

In line with this explanation, research on reading suggests that reduction of mind wandering and increased control of mental operations is essential to the understanding of literary and especially expository texts (e.g. Swett et al. 2013; Elosúa et al. 2013). A study by Smallwood et al. (2008) demonstrated that mind wandering and engagement in stimulus-independent thought (SIT) while reading is negatively correlated with comprehension accuracy. The reason is that for reading to convey information, that is (ibid., p. 1144):

> to make the best sense of the story, the reader must build a model that integrates general world knowledge with information from both within and between different episodes in a narrative. In a process somewhat analogous to that of a detective, readers combine these disparate sources of information to create a *situation model* that denotes the cognitive representation of the narrative.

According to Smallwood et al. (2008), a central feature of the situation model is so-called foregrounding, which is a result of resonance (or match) among those events that occur in the current narrative, those that appeared earlier in the discourse, and those that are drawn from general world knowledge:

> *Foregrounding* is the reactivation of previous text or background knowledge through automatic or strategic attempts to build associations and to establish causality and coherence in the narrative. Foregrounding is demonstrated by a systematic variation in the accessibility of different concepts, with respect to their relation to the current events in the narrative […] and task instructions (Smallwood et al. 2008, p. 1145).

Obviously, comprehension of a narrative depends on dedication of an appropriate level of attentional resources, otherwise understanding may be compromised. Smallwood et al. (2008) examined whether reports on zoning out (as described, episodes not known to individuals) during reading were indicative of a lack of updating of the situation model. In the study, word-by-word subjects read a novel by Arthur Conan Doyle, in which the identity of the villain was only identifiable by inference building. The researchers listed four inference critical episodes (ICE) in which the author delivered important clues to the identity of the villain. While reading, at each of the ICEs, the subject was briefly stopped and asked: "just prior to being asked, was your attention on or off-task?" Subjects were requested to distinguish between tuning out, zoning out, and being on task. Also, participants were asked questions concerning facts that were detailed explicitly in the narrative as well as questions which were based on inferences only. The study concluded that zoning out denies participants the possibility of retrieving information that would lead them to identify the villain. Attentional lapses at critical junctures of the narrative led to shallow processing of the text detrimental to the construction of a viable situation model. To counteract the inclination to mind wander, writers may employ certain 'derived embodiment' techniques, such as increased use of concrete elaboration of abstract ideas (e.g. Sadoski 2001; see Marley et al. 2007 for physical instantiations of concrete support during listening comprehension).

To sum up, the mechanism of derived embodiment that depends on conversations with an emphatic interlocutor is likely to further cognitive skills beyond that of understanding a particular concept not directly experienced. The cognitive

processes involved and therefore enhanced during derived embodiment processes among other abilities include: establishment of imagination based on conversation, monitoring of the imagination, maintenance, manipulation and comparison of multiple imaginary interpretations, the ability to enhance vividness and dis-identify with sub-phenomena in the inner landscape, while disregarding irrelevant external and internal stimuli, development of self-representations in metacognition, etc. Such qualities are characteristic of improved academic performance, the ability to self-distance from negative emotions, and better quality of life. Therefore, intensive engagement in derived embodiment processes may have consequences beyond that of contributing to the vocabulary and development of interactional expertise-like knowledge. Employment of derived embodiment processes entails extensive mental training that to some extent bears resemblance to advanced meditative techniques.

6.7 Advanced Cognition and Imagination

Indeed, the derived embodiment processes that lead to excelling in interactional expertise as devised by Collins and Evans (2007) may also precede the highly advanced mental operation of hypostatic abstraction. In this section, I focus on what derived embodiment processes may not achieve on their own in relation to cultivation of the mental abilities but may prepare the individual mind for.

While interactional expertise is characterised by off-line cognitive operations that aim at understanding real though never experienced phenomena (referred to as category 3 in Chap. 4), the cognitive ability known as 'hypostatic abstraction' is one step further away from reality (and as we will see in most instances category 4 applies).

According to Stjernfelt (2012, p. 52):

> The basic cognitive purposivity of hypostatic abstraction stands out as its raison-d'être: it facilitates the explicit reasoning and investigation pertaining to general issues which would otherwise remain implicit, transient or lost in concrete particulars.

Although hypostatic abstraction takes the concrete as the starting point, this kind of reasoning is not confined by what is encapsulated by the concrete. Hypostatic abstraction differs from interactional expertise-like knowledge, which is continually assured by reality checks and rather transgresses the boundaries of what may be perceived. Hypostatic abstraction extends into what may exclusively be imagined.[9]

[9]In the sense that reference to real phenomena, which gives credence to interactional knowledge, is of minor importance to hypostatic abstraction. One may argue that interactional expertise always refers to 'what is' whereas hypostatic abstraction refers to 'what is in the logical sense'. To distinguish between what is decided by the natural laws of this world and what is decided by the laws in general, Chalmers (1996) makes a similar distinction on nomological and logical supervenience in relation to the discussion of consciousness (see also Collins 2010).

Following the proposal by the philosopher Charles S. Peirce, Stjernfelt defines hypostatic abstraction viewed from the cognitive perspective as (2012, p. 51):

> The process of taking a thought for a thing, so that a new cognitive object is constructed on the basis of a thought—alternatively described as the "stiffening" of transient, fleeting cognitive content into a stable shape facilitating further reasoning pertaining to this new, abstract object.

Thus, the result is the production of a new higher-level cognitive object that exists in the mind as when 'constructing' an event or object one has not perceived from fragments of the imagination of similar occurrences (as thoughts about a future birthday party). Having constructed the future birthday party event, it is possible to control and manipulate it to an extent similar to past events (see also Chap. 2 on false memories of hot air balloon riding).

In Stjernfelt's interpretation, Peirce also distinguishes a process 'distinction' different from hypostatic abstraction that permits attending to particular *parts* or *aspects* of an object at the expense of other parts or aspects of the object. Distinction is further subdivided into three attentive abilities: 'dissociation', 'prescission', and 'discrimination'. Stjernfelt elaborates (2012, p. 53):

> Dissociation is what permits the distinction between different independent qualities, such as "red" from "blue": prescission is what permits the distinction of a part which may be supposed to exist independently of another part, such as "space" from "color", while discrimination is what permits the distinction of a part which may be only imagined separately, such as "color" from "space". These two latter distinction types are important to the investigation of objects involving features dependent on each other in different patternings. The kind of attention they pertain to, however, involves imagining the object endowed with indeterminate parts: "In general, prescission is always accomplished by imagining ourselves in situations in which certain elements of fact cannot be ascertained. This is a different and more complicated operation than merely attending to one element and neglecting the rest".

Though dissociation, prescission, and discrimination are cognitive activities that create relatively more abstract 'images' further distanced from perceived reality, I propose that they still share the mental machinery that sustains processes of derived embodiment.

The ability to extract certain features from their normal mode of existence at the representational level, for instance colour from space, depends on the ability to attend to particular parts of the elicited image in a way that obviously breaks with and appears more advanced than representations resulting from re-enactments of normal perceptual experiences. To experience space without colour takes more than mere re-enactment. To abstract certain qualities which normally co-exist depends on alignment, maintenance, and control of more scenarios in our mind's eye, processes inherent to derived embodiment.

There is however a marked difference between derived embodiment and this kind of advanced cognition. When we associate new phenomena with re-enacted experiences, the re-enactment and therefore the revival of actual experiences are pivotal to the process. Thus, indirectly reality has a manifest impact even if only in a derived sense. In derived embodiment, the manipulation that leads from images

we are familiar with to new 'derived' images is at no point overtly in opposition to how we originally perceived reality. One may argue that derived embodiment processes are entirely additive in nature, since what is produced from the imaginary procedures is just 'more of the same' (namely phenomena that belong to the kind of reality that someone has actually perceived). In derived embodiment the learner is nudged to get a better grip of what has been experienced in order to produce products he or she has not experienced but which exist and comply with the natural world. He or she is truly standing on the shoulders of others and piggybacks on the direct knowledge already perceived. The crucial point, then, is that derived embodiment substitutes for what he or she *could have* experienced. To the contrary, in the Peircian sense of 'distinction', processes seem to subtract in order to generate. The experience of the derived embodiment product may actually help individuals to the point of acceptance of imaginary products without well-known 'reality cues' as implied in the Koening results.

And the 'distinction'-product which is generated could not be experienced and has not been experienced by any one perceptually. We cannot dissociate space from colour unless we 'bend' normal perception. When separating space from colour we allow ourselves to view (experience in mind) each of them individually. But when we separate colour from space which normally co-occur, and re-enactment of 'space-colour' imagination is likely to reproduce this co-existence, we need to suppress one parameter while accentuating another though still accepting the dimensions and certain elements of fact that cannot be ascertained as part of a larger whole.

Obviously, such complicated mental operations need some cultivation to emerge. Stjernfelt highlights the Peircian thought of strong connections between advanced cognitive abilities and a higher degree of self-control (which may refer to a specific conception of top-down control). In Stjernfelt's interpretation (2012, p. 56):

> Importantly, Peirce sees a decisive aspect of self-control in the psychological ability to isolate a thought from other intrusions - a psychological equivalent to the logical notion of "distinction" discussed above: "Contemplation consists in using our self-control to remove us from the forcible intrusion of other thoughts, and in considering the interesting bearings of what may lie hidden in the icon, so as to cause the subjective intensity of it to increase".

The self-control that may lead to eminent cognitive operations such as hypostatic abstraction and distinction takes several steps. Stjernfelt (still following Peirce) summarises these as:

> 1) training, 2) self-training, controlling one's own self-control, involving imagination, 3) adoption of a rule guiding this meta-control, 4) improvement of that rule after some higher ethical standard, thus controlling the control over one's control and 5) controlling, in turn, that rule after some aesthetic standard.[10]

[10]According to Stjernfelt (2012, p. 56, to refer to for further reference), the summary is taken from the quote in Peirce: "To return to self-control, which I can but slightly sketch, at this time, of course there are inhibitions and coordinations that entirely escape consciousness. There are, in the next place, modes of self-control which seem quite instinctive. Next, there is a kind of self-control

Although self-training seems central to the development of these advanced cognitive traits, Stjernfelt claims that self-control always involves (p. 59):

> (at least) two levels, that of inhibitory controlling, and that of imaginarily creative (and controlled). This implies that the focus of control must alternate between the levels, evolving inferences on the lower level and pruning them on the higher level.

To Stjernfelt, the dialogicity salient of thought is already present in early social interactions such as joint attention (he refers to Tomasello 2008) in the form of turn-taking and turn switching which resembles (2012, p. 60): "performing logical arguments and proofs, the same person occupying alternately pro—and con-positions in an ongoing dialogic process".

In light of derived embodiment mechanisms, Stjernfelt's dialogicity imported from turn-taking and turn-switching experienced in early social interactions may bear resemblance to the process of coming to conscious terms with vague or tacit phenomenal experiences in the mind's eye. The process presupposes an alternation between a stage that allows encompassing susceptibility to the stream of consciousness or the previously introduced pulsation of the inner landscape, which for Stjernfelt is the 'imaginarily creative' and application of directed attention here termed the 'inhibitory controlling' (along similar lines see divergent and convergent thinking, e.g. Colzato et al. 2012; Capurso et al. 2013). The mental movement between unchained acceptance of consciously half-sensed phenomena and immediate conservation, when determining the experience, is crucial to the process of abstraction and creation of something entirely new.

It is worth highlighting that even if such sophisticated mental operations as the Peircian conception of hypostatic abstraction and distinction are characteristic of highly creative work, since they, contrary to derived embodiment, presuppose and produce representations that are 'outer worldly', they may nevertheless originate in derived embodiment processes. Stjernfelt (with Peirce) enumerates the steps as if the next step presupposes those before. In other words, it seems likely that skills to control direct attention, exercised in derived embodiment processes, are fundamental steps to the advanced skill of hypostatic abstraction. Hypostatic abstraction, though fundamentally an achievement of the skilled individual, may then depend on

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(Footnote 10 continued)

which results from training. Next, a man can be his own training-master and thus control his self-control. When this point is reached much or all the training may be conducted in imagination. When a man trains himself, thus controlling control, he must have some moral rule in view, however special and irrational it may be. But next he may undertake to improve this rule; that is, to exercise a control over his control of control. To do this he must have in view something higher than an irrational rule. He must have some sort of moral principle. This, in turn, may be controlled by reference to an esthetic ideal of what is fine. There are certainly more grades than I have enumerated. Perhaps their number is indefinite. The brutes are certainly capable of more than one grade of control; but it seems to me that our superiority to them is more due to our greater number of grades of self-control than it is to our versatility".

massive social exchanges, extensive guidance and support by an interlocutor, to a much wider extent than that recognised by Peirce or Stjernfelt, in order to be developed.

In the perspective of the stepwise progression, when individuals unproblematically engage in derived embodiment processes, they seem to match the level in which:

> a man can be his own training-master and thus control his self-control. When this point is reached much or all the training may be conducted in imagination. When a man trains himself, thus controlling control, he must have some moral rule in view, however special and irrational it may be (Stjernfelt quotes Peirce, p. 56).

Or in the Stjernfelt's own interpretation: "improvement of that rule after some higher ethical standard, thus controlling the control over one's control" (2012 p. 57).

For subjects to reach the advanced cognitive level, they must therefore have passed the stage of joint attention and that of derived embodiment and have been thoroughly engaged in meditative self-control topped off with, to follow Peirce, mastering of aesthetic judgments.

In sum, in light of derived embodiment mechanisms and following Peirce, truly advanced cognitive operations depend on self-development and immense practice. However, it is my assertion that such individual mental activities are realised only after fundamental cognitive abilities have been cultivated in social interactions. Though individual dedication and perseverance is key to self-training, and the reason why endless numbers of students are forced to read despite the heavy cognitive load, intersubjective exchanges as exemplified by the parental reading aloud, the shaman master's navigation of the novice mind, or the singing teacher's sensibility to comprehensive metaphors seem to hold the key to paving the way.

