V Concepts and Language

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10 What's in a Concept? Analog versus Parametric Concepts in LCCM Theory

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10.1 Introduction

Any account of language and the human mind has to grapple, ultimately, with the nature of concepts. In the words of cognitive scientist Jesse Prinz, concepts are "the basic timber of our mental lives" (Prinz 2002, 1). For without concepts, there could be no thought, and language would have nothing to express. What is less clear, however, is exactly how concepts are constituted, and the relationship between language and concepts. These are the two issues I address in this chapter. I do so by posing and attempting to answer the following question: Do linguistic units (e.g., words) have semantic content independently of the human conceptual system (which, in rough terms, can be thought of as our repository of concepts)? The answer to this question is, I will argue, a clear yes.

The thrust of the argument I present in this chapter is that there is a qualitative difference between concept types. Concepts in the conceptual system, on the one hand, and in the linguistic system, on the other, are of two qualitatively different sorts, which reflect the function of the two systems. The conceptual system is, in evolutionary terms, far older than the linguistic system. And at least in outline, many other species have conceptual systems that are continuous with the human conceptual system. In contrast, language evolved, I argue, to provide an executive control function, harnessing concepts in the conceptual system for purposes of (linguistically mediated) communication. The consequence is that the concepts that inhere in each of these systems evolved to fulfill distinct, albeit complementary purposes. Moreover, the findings giving rise to a grounded (or embodied) cognition perspective has, in recent years, led to a reframing of how we should think about concepts, in both the conceptual and the linguistic systems.

Accordingly, in this chapter I present arguments for thinking that the distinction between the conceptual and linguistic systems relates to concepts that are *analog* in nature, on the one hand, and those that are *parametric* in nature, on the other. In so doing, I argue against received accounts of embodied cognition that fail to recognize such a distinction. I also argue against disembodied accounts of concepts. My overall conclusion is that parametric concepts facilitate access to analog concepts in the process of meaning construction. Although both types of concept are derived from embodied, or as I shall prefer, *grounded* experience, they are qualitatively distinct. Parametric concepts are schematic, while analog concepts are richer, more closely constituting analogs of the experience types they are grounded in. Once I have developed an account of these distinct concepts, I advance a theory of lexical representation and semantic composition, referred to as the theory of lexical concepts and cognitive models, or LCCM theory for short (Evans 2006, 2009, 2010, 2013). I use LCCM theory to show the distinct functions of parametric and analog concepts in meaning construction.

The chapter is organized as follows. In the next section, I advance a grounded cognition approach to lexical and conceptual representation. In particular, I argue that representations in the conceptual system are multimodal, being constituted of a range of information types, including sensorimotor information. I also disambiguate knowledge representation (concepts) from meaning construction (semantic composition). The two phenomena are often conflated in the cognitive science literature on concepts. But, I argue, they are, in fact, distinct. In section 10.3 I review evidence for thinking that language is subserved by analog concepts (within the conceptual system). I do so by reviewing empirical findings for what I term *grounding effects*. Section 10.4 then develops the central qualitative distinction I argue for, between nonlinguistic and linguistic concepts. I do so by first observing that extant embodied/grounded theories of concepts assume that linguistic meaning is equivalent to conceptual representation. I present arguments that lead to a distinction in terms of conceptual versus lexical representations. I then operationalize this distinction in terms of parametric concepts (linguistic system) versus analog concepts (conceptual system). Section 10.6 introduces LCCM theory, which operationalizes these distinct types of representation in terms of the theoretical constructs of *lexical concept* (linguistic system) and *cognitive model* (conceptual system). The LCCM theory framework provides a basis for understanding the respective contribution of each distinct concept type in facilitating linguistically mediated meaning construction, which is complementary, albeit orthogonal to, an account of knowledge representation (concepts).

10.2 Toward a Grounded Cognition Approach to Concepts

Broadly speaking, there are, within cognitive science, two prevalent views of concepts. The first view is, very roughly, that concepts are abstract, disembodied symbols—Barsalou (1999, 2008) describes this perspective as the amodal view of cognition—a view that assumes that the representational format of a concept is qualitatively different from the sensory experiences concepts relate to. Although the details of specific disembodied theories vary considerably, this general perspective assumes that concepts

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are ultimately abstracted from the brain states that give rise to them, with information encoded in a different format. This view of concepts makes a principled distinction between conception (or cognition) and perception (and interoceptive experience more generally)—see Cisek (1999) for discussion. Representatives of this general approach include Dennett (1969), Fodor (1975, 1983, 1998, 2008), Haugeland (1985), Jackendoff (1983, 1987), Newell and Simon (1972), Pinker (1984), and Pylyshyn (1984).

More recently, a different perspective has emerged, which blurs the distinction between perception/interoception and conception/cognition. On this view, concepts are directly grounded in the perceptual and interoceptive brain states that give rise to them. Again, while details relating to specific theories differ, this *embodied*, *modal*, or as I prefer, *grounded* cognition perspective sees cognition as broadly continuous with perception/interoception, rather than reflecting a wholly distinct type of representation (see Barsalou 2008 and Shapiro 2010 for reviews). Notable exemplars of this view include Barsalou (e.g., 1999), Chemero (2009), Clark (e.g., 1997), Damasio (1994), Evans (2009), Gallese and Lakoff (2005); Glenberg (e.g., 1997), Lakoff and Johnson (e.g., 1999), Vigliocсio et al. (2009), and Zwaan (e.g., 2004).

The grounded view assumes that concepts arise directly from representative brain states. Take the example of the experience of cats. When we perceive and interact with cats, this leads to extraction of perceptual and functional attributes of cats, which are stored in memory in analog fashion: our concept CAT, on this view, closely resembles our perception and experience of a cat. When we imagine a cat, this is made possible by reactivating, or to use the technical term, *simulating* the perceptual and interoceptive experience of interacting with a cat—these include sensorimotor experiences when we stroke and otherwise interact with a cat, as well as affective states, such as the pleasure we experience when a cat responds by purring, and so forth. But while the simulated cat closely resembles our conscious perceptual and interoceptive experience, it is attenuated.

In other words, the concept CAT is not the same as the veridical experience of perceiving a cat. When we close our eyes and imagine a cat, we are at liberty to simulate an individual cat, or a type of cat, or a cat composed of aspects of our past experiences of and with cats. But the simulation is attenuated with respect to the veridical perceptual experience of a cat. Importantly, the claim made by the embodied perspective is that the simulation is directly grounded in the same brain states—in fact, a reactivation of aspects of the brain states—that are active when we veridically perceive and interact with the cat. The simulation is then available for language and thought processes. As the reactivation of some aspects of the perceptual and interoceptive experiences of a cat is, in part, constitutive of the concept CAT, the concept is an analog of the perceptual experience.

In contrast, the disembodied view of concepts and mind assumes that perceptual experiences are redescribed into a symbol, which stands for, or *tokens,* the perceptual

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experience. In some disembodied theories, the symbols are represented using natural language, and the symbols are thought to comprise lists of features or attributes. In others (e.g., Fodor 1975, 2008), the concepts are represented in a format that is in some sense language-like: the idea is that the mind features its own operating system, universal to all humans—mentalese. Various approaches to mentalese have been developed in some detail (see, e.g., Fodor 2008; Jackendoff 1983).

The key difference between the two perspectives is that the disembodied view of concepts assumes that concepts are mental representations fundamentally unlike what they represent. Thus, critically, perceptual and interoceptive brain states are *not* constitutive of concepts. For embodied cognition proponents, simulations, in contrast, are analog presentations, in the sense of re-presentations of perceptual and interoceptive experiences—they are directly grounded in the body-based and subjective perceptual states that give rise to them. As such the grounded cognition view assumes that perceptual and interoceptive brain states *are* constitutive of concepts. Figures 10.1 and 10.2 capture the distinctions between the disembodied and grounded approaches to concepts.

A particular challenge that has been leveled against the disembodied view of concepts relates to what has been dubbed the "symbol grounding problem" (Harnard 1990. What is at stake is the nature of content available for semantic analysis, given that concepts presumably facilitate thought and language—about which I shall have more to say in section 10.3. In other words, if symbols are abstract, which is to say, unlike the perceptual and interoceptive mental states they represent, how do they relate to the states they are supposed to be representative of? In short, the challenge for the disembodied view is to show how concepts facilitate semantic analysis when they are not directly grounded in the content that they represent.

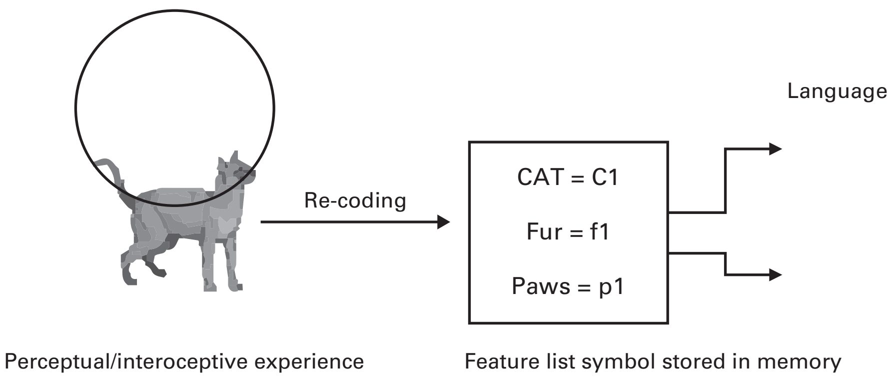

Figure 10.1
Disembodied conceptual system.

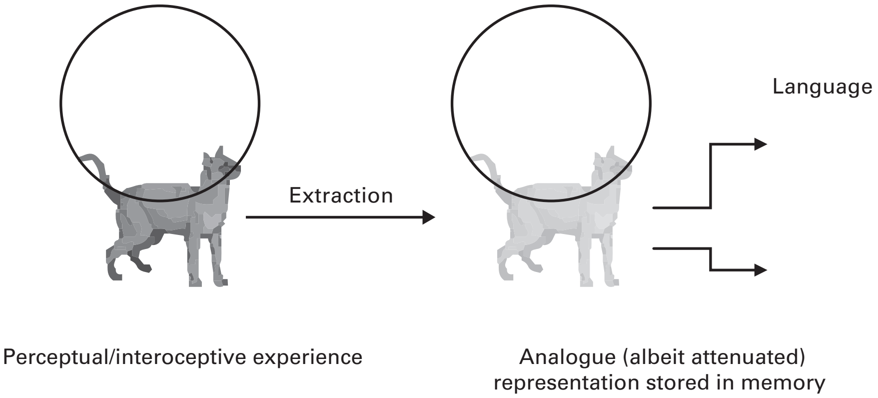

Figure 10.2
Grounded conceptual system.

One early solution to this, in one disembodied theory of concepts, was to assume that concepts are innate. This was the proposal made by Fodor (1975), detailing mentalese (a.k.a. the language of thought). Adopting this view, Jackendoff posited a range of abstract conceptual primitives that could be combined using rules of mental syntax, facilitating a full-fledged disembodied conceptual system. In later work, Fodor (e.g., 1998) recanted, arguing that concepts were not themselves innate. Rather, concepts are grounded by virtue of a process whereby abstract symbols became *locked* to the perceptual states in the world that they represent, or *token*, in his parlance. He declined to speculate on how this locking process comes about, however, arguing that although the mechanisms that facilitate it may be innate, understanding how symbols become locked to perceptual states is not the proper concern of cognitive psychology.

The grounding problem is resolved in the grounded cognition view of concepts by positing that concepts are directly grounded in brain states: hence concepts are very much like the brain states they are representations of. Most versions of grounded cognition (e.g., Barsalou 1999; Clark 1997) assume that although brain states are constitutive of concepts, concepts are nevertheless representations, and thus distinct from brain states (e.g., sensorimotor activations). Barsalou (1999) refers to such concepts as "perceptual symbols": on this view, perceptual symbols are stored traces of prior brain states that can be reactivated, or simulated, for purposes of language and thought. Hence, the difference from the disembodied view is that perceptual symbols are directly grounded in brain states.

A more radical approach to embodied cognition removes the requirement for symbols altogether. For instance, Chemero (2009) argues that concepts are entirely constituted of brain states (rather than representations of prior brain states). Building on dynamic systems theory, and James Gibson's ecological approach to perception, Chemero thereby entirely removes the distinction between perception and conception.