Chapter 7
Educational Implications

Hitherto, we have discussed how the first phase of the linguification process (first order linguification process) consists of the co-activation of multimodal (verbal and non-verbal) processes that are neurally associated in a single neural correlate. We have discussed how linguistic knowledge acquisition is realisable as a result of simultaneous and systematic bottom-up exposure to environmental and linguistic stimuli as explicated by the word-object paradigm. Subsequently, we turned to interactional expertise-like knowledge learning and derived embodiment processes (second order linguification processes), which appear to be mainly top-down controlled in the sense of depending on conscious imagery constructs. In the last chapter, the focus was on the facilitative effects of derived embodiment mechanisms on advanced cognitive functions and the derived improvement of general intellectual abilities.

So far, the discussion has mainly centered on the switch of particular mechanisms in language acquisition when the reference turns the context from the concrete to the abstract condition. As discussed, in both conditions direct experiences are, though via different mechanisms, central to understanding. In concrete learning, understanding is corroborated by perceptual experiences whereas in abstract learning the perceptual anchoring is replaced by the 'resonance board' revealed by subtle language use to sustain second order linguistic processes.

In this account, the focus has thus been on the possibility of linguistic knowledge to substitute for direct experiences. When Collins and Evans (e.g. 2007) claimed the existence of interactional expertise, the issue was to uncover the fact that linguistic immersion may make up for the lack of relevant perceptual corroboration in the individual (as exemplified by the individual embodiment thesis, for instance; Collins 2004). However, my explication of how the derived embodiment mechanism may illuminate what criteria to meet for linguistic immersion to work as the

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_7

sociologists conjectured, is not a discussion about which kind of knowledge to prefer. My concern has been to, at the micro level, explore how subjects may obtain (qualified) knowledge about phenomena of which they have had no direct experience.

In this account so far, implicit to the embodied cognition perspective but only peripherally touched upon in relation to online and off-line processing, is the understanding that at the neural level, interactional expertise-like knowledge and knowledge grounded in direct experiences differ. Thus, the point that subjects through linguistic immersion may actually obtain useable, and from a purely linguistic point of view insignificantly different, knowledge, and in addition improve important cognitive features, is not to be mistaken for a recommendation of interactional knowledge. Though Chap. 6 was concerned with various cognitive side effect very much in demand it was devoid of any evaluation of how knowledge acquisition *should* occur. In that perspective, second order linguification could just as well be viewed as a *second best* alternative in case subjects are prevented from accessing the referent in question. In some cases, but beyond the scope of this account, it could also be argued that second order linguification processes should be pursued to increase creative thought, for instance, disregarding the time and social costs of obtaining the ideal circumstances for derived embodiment learning to take place.

At issue in this chapter is then that from a neural perspective, first order and second order constructs differ. The question is more exactly how, and to what extent? Furthermore, to what extent might this difference be thought to influence the quality of different learning paradigms? In this chapter focus is directed towards the 'microcharacteristics' of linguistic knowledge obtained with and without direct experiences and not on exclusively, whether the knowledge obtained in different conditions is indistinguishable at the conversational level. Such microcharacteristics could involve systematic differences in categories of words, the preferred position of the narrator, or in extension of the perceptual considerations emphasised in this account, the differences at the neural level as well as their implications. For linguistic knowledge to count as knowledge, however, some sort of understanding is implicitly assumed. Thus, the interest is on the neural features of linguistic knowledge and the assumed concept of understanding obtained by A and A* from Chap. 2. The theoretical analysis is highly speculative and in that sense is mostly of academic interest. As such, it should be applied to practice with caution as it rests on assumptions about neural strength and functioning and to a much lesser extent on empirical studies, with the aim to address qualities of differently grounded linguistic knowledge revealed through the representational perspective.

However, the relevance of the endeavour is founded in the recognition of interactional expertise-like knowledge as a legitimate kind of knowledge (as compared with false memories in Chap. 2) that by its mere existence challenges the putative causal relation between the neural correlate and the linguistic and experiential level.

7.1 Neural Considerations in Education

When formal learning makes use of the multifaceted presentation of objects, events, and processes to accompany learning, the learning process taps into perceptual resources spontaneously thought to lead to improved memory and usability of the acquired knowledge (e.g. Glenberg et al. 2011; Glenberg 2008). In view of first order linguification processes, exposure to concrete referents takes advantage of the nature of our 'original' (and somewhat intuitive) learning style and, as discussed in Chap. 3, wide susceptibility to the surroundings. Active exploitation of concrete phenomena is overtly supported by the theory of material anchors. In light of the word-object paradigm, the intuition that perceptual corroboration consolidates knowledge seems valid. However, this conception may not take into consideration that the concrete phase and first order linguistic processes seem overly well functioning in subjects who are not already competent language learners, because they are in the process of *becoming* competent language learners. As argued in Chap. 3, it could be the case that in early age concrete learning is the only option available. This, however, does not pertain to subjects who are already competent language learners. Thus, what seems intuitive at an early stage may seem less so later in life.

The question this raises is whether after passing the first-order linguistic stage, environmental stimuli may still be generously exploited to generate facilitative learning effects. Will first time experience of a new referent in a competent language user still seem more effective than learning by derived embodiment mechanisms? What about perceptual acquisition in a post-learning event (wise after the event, i.e. knowing the referent conceptually before the actual acquaintance[1])? Will this improve significantly what has already been acquired? (For considerations along similar lines in discourse comprehension, see Zwaan 2016).

In this account of concrete learning, environmental phenomena are thought to massively co-define the content of the linguification process, which includes tacit knowledge. To the contrary, in abstract top-down processing the linguification processes are internally controlled, which leaves the involvement of tacit knowledge at a comparatively much lower level. In derived embodiment, though direct experiences are crucial to the associative process that sustains the abstract understanding, these are mentally manipulated in the sense of explicit control. Thus, as discussed in Chap. 6, the experiences are re-enacted top-down, the specific content is intentionally emphasised, and the neural correlate is therefore likely to differ from the correlate of similar on-line experiences. I conjecture that the difference consists

[1]Throughout this account, by abstract knowledge I have referred to interactional expertise-like knowledge. Thus, I have argued that second order linguification pertains, when direct experiences are not available. However, this does not exclude the possibility that later exposures (after second order linguification) to a referent may be possible. One may object however, to the application of the concept 'abstract knowledge' to knowledge which in the post-competent language phase is supported by direct exposure. For the sake of clarity, unless otherwise stated I stick to categorising knowledge by the original characterisation and use 'abstract' even if abstract knowledge, as is often the case, is influenced by concrete exposures in the post-competent language phase.

in both span of the experience, weight of specific sub-phenomena within the experience (referred to at the neural level as sub-aggregates), and degree of bodily involvement. Following expertise-like kind of knowledge, this difference was insignificant to the highly specific linguistic competences that could be tested in imitation games and become apparent in real life conversations. However, when we turn to the issue of understanding, these differences may seem to be of importance, nevertheless.

If we boldly 'translate' ideas about the neural correlates in concrete learning in which tacit knowledge corroborates meaning in substantial ways whereas abstract learning rests on those knowledge processes actively selected, what are the educational implications? Given this characterisation, it seems likely that exposure to concrete experiences in the post-competent language phase (where abstract language acquisition increases) contributes to the content of linguistic (conceptual) knowledge *by adding experiential and tacit qualities* to the neural assembly that sustains derived embodiment. Along these lines, in the concrete case in which the linguification process relies on direct experiences, concrete experiences in the post-competent language phase just add more 'of the same kind of experiences' to consolidate the learning. This situation may be true of most linguification products that refer to concrete items. In that respect concrete words are experientially renewed in a sense that resembles the reactivation of face-recognition assemblies when meeting a friend. Linguification products that refer to teddies, dogs, bottles, cars, or books are continuously modified by real life interactions, whereas abstract concepts are less likely to become renewed on a daily basis.

How can we validate the educational benefits of exposure to the concrete in the post-competent language phase?

Would direct experiences of the sea, which followed after the subject was introduced linguistically (and thus abstractly) to the concept in a post-competent language phase, invoke qualitative changes to the concept? Following Collins and the story about Weightless Wanda introduced in Chap. 2, apparently concrete experiences are non-influential in the post-competent language phase (2004, p. 138):

> Weightless Wanda will be able to say everything about weight that is sayable. Wanda, it seems to me, will be in something like the same condition in respect of the sea before I saw it at the age of about five (I remember that sight quite clearly). I do not think my linguistic abilities in respect of the sea suddenly changed when I first saw it.

In the following, we will discuss why and to what extent the 'no-change' contention is challenged by the neural perspective. I will explore how competent language users might benefit from direct experiences and whether direct experiences in the post-competent language phase are beneficial to learning. These answers will therefore address what characterises linguistic knowledge that involves relevant perceptual processes compared with knowledge without.

To stipulate the neural take on the answer, I briefly return to exemplary neuroscience and behavioural studies to reiterate the impact of perceptual processing on language.

As it turns out, the exploration revolves around what is meant neurally by linguistic knowledge and especially the relation to understanding. In the analysis it becomes clear that the neural perspective frames knowledge in particular ways that differ from the perspective sociologically implied (discussed in Chap. 2).

7.2 Direct Experience and Entry by Back Doors

Is the intuition that co-activation of perceptual stimulation while acquiring conceptual knowledge strengthens the knowledge sustained? In the acquisition phase of, say, apples, the perceptual contribution to the neural correlate of knowledge seems to facilitate retrieval processes (Ross et al. 2007). Apparently, accessibility to processes in the neural substrate corroborating the concept of apples improves because of the inclusion of somatosensory experiences. The question is why?

According to the theory of situated conceptualisation as proposed by Barsalou (2009), the neural correlate of stimuli of events, phenomena, and properties etc. forms because of being activated bottom-up. As discussed throughout this account the degree to which attention processes (and the level of consciousness) are constitutive components represented in the neural correlate formed in connection to direct experiences, is underdetermined.

However, despite the uncertainty of the role played by consciousness, the comprehensiveness of co-activities sustaining the linguistic acquisition during direct experiences and thus bottom-up, is still significant. The automatic encoding that depends on susceptibility to particular stimulations and the associative bridging of co-activated occurrences adds flexibility without conscious processing. It is the bottom-up mechanism that explains why tacit knowledge characteristics of direct experiences are of importance. For instance, in implicit memory, former stimulations facilitate the processing of perceptual information which leads to accelerating the processing of later perceptual episodes (Barsalou 2009). Barsalou writes (p. 1286):

> To the extent that perceptual memory matches the stimulus, the memory predicts that the stimulus is another instance of itself, thereby increasing the fluency of perceiving it via top-down activation. When for example, a perceived face activates an implicit memory, the face memory predicts that the perceived face is another instance of itself and aspects of its processing.

Exposure to events or actions which are already neurally encoded re-enacts the established memory either as behavioural changes or as sudden explicit thoughts (i.e. now available for top-down processing). Neurally, the facilitation is the raison d'étre of memory. To retain information in memory is to improve the processing in the next encounter with similar stimuli. However, exposure to similar stimuli may also erupt the memory based on former events since a new reverberating circuit is now created. Concurrently, the intercalation of slightly different stimuli into the well-established framework destabilises the memory and increases the chance of consolidating a slightly different memory (e.g. Tronson and Taylor 2007).

As discussed in Chap. 3, the facilitative effect of perception on linguistic processing is supported by many studies within grounded cognition on the processing effects of congruence between re-enactments and representations, and may be summarised by the following quote by Pecher et al. (2011, p. 222):

> Participants were faster and more accurate to recognize the object when the orientation of the picture matched the orientation implied by the sentence than when it did not match. Similar results were obtained for overlap in shape (e.g. sliced vs. whole apple, Zwaan et al. 2002) and color (brown vs. red steak, Connell 2007). These compatibility effects even arise when representations and perception are separated by a delay (Pecher et al. 2009) or when representation and perception only overlap in sensory modality and not in the specific concept that is simulated (van Dantzig et al. 2008), which indicates that the effects are not due to strategic imagery.

Moreover, such effects are not exclusive to neurophysiological studies. Within context-dependent memory research, it has long been known that one possible effect of environmental stimulation and hence the inclusions of perceptual particularities in the neural correlate that forms during learning, is to promote accessibility of memory during recall. In a renowned study, divers who learned arbitrary word strings on a beach and later tested in a forced recall test either in the same environment or under water demonstrated significantly better memory for the words in the list in the environment of the original learning (Godden and Baddeley 1975, however see also Goh and Lu 2012).

Though to memorise lists of arbitrary words is a conscious and therefore explicit task, environmental stimuli (context) which the subject is not aware of increase the accessibility of explicit memories possibly by increasing the number of perceptual experiences (putative back doors) that form part of that particular memory. If representations of these experiences are re-enacted through repetition of experiences, which in similar environments are likely to involve several instances similar to the original stimuli (either belonging to the environment of the beach or underwater), larger parts of the originally formed representation are being re-excited to further facilitate activity in the already established connections. Even though researchers instructed subjects and tested only for the representation of the recall, that is the explicitly memorised stimuli, environmental data which seem irrelevant to the explicit recall are also involved. Due to the established associations between the list of words and the environment, the larger the part of the original stimulations present during intentional recall, the more likely it is for the learned material to reach the threshold for conscious recall.

Commonly, from a the neural perspective the facilitation of memory that results from perception of external anchors is perceived as faster recall and more resilient memories as demonstrated in a study by Holt and Beilock (2006). Here drawings of domain-specific (or everyday) objects or actions were presented to expert hockey and American football players as well as to novices of the same sports to accentuate differences in the pace of neural processing. Afterwards, subjects were asked to assess whether any mentioning of represented objects or actions in the sensible sentences that followed had occurred. When the respondents assessed the occurrence of pictured items or actions that had also been mentioned in a preceding

sentence, experts showed larger reductions in RT than novices. In the everyday condition, subjects were exposed to sentences like 'the child saw the balloon in the air'. Subsequently, they were exposed to pictures of either an inflated or deflated balloon and had to judge whether the represented object had just been mentioned in the sentence before.

In the case of the inflated balloon the target matched the sentence, whereas in the case of the deflated balloon the target mismatched the sentence because deflated balloons are unlikely to appear in the air. There were no significant differences in how experts and novices responded to everyday objects and situations. However, in the domain-specific condition, when football players and novices were asked to assess a sentence like 'the trainer saw the offensive lineman protect the quarterback', only experts showed reduced RTs.

Thus, in this study being a non-expert did not exclude the possibility of coming up with the right answer, although RTs increased compared with the time spent by experts. Where does that fit in an examination of linguistic knowledge developed with or without direct experiences?