Two main lines of empirical evidence support the grounded cognition view of concepts:

1. Brain-based demonstrations that the sensorimotor and other modal systems are activated during conceptual processing: a raft of studies provides clear evidence that, for instance, motor processes are automatically engaged when subjects perform perceptual and conceptual tasks. A range of different methodologies have demonstrated such automatic activation in both nonhuman primates and humans. For instance, the human motor system is automatically activated when subjects observe manipulable objects, and when they observe the actions of another individual. Methodologies deployed to demonstrate such data include studies involving functional neuroimaging, neurophysiological recordings, EEG, transcranial magnetic stimulation (TMS), and kinematic analyses. For representative reviews of the various extant findings, see Barsalou (2008), Boulenger et al. (2008), Gallese and Lakoff (2005), Pulvermüller et al. (2005), and Rizzolatti and Craighero (2004).
2. Behavioral demonstrations that activation of the sensorimotor system spread to conceptual levels of processing. Many of the relevant studies have involved sentence comprehension and lexical decision tasks. I will have more to say about the relationship between language and concepts below; however, one representative and important study is Pulvermüller et al. (2005). For instance, subjects were required to perform a lexical decision task employing action verbs relating to either arm or leg actions. A pulse of subthreshold TMS was then applied to either the *leg* or *arm* region of motor cortex immediately after exposure to the lexical cues. Pulvermüller and colleagues found that TMS exposure to the *arm* region induced a faster decision for arm action words, as opposed to leg action words. And when TMS exposure was to the *leg* region of the motor cortex, the reverse pattern in lexical decisions was found. This would appear to suggest that embodied (perceptual and interoceptive) states play a direct role in conceptual processing as it relates to language comprehension.

In the light of demonstrations such as these, the difficulty for a disembodied view of concepts—at least as classically formulated—is this: concepts are supposed to be abstract symbols, which are not constituted by sensorimotor (and interoceptive) brain states. In short, semantic analysis of concepts is independent of sensorimotor and other brain states, and hence, should not result in automatic processing of these. Although disembodied accounts would not deny that concepts for sensorimotor experience, for instance, will require activation of the relevant region of sensorimotor cortex, the point is that such activations are ancillary to the semantic analysis that the disembodied symbols furnish, for purposes of facilitating language and thought. That is, sensorimotor activation plays no role in semantic analysis during conceptual processing. Hence,

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this finding—that brain states such as sensorimotor activations appear to play a role in conceptual processing—would appear to falsify disembodied accounts of concepts, as classically formulated.[1]

It is also worth noting that just as the disembodied view is falsified by empirical findings briefly reviewed above, so too is the radical view of embodied cognition. The relevant finding concerns patients with apraxia—patients with impairments for using objects such as hammers are nevertheless able to name and describe in detail the nature of the same objects they cannot use (Johnson-Frey 2004; Mahon and Caramazza 2008. This illustrates that subjects appear to have some type of representation, at least for purposes of linguistic encoding, without being able to activate a supporting sensorimotor perceptual state. This finding would appear to undermine the radical claim that representations are not required for a functioning conceptual system.

The empirical findings about the role of brain states, especially sensorimotor activation in conceptual processing, appear to demonstrate that concepts, especially sensorimotor concepts, involve activation of brain states. However, this is unlikely to be the whole story: Mahon and Caramazza (2008) argue that part of the disembodied account, that concepts involve abstract (and hence non-analog) symbols, appears to be supported by findings such as patients with brain motor deficits who nevertheless retain motor concepts, as in the case of apraxia. Accordingly, they have proposed an account of concepts that can be seen as situated midway between an embodied and a disembodied account of concepts, integrating what they perceive to be the strengths of each. Mahon and Caramazza accept the empirical findings that have been used to argue for a grounded view of concepts. However, they argue that such data do not entail that a disembodied view is incorrect.

First, they argue that any embodied view is limited up front because it assumes that all concepts are constituted by sensorimotor experience. And that being so, an embodied approach inevitably cannot deal with abstract concepts such as TIME, JUSTICE, ENTROPY, or PATIENCE. For some of these concepts, they argue, there doesn't appear to be sensorimotor information that could correspond in any reliable or direct way to the abstract concept. For others, such as BEAUTIFUL, there appears not to be consistent sensorimotor experience associated with it. For instance, mountains, a lover's face, or even an idea can be beautiful: no specific type of sensorimotor information is apparently instrumental in the realization of the concept BEAUTIFUL. Second, some information is clearly abstract even for sensorimotor concepts, as evidenced in the case of apraxia, already

1. Some commentators have observed, however, that a suitably modified version of the disembodied account may be consistent with data that have led to the embodied/grounded cognition accounts—for discussion see Dove (2009), Mahon and Caramazza (2008), and Machery (2007). For criticism of the embodied approach on philosophical grounds, see Weiskopf (2010). I discuss proposals made by Mahon and Caramazza below.

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discussed, where part of the concept is retained in the absence of the ability to simulate the motor experience associated with the concept.

In light of these observations, Mahon and Caramazza posit a "grounding by interaction" view of concepts. On this account, they retain the idea that concepts consist of abstract symbols—symbols that are non-analog in nature. Hence, they argue, concepts are not constituted by the brain's modal states, such as sensory and motor modalities. As they accept the empirical findings of the embodiment tradition, however, they assume that embodied states are not ancillary to conceptual processing. Rather, what they claim is that modality-specific activation of brain states, such as sensorimotor information, may constitute instantiations of the concept. To illustrate, reconsider the concept HAMMER. For Mahon and Caramazza, the concept consists of an abstract, disembodied symbol. And this disembodied symbol is the relevant unit for semantic analysis (upon which language and thought are contingent). That said, the referent of the concept is a concrete entity in veridical experience. And this is instantiated as sensorimotor experience. Hence, on this account, the abstract symbol HAMMER is grounded by virtue of an interaction between the abstract symbol and sensorimotor activation: they propose that the sensorimotor activation results from a cascading spreading activation from the conceptual system—where the concept is housed—to the relevant region of the motor cortex.

There are a number of problems with the grounding by interaction view. First, the assumptions it makes about the embodied cognition view are erroneous. To argue that embodied cognition researchers assume that all concepts are constituted exclusively of sensorimotor experience is patently incorrect. For instance, Barsalou's account of perceptual symbols, arguably the best-developed theoretical account of concepts from an embodied cognition perspective, explicitly includes brain states other than sensorimotor experience. Barsalou uses the term *perception* in a rather more inclusive way than is normally the case: he assumes that perceptual symbols include sensorimotor experiences as well as other sorts of more subjective modalities, such as interoceptive experience, affect, and cognitive states. In later work, Barsalou (2008) explicitly prefers the term *grounded*—rather than embodied—cognition in order to make clear that, in his view, concepts encompass all of the brain's modal systems, not just sensorimotor areas. Grounded cognition is also the nomenclature preferred in the present chapter.

Second, Mahon and Caramazza are incorrect in claiming that the embodied cognition view cannot account for abstract concepts up front. An entire research tradition associated with Lakoff and Johnson (e.g., 1980, 1999) has argued that abstract concepts are indeed largely constituted in terms of sensorimotor experience. Take for instance, the abstract concept TIME. Lakoff and Johnson argue that the domain of time is systematically structured by mappings, which inhere in long-term memory, that provide a long-term stable link from the domain of motion through space. The series of mappings that facilitate the projection of conceptual structure, asymmetrically from one

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domain onto another, are termed *conceptual metaphors*. These conceptual metaphors facilitate the structuring of concepts such as DURATION in terms of *physical extent* (i.e., length), as implied by linguistic examples such as (1):

(1) The relationship lasted a long time.

In (1), *long* refers to temporal rather than spatial extent (see Evans 2013 for discussion). And behavioral findings support the view that spatial extent is automatically activated by the concept of duration but not vice versa (Casasanto and Boroditsky 2008). Conceptual metaphor accounts exist for a host of abstract domains ranging from mathematics (Lakoff and Nuñez 2001) to morality (Lakoff and Johnson 1999). And behavioral studies now provide evidence that abstract concepts involve processing of sensorimotor experience—about which I shall have more to say in the next section.

That said, what has perhaps been underestimated by embodied cognition researchers, including Lakoff and Johnson, is the degree to which abstract concepts are constituted by information from modalities other than the sensory and motor modalities. With respect to time, for instance, at the neurological level, it appears that the range of phenomenologically real temporal experiences, such as duration, succession, and present/past/future, are subserved by a range of non-sensorimotor systems (for reviews, see Evans 2013; Kranjec and Chatterjee 2010). Nevertheless, representations for time also appear to be constituted, in part, in terms of sensorimotor information. Accounts differ as to the reason for this (Bonato et al. 2010 versus Bueti and Walsh 2009). But the parietal cortex appears to be implicated in linking representations for space and time.

The third problem with the grounding by interaction view is that accounting for automatic activation of sensorimotor information by allowing for interaction still doesn't provide a grounded theory of concepts. After all, the sensorimotor information still remains ancillary, as per disembodied theories: semantic analysis takes place without reference to the sensorimotor information. In essence, Mahon and Caramazza's proposal remains essentially a disembodied account, but with bells and whistles: it is arguably consistent with the empirical evidence, but the grounding problem is still not resolved because modality-specific information remains excluded from conceptual content. An alternative, which I explore below, is that concepts are of different types, some directly grounded in perceptual and interoceptive experience—what I refer to as *analog concepts*—and some that represent abstractions derived from grounded experience—*parametric concepts*. As we shall see, parametric concepts are abstract; but they are grounded in modal brain states by virtue of being schematizations, abstracted from said brain states.

The final problem is that Mahon and Caramazza conflate, and confuse, knowledge representation—the issue of *what* constitutes a concept—and meaning construction. El

Their discussion of the concept BEAUTIFUL and the divergent sensorimotor properties instantiated by this concept requires an account of meaning construction, rather than knowledge representation. Meaning construction is, in part, a linguistically mediated phenomenon, and it requires an appropriate account of compositional semantics. An account of the concept BEAUTIFUL in different contexts of use turns on issues relating to semantic composition and language use, rather than knowledge representation. It is therefore disingenuous to criticize embodied cognition accounts of concepts when pointing to phenomena that relate to something other than knowledge representation. Once I have developed my account of analog versus parametric concepts, I present, later in the chapter, an account of semantic composition within the framework of LCCM theory, which addresses this issue.

In the final analysis, concepts appear to be constituted, in part, by multimodal brain states, not exclusively sensorimotor experience types. A theory of conceptual representation is, in principle, distinct from that of linguistically mediated semantic composition. And as such, we must now turn to a consideration of the relationship between concepts and language.

10.3 Grounding Effects in Language

If concepts subserve language, then it stands to reason that language relies on concepts, at least in part, to facilitate the construction of meaning. The purpose of this section is to review the evidence in support of such a view. Given the grounded cognition perspective developed above, if language is subserved by concepts grounded in multimodal brain states, we should find evidence of *grounding effects* in language. A grounding effect, as I define it, constitutes an observable and intersubjectively robust intrusion of embodied (not exclusively sensorimotor) experience in conceptual and especially linguistic representation and processing.

Recent findings in both psychology and cognitive neuroscience now clearly reveal a series of grounding effects when we use language (see table 10.1). First, multimodal brain states are activated when we deploy language. Moreover, these activations are

Table 10.1
Three types of grounding effects in linguistic cognition

Automatic activation of brain regions	Brain regions that are specialized for specific types of processing are activated when the corresponding language is processed.
Immersed bodily behavior	Specialized bodily behaviors are activated by the processing of the corresponding language.
Structure and organization of language	Language appears to be structured in terms of embodied brain states, especially representations grounded in sensorimotor experience

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fast—multimodal information is activated instantaneously, automatically, and cannot be avoided—and somatotopic—they relate to specific functional brain regions; for instance, action words referring to hand actions activate the *hand* area of motor cortex and not the *leg* area (Pulvermüller et al. 2005). Second, psychologists have discovered that human subjects behave as if immersed in an embodied state when using or understanding language relating to perceptual experience. Third, grounding effects show up directly in the nature and structure of language. Together, this amounts to persuasive evidence in favor of the grounded view I am advancing: the human mind is continuous with the human body and bodily experience, rather than being a separate process.

So what then are examples of grounding effects? Let's focus on the somatotopic aspect of brain activation: specific brain regions are activated when we use the corresponding words, or types of words. It is now well established that distinct parts of the cortex process and store sensory information: for instance, visual, auditory and tactile experience. Other parts of the cortex process motor information: for instance, information relating to hand or body movements. And finally, subcortical structures, such as the amygdala, process and store emotional experience. Recent findings have shown that all of these brain regions are automatically and immediately activated when corresponding body-based language is being processed.