In the study by Holt and Beilock (2006), one obvious explanation of the results with football experts (contributory experts or Chap. 2's A*'s) would be in line with embodied cognition interpretations that the mere reading of the sentence 'the trainer saw the offensive lineman protect the quarterback' recruits neural areas that are active when we directly experience that 'the trainer saw the offensive lineman protect the quarterback'. In case of direct experiences, the same sentence is, among other things, neurally constructed from different modalities and the respective sub-activities; say sight, smell, and texture (due to embodiment in the acquisition phase). The football expert has numerous practical experiences of quarterback protection that fit such descriptions. To him, the neural correlate which constitutes the understanding of the sentence consists of input from many different modalities, which, due to numerous episodes of concurrent activation, are tightly associated. In contrast, novices with no direct experiences to back up the understanding of football would incorporate the concept of protection of quarterbacks almost entirely in the linguistic framework. The neural representation corroborating the understanding of the concept would be based on fewer connections and contain fewer back doors (as discussed in Chap. 3 and as implied here by the study on divers), which again would make the recruitment less efficient and therefore slower.

In an fMRI study by Beilock et al. (2008) using a similar design, the linguistic comprehension of experienced hockey players were compared with that of hockey watchers (no hands on experience) and novices. The researchers conclude (p. 13272):

> The impact of athletic experience on comprehension is explained by greater involvement of brain regions that participate in higher-level action selection for those with hockey playing and watching experience and greater involvement of brain regions that participate in step-by-step action instantiation for those without such experience. These areas fall outside the neural networks usually implicated in language comprehension.

To sum up, in neurologically informed behavioural studies knowledge is correlated with reaction times and/or the strength as well as the spreading and extent of the neural signal. Moreover, intriguingly knowledge seems to presuppose some kind of understanding.

7.2.1 Thoughts on Deeper Understanding

Following neural and behavioural studies as those by Beilock and colleagues, relevant external stimuli in support of conceptual knowledge acquisition are thus intuited to provide what may be named 'deeper understanding' (in the sense of improved). Expressions such as 'faster and more accurate' or 'greater involvement of brain region' denote neural data in which the perceptual part of the correlate sustaining a concept shows its impact. The impression that perception leads to faster processing may explain why we expect from expert commentators that their utterings build on direct experiences and why we disbelieve that linguistic immersion could ground particular knowledge skills without support from direct experiences. Apparently, the comparison between football and novice football experts on assessment of meaningful sentences tempts us to refuse the interactional expert as insignificantly different from the contributory expert. However, keep in mind that the novice football expert is in no meaningful sense of the term comparable with an interactional expert with perhaps 10 years of linguistic experience within a field (Collins 2004).

However, such studies bluntly reveal that neurally we address a particular kind of knowledge measured by standards relating to features such as 'strength', 'speed', 'stability', and 'robustness' without distinguishing between implicit and explicit skills, for instance. Though subjects are requested to apply semantic skills, the empirical data in themselves are not explicitly distinguished on the basis of non-conscious and conscious processing.

The reason why this is of interest is that the compilation of implicit and explicit processing and their internal relation may very well be central to the issue of understanding and the competence of interactional expertise-like knowledge though they remain underdetermined in the scientific literature. Thus, an attempt to compare interactional expertise-like knowledge with concrete knowledge must involve attempts to uncover the 'intuitive' assumptions regarding understanding.

As a first approximation, is the implicit conjecture that 'deep' understanding correlates with the ability to establish memories that include representations of phenomenal qualities, so that re-enactment of the event feels like something in the sense of associations with a particular felt sensation? That would mean that pure implicit knowledge may never count as deep. However, viewed from the perspective of the (linguistic) handles and back-door entries discussed in Chap. 3, if phenomenal qualities means the emergence of privately felt sensations that may open into sub-aggregates of larger neural correlates, many such 'handles' may feel like a 'saturated landscape' and express a richer ability to address the problem field

even if it depends on implicit processes in the first place. A saturated landscape would feel like possessing 'understanding' and the weight would be on the consciously accessible but phenomenal part that occurs because of perceptual experiences.

On the other hand, is 'deep' understanding characterised by consistent knowledge that resonates with the constraints of the world and therefore amounts to knowledge of aspects (eventually by simulation), their features, and internal structure? Apparently, expanding the number of possible interpretations related to a particular problem paves the way for the ability to abstract from the current context and navigate between different representations, as when a skilled musician seeks the knowledge of different master musicians to obtain a number of perspectives on the same problem field (e.g. Dreyfus and Dreyfus 1986). This interpretation of understanding is in accordance with the discussions on flexible thinking and executive functions that we encountered in Chap. 6. In that sense, deep understanding is numerous associations tied together within the knowledge span. This may also depend on consciously accessible but not necessarily phenomenal processes. In other words, the better one is acquainted with a phenomenon, the more 'meshed' the representation of the phenomenon appears, in so far as more aspects related to the particular knowledge become immediately (and potentially) accessible to the individual. Therefore, the weight is also here on implicit processes caused by direct experiences.

Thus, to have deeper understanding presupposes a nuanced take on a problem field that is structured bottom-up but to a large extent is operated top-down (associated with either access or phenomenal consciousness).

What does it mean that understanding is structured bottom up? And why is it intuitively so that linguistic knowledge has a lesser scope and is therefore considered less deep?

An explanation peripherally touched upon in Chaps. 3 and in the introduction to the current chapter emphasises the essentials between bottom-up and top-down acquisition. The suggestion pivots around tacit processes based on ubiquitous sensitivity to environmental stimuli and explicit processes based on the limited capacity of WM and serial processing. In bottom-up learning, the neural substrate that sustains learning and corroborates subsequent conceptual knowledge *is* therefore more richly connected compared with off-line top-down learning (see Marois and Ivanoff (2005), and Melnick et al. (2013) for a discussion on bottlenecks in conscious learning and in relation to intelligence). As in the diver study, the mere formation of a systematic part of the neural aggregate makes the peripheral neural activities significant to knowledge. Apart from acting as back doors, a bold suggestion could be that these 'dormant' associations in the form of subliminal connections in the ensemble under particularly favourable conditions have the potency of being attended to and become part of the top-down processing controlled by the individual.

Thus, the issue is not that bottom-up processing is stronger or more solid, but that such processing is potentially richer and may provide the subject with much more information if a switch from the non-conscious to the conscious state is

possible (the potential significance of a switch like that was briefly introduced in Chaps. 3 and 4). In the following section we will expand this idea further.

7.2.2 *Phenomenal Richness and Cognitive Load*

Following Cleeremans (2008), during learning environmental stimulation seems to corroborate knowledge acquisition by way of representations that accommodate particular qualities such as strength, stability, and distinctiveness.

It is the stronger multimodal processing that holds the key to subliminal associations that may or may not surface into consciousness and thus explains the 'richer' characteristic of knowledge based on direct experiences. The limitation of directed attention to external stimuli forces some stimuli into focus while others, as briefly discussed in Chap. 3, may stay subliminal though processed (otherwise responses would not habituate by repetition). The heightened activity of subliminal processes may for different reasons increase further, for example if brought closer to the attentional focus without being in focus. This operation may not be intentionally controlled in the sense discussed in Chap. 6, but could be conceived of as much more random. However, non-conscious processes in direct experiences may hold the potential to become facilitated and thus achieve attention. We as the perceivers may conceive of this as intuition, deeper knowledge or inspiration. The end result is that direct experiences possess this extra bottom-up source of potential knowledge silently pulsating in the periphery, which seems relatively more absent in abstract top-down knowledge. The richness is on-line. This putative richness associated with direct experiences is asserted in the interrogation of eyewitness accounts and studies that show explicit/declarative knowledge to be just a minor aspect of a larger knowledge bank (e.g. Prinz 2010). Given that second order linguification processes depend on re-enactment of previous experiences consciously accessible to the subject, why is this richness of direct experiences not transferred?

As a matter of fact, in second order linguification processes the richness of the perceptual content may still pertain to some extent. After all, it is the retained multimodal memory that linguistic handles and back-door entries access, which causes the pulsation of the inner landscape that the learner is supposed to engage with to grasp phenomenal experiences off-line as thoroughly discussed in Chap. 6. Thus, at the outset the off-line virtual world carries the potential to be considered rich. It may be far from as rich, as is characteristic of direct experienced representations, but the subliminal co-activities represent an underwood of potential phenomenal experiences if sustained adequately by attentional processes.

What differs significantly, though, is the distribution of the phenomenal experiences. In direct experiences, the distribution is determined bottom-up. Thus, different perceptual processes are simultaneously active and pervading the mind. Some may grow relatively stronger and seize the attention span. Often, though, no singular perceptual task predominates and the mind is disengaged in a sense that allows the processes of multiple perceptions.

In the second order linguification phenomenal experience, the top-down control aims at single phenomenal experiences. The working memory span is limited and the mind may only engage with a few sensory modalities at once. The virtue of top-down control is also its vice. The ability to sustain and focus reduces the potential multidimensionality of the retained representation of previous direct experiences. In off-line thinking, the subject is forced to attend to the multidimensionality serially as a bumblebee that flutters to flowers one at a time. Since the phenomenal experience is maintained voluntarily, it is possible to twist the re-enactment to an unrealistic extent. Strawberries may taste extra sweet, childhood ice creams were enormous, and summer weather was always sunny. The 'untamed wild-life' of phenomenal re-enactments based on the serial processing also justifies the accent on a significant other who by his or hers continuous verifications represent the much needed reality check.

In effect, the top-down controlled mind lacks nothing in phenomenal strength, yet the re-enacted experiences are typically phenomenally biased, dimensionally simple and therefore often flamboyantly extravagant due to lack of contrasting counterparts.

7.3 Cognitive Load and Attention Restoration Theory (ART)

The inferred differences have important implications with respect to cognitive load in bottom-up and top-down control of the mind. The differences in cognitive load aid in conceptualising differences between acquisition by direct experiences and abstract acquisition that may substantiate the bold suggestion of direct experiences as potentially richer and also point to differences at the level of micro-characteristics (cognitive load was also discussed in connection to the acquisition of abstract learning by conversation and by reading in Chap. 6). Differences in cognitive load may be of importance when distinguishing direct experienced knowledge and linguistically based knowledge.

According to therapeutic studies on the so-called attention restoration theory (ART) (e.g. Kaplan 1995), to engage in perceptual interactions with nature improves general cognitive performance. Following ART, and as briefly discussed in Chap. 6 in relation to mind wandering, directed attention occasionally becomes exhausted and needs to replenish to gain renewed strength to sustain the ability to learn.

Following ART, four different conditions in nature may promote the recovery of fatigue: 'being away', 'extent', 'fascination', and 'compatibility'. 'Being away' accentuates the distancing of oneself from the activities that lead to mental fatigue. To obtain the effect one can switch location physically to change the set of impinging stimuli, for example by taking a walk in a park. It is a precondition, however, that the change is followed by a mental switch (change of attention) to be productive.

'Extent' expresses the need of the putatively restorative site to be sufficiently rich to be perceived as a coherent structure that produces enough to see and think about to fully engage the mind.

Nature is ripe with inherently fascinating stimuli that attract involuntary (external) attention while leaving direct attention resources unaffected (Berman et al. 2008).

'Fascination' thus is the attraction of attention that does not require effort and has no inhibition of competing stimuli, sometimes referred to as 'soft', such as the viewing of a colourful sunset, whereas 'hard' fascination obsesses one's attention as in viewing a competitive sporting event.

'Compatibility' denotes the co-occurrence of what the individual is trying to achieve and the affordances provided by the environment in the sense that the information needed for the individual to attain his or her goals are actually provided by the environment.

A study that recorded the psychophysiological response to images that hypothetically represented the four criteria of restorative environments, corroborates the mental benefits of wildland-wilderness environments (Chang et al. 2008; see also Taylor and Kuo 2009).

Likewise, a study that instructed college students to imagine themselves cognitively fatigued while rating the perceived restorativeness of depictions of different locations at campus, such as no views of nature, window views of nature, views of outdoor nature with actual scenes, and two nature murals with or without water features, showed a difference between the perception of plain nature and nature including built structures. Students also showed a preference for large dramatic nature murals, especially if they included water, to views of real but mundane nature with built structures (Felsten 2009).

Though urban areas are rich with stimuli that exert a pull on external attention, more often these are dramatic and therefore require directed attention (Berman et al. 2008, list as examples avoiding traffic and ignoring advertising). I suggest another effect of urban stimulation that relates to the linguification product and the tendency to evoke symbolic thought. Even though nature and urban environments elicit similar bottom-up stimulation, it is likely that natural stimuli make comparably less symbolic associations. A pond full of carps signifies nothing or only very little beyond itself. Carps swimming just 'are', whereas a picture of carps as in advertisements normally signifies or stands for something different. Advertisements may be bottom-up stimuli, just like carps swimming, yet their content is often verbal or pictorial and instigates serial thought processes that call upon executive functioning.

The point is that nature's stimuli relatively more often may elicit strong phenomenal sensations that signify nothing or only very little beyond themselves. Perhaps the 'closed signification' that is the fact that they point to themselves and not away from themselves to something beyond, intensifies the experiences related to natural signals?

To sum up, the understanding of knowledge in embodied cognition entails such features as strength, robustness, and speed of processing as well as flexibility and

associative span. In that understanding, obviously the stronger the neural correlate the better the knowledge (and by the same token understanding) it sustains. Implicit to this claim is the idea that the knowledge is more accessible and may be reached top-down. Direct experiences are multi-sensory and the neural correlate may be extensively encoded. The restorative effects of natural environments on mental health suggest that we possess an enormous potential for subliminal processing. We definitely possess the ability to indulge in manifold shallowly engaging perceptual stimulations. This potential suggests that we may also be more receptively vibrant when acquiring knowledge by direct experiences even though this situation normally calls for more controlled attention.

What may we conclude about interactional expertise-like knowledge compared with knowledge obtained through direct experience? On a scale that measures knowledge by reaction times, strength, and robustness, are second order linguification processes proficient alternatives to first order linguification experiences? Is interactional expertise-like knowledge useable because it makes an equal or just an acceptable alternative?

In light of the multimodal on-line perceptual experiences, the off-line condition that controls the virtual room top-down appears stripped and partly skewed and phenomenal experiences are typically serially accessed. Moreover, studies on stress-relief obtained in natural environments support the claim that top-down control as viewed in second order linguification processes entails cognitive load from which we may sometimes need to be relieved.