For example, brain regions that are active during the processing of actions, such as using tools like hammers, screwdrivers, and saws, are automatically and immediately activated when we hear or read sentences relating to using tools of these kinds (Isenberg et al. 1999; Martin and Chao 2001; Pulvermüller 1999; see also Buccino et al. 2005; for a review, see Taylor and Zwaan 2009). Put another way, when you or I understand an expression such as "He hammered the nail," there is automatic and immediate activation of that part of the brain that is engaged to produce the hammering action. In addition, regions of the brain that process visual information are activated when we comprehend words and sentences relating to visual information, such as object shape and orientation (Stanfield and Zwaan 2001; Zwaan and Yaxley 2003). For instance, visual areas that process animal recognition shapes are activated when we hear or see certain animal words (Büchel, Price, and Friston 1998; Martin and Chao 2001). And finally, language involving emotional affect also results in automatic activation of the relevant brain regions. For instance, threat words such as *destroy* and *mutilate* automatically activate parts of the amygdala (Isenberg et al. 1999). This is an evolutionarily older part of the subcortical brain that neurobiologists have established as being involved in emotional processing (LeDoux 1995).

The second type of grounding effect is behavior. Human subjects, when using or understanding language, behave in myriad subtle ways, as if they are engaged in the sensorimotor activity that corresponds to the sensorimotor language; it is as if language primes language users for particular veridical actions. For instance, when reading about throwing a dart in a game of darts, human subjects automatically activate muscle systems that ready the hand grip common to dart throwing; when we use or hear language, our eye and hand movements are consistent with the sensorimotor activity being described (Glenberg and Kaschak 2002; Klatzky et al. 1989; Spivey et al. 2000). It is as if language facilitates the vicarious experience of the events being described in language.

The psycholinguist Rolf Zwaan has described this in terms of language users being immersed experiencers. He argues that "language is a set of cues to the comprehender to construct an experiential (perception plus action) simulation of the described situation" (Zwaan 2004, 36). And this could only be so if language provides direct access to representations of body-based states: concepts are embodied.

Behavioral evidence for immersion in embodied states, when using language, comes from the psychology lab. In one experiment, subjects were asked to judge whether action sentences such as "He closed the drawer" were meaningful or not (Glenberg and Kaschak 2002). Subjects did this by pressing one of two buttons, which were located sequentially in front of the subject. The button signaling that a sentence was meaningful was closer to the subjects and thus involved moving their hand toward their body, the same direction of motor control required to open a drawer. It was found that responses to whether the sentences were correct or not were faster when the direction of motion corresponded to that described in the sentence. This finding supports the view that bodily motor states are automatically activated when reading a corresponding sentence. An action required by the experiment that is at odds with the motor simulation activated by the sentence provides interference. And this, in turn, slows down the subject's response to the semantic judgment, the ostensible purpose of the experiment.

The third type of grounding effect derives the structure and organization of language: language for abstract states appears to draw on language from sensorimotor experience in an asymmetric way. Linguistic evidence of this sort is compatible with the grounded cognition view of concepts but not the disembodied perspective. Perhaps the most clear evidence in language has been highlighted in the work of Lakoff and Johnson (1980, 1999). As noted in the previous section, conceptual metaphors appear to work by recruiting structure from sensorimotor experience in order to structure representations relating to interoceptive experience types. For instance, various aspects of our representations for time appear to be systematically structured in terms of representations recruited from the domain of (motion through) space. Consider some linguistic examples, which have been claimed to evidence this:

(2a) Christmas is fast approaching.

(2b) We are moving up on Christmas fast.

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These examples suggest the following. The relative imminence of a future event, Christmas, is structured in terms of the motion of an event—an event conceptualized *as if it were* an object capable of motion—toward the ego, or the ego's motion toward Christmas, conceived as a location in space. Lakoff and Johnson posit that we structure our representations of time in terms of relative motion of objects or our relative motion with respect to stationary objects (see also Moore 2006). Moreover, the evidence for conceptual metaphors—from language, from psycholinguistic tasks (Boroditsky 2000), and from psychophysical tasks (Casasanto and Boroditsky 2008)—appears to show that the structuring is asymmetric. That is, representations for time are systematically structured in terms of representations for space and motion through space, but space appears not to be productively structured in terms of representations for time.

Interestingly, and in keeping with the proposals made by Lakoff and Johnson, a range of abstract concepts also appear to exhibit grounding effects. Lakoff and Johnson have argued that we conceptualize communication as physical transfer. Evidence for this comes from linguistic examples, as when we say things like, "I couldn't get my ideas across," "put it into words," and so on. Indeed, Glenberg and Kaschak (2002) found that the same pattern applied to abstract concepts.

Consider a sentence such as "I gave him some words of wisdom." Metaphorically, this involves transferring the "words of wisdom," some advice, from the speaker to the listener, a pattern of motion away from the body. The processing time to judge whether the sentence was semantically acceptable was quicker when the button that was required to be pressed involved an action away from rather than toward the subjects' bodies. In other words, physical action that accorded with the metaphorical action facilitated faster understanding of the linguistic expression. What this reveals is a grounding effect for abstract, as well as literal, language, a finding in keeping with the broad prediction of conceptual metaphor theory.

Further evidence for abstract concepts being structured, at least in part, by sensorimotor experience, comes from the work of Casasanto and Dijkstra (2010). In one experiment, Casasanto and Dijkstra investigated abstract concepts such as pride and shame: subjects were asked to recount experiences that had either made them proud, or ashamed. They did so while simultaneously moving marbles from a lower tray to a higher tray or vice versa. Lakoff and Johnson (1980, 1999) argue that positive experiences are metaphorically conceptualized as being up, while negative experiences are experienced as being down. Casasanto and Dijkstra found that the speed and efficiency of the autobiographical retelling was influenced by whether the direction of the marble movements was congruent with the autobiographical memory: upward for pride, downward for shame. This provides compelling evidence that even abstract language appears to involve automatic activation of sensorimotor simulations in the brain: we understand what the words *pride* and *shame* mean, in part, by virtue of the

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upward and downward trajectories that metaphorically structure them being activated in the brain.

More generally, an important conclusion from this discussion is the following. The traditional distinction between perception and cognition—an artifact of the earlier distinction between body and mind arising from the seventeenth-century philosophical underpinnings of psychology—may be too strong (for discussion see Barsalou 1999; Bergen 2012; Prinz 2002). Representations that arise in language use and comprehension are grounded in the same knowledge that is used in processing our experiences of the world around us. The distinction between perception and cognition, at the very least, may not be as clear-cut as some cognitive scientists have claimed. Talmy (2000), one of the pioneering linguists who first saw that language encodes embodied concepts, argued for a unified category, which he termed *ception*; Talmy sought to emphasize the continuity, rather than separation, between perception and conception (or cognition).

10.4 Conceptual Structure versus Semantic Structure

In light of the foregoing, the conclusion I draw is this: language and body-based representations would appear, together, to co-conspire in the integration process that gives rise to meaning. The question is how, a question I begin to address in this section.

From an evolutionary perspective, the perceptual and interoceptive representations in the conceptual system must have preceded language. The conceptual system allows us, and many other species, to have available for reactivation the body-based representations that arise from our interaction in our socio-physical world of experience. Humans are not alone in possessing conceptual systems and, presumably, body-based representations in those conceptual systems (Barsalou 2005; Hurford 2007, 2012). A conceptual system enables an organism to represent the world it encounters, to store experiences, and hence to respond to new experiences as a consequence. A conceptual system is what enables us and other species to be able to tell friend from foe, competitor from potential sexual mate, and to act and interact in situationally appropriate ways. Our repository of concepts facilitates thought, categorization of entities in the world, and our action and interaction with, in, and through the spatiotemporal environment we inhabit.

But complex thoughts, actions, and so on require that our concepts can be combined compositionally in order to form complex ideas. While many other species have conceptual systems, humans appear to be unique in having language. And the range and complexity of human thought appear to far exceed those of any other species. As Bertrand Russell pithily observed, "No matter how eloquently a dog can bark, it cannot tell you that its parents were poor but honest." An obvious implication, then, is that language may provide, in part at least, a means of harnessing our conceptual system,

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of releasing its potential—a conclusion that has been reached by a number of leading cognitive scientists (see, for example, Bergen 2012; Evans 2009; Mithen 1996,;and references therein).

Barsalou (2005; Baraslou et al. 2008; see also Evans 2009) has suggested that the function of language is to provide an executive control function, operating over grounded concepts in the conceptual system. And this view has much to commend it. The idea is that language provides the framework that facilitates the composition of concepts for purposes of communication. This is achieved by language consisting of a grammatical system, with words and constructions cuing activations of specific body-based states in the brain (see Bergen 2012, chapter 5). Their integration gives rise to complex simulations, which is the stuff of thought. On this account, language provides added value. It allows us to control and manipulate the conceptual system, which, after all, must have originally evolved for more rudimentary functions, such as object recognition and classification. Under the control of language, we can make use of body-based (not exclusively sensorimotor) concepts in order to develop abstract thought. As Barsalou et al. (2008) explain:

> Adding language increased the ability of the simulation [=conceptual] system to represent non-present situations (past, future, counterfactual). Adding language increased the ability to construct simulations compositionally. Adding language increased the ability to coordinate simulations between agents, yielding more powerful forms of social organisation. (274)

However, if the function of language is to index or activate body-based concepts, we might reasonably ask what language is bringing to the table. Do words have meanings in their own right, independent of the perceptual and interoceptive representations they point to?

Some embodied mind researchers have denied that language contributes to meaning per se. Representatives of this position argue that language has no semantic properties of its own, independent of the simulations produced by grounded concepts in the conceptual system (see Glenberg and Robertson 1999; Barsalou et al. 2008).

One reason for thinking this is that decontextualized words on their own do not trigger simulations. In contrast, analog representations such as pictures and images do (Lindemann et al. 2006). For instance, being exposed to the word *cat*, unless embedded in a sentence, will not normally, on its own, give rise to a particularly rich conceptualization. In contrast, a picture of a cat, which is analog—it iconically represents our visual experience of a cat—gives rise to a simulation.

Another line of evidence relates to gist. Upon hearing a story, subjects appear to store the gist of the narrative but not the form that it was told in—subjects can recount the story, but often use quite different words to do so. This takes place after about twenty seconds, suggesting that while the language used to convey the story erodes, the story itself is represented in a nonlinguistic form, a complex representation, a simulation, in

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the conceptual system (Bransford and Franks 1971). This suggests that once a simulation has been achieved, language is largely irrelevant for, and hence independent of, the underlying meaning (Barsalou et al. 2008).

Barsalou and colleagues conclude from this that language processing is not very deep, in terms of the semantic representations it can evoke on its own. The role of language is to provide structure, which aids the assembly of perceptual states in the construction of meaning. In other words, simulations arise from activation of nonlinguistic concepts. And it is these simulations that linguistic forms provide direct access to. According to Barsalou (e.g., Barsalou et al. 2008), language provides a level, essentially, of formal (sound or signed) representation, but no semantic content. The forms then hook up with perceptual and interoceptive states, thereby facilitating reactivations—simulations.

However, this view is likely to be too strong. First, if language has no independent semantic content, then presumably we can't use language to evoke ideas we haven't yet experienced—because the brain states don't yet exist for the experiences. Yet, we *can* use language to evoke experiences we haven't yet experienced (Taylor and Zwaan 2009; Vigliocco et al. 2009). The experiences evoked via language, in the absence of a fully "immersed" experience, such as seeing or enacting the experience, is somewhat attenuated and full of gaps. Nevertheless, language can facilitate an approximation.

By way of illustration, consider the lutz jump. Readers largely ignorant of ice-skating will also be ignorant of what this move entails. Now read the following definition of the lutz jump:

> A jump in figure skating in which the skater takes off from the back outer edge of one skate and makes one full rotation before landing on the back outer edge of the other skate

Having read this, readers will have a rough idea of what the lutz jump is. They will understand it is a move in ice-skating, which involves a particular kind of footwear on a particular kind of surface. Moreover, readers will be able to close their eyes and rehearse a move in which an ice-skater takes off, performs one rotation, and lands. To be sure, many of the details will be unclear. If readers were then to look up *lutz jump* on YouTube, they would be able to watch clips of the lutz jump being performed. And this illustrates a point I will return to later: veridical experience, the experience of seeing, acting, and interacting, gives rise to body-based representations that are analog in nature. Having seen the lutz jump, readers can, thereafter, picture it in their mind's eye. Language, in contrast, doesn't work like that, I contend. The representations are more sketchy, more partial; they are not analog at all.

More troublesome for Barsalou, and for others who seek to exclude semantic content from language, is the following: although simulations arise automatically in response to language use, they are not necessary for language to be successfully used. Patients with Parkinson's disease who display difficulty in carrying out motor movements,

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suggesting their motor representations are damaged, are still able to use and understand, more or less, corresponding action verbs (Boulenger et al. 2008). Likewise, patients with motor neuron disease are still able to process action verbs, albeit suboptimally (Bak et al. 2001). Indeed, this was the one of the objections to an embodied approach to concepts raised by Mahon and Caramazza (2008), discussed earlier.