7.4 Post-competent Language Phase and Concrete Crutches

If interactional expertise-like knowledge appears more neurally weak, it may gain from perceptual explications as in the case of being exposed to the sea after the acquisition of the concept or to some extent in the case of metaphor use to teach singers. In general, interactional expertise-like knowledge is opted for, because direct experiences are unavailable and because ideally interactional expertise-like knowledge is not remarkably reduced. However, if at all possible abstract knowledge gains in strength from the perceptual corroboration.

As discussed in relation to rumination studies, the concrete is superior as mediator between imagination and actions and therefore adds a different quality to understanding. Momentarily, concrete experiences offer affordances and solutions that accentuate the immanent difficulty of establishing a virtual universe that echoes the concrete world in which we act, entirely off-line.

To exemplify, for subjects suffering from, say, stress, to use the concept of ‘landscape’ about the jumble of their inner sensing (which I did in Chap. 6 for the same reasons) commonly associated to large scale units in nature might provide them with a *perceptually accessible* ‘handle’. The metaphor ‘landscape’ has centrally embodied connotations acquired previously, but when used when resting in

natural environments the direct experience facilitates understanding. In stress therapy the metaphor and nature as material crutch may be useful in gaining access to and operationalise mental rooms, the exploration of which could be an essential part of the healing process (Corazon 2012; see Corazon et al. 2011 for an introduction to and practical implementation of use of metaphors in garden therapy).

When using 'landscape' as metaphor for the stream of consciousness, the therapist concretises and thereby structures the phenomenal feel of one's mind, which might otherwise suffer from rather vague representations (for elaboration on this point in relation to theory of mind, see also Chap. 8). Of course, if no concrete crutches are involved then the use of 'landscape' for the mind resembles a normal second order linguification process. In the post-competent language phase, the therapist actually induces a 'something' to handle for the client when addressing his or her mind (Jordan 2009).

What in these 'concrete' experiences makes them handles? The concept of landscapes implies space, natural sceneries, the possibility of navigation, and personal freedom of travelling without boundaries. However, as discussed in Chap. 5 on metaphor use in the teaching of singers, to find common denominators is not always straightforward. To some, the figurative understanding of landscape probably produces less positive alternative re-enactments such as lack of direction, agoraphobia, or fear of wild animals.

Obviously, in the early phase of establishing new associations between landscapes and inner sensing, the therapist may get help from the concrete surroundings, while accentuating patients' experience of inner sensing. By a modified kind of first order linguification process (which is more top-down controlled in particular), neural connections of sub-activities which have not been made before are established. As a result, the concept of 'landscape' now changes in content.

What does this example demonstrate in relation to acquisition of concepts by direct experiences in the post-competent language phase? The association is by no means trivial since linking *the mental* and *external space* will be new to subjects. However, although acquisition of the association (use of landscape for the inner sensing) is verbally introduced, after perceptual exposure it will generate images readily provided by the experience of concrete phenomena in the current environment. The sensation of wandering in nature, continuous experiences of sceneries, and the sense of travelling and agency actively engages and weaves into the fabric of the slightly changed notion of 'landscape'.

Why introducing concrete handles, if derived embodiment processes could successfully do the work? Obviously, as described in the last section it is more costly for the executive system to operate on representations it has to call forth independently of relevant external stimulations than to operate on accessible external stimuli. Following Kirsh (2010, p. 445):

> Everyone knows it is useful to get things out of the head and put where they can be accessed easily any time. It is well known that by writing down inferences, or interim thoughts, we are relieved of the need to keep everything we generate active in memory. As

> long as the same information can be observed and retrieved outside, then externalizing thought and structure does indeed save us from tying up working memory and active referential memory.

If the cognitive load is lessened, executive control resources are freed to facilitate further thinking processes. To exemplify, if subjects get help from the environment to imagine their internal sensations as a landscape, by simply watching and sensing the landscape, they do not have to spend mental resources on the construction and maintenance of an image of a landscape. Hence, in such subjects the liberated mental resources might now become directed to sustain processes further down the stream of thinking. 'Metaphorically' speaking, the subject hits base 2 where he or she may now imagine the self in an internal landscape that offers specific locations and virtual affordances. The concreteness of the otherwise intangible mental room may facilitate the subject's ability to concretise and, as discussed in relation to the rumination studies in Chap. 4, most importantly find solutions. In comparison, subjects provided with the landscape metaphor without perceptual corroboration (as would pertain to interactional expertise-like knowledge) might have a hard time sustaining the image and may get stuck at base 1.

In addition, as mentioned, the concrete landscape affords opportunities that transgress internal representations and mediates between thinking and acting. According to Kirsh (2010, p. 446):

> Things in the world behave differently than things in the mind. For example, external representations are extended in space, not just in time. They can be operated on in different ways; they can be manually duplicated, and rearranged. They can be shared with other people. Tools can be applied to them. These differences between internal and external representations are incredibly significant.

This claim challenges the efficiency of derived embodiment processes as compared with first order linguification processes. Since derived embodiment processes occur in complete absence of relevant external anchors, no tangible features in the environment are actively exploited and the load is all in the mind. Therefore subjects seem to willingly opt for concretisations. In the following this inclination is further explored.

7.5 Japanese Interpreters in Brazil

Material crutches were namely actively sought by Japanese interpreters in the Brazilian steel industry, who to start with were asked to interpret words they had never encountered before (Ribeiro 2007).

These interpreters were in Brazil to support technology transfer from a steel company in Japan to one in Brazil. According to Ribeiro (2007) their job required them to be interactional experts in steel-making (p. 717):

> The interpreters say that the first thing they must learn are the 'technical terms', for equipment, processes, and activities. Knowing the names for things is not enough for the

> purposes of interpreting, however. To interpret, the meaning of terms has also to be understood; the purpose of the equipment, the processes, and the way they are interconnected must be grasped.

To acquire this knowledge, the Japanese–Portuguese interpreters voluntarily seek to become immersed in more than the language of steel-making. Apparently, they seek out so-called physical contiguity which is closeness to actual practices without being involved in those practices. For instance, being able to observe the circumstantial connections referred to by language is valuable.

Ribeiro describes how interpreter J points to many 'common words' (p. 719):

> which they would have difficulty understanding and interpreting without technical knowledge. For instance, 'liner' is a plate which is used to avoid wear and tear, but when participants say it, the question is 'which liner', in which equipment? The same applies to 'standard', 'pattern', 'control', and 'design'.

The dependence on physical contiguity to obtain understanding was the reason why the interpreters in the study found it harder to learn to interpret in areas where there was nothing to see, such as informatics, electrical maintenance, and research (Ribeiro 2007). In relation to language acquisition without direct experiences, understanding apparently becomes relatively more arbitrary. Direct experiences tie understanding to particular interpretations congruous to the constraints of the real world. As described in Chap. 6, abiding by the constraints of the real world seems appropriate when knowledge aims at optimising actions and judgements that pertain to the real world. If knowledge aims at expanding the real world, the subject may be better off abandoning concrete crutches. As when separating phenomena analytically though the endeavour is impossible in practice.

Moreover, sometimes observation without doing may be less potent as contributor to understanding. For instance, mirror neuron system activation by observation seems to be far more successful if preceded by self-induced mirror activation. In a study by Cross and colleagues (2006), the activity of particular brain areas were looked at while expert dancers observed a skilled dancer perform dance movements they had either rehearsed or had not previously rehearsed themselves. Mirror neuron systems were more active in the familiar condition, emphasising the effect of activity of self. A similar conclusion is found in Calvo-Merino et al. (2005). It follows that in some cases, to take full advantage of watching for instance contributory experts, one should have been engaged in the very same practice at previous occasions. Thus, to exploit the susceptibility and reconstruction feature of observation, in some instances, the interpreters must already have employed the same neurons in the past to obtain full value.

To sum up, interpreters whose work hinges on profound ('deep'?) understanding in order to correctly translate actively seek opportunities that will provide information from direct experiences. The utility of physical contiguity may be especially high in case of radically unfamiliar areas of expertise so that entirely novel understanding and subsequent memory is to be formed by observation. Thus, normally we may be inclined to add proximity to actual practices and seek out direct experiences to gain in conceptual clarity when we attempt to understand

fields of which we have no prior knowledge. When the accessibility of relevant situations is unrealisable, the next best way to circumvent shortage of direct experiences is to acquire concrete crutches. This inclination to immediately turn to material crutches might also explain why we seem to enjoy and become attached to readily accessible stimuli primarily provided by contemporary smart technology (Lee et al. 2014; Samaha and Hawi 2016; Schilhab (2017b, c); Vincent 2013; Wilson et al. 2014).

As discussed in Chap. 6, it is obvious that maximum utilisation of second order linguification knowledge requires advanced mental abilities. Furthermore, the accomplished products are mind products that depend on similar advanced abilities in peers to be shared. One may conclude that the cultivation of second order linguification mechanisms depends on many years of training (remember the necessary steps proposed by Peirce and Stjernfelt, discussed in Chap. 6), whereas utilisation of concrete crutches is less demanding and thus available to a larger number of people.

Moreover, thinking with crutches abides by the constraints of the world, which may condensate the real-world relevance. From that perspective second order linguification processes may be viewed as useable substitutes but never as equal to processes obtained through direct experiences.

Chapter 8
Issues to Consider

Let us begin this last chapter by summing up the arguments presented. Throughout this account (and in the elaboration in Chap. 7) based on biological assumptions about cognition, the underlying contention has been that all else being equal, concrete phenomena are perceptually and thus phenomenally more influential (and therefore conceived of as more real) than non-crete phenomena. In support of this position is the argument that representations that refer to concrete phenomena exhibit relatively more stable neural connections than non-crete representations due to more perceptual properties. As Borghi and Cimatti put it (2012, p. 28): "with MCWs the world structure provides more constraints on how categories are assigned than with MAWs" (where MCWs and MAWs refer to meanings of concrete and abstract words, respectively). The constraints of the world result in perceptual responses distributed along preferred frequencies hereby generating significant neural patternings (e.g. O'Regan and Noë 2001).

Studies on the universality of linguistic categories such as 'containers' seem to corroborate that contrary to cultural restrictions imposed on linguistic categories, categories of concrete phenomena are constrained by 'the structure in the stimulus space' (Malt et al. 2003). As a result of the structure imposed, that works bottom-up, the representations of concrete phenomena are neurally characterised by stronger internal connections than connections to external phenomena not constitutive of the phenomenon. As an example, bananas come with a particular smell and texture (internal connections) but may be bought in a plastic or paper bag (external phenomena). In comparison, representations for abstract objects, on the other hand, appear neurally weaker due to the absence of perceptual anchors to constrain the connections. Thus, connections internal to the representation of the abstract phenomenon may be comparatively weaker compared with the connections formed to external phenomena which are not constitutive of the phenomenon, making the boundary more blurry. In other words, the neural corroboration of linguistic referents for concrete phenomena, events and situations is stronger, more focused, and less arbitrary. To illustrate how external constraints work, as discussed in Chap. 5 in every grasp the same cup will elicit a particular neural activity (Cashman 2008). Likewise, regarding the drinking coffee routine discussed by

T. Schilhab, *Derived Embodiment in Abstract Language*,
DOI 10.1007/978-3-319-56056-4_8

Sheckley and Bell (2006) the repetition of any activity entails that the neurons involved would fire together many times.

However, for abstract referents the neural corroboration of concepts is less focused (i.e. less constricted), less strong (i.e. fewer connections), and more arbitrary (varies from episode to episode). To exemplify (and as discussed in Sect. 4.3.2), when dealing with the acquisition of abstract concepts, we are deprived of the numerous structures in the world that influence bottom-up (often subliminally) and add tacit connections to the neural representation. Abstract linguification products that are not and could not have been experienced depend on volitional and conscious selection top-down (as demonstrated by studies on how the imagination of the future depends on conscious remembrance of previous experiences).

In line with this conjecture, an implicit assumption throughout has been that knowledge of real phenomena are ontogenetically (and phylogenetically) primary in the sense that direct experiences entail 'the original way' of acquiring knowledge or at least the way we are biologically disposed for at an early age before competent language is established (as discussed in Chap. 3). An immediate argument in support is that we are postnatally (and the dynamics of the neural system) tuned to acquire amodal (co-occurring perceptual stimuli from more modalities and therefore intersensory) information prior to modal (perceptual stimuli in a single modality) information.

Thus, Bahrick and Lickliter claim (p. 193):

> It is important to emphasize that our findings supporting intersensory facilitation do not suggest that intersensory redundancy is always better for perception or learning than unimodal stimulation nor that, as some studies suggest (e.g. Shams and Seitz 2008), it is superior for perception of all stimulus properties. Rather, intersensory redundancy promotes attention to certain properties of stimulation (amodal) at the expense of other properties (modality specific). Given that the environment provides far too much stimulation to attend to at any given time and that intersensory redundancy is high on the infant's salience hierarchy, it can play a powerful role in regulating and constraining which aspects of stimulation are attended to, particularly early in development when attention resources are most limited.

Thus, the assertion has been that direct experiences central to first order linguification processes provide the language learner with neural representations qualitatively different from linguification processes *without* direct experiences of the referent. The differences warrant the analysis of the distinction into concrete and abstract knowledge acquisition.

Moreover, the assumption has been that acquisition of knowledge is considered abstract when phenomena are not directly experienced but grasped instead through the derived embodiment mechanism. Therefore, abstract knowledge pertains to understanding things that are either not perceptible, i.e. black holes (because our sense organs are inappropriate for managing the task), or not directly experienced, i.e. exotic places, events, or phenomena that we have never experienced ourselves and therefore have no experiential grounding of (in Chap. 4).

In Chap. 7 I argued that from the perspective of strength, robustness, and distinctiveness, interactional expertise-like knowledge is qualitatively not comparable

with first order linguistic knowledge, though from the sociological perspective of making judgments interactional expertise may be. The different takes on the issue of quality depend on the level of the assessment and thus the purpose of the linguistic knowledge in question.