Taylor and Zwaan (2009) account for this by proposing what they call the *fault tolerance hypothesis*. This makes the following claim: humans construct their conceptual representations from various sources, including language. Moreover, these may be incomplete. For instance, a novice skier doesn't have the motor routines necessary for skiing; an unconventional ski instructor might ask the novice skier to imagine being a waiter, with a tray held aloft, weaving through a busy Parisian café, in order to simulate the type of body posture and motor routines required when on skis.[2] The point is that evoking such a simulation, via language, while not the same as the embodied experience of skiing, facilitates the learning of the requisite motor routines that, in time, will lead the novice to becoming an accomplished skier.

The third problem is this. The grammatical subsystem appears to encode semantic content—albeit schematic content—independently of the conceptual system (Evans 2009; Evans and Green 2006; Talmy 2000; see also Bergen 2012, chapter 5). To illustrate, if we exclude the semantic content associated with open-class elements such as nouns, verbs, adjectives, and adverbs, we are left with a type of schematic representation that is not straightforwardly imageable, or perceptual. In short, the representations associated with grammatical structure, so-called closed-class elements, appear not to relate, in a straightforward way, with perceptual representations. And yet, such representations appear to be meaningful. For instance, the distinction between the definite article *the* and the indefinite article *a* is one of specificity. But it is not clear what *the* might relate to in the conceptual system: although we can visualize open-class lexical items, such as *chair* or *tree*, and simulate the feelings and scenes associated with more abstract nouns such as *love* and *war*, we can't simulate whatever it is that *the* corresponds to, for instance.

To make this point more explicitly, consider the following:

(3) **Those** boy**s** **are** paint**ing** **my** railing**s**

In this example, if we strip away the open-class elements we are left with the closed-class elements in bold—the bound morphemes (*-ing* and *-s*), and the closed-class free morphemes *those, are,* and *my*. Moreover, the state of being a noun, which is to say, the schematic category *noun*, and the schematic category *verb* (although not specific exemplars of nouns, exemplified by *boy*, *railing*, and *paint*) are also closed-class elements.

2. This example is due to Fauconnier and Turner (2002).

The composite meaning of all these closed-class elements in (3) is as follows: *Those somethings are somethinging my somethings*. This can be glossed as follows: "More than one entity close to the speaker is presently in the process of doing something to more than one entity belonging to the speaker." This actually provides quite a lot of meaning. That said, this semantic representation for the closed-class entities is schematic. We don't have the details of the scene: we don't know what the entities in question are, nor do we know what is being done by the agent to the patient.

Nevertheless, this illustration reveals the following: there appears to be a type of semantic representation that, arguably, is unique to the linguistic system. Moreover, this representation provides information relating to how a simulation should be constructed (see Bergen 2012 for a related point). After all, the grammatical organization of the sentence entails that the first entity is the agent and the second entity the patient: the first entity is performing an action that affects the second entity. This level of semantic representation derives exclusively from language, rather than from conceptual structure, providing an instruction as to the relative significance, and the relation that holds, between these two entities. In short, closed-class elements, and the grammatical configurations in which they reside—which are themselves closed-class elements—involve semantic content, albeit of a highly schematic sort (Evans 2009; Goldberg 1995, 2006; Talmy 2000).

There is one further difficulty with assuming that language has no semantic content, independent of conceptual structure. We now know that language appears to directly influence perception. In a language such as Greek, for instance, there are distinct words for light blue (*ghalazio*) and dark blue (*ble*). This contrasts with English, where there is a single word: *blue*. Neuroscientists have shown that whether one is a native speaker of Greek or of English influences how we *perceive* blueness. Using event-related potential (ERP) methodology, Thierry and colleagues (2009) found that the brain activity of Greek speakers diverged when they perceived the different shades of blue. In contrast, English speakers exhibited no divergence in brain activity across the blue shades. The conclusion that emerges from this is that there is clear relationship between a linguistic distinction in a speaker's native language—Greek divides blue color space while English doesn't—and the low-level, automatic perception of color, as measured by brain activity at the onset of preattentive awareness, before subjects become conscious of the color they are perceiving. For present purposes, the relevance of this finding is that it provides direct evidence that a parametric distinction imposed by a language—dark versus light color—modulates nonlinguistic perceptual categorization in visual experience. This could not be the case if language had no semantic content independent of the conceptual system.

Finally, language appears to induce the illusion of semantic unity. This is an effect of language rather than of the conceptual system. For instance, the word *time* in English encodes a range of different, albeit related, concepts (Evans 2004):

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(4a) The time for a decision has arrived.

(4b) The relationship lasted a long time.

(4c) Time flows on forever.

(4d) The time is approaching midnight.

In these sets of examples, all involving the lexical item *time*, a different reading is obtained. In (4a), a discrete temporal point or moment is designated, without reference to its duration. The example in (4b) provides a reading relating to what might be described as "magnitude of duration." In the sentence in (4c), *time* prompts for an entity that is infinite and hence eternal. Thus, in (4c) the reading relates to an entity that is unbounded. Finally, the example in (4d) relates to a measurement system, and specifically a point that could be paraphrased as "The hour is approaching midnight."

Although English has one word for a range of (arguably) quite distinct concepts, other languages do not have a single word that covers all this semantic territory. For instance, recent research on the Amazonian language Amondawa reveals that there is no equivalent of the English word "time" in that language (Sinha et al. 2011). To give another example of typologically distinct languages, Inuit languages also don't have a single lexeme for *time* (Michael Fortescue, pers. comm.). Moreover, even genetically related languages use distinct lexical items to describe the semantic territory covered by the single lexical form *time* in English.

French is a good example of this:

(5) C'est l'heure de manger

"It's time to eat"

While the lexical form *heure* (hour) is used to describe the moment sense of time, equivalent to the English example in (4a); some of the other senses for English *time* are covered by the form *temps* (time). What this illustrates is that word forms can provide an illusion of semantic unity (Evans 2009) and give rise to the myth that time, by way of example, relates to a homogenous set of experiences. This is, I suggest, an effect of language, rather than nonlinguistic knowledge, which remains broadly similar across English and French. In short, other languages don't group the same semantic territory with a single lexeme. Still others separate out across distinct lexemes. In the final analysis, it appears that semantic unity is an illusion, an artifact of linguistic organization and use. This provides compelling evidence that language brings with it its own semantic contribution, independent of the rich and detailed knowledge representation of the nonlinguistic conceptual (or simulation) system.