The thesis has been that abstract knowledge acquisition of phenomena that exist but from an epistemological angle to the learner deprived of relevant physical attributes, depends on derived embodiment processes. These processes entail controlled imaging of previous knowledge including phenomenal experiences that are then attached to new concepts. Therefore, somewhat anticipated, abstract knowledge is not all that mechanically different from learning about the concrete. When learning via derived embodiment, in general we reuse the mechanisms that sustain first order linguification. What differs in the acquisition of knowledge of concrete and abstract phenomena is the degree of subjective control (in case of second order linguification, of the simulation), the origin of the phenomenal feel (whether it belongs more to the current situation or to a re-enactment) and, consequentially, the access to the phenomenal feel. Since understanding concrete phenomena is the 'original' linguification process and therefore regarded as first order, understanding abstract phenomena using the derived embodiment process may be viewed as a second order linguification process.

8.1 Limiting Conditions[1]

Given that derived embodiment aims at simulating concrete understanding by exploiting, for instance, the facilitatory effects of perceptual corroboration entailed as phenomenal experience in word use, one could justly question the applicability of the mechanism. How general is derived embodiment? The question seems all the more legitimate when considering that the circumstances that sustain derived embodiment mechanisms appear incomparably sophisticated. After all, for the derived embodiment mechanism to be functional, a receptive interlocutor is required who readily welcomes the challenge to teach by a cooperated, carefully developed yet virtual and fragile 'parallel universe'. For example, how frequent are dialogues on existing but absent phenomena entirely unbeknownst to one of the interlocutors? How often do we dedicate ourselves to elaborate explanations in asymmetrically conducted conversations? And how probable is it that we have not already been linguistically exposed, though generally unaware of the fact (thus 'primed'), to phenomena we did not directly experience before an interlocutor took the time to explain the phenomenon in detail? Apparently, infants are involved in fully matured conversations before attributing conventional meaning. Along similar lines of thinking, derived embodiment may not be the ultimate source of abstract knowledge acquisition. We may also obtain knowledge of abstract phenomena and

[1]Part of this chapter has previously been published as part of my 2007b, 2011, 2015a, and 2017b publications.

situations regarding their meaning by extracting statistical information from linguistic input (e.g. Andrews et al. 2009). If using such alternative routes is more the rule than the exception, we cannot exclude that these alternative exposures may to a considerable extent be influential, making the claim of learning about phenomena purely linguistically less persuasive.

A related issue to consider is whether abstract understanding always presupposes linguistic conversations. In the sense of second order linguification processing, are genuine conversations presupposed for abstract linguistic understanding to occur? If so, then what characterises the kind of knowledge acquired exclusively from written material as we read books or scan the internet, activities that seem to play a significant part in most educations (this issue was raised in Chap. 6)?

Undoubtedly, derived embodiment processes are luxurious additions to linguistic activities with numerous functions beside epistemological insight. In pure form, ultimately, as described in Chap. 6, derived embodiment processes may manipulate knowledge far beyond the representational stage and even promote cultivation of metacognitive competences that correlate with general success in life.

However, in opposition to the limited applicability suggestion, it might be wrong to conceive of derived embodiment mechanisms as influential only to the extent that they occur in the ideal form. What if derived embodiment processes are not confined to deep conversations based on phenomenally experienced re-enactments of direct experiences and massive ingenious interventions by an emphatic interlocutor looking ahead. What are the odds that derived embodiment processes also apply to acquisition of knowledge that does not meet all of the criteria of derived embodiment mechanisms in the strict sense above?

A telling example of knowledge acquisition that partially draws on derived embodiment processes concerns the conceptualisation of the mental states of others.[2] To some extent, the acquisition of a theory of other minds depends on the abilities of the interlocutor to associate phenomenal experiences from previous direct experiences to experiences with a different perceptual content. I propose that the task is corroborated by some of the processes pertinent to genuine derived embodiment processes as exemplified by instructed fear response. I conjecture that in the learner the acquisition of a concept of other minds depends on an ability to grasp phenomenal experiences in the stream of consciousness that may then through the mediating help of the interlocutor become associated to a superficially distinct perceptual experience conceptualised through first order linguification processes.

Thus, for ToM to develop, the learner must associate previous phenomenal experiences to a concept that refers to concrete circumstances that elicits perceptions bottom up of a different kind. Thus the associations are not straightforward. In this process, interlocutors therefore, seem decisive as catalysers for the association

[2]The ability to attribute mental states, such as beliefs, knowledge, intents, emotions, and desires to oneself and others and to understand that others have beliefs, desires, and intentions that are different from one's own is named 'Theory of mind' (ToM).

to take place. As in derived embodiment processes, by conversation interlocutors must bring about the phenomenal experiences elicited in an entirely different condition. How this is accomplished will be discussed in the next section. Though we focus on the character of linguification processes specific to the knowledge acquisition of mental states in others, I hope to establish the applicability of derived embodiment beyond the interactional expertise-like condition in which it originally was discussed.

8.2 Expanding the Vocabulary—ToM

Understanding the mental states of others depends on a special and truly important case of 'abstract' knowledge acquisition that on the one hand challenges our inclination to acquire knowledge perceptually, and on the other hand seems crucial to social embedding as a human being. Mental states such as 'feelings of loneliness' or 'worry' in others and oneself are not experienced in comparably the same direct way as concrete phenomena but appear to depend on higher cognitive processes that, as I will assert here, to a large degree are mediated by language. For this reason to learn about mental states in others bears resemblance to abstract knowledge acquisition.

Philosophically, mental states are considered to be of specific interest in the sense of first-person experiences, the subjective stance on the stream of consciousness, which renders mental states impenetrable to third parties. The simultaneous subjective perspective on mental states is tightly connected to so-called 'privileged access' (e.g. Crane 1995). Hence, acquisition of knowledge about mental states differs considerably from knowledge acquisition of intersubjective phenomena. Consider, for example, exchanges in discourse when language acquisition refers to concrete phenomena, such as bananas or a green light at a zebra crossing. All else being equal, interlocutors and learners perceptually appear on equal terms when making judgments. Subsequently, they are also more or less on equal terms when negotiating the appropriate linguistic descriptions for their 'shared' subjective experiences.

The subjective, yet in others ways, shared experiences provide the interlocutor with legitimacy as his or her direct experiences (as revealed by wording and behaviour) are comparable with those of the learner. As previously discussed, real experiences make children confident about the expected outcome of the perceptions of others (Koening et al. 2004). Thus, in case of potential perceptual symmetry of familiar objects, children perceive themselves as equivalents in assessing perceptual experiences.

Why is that? As briefly discussed at the beginning of this chapter, perceptual processing of concrete phenomena, which are concrete because they are perceptible to us, may elicit certain generalisable perceptual experiences as a result of the constraints of the real world. Some researchers refer to is as 'categorical perception' (Regier and Kay 2009). Hence, it is likely that the green or red traffic light strikes

similar circuits in both the interlocutor and learner and comparably perceptually contributes to the level of information about light conditions. Unless top-down activity is inappropriately influential (as when parents deliberately misrepresent certain concepts to divert the attention of the child by for example pretending that a common words like 'cream' is a profanity to nudge the child away from using foul language), when observing the switch from green to red, the stimulus influences exogenous attention in a fashion similar in all individuals. Apart from the fact that the design of the green and red light seems to obtain its rationale from perceptual saliency, a fictive society in which red and green light was perceptually and therefore actively ignored is indeed fathomable. Thus perceptual stimuli are immediately prone to top-down regulation that may modulate the perceptual impact. Thus, the existence of uniform (thus species-specific) sensitivities to like phenomena still allows for strong social influences as suggested by the study by Kwok et al. (2011).

Therefore, when being taught about how to appropriately interpret light conditions at zebra crossings, the shared experience of the light is more likely to render synchronicity in understanding. In contrast, the lack of instant similarity between direct experiences in interlocutor and learner turns the process of linguification of mental states into a special case.

In the latter case, everyone knows his or her own mental states from direct experiences but is confined to understand mental states of others exclusively by external observation. Though some philosophers find the postulate of conscious experiences problematic and on that account dispute the idea of privileged access, here I presuppose that at the individual level it feels like something to experience one's own mind (e.g. Nagel 1974; see also Prinz 2007).

Obviously, any experience is by definition private irrespective of the location of the referent, whether internal or external to the body as in the case of public light poles. My current mental state, related to the perception of cyclists passing my window, is private in so far as it depends on representational activity in *my* neurons.

However, since a moving bicycle is publically accessible, the perception of the bicycle driving by is private in a predictable sense, assured by the social affirmation of the event. Interlocutors and learners watching bicycles passing by are relatively comparably perceptually informed and, as in the case of light conditions at zebra crossings, may have adopted similar linguistic conceptualisations for the events through numerous linguistic 'negotiations'.[3] These have led to harmonisation of expressions and agreement on how to linguistically codify such experiences. In the sense of asymmetry in accessibility to particular mental states, it seems meaningful

[3]From behavioural similarities, one cannot deduce similarity in mental states (see Crane 1995). That comes down to the fact that similar perceptual stimuli impinging on subjects may not elicit similar mental experiences. This also goes for observing a green light or bicycles. However, the discussion on the world's constraints as presupposed in exogenous attention for instance suggests that bottom up activity (i.e. green light) may elicit relevantly similar perceptual activity in observers affected by similar events.

to dissociate private (in the sense of experiences of mental states) from public experiences (in the sense of experiences of public objects) such as traffic lights.

8.2.1 Two Categories of Mental State Contribution

This seems to suggest that the phenomena to which concepts of various mental states apply belong to two distinct categories distinguished by how we obtain knowledge about the mental. On the one hand, we use terms such as 'happy', 'depressed', or 'lonely' about the particular *phenomenal feel* experienced in the first-person sense. On the other hand, we attribute these terms to the mental states of others when particular *behavioural criteria* are met. Hence, to grasp what is meant by particular mental states, such as 'happy' etc. in one self and in others, learners must learn to associate phenomena they know of from direct experiences to phenomena they know of in the third-person perspective. And this is what renders mental state attribution dependent on derived embodiment mechanisms to some degree. Since we must carefully separate the first- and third-person conditions when we discuss the proper characterisations of what it means for an experience to be direct, the situation is even more convoluted than described above. Obviously, for the learner who acquires the concept of mental states in others, the third-person perception of mental states offers direct experiences as well. When watching pain behaviours of others, for example, the observation is manifest as a direct experience (of pain in others) that is associated with linguistic conceptualisations in the first order linguification process. Thus, what seems to be at stake is that the direct experience of particular states that appear to the individual in the subjective sense, elicited as first-person experiences, are to become associated with the perceptual experiences related to the third-person perspective, which are not experienced in the first-person sense (see also Chap. 4 on interoception).

The point is that the learner must grasp phenomenal experiences in the stream of consciousness (feeling pain) obtained in previous (private) experiences and associate these with a superficially similar perceptual experience (observing pain in others).

Obviously, the situation is significantly different from cases in which interlocutor and learner have equal access. When learning the concept of 'butterfly', for instance, both interlocutor and learner access the experience of a colourful esoteric creature that 'flutters here and there' (see Ingold 2011 for this particular description attributed to the Koyukon people, p. 169), similar to light experiences at zebra crossings. The knowledge accentuates the perceptual third-person experiences that relate to the phenomenon 'out there' (as do the bicycles outside my window) and that can be shared. When learning about mental concepts, on the other hand, the learner acquires the concept in two distinct conditions, namely the first-person and third-person condition.

In the third-person condition, the interlocutor and learner may share the perceptual stimulation pertaining to behavioural criteria in the same way they would

share the experience of a butterfly and the traffic lights at a zebra crossing as 'out there'. Thus, observing a third party and assigning the agreed term, the use of mental terms aligns in much the same way as 'flutters here and there'.

This calls for some clarification since first-person experiences may in fact also be shared as a result of similar stimulations. Imagine losing the family dog to old age; the whole family may access and experience grief in a sense similar to sharing the experience of a butterfly. Likewise, when parent and child share a bold ride on a roller coaster they may also share the first-person experience of fear, pleasure, or excitement. In such cases, the association between phenomenal feeling of fear, pleasure, excitement etc. and third-person criteria such as screaming and enthusiastic grimaces may be established (e.g. Keysers and Perrett 2004). Shared experiences in this sense may be responsible for the 'education' of mirror neurons which some theoreticians (for instance in the social neurosciences) take to sustain the ability to theorise about other minds (see, Catmur et al. 2007, 2009; Kohler et al. 2002; see also Paulus et al. 2003). When observing the parent laughing while experiencing oneself laughing, neural correlates that sustain the observation of laughing in others are coupled with the neural correlate that sustains laughing in the self.

Apparently, studies on the capacity for learning in mirror neurons exist (e.g. Cook et al. 2014). For instance, a dance study by Calvo-Merino et al. (2005) shows that mirror neuron areas connected to motor learning were significantly less activated in naïve subjects compared with experienced capoeira dancers when viewing videos of capoeira actions (a similar issue was also briefly discussed in relation to the interpreters in Brazil, in Chap. 7). The 'education of mirror neuron systems' to an extent that makes the division between the perspectives of others and self indiscernible is supported by a study by Mattar and Gribble (2005), in which observing another individual undergoing the process of motor learning affected the subsequent performance of naïve observers (see also Stefan et al. 2005 for formation of a motor memory by action observation). After passive observation of organised hand movements of a model, TMS evoked thumb movements that imitated those of the model in the sense that the probability of copying the exact track was considerably increased.

8.2.2 Learning ToM and Derived Embodiment Mechanisms

Mental states are often subjectively experienced without sharing conditions with peers. For example, when comforting a child in pain who has fallen off their bicycle, the interlocutor is likely to have no subjective access to the mental state of the child in the sense of phenomenal experiences and therefore relies entirely on behavioural correlates.

Thus, mental terms are elusive in the sense that consensual agreement based on mutually informed direct perceptions (as when both laugh in response to a joke) by different observers seldom pertains to the experienced first-person content.

The dual 'reality' of mental states (that is combinations of the first-person and the third-person aspects) has implications with respect to how the concept is handled in practice (both in every day and scientifically, though the significance of this appears largely unnoticed).

In ordinary language use, the 'ontological' (first-person aspect that 'it feels like something' to be in that particular state) and 'epistemological' statuses of mental states (criteria for when to apply to others) are normally merged into a unified concept.[4]

As a result, subjective experiences of particular mental states are associated with behavioural patterns not supported by direct first-person experiences. Thus, the merging relies on interlocutors to establish and explain the connections. And as in derived embodiment processes, by conversation, interlocutors must bring about the phenomenal experiences elicited in an entirely different condition (for instance the personal experience of being in a state of pain while understanding the pain of others) to pave the way for repeated co-activation of third-person and first-person perspectives.

In case of the subjective experiences of pain, the language learner in pain is in a sense both more knowledgeable qua his or her privileged access to the state and less knowledgeable qua the linguistic dependence on consensual rules to assess these states and conceptualise them. In 'public' experiences, as for instance the perception of the colour of traffic lights, the experience seems to be the result of both bottom-up and top-down processes. The perceptual activity which all observers, all else being equal, experience is weighted against top-down criteria of when the concept applies. In 'private' experiences of pain, however, top-down experiences seem to dominate. Parents perceptually access experiences of pain in children mostly through pain behaviour and circumstantial factors (what they assume to be the case due to the circumstances) that seem to corroborate the interpretation. However, these may not be infallible signs of and therefore irrefutably predictive of pain experiences (e.g. Crane 1995). We return to the problem of behaviour and causal links to particular mental states below.

According to Barrett et al. (2011), p. 287:

> When a scowling face (anger) or sneering face (disgust) is placed on a body with fists in the air (anger), perceivers look more to the eye region of a face than to the mouth (as if the face

[4]The difficulty of determining what behaviours are criterial of which mental states typifies many approaches that depend on both first-person and third-person perspectives. For instance, in self-recognition studies of children (Amsterdam 1972) verbal identification of 'self' such as personal pronouns or name (verbal behaviour) in response to the mirror image is emphasised as criterion of self-awareness (see Schilhab 2002).

Likewise, attempts to develop a science of consciousness also rest on verbal behaviours, when validating conscious states in others (e.g. Varela 1996; Velmans 1996; Dennett 2003). The methodology reflects the lack of alternatives to circumvent the asymmetry. One simply has to consent to the epistemological constraints and adopt assumptions of behavioural correlates if one is to address mental states in others.

> was angry); when these posed faces are placed on a body holding a soiled object (disgust), perceivers look at both the eye and mouth region in equal amounts (as if the face was disgusted).

The point is that attribution of mental states during linguification processes, just as in the case of traffic lights, happens according to perceptually experienced criteria. In case of traffic lights, observers are likely to be moved in similar ways due to the bottom-up elicitation of the activity. In case of observation of pain behaviour, it is not the observer who is moved in the bottom-up way, but rather the sufferer. The variability of circumstantial factors and complexity of involved parameters renders pain assignment more vulnerable to customs and traditions especially because external behaviours become signs for internal states.

As pointed out by Barrett et al. 2011, p. 288:

> when looking at startled and sneering faces, Western Caucasian perceivers fixate around the eyes, nose, and mouth of a target face, whereas those from an East Asian cultural context fixate primarily on the eyes (Jack et al. 2009). Because the diagnostic features in posed startles and sneers are centered in the mouth area, the East Asian fixation on the eye region is responsible for their common perception of startled faces as surprise (rather than fear) and sneers as anger (rather than disgust)

In the mental state learning condition, due to lack of bottom-up elicitation of neural activity the variability makes room for influential top-down processing. As demonstrated by Gendron et al. (2012), conceptual knowledge associated with emotion words influences encoding of emotion percepts in a way that resembles how colour words shape perception of colours (e.g. Chap. 3, see also Barrett and Bar (2009) on affective predictions during object perception).

As we will discuss in the next paragraph, if attribution of pain depends on a variable set of behavioural criteria then the ability to 'correctly' predict mental states from behaviours, in the sense of bottom-up phenomenon, seems less persuasive. As in the case of anger, one cannot from a scowling face deduce anger unless fists are in the air. The heterogeneity of behavioural criteria may explain the development of different cultures on assessing pain behaviour since different traditions may accentuate particular aspects of a set of the third-person criteria.

To sum up, the claim here is that in case of mental states, due to the complex combination of criteria of which the public ones are the only ones accessible to the interlocutor, the relation between the referent, the mental states as they are perceived in the first-person perspective, and the concept is likely to vary. In comparison, though colour perception is also mental in so far as colours possess no cues apart from how they look, the relation between the mental state of seeing green or red and the concept may still be relatively less variable intersubjectively.

The problem seems to be that when attributing mental states to others there is no direct way of knowing if the particular public criteria are causally related to the first-person experience in question. This pertains to the situation in which the interlocutor first addresses, say, pain in the child. Thus, when observing a third person hitting his thumb with a hammer, there is no acknowledgment of how it feels to hit a thumb with a hammer apart from how the incident is perceived in the

third-person perspective. So how do we come to know anyway? The ability to associate the phenomenal feel to the public third-person criteria seems to depend on derived embodiment processes in so far as the learner has to explore phenomenal experiences in his or her mind's eye *and then* associate these to the third-person criteria in what appears to be a second order linguification process.

Thus, the assertion here is that to a severe extent (and in the face of bottom-up mirror neuron activity if this proofs influential after all) acquisition of concepts of emotions and mental states depends on parental interpretations and inclinations to linguistically handle mental phenomena in a slightly changed version of derived embodiment processing. Empirical studies to which we now turn seem to corroborate this conjecture.

8.2.3 Empirical Studies on Top-Down Control of ToM

According to Slaughter et al. (2007), the mothers of pre-schoolers vary both with respect to the frequency with which they address mental states while narrating stories and their production of causal and contrastive clarifications on mentalist themes. These inclinations and abilities seem to have a significant impact on the ability of the child to develop a theory of mind (see also Meins 2011).

In the study by Slaughter and colleagues, the relation between parental talk and child understanding of ToM was assessed using a narrative. The mother was instructed to narrate a story from the wordless picture book 'Good dog, Carl!' about a dog and an infant exploiting the story mother's absence to engage in dress-up play, cooking, and dancing in the living room while she is out. In the study, the mother of the involved experimental subject was urged to go through the book and narrate a story as she would normally do at home. The final pages depict Carl the dog watching for the mother in the window pane while engaging in a frantic clean up to conceal their activities. The story mother is therefore blissfully unaware of the intermezzo and praises Carl for looking after the baby.

In the experiment, the researchers extracted the sentences for mentalistic content by coding those utterances that made reference to the psychological states of one of the characters in an attempt to (ibid., p. 842):

> concentrat[e] the focus of our study upon those utterances, supported by pictures, that would provide the child with maximum opportunity to use the pictorial context and narrative flow to scaffold their understanding.

Maternal narrative language varies between mothers, demonstrated by two examples of the narration related to the home-coming of the ignorant story mother.

Here, Carl and the baby quickly finish their play, clean up the mess and appear to have been resting.

According to mother #1 (ibid., p. 846):

> He's putting it all back so she doesn't know they've been into it! Ah! And then he looks out the window and Mum has come back home. And he is all happy, because the baby's in bed,

> nice and clean, and he's cleaned up and Mum doesn't know that they had fun in the house, did they?

Whereas mother #2 narrates:

> He's gone back upstairs to tidy up. Oh, here she comes! And there's Carl waiting for her. Look at that! She's home! And the baby's still safe in the bed. He was a good dog, that dog, wasn't he?

Slaughter et al. suggest that parent's tendencies to engage in elaborate talk about mental themes may be uniquely associated with children's developing ToM (Slaughter et al. 2007, p. 846):

> Our finding demonstrates that it is mothers' tendencies to provide clarifications of story characters' thoughts, rather than the simple fact that they utter cognitive terms that are associated with their children's false belief understanding.

Thus, the results of the study seem to suggest that the verbalisation provided by mothers (caregivers) enables the connection of mental concepts as experienced (the first-person condition) to the public criteria (the third-person sense). How can we make concrete sense of that? In the example, mother #1 verbalises perspective taking by pointing to the story mother as being ignorant about what happened while she was out because Carl cleaned up the mess that would have exposed their partying. Mother #2 does not make such overt connections in her retelling of the picture book.

When mother #1 linguistically directs the attention of her child to that interpretation, she emphasises associations between the state of knowledge of the story mother and her options for knowing. But simultaneously she brings the attention of the child to how Carl the dog also acknowledges this aspect of the story mother's knowledge state, which makes him behave in certain ways. This 'mental furniture' is absent in the narrative by mother #2, who seems to 'just' refer to and enhance what is also literally depicted by the illustrations.

To see the difference, in a bed story context, mother #2 would seamlessly be able to ostensively point to fragments of pictures in the pages to emphasise her interpretation, while mother #1 would be aided to a lesser extent by the illustrations in her mentally biased retelling. There is no concrete entity or illustration to accommodate the mental interpretation, thus to understand the meaning depends on something different from what is depicted by the illustrations.

The conception of understanding of ToM as a result of mental terms being verbally clarified along the line demonstrated by mother #1 is, however, somewhat opposed by researchers such as Shai and Belsky (2011) (and as already mentioned, by studies within social neuroscience pointing to mirror neuron mechanisms, e.g. Bastiaansen et al. 2009).

In their discussion of parental mentalising (PEM), i.e. the parental capacity to treat the child as a psychological agent based on the assignment of mental states such as thoughts, beliefs, intentions, feelings and desires apparent in parent-infant interactions, Shai and Belsky propose that it is non-verbal since it focuses on bodily movements (see also Di Paolo and De Jaegher 2012). Furthermore, this non-verbal

interaction is likely to provide the child with mental concepts (for objections to the view, see Fogel 2011).

That development of conceptual knowledge of mental terms might result from a number of co-operative parameters and not exclusively from verbal exchanges (as also claimed when asserting the dual approach), is supported by a study by Pavarini et al. (2012). These researchers reviewed 78 research reports published in English between 1980 and 2011 on how to nurture young children's understanding of the mind. They summarise three main suggestions that crystallise from the material (Pavarini et al., p. 849):

> "acting in a sensitive and responsive fashion to their mental states from very early on in their development". Secondly: "parents should speak to children about mental states in an elaborate and connected way, pointing out their causes and consequences, and explaining that these may be different for different people", and "Finally, parents should expose their children to a wide range of emotions while being careful not to express over-frequent and inconsistent negative affect".

Thus, the positions that mental thought assignments are linguistically nurtured and their abilities depend on parental behaviour are not irreconcilable.

For instance, there might be an interesting connection between the first and second condition in the Pavarini et al. study, between treating children as intentional agents, and the inclination to linguify that seems to sustain the study by Slaughter et al. (2007). When children are treated in particular ways according to third-person 'signs' (public criteria) of their intentionality, say, 'yawning' is interpreted as a sign of being tired or bored, the variation in treatment (say, the surroundings help you do your chores or attempt to brighten you up by entertaining you) becomes 'concrete evidence' of your particular inner states. Thus, parental nonverbal cues, as argued by Shai and Belsky, may become handles in a sense similar to the verbal grasping of mental states and help children gain access to ideas (and concepts) about mental states. External linguistic and non-linguistic feedback may help the child to grasp distinct internal differences in his or her mental state, differences which otherwise would be at risk of blending into each other if not for these external markers (as also discussed in the section on the top-down influence of language in Chap. 3). Note, however, that non-verbal ostensive pointing may work bottom-up whereas linguistic facilitation in the derived embodiment sense works top-down and therefore the different approaches may have different effects on the executive functions of the individual.

The combination of a variety of components in mental state attribution (as discussed in relation to the two conditions in the last paragraph and the example of anger vs. disgust) and relative dependence on parental linguification adds to cultural variation in conceptualisation of mental states. According to Shahaeian et al. (2011, p. 1240):

> many middle-class samples in the United States (like those in Australia) evidence individualistic, independent views of personhood (Greenfield et al. 2003; Nisbett 2007) according to which children are encouraged to think for themselves, to develop their own ideas, to assert their opinions freely, and to engage in reasoned discussion without privileging the traditional wisdom of elders over the creative new ideas of the young. It is

> conceivable that this style of child rearing leads many children in the United States and Australia to form initial conceptualizations of mind in terms of differences of opinion.

They continue:

> Contemporary, middle-class Chinese samples, by contrast, experience collectivist, interdependent cultural practices (Greenfield et al. 2003; Nisbett 2007) according to which many parents teach filial respect, emphasize the acquisition of well-established knowledge, and encourage children's conformity to the cultural models, rules, and traditions conveyed by their elders rather than self-assertive expression of their own independent points of view. Such an approach to child rearing may redirect ToM development in many Chinese children so that key concepts of mind are initially constructed around the insight that people can be knowledgeable versus ignorant rather than that people are often diverse in their opinions and beliefs.

To sum up, how are derived embodiment mechanisms either fully or partially involved in the acquisition of knowledge of mental states?

First, acquisition of knowledge of mental state concepts seems to depend on two distinct conditions in the sense of first- and third-person perspectives, respectively. The connection between these perspectives and their relation to the referent of mental states is not likely to occur in the same way as in first order linguification processes. Mainly because simultaneous exposures to both the phenomenal feel in oneself and the third-person behavioural criteria (because of another experiencing the same state) as in a roller coaster experience or the loss of a family dog are rarer than the experience of either one of these conditions.

Second, the asymmetry in access to phenomenally experienced mental states makes the verbal exchanges necessary for grasping particular sensations with clarity. Here, the picking out of particular sensations makes words material anchors. Therefore, mental term acquisition (in others) in Western culture seems at least partially to conform to top-down processing in a way similar to how we adopt new colour terms (e.g. Kwok et al. 2011). Expressions in linguistic exchanges act by picking out particular sensations. Which sensation to associate with is, however, less straightforward. Therefore the dependence on a knowledgeable interlocutor becomes increasingly important. Only through carefully guided verbal ostensive pointing to particular self-experienced mental states will the learning child become able to associate the elicited feeling with external stimuli and by that acquire ToM.[5]

The delicacy involved and the extent of the burden that is carried by interlocutors in mental state knowledge acquisition is demonstrated by mother #1 in the Slaughter study (2007), who among other things concretely associates happy Carl (thus the state 'happy') with the fact that he has successfully navigated around the perspective of story mother. Here the happy state is asserted to be a reflection of the

[5]Of course, in everyday interactions and not as may be assumed from laboratory experiments, it may be difficult to decide when a concept is fully acquired. It is not at all unlikely that unfortunate individuals who were not lucky to be enrolled in careful linguistic exchanges might still, however rudimentarily, comprehend and use concepts characteristic of those who have grasped ToM. As we saw, ToM is likely to be acquired by more than one mechanism. Moreover, language is somewhat tolerant with respect to the eloquence of its users. I return to this problem later in this chapter.

successful action and the avoidance of anticipated problems. When making this connection, mother #1 'draws' a line between the inner state of Carl and his actions and by that creates and associates the mental state 'happy', with which the child may have direct phenomenal experiences [bottom-up (and top-down) sensations in his or her own case], and the action of a third person, Carl. Carl is perceived as a third person and the child would therefore not automatically experience Carl mentally. When exposed to the term 'happy', the child may be moved into 'the experience of feeling happy' which is then by the mother associated with third-person actions, which the child is not moved by in the bottom-up way (for detailed interpretations on how language influences children's understanding of mental states, see Harris et al. 2005).

To the contrary, when the mother retells the story without use of mental terms, the child is not brought to a phenomenal state of 'happy' or 'worry' and will not train to re-enact these sensation in the top-down activity that seems necessary when addressing the mental states of others.

8.3 The Definition of Abstract Knowledge in Derived Embodiment?

In the last paragraphs we have discussed the applicability of derived embodiment in the acquisition of ToM. Apparently, derived embodiment mechanisms are partly involved when we learn about mental states of other minds and especially when we learn which experiences in our own mind to attend to (implicitly or explicitly) when meaningfully assigning mental states to other minds. Thus, knowledge acquisition that depends on linguistic conceptualisation because the phenomenon to grasp is perceptually inaccessible (mental states of others) is likely to overlap with derived embodiment processes. Especially those concerned with the mediating help from the interlocutor to select specific experiential perspectives such as maintenance of focus, exercising of transliminal abilities, and sustenance of sensitivity to external cues (described in Chap. 6). These features seem to be highly influenced by the social interaction and therefore top-down control as opposed to unattended perceptual bottom-up activity. As demonstrated in the case of ToM, the ability to intentionally attend to previous first-person experiences, not available bottom-up and therefore off-line in competition to and therefore often on the expense of on-line perceptual experiences of third-person activity elicited bottom-up, is in ample need of tutoring.

Despite the probable use of the derived embodiment mechanism in ToM, the question is whether derived embodiment mechanisms explain abstract knowledge acquisition in general. How widespread or limited is the mechanism apart from instructed fear conditioning, guided imagery therapy, in the teaching of singers and now also the acquisition of ToM? In the remainder of this chapter, I elaborate on the generality of the derived embodiment mechanism to strengthen the characterisation,

in order to stipulate the applicability of the concept and to point to apparent limitations of the mechanism in a broader view.

To begin with, obviously, the fact that derived embodiment mechanisms are concerned with *verbalisation processes* related to abstract knowledge is central. That raises a number of issues in relation to the assumed applicability and gives some clues to what kind of abstract knowledge the concept of derived embodiment involves. For instance, the mechanism of derived embodiment assumes of the referent of the abstract knowledge in question

- that it exists to someone in the sense of possessing physical attributes (premise one)
- i.e. that the interlocutor and/or a group of people have had direct experiences with the putative referent and therefore is of significant common relevance (premise two)
- it lends itself to processes of knowledge sharing in the sense of language (premise three).

Hence, if the referent is of no perceptual significance or no one cares about the referent to an extent to bother to verbalise it, the concept will not appear in conversations between a learner and an interlocutor. Thus, abstract knowledge that does not meet these criteria is not explainable by derived embodiment mechanisms. Consequently, abstract knowledge that is acquired by means different from the derived embodiment mechanism exists. But given the premises, how far reaching is abstract knowledge acquisition by way of derived embodiment mechanisms?

8.3.1 How Is the 'Weather' Concept Acquired?

In Chap. 4 we touched upon the idea of phylogenetic existence in the sense of availability to the senses, here listed as premise one. In the next paragraph we briefly return to that discussion to elaborate on the extent and implications of the existence criterion in order to get a firmer grasp on what is meant by availability to the senses.

How likely is it for derived embodiment mechanisms to be applied when we understand the referent of 'weather', which to Ingold (2011) seems to belong to an immaterial category compared with the landscape. Ingold posits (2011, p. 97): "Thus, while the landscape appears real, the weather can only be imagined". Here, Ingold opposes the visibility of the landscape to the invisibility of the weather, which then has to be imagined to be understood and therefore following the interpretation pursued throughout this account, gives rise to abstract knowledge.

If Ingold's weather analysis is correct, weather cannot be addressed from direct experiences. But since we can talk about the weather, weather knowledge may have been obtained on the basis of elaborate discussions that involve experienced conversational partners. But in that case, contrary to the criteria of derived embodiment mechanisms, weather knowledge is an example of abstract conceptual knowledge

which no one has had direct experiences with but still talk about. To get an idea of when derived embodiment processes are involved let us pursue the concept of weather a bit further.

Along the scale of visibility and following Ingold, obviously the landscape seems concrete and readily available to the senses whereas the weather is not. One may, however, object to the invisibility claim in so far as the weather acts visibly on the surroundings as when large areas of ripe cornfields bend with the wind or the road ahead becomes progressively more wet by the pulse of rain drops hitting. In relation to the above discussion on ToM, it could be argued that such links are also at stake when connecting the mental experience of the first person to behaviours (i.e. the third person perspective). Thus, the position Ingold seems to defend, and for very good reasons, is that weather as such is not concrete in a sense comparable with the landscape. The reason why this interests us here is the question of whether the lack of being concrete in the sense of the landscape makes weather incomprehensible to the senses (thus outside the range of direct experiences) and only comprehensible in imagination. A confirmative answer obviously allows for an alternative mechanism to derived embodiment to participate in abstract knowledge acquisition that may show the limitation of derived embodiment as explanatory of abstract knowledge besides the examples already discussed.

The interpretation put forward by Ingold seems to hinge on the idea that lack of visibility grounds the necessity to imagine. However, this may not hold as a general rule. If we accept that the weather is difficult to visually grasp (despite the visibility of the effects) it may not exclude the accessibility of weather through other senses. If, for instance, the concept of weather could be instantiated through simultaneous experiences of temperature, colour of the sky, formation of clouds, the forces of the wind, character of clothes worn by people, and raindrops caressing the skin, first order linguification processes may still apply. In this interpretation, weather knowledge would not fall within the class of abstract knowledge as defined throughout this account (see also the discussion of stars—Chap. 4). The conceptualization of weather would build vicariously on other concrete phenomena to make perceptual sense and thus be subject to common first order linguification processes. In Schilhab (2007b), I placed fabulous monsters such as unicorns and dragons in a so-called 'as-if' category, because such objects come into existence through fairy tales, wallpaper, and children's toys. In that form, they materialise to a kind of 'as-if' existence that physically instantiates the concept and materialise to a form accessible to the senses. As-if objects are indebted to the existence of real referents (that are phylogenetic present) because their tangibility is provided by superfluous likenesses to sensible objects. Thus, they do not themselves meet the first premise of phylogenetic existence. As-if existence applies not exclusively to fabulous monsters such as unicorns and dragons, but to all figments of the imagination that may assume a definite shape to be taken up by our senses, such as 'Atlantis' and 'flying saucers'. Thus, they are neither real (you could never encounter 'Atlantis' or 'Unicorns') nor non-existent in the sense that they may not be perceptually comprehensible (because you understand parts of the concept of

'flying saucer' as 'fly' and 'saucer', and 'unicorns' can be encountered as toy figurines or illustrated in a children's book).

On the other hand, 'weather' may be more similar to 'democracy' (or 'luxury', or even mental states etc.) insofar as it cannot be depicted in the form of a piece of wallpaper. Instead, 'democracy' (and by analogy 'weather') is partly instantiated by politicians, parliament buildings, and election ceremonies. The same relation exists between a university and the university buildings. No building or assembly of buildings meets single-handedly the criteria of being the university, as the referent also includes activities, agents, and extensively unspoken conditions (Ryle 1949/2002). There is no unambiguous object to relate the notion of university to, though it is possible to point to particular materialisations that form part of what is meant by the notion. Likewise, weather may be understood by the impact on the surroundings, e.g. large areas of ripe cornfields bend with the wind or the road turns increasingly wet by the pulse of rain drops hitting the gravel.[6]

8.4 Phenomenal and Interoceptive Crutches

On this account, Ingold's dichotomy between the material landscape and the immaterial weather and the inferred necessity of imagination may not hold with respect to the definition of abstract discussed here. The concept of weather may come about as a result of the use of other senses, or by way of instantiations.

However, the observation put forward by Ingold carries an important message as it accentuates why knowledge acquisition in some instances appears straightforward, as in the easy depiction and understanding of the concrete landscape, and why sometimes language acquisition is not, as when addressing 'the immaterial sky'. Even if we may, after all, get to know about weather through the application of the other senses the 'referent' certainly appears more 'diffuse' than when we learn about 'natural kinds'. If weather as such lacks in materiality and depends on instantiations which are less intuitive, it is still unresolved whether the

[6]The instantiations may act like concrete 'crutches' to support abstract thoughts. We already touched upon this issue in Chap. 7 on using 'landscape' to support the inner focus of patients. The physical world acting like crutches is forcefully demonstrated in an excerpt on 'Using Concrete Meanings to Support Comprehension of Abstract Concepts' from the website 'A Resource for Teachers, Clinicians, Parents, and Students by the Brain Injury Association of New York State':

"When learning to add and subtract, first graders commonly rely on their fingers or other physical objects to represent the abstract numbers. The children's conceptual transition into the world of abstract numbers is supported by the representation of those numbers in physical things that can be seen, held, and moved. Similarly, concrete thinking high school students might be able to understand an abstract social arrangement, like the caste system in India, by comparing it to social cliques they are familiar with in their school. Discussing similarities and differences between that which is unfamiliar and distant (i.e., abstract) and that which is familiar and close to home (i.e., concrete) is a valuable way to help students grasp the abstract concept". Retrieved from http://www.projectlearnet.org/tutorials/concrete_vs_abstract_thinking.html090414.

understanding of weather after all depends more on social ostensive pointing than for instance the understanding of 'rock' or 'lake'? Being relatively more immaterial, could it be that the linguistic concept of weather to a larger extent depends on the growing feeling associated with 'weather' at the individual level? As 'weather percepts' are elicited with less regularity and are therefore perceptually recognisable in a weaker form, does 'weather' as a concept depend less on external sensations? If we take Barrett's assertion seriously (2009), that every moment of waking life the human brain realises mental states and actions by combining three sources of stimulation (sensory stimulation captured from the world outside the skin, sensory signals captured from within the body, and prior experience that are reactivated), and if external perceptual particularities are reduced, maybe the linguistic concept of weather lends itself more to be grounded in experiences that arise internally.

Thus, phenomena that carry less opportunity to perceptually influence us systematically may become relatively more associated with phenomenal experiences internally elicited, since when systematic external stimulations are absent these are all the more salient. According to Vigliocco et al. (2013), abstract concepts (here the term 'abstract' is of course not related to the criteria related to that of derived embodiment) have stronger emotional attachments than concrete concepts which, in line with the conjecture by Barrett, seems to suggest that as the external contribution to the neural representation decreases the emotional aspects become more salient (see also Kousta et al. 2011).

In the case of concepts with relatively less perceptual anchoring, when based more on the phenomenal contribution from the interoceptive state of the individual, such concepts may appear more intersubjectively arbitrary, more prone to top-down control as in the case of ToM, and therefore in relevant ways relatively closer to the cognitive structure observed with abstract phenomena obtained through derived embodiment mechanisms.

This seems to raise another question. Insofar as we are continuously phenomenally poised by interoceptive processes, also during conversations, is not grounding by way of interoceptive experiences acting bottom-up competing with grounding obtained top-down by way of an interlocutor?

Obviously, the phenomenal feel associated with having a conversation co-determines the phenomenal experiences elicited by the content of the conversation. However, as demonstrated by grounded cognition studies on cinnamon, the quality of the inevitable experience of being present does not obliterate the systematicity that seems to arise from the semantic content, possibly as a result of the controlled processes associated with the phenomenal experience of cinnamon. Moreover, in the genuine derived embodiment conversation, when conversing with the interlocutor, his or her choices direct and decide what fragment of the phenomenal content is zoomed in on. Thus, his or her interpretations and focused manipulations guarantee the elicitation of particular phenomenal processes in the individual at least to some extent.

However, one could hypothesise that when conversations are less optimal in the sense that the interlocutor may miss out on the level of comprehension or chooses inappropriate metaphorical expressions, the derived embodiment processes may

suffer. In such cases it is likely that the grounding of the acquisition downplays the derived embodiment processes on the cost of the emotional and interoceptive content.

8.5 Status of Derived Embodiment Knowledge

The third premise infers another obvious objection that concerns the status of linguistic knowledge implied here. For interactional experts to obtain linguistic knowledge insignificantly different from contributory linguistic use, everything that could be said about a topic must in fact have concerned and been said by contributory experts (the second and third premise). Only then could the phrase and meaning eventually be picked up by interactional experts. But how likely is this?

It is highly conceivable that interactional experts produce ideas (based on their purely linguistic competences) that follow the general linguistic rules of the scientific community but conflict with non-linguistic knowledge which the interactional experts as a result of their status would never encounter (it could be the male midwife who may never participate in discussions about the sensation of abdominal tissue stretch, also Chap. 2). Here, non-linguistic knowledge could be knowledge that has not yet been formulated but still informs every contributory expert. It is knowledge gained from practice but, for some reason, not yet formulated. In laser building, it could be the length of capacitor leads, which H did not notice at first in the source laboratory but never the less had some vague ideas about (Collins 1992, p. 61).

In a perfect world, in which contributory experts (the world's A*s from Chap. 2) would physically acquire all the experiences there were to experience and have all the time in the world to be able to expound all their experiences to the benefit of interactional experts (As), there would be no linguistic differences between A and A*; As and As would inconspicuously blend. In such a world, connections or processes outside our attention, such as subliminal stimuli and tacit perceptual knowledge beyond our comprehension, in so far as they influenced language, would make themselves intelligible also to interactional experts.

Would the existence of such a world convince us that linguistic knowledge of A and A* was indiscernible? An obvious objection plays on the concept of *linguistic* knowledge to reiterate the question of what the proposed linguistic knowledge refers to in reality. In line with this perspective we may need to distinguish between the effects of knowledge in relation to the linguistic domain and knowledge pertaining to non-verbal actions. Again the answer depends on the definition of knowledge and as we touched upon in Chaps. 2 and 7 and the concept of sensory signature, whether we restrict our 'insignificance' criterion to exclusively the level of conversation.

However, that limitation may be unacceptable. As shown throughout this account the contributory expert refers to experiences that have a more solid ground due to perceptual experiences than the interactional expert despite the derived embodiment obtained in elaborate conversations. What supports that intuition?

When contributory experts and novices are asked to imagine a practice as discussed in relation to imagining high jumps, there are significant differences between simulations from the outside and inside (Olsson et al. 2008). This difference has been sustained in a study analysing the neural activity in relation to imagining the movement of thumb in synchrony with the beat of a metronome (Stinear et al. 2006).

For instance, an fMRI study on how processes underlying imagery differ among novices and experts in a complex motor skill (the high jump) showed considerable divergence with respect to the involvement of motor areas such as the supplementary motor area (SMA) and primary motor cortex (Olsson et al. 2008, see also Schilhab 2017b for the discussion of high jumpers in relation to reading on screen vs. print). In the study, subjects were asked to imagine the performance of a full jump, with special emphasis on certain stages, such as take-off or clearing the bar. Moreover, the instructions clearly emphasised the first-person perspective, forcing participants to take an internal stance on imagination. Novices who did not have previous experience of the high jump showed more activation of visual, occipital, and parietal areas, suggesting that they were more likely to take an external view of the task (watching the jumps from without as if out of the body) possibly, because their previous experiences with high jumps were primarily as spectators to high jumps. Thus, the activation of SMA, which is suggested to be responsible for internally guided actions both while executed and imagined, was lower in novices than it was in expert high jumpers (Olsson et al. 2009) (the activation of SMA during tennis imagery was also found in Owen et al. 2006). The difference between internal (from within) and external (from without) imagery seems significant to the activity of particular motor-related cortical areas (see also Aziz-Zadeh et al. 2012).

Likewise, in a study by Stinear et al. (2006), subjects were asked to imagine seeing their thumbs moving in time with a metronome to produce external imagery (Visual Motor Imagery). This condition was compared with the internal imagery (Kinaesthetic Motor Imagery) in which subjects were asked to imagine moving their thumbs in time with the metronome and the feeling that it produced. Whereas the internal condition successfully activated the motor cortex, which is recruited during actual movements, the external condition did not. Apparently, the parietal cortex is implicated in converting sensory information to motor commands [for more views on imagery in practice see Dickstein and Deutsch (2007) and Buneo and Andersen (2006)].

Thus, one may conclude that skill learning changes the neural representation and this may imply that differences between As and A*s are inevitable.

8.6 Linguistic Tolerance

Apparently, in experts the practical experience changes the neural pattern correlated to the activity. By analogy, the way to reason about the practice may also change. However, an intervening factor that distorts this derivation based on objective

differences is that we don't know how neural differences may translate to language use. Surely, a prominent asset of language *is* its ability to neutralise individual starting points and thus minimise the resulting effect of variance in referential meaning.

Linguistic tolerance arises from the dialectic movement between the individual language user and the norms of language in the sense of internalisation (or embodying) of particular expressions. The individualisation makes language plastic and more imprecise or spacious than we normally envision. Though we acquire language according to rules of the linguistic community we take part in, and share large parts of the same vocabulary, language does not annul the differences in the private experiences which we individually attribute to make sense of linguistically. The individual interpretation of language as to what is really meant by an expression, which criteria in the sense of circumstantial instances have to be the case, is always based on the personal experiences of the individual.

The coordinated understanding of the perceptual experiences that accompany the green light in zebra crossings and which due to the worlds' constraints may be fairly similar may ground our early language acquisition, but later on as we have discussed perceptual similarities are not efficient on a daily basis. Recall, however, that green light experiences are still individually interpreted experiences.

Language constrains and reduces our verbal creativity. On the one hand, we must follow standard grammatical rules to form meaningful sentences to get our messages through and not risk them being dismissed as nonsense. On the other hand, individuals have to form, implicitly or explicitly, personal interpretations of particular expressions. These are inevitably private and therefore secretly affect the rigorousness of linguistic meaning. To exemplify, at first, a boy may misrepresent the referent of the expression 'tree', without anyone ever noticing the mistake. But if the same child points to seagulls when exclaiming 'tree' he will be overtly corrected to later apply the concept according to linguistic norms (see Fig. 8.1).

How do we make sure that after the linguistic correction the child associates just what is appropriate of seagulls? That he is not too restrictive, attributing the meaning of seagull exclusively to the bird in his book and not too extensively to include all airborne animals with wings such as flying dogs and bats? How may we assess that his image of the appropriate referent is similar to his mother's, his sibling's, to mine, and to other languages users? The fact is that we may not.

For all we (the competent language users) know in the present situation in which he learns not to include the category of trees, he is abiding by the rules of language which is as good as it gets.

In most educational settings when language has been established to fully understand knowledge expressed by linguistic representations such as 'at autumn apples ripen', one draws on real life experiences with apples, autumn, and maturation. As a result, private associations that corroborate the concept and constitute the referent might differ significantly from individual to individual. If child X associates the green fruit from his or her childhood apple tree with the teacher's claim that 'at autumn apples ripen', the association of that specific apple will not 'violate' language rules as the teacher did not infer any apple in particular. Not even

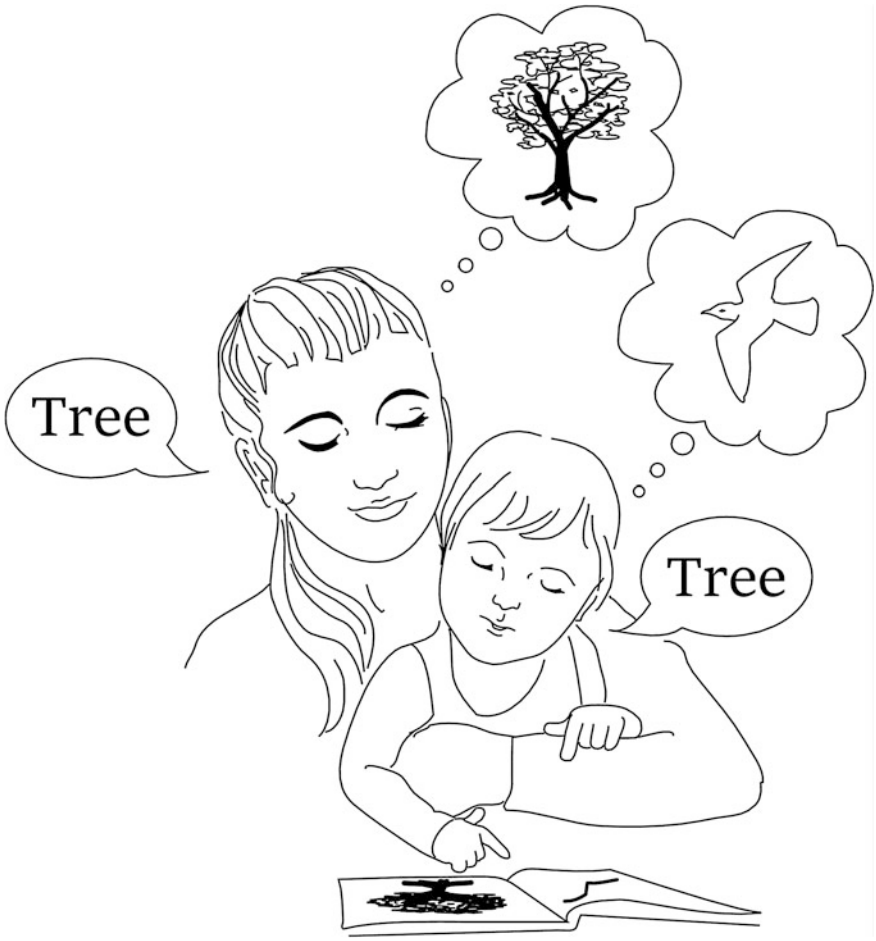

Fig. 8.1 An example of how concept formation is built from individual perceptual experiences and conventional linguistic rules.

if child Y associates the red fruit from the apple tree in his or her childhood garden. Although the *linguistic* expression stays the same in the minds of the two children, the referents are quite different. There is barely any identity between the physical instantiation of child X's green fruit and child Y's red fruit, still at the level of communication they are embraced by the same concept.

When comprehending and using linguistic knowledge, it seems free of charge (within the boundary of rules of the language community) to apply one's own idiosyncratic interpretation by adding details that were not originally implied. Subtraction of details, say to imply less, when applying language is also a possibility, in so far as the subtraction is not revealed in communication.

Though referents differ markedly between individuals owing to individual experiences and private associations, communication is still possible. Due to the tolerance of language inevitable individual differences are absorbed.

Tolerance towards the idiosyncrasy of individuals and their particular experiences adds to the efficiency of interactional expertise-like knowledge. Given that contributory experts also differ significantly in experiences, their language may not turn out as significantly different from that of the interactional experts.

To sum up, if contributory language refers to reality to a variable extent, that makes it indistinguishable from interactional language, why bother about what their vocabularies actually refer to?

It is important to be straight about the conditions under which language is used. If viewed beyond the linguistic practice, which is the focus of the original discussion of contributory and interactional expertise, the effect of the differences between referents is revealed. For instance, when trained hockey players talk about hockey, areas related to the physical activity are likely to become recruited (Beilock et al. 2008). Thus, while conversing about hockey the trained hockey player is simultaneously preparing himself for actual physical events. This is probably the case with experienced high jumpers as well. Similar 'priming' is unlikely to occur in the interactional expert who acquired the linguistic knowledge entirely top-down. Though derived embodiment associations are surely involved to embody the imaging during the conversation, as discussed in Chap. 7 the neural corroboration will not entirely match that involved in the direct experience (see also Beilock and Lyons 2009).

What does that imply? Apparently, bodily reactions resulting from linguistic activity may differ, and studies tapping the physiological consequences are likely to detect differences that according to the theory of interactional expertise are not revealed linguistically. Still, that kind of testing does not apply in the world of human interactions which are of interest here. The student who learned from derived embodiment processes is not a full blown practitioner and the fallacy is to believe otherwise. At the educational level, we have accepted that most learning is theoretical and in that sense we have accepted to treat knowledge as useful even if it would come short in a practical context. As discussed in relation to WMC acquisition of knowledge derived embodiment mechanisms cultivates other important skills but not the practical implications that involve first-person experiences of the actual perception that relates to the practice.

8.7 Concluding Remarks

I have discussed a number of reasons why interactional expertise and derived embodiment processes in the strict sense may be hard to find. As discussed in Chap. 7, humans tend to make use of concrete crutches to alleviate cognitive load and therefore search for conditions that allow faster processing.

The experience of approaching the mental limit or becoming mentally exhausted as a consequence of maintaining elaborate imaginings urges subjects to obtain help in the concrete environment.

A connected obstacle that seems contrary to the claim that interactional expertise-like knowledge in its pure form is widespread relates to the influence of non-verbal behaviour. When is linguistic acquisition ever detached from context? I have argued that in second order linguification contexts the contextual background is of less importance than in first order linguification processes. Acquisition by conversation seems far from divers learning texts on the beach or submerged in water. However, we tend to forget that talking bodies are contexts. Gestures not only seem to aid the speaker to increase the simulation of the experience that language refers to, simultaneously it may provide the learner with clues and cues that are close to being considered contextual (Goldin-Meadows and Beilock 2010). The non-verbal context may be partly responsible for the emotional bias of abstract concepts. As external stimuli are lacking, the interlocutor may become more emotionally significant to emphasise meaning. This could be mirrored in non-verbal behaviour and intonation (for impact of unconsciously seeing happy faces on evaluation of soft drinks, see Winkielman et al. 2005).

Learning language may not depend on being exposed to all practical facets and every referent in the same sense as the contributory expert, but it is a precondition to be intensely exposed to the linguistic community and ways of speaking, which in a fundamental way socialises the subject to non-verbal contextual cues (e.g. Kontra et al. 2012).

If indeed derived embodiment and thus interactional expertise-like knowledge is rarely found in the genuine form discussed in the outset of this account, why devote a full book to that very concept?

First, I want to emphasise that there are instances in which derived embodiment is important, such as instructed fear conditioning, guided imagery therapy, acquisition of mental state concepts and teaching of singers. Similarly, the putative effects on executive functioning as suggested in this account fully merits the attention given to derived embodiment and interactional expertise-like knowledge. Even if genuine examples would not easily appear, conceptually interactional expertise is remarkable. The concept forces us to rethink how language works, what is linguistic transfer and what is the connection between actual experiences and the linguistic retelling. If we abandon the idea of interactional expertise and the idea of derived embodiment, how could we explain the exchange of ideas in common conversations that all of us engage in on a daily basis?

The risk of downplaying the linguistically grounded share of ideas (e.g. in books) is that we may not come to understand the actual span of embodied cognition. As demonstrated in this account, any concept of interactional expertise implicitly assumes language to be embodied.

When we acquire particular abstract knowledge, the embodiment is understood in the sense of being grounded in interoceptive sensations and experiences.

Most importantly the idea of derived embodiment suggests that crucial to human cognition is the social sharing that when successfully pursued generously opens a

wealth of cognitive tools and potentialities in the learner, but when failing shrinks the world to a claustrophobic straitjacket. Fundamental to the human condition is the phenomenal experience. It is the ability to and especially the quest for experiencing that drives language acquisition. Phenomenal experiences are particularly critical to second order language acquisition as they form the basis for understanding abstract phenomena. It is the craving for phenomenally experiencing even that which is beyond the scope of the individual that drives abstract learning. Hence, the ability to experience and to consciously re-enact whatever pulsates in the mind's landscape holds the key to abstract from the immediate surroundings and to exploit the experiences linguistically provided by the significant other. Whereas the ability to experience may be immediate bottom-up, it is the ability to re-enact top-down that takes its toll and is in need of supervision to unhindered unfold. When dissecting the mechanism of sharing into micro components, it becomes clear that human cognition instantiates an actual scaffold.

Thus derived embodiment mechanisms provide a provisional but viable frame for how a specific (and essential) part of abstract knowledge might be accounted for on a sound biological foundation in an attempt to address humans as a natural part of the biological world.

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