In sum, it is difficult to maintain the view held by some eminent embodied/grounded cognition researchers that semantic structure in language equals conceptual structure. There appear to be two distinct types of representations. I now turn to a consideration of what these might be.

10.5 Parametric versus Analog Concepts

In this section, I consider the distinction between representations in the linguistic system, and those that inhere in the conceptual (or simulation) system. But let's first consider what it means to say that language activates sensorimotor states. From the present perspective, the idea is that words are in fact cues that index or point to body-based states processed and stored by the brain (Evans 2009, 2013; Glenberg and Robertson 1999; Fischer and Zwaan 2009. To illustrate, consider the use of *red* in the following example sentences (adapted from Zwaan 2004):

(6a) The schoolteacher scrawled in red ink all over the pupil's homework book.

(6b) The red squirrel is in danger of extinction in the British Isles

In the first example, the use of *red* evokes a bright, vivid red. In the second, a dun or browny red is most likely evoked. This illustrates the following: The *meaning* of *red* is not, in any sense, there in the word (although I nuance this view below). Rather, words cue perceptual and interoceptive states stored in the brain. And these body-based states are reactivated during language use. Put another way, the word form *red* gives rise to distinct simulations for different hues of red. These simulations arise as a consequence of reactivating stored experience types. These reactivated experiences we might refer to as *analog concepts*—concepts that are directly grounded in the experiences that give rise to them. How then does semantic structure (in language) differ from this level of conceptual structure—which is to say, from analog concepts?

To illustrate, I consider the use of the adjective *red*, and the noun *redness*, in the following examples, adapted from a skin-care product advertisement:

(7a) Treat <u>redness</u> with Clinique urgent relief cream.

(7b) Treat <u>red</u> skin with Clinique urgent relief cream.

Both words, *red* and *redness*, relate to the same perceptual state, presumably. But the words package or serve to construe the content in a different way, giving rise to distinct simulations. In the example in (7a), *redness* gives rise to an interpretation relating to a skin condition. In the second, (7b), *red* refers more straightforwardly to an unwanted property of the skin.

The different interpretations arising from these sentences are not due to a different hue being indexed. Rather, the words (noun versus adjective) modulate the perceptual hue in a slightly different way, giving rise to slightly distinct simulations: "skin

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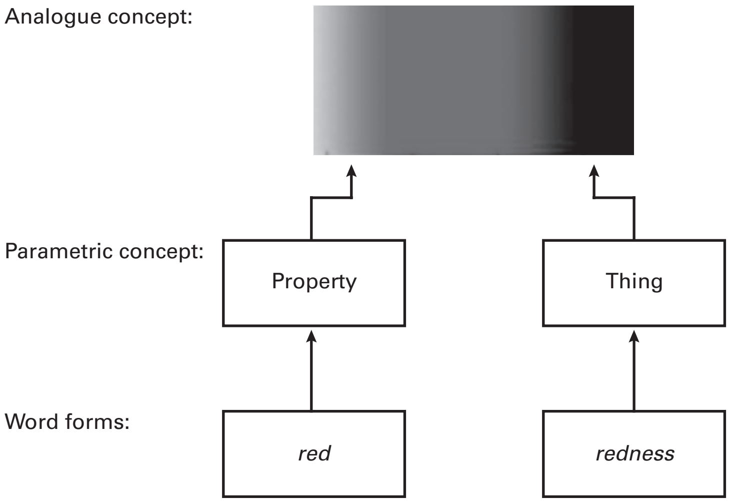

Figure 10.3 (plate 10)
Analog and parametric concepts.

condition" versus "discoloration of skin" interpretations. In other words, the grammatical distinction between the adjective (*red*) and noun (*redness*) appears to relate to a semantic distinction between the notion of property versus thing. The words *red* and *redness*, while indexing the same (or similar) perceptual state, also encode schematic concepts: PROPERTY versus THING (cf. Langacker 2008).

But unlike the body-based perceptual state—the hue of red—which is analog, PROPERTY and THING are highly schematic notions. They are what I refer to as *parametric concepts*. Unlike the perceptual experience of redness, with comes to mind when we variously imagine a fire engine, a Royal Mail post box (ubiquitous in the UK), henna, fire, the Chinese flag, or superman's cape, parametric concepts are not like veridical embodied experiences. There is nothing about the (parametric) concepts PROPERTY or THING that is akin to the perceptual experience of redness (an analog concept). Parameters are abstracted from embodied (perceptual *and* interoceptive) states, filtering out all points of difference to leave highly image-schematic content: the parameter.[3] The word form *red* encodes the parameter PROPERTY, while *redness* encodes the parameter THING. This is another way of saying that *red* is an adjective—it describes a property of a thing—while *redness* is a noun—it describes a property that is objectified in some way and established as being identifiable, in principle, in its own right, independent of other entities in world. Figure 10.3 (plate 10) captures the relationship between a word form and its parametric and analog concepts.

3. Cf. the related notion of image schema developed in the work of Johnson (1987).

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My claim, then, is this. There is a distinction between analog concepts on the one hand and parametric concepts on the other. The former relate to nonlinguistic concept types that, in evolutionary terms, had to precede the existence of language. Parametric concepts constitute a species of concept that arose as a consequence of the emergence of language. They provide a level of schematic representation directly encoded by language: parametric concepts guide *how* analog concepts are activated and, consequently, *how* simulations are constructed in the service of linguistically mediated meaning construction. For instance, the forms *red* and *redness* both index the same perceptual state(s). But they parcellate the conceptual content in a different way, giving rise to distinct simulations: *redness* = condition; *red* = (unwanted) property of skin. The schematic parametric concepts, which is to say, that part of meaning that is native to language, relates to THING versus PROPERTY. Parametric concepts are language-specific affordances, rather than affordances of the simulation system.

Related proposals have been put forward by Bergen (2012) and Taylor and Zwaan (e.g., 2008, 2009). Taylor and Zwaan have captured this view in terms of what they dub the *linguistic focus hypothesis*. They argue that during language understanding, motor representations are activated that are under the governance of linguistic constructions. These serve to differentially direct focus on the referential world. Bergen's findings are consonant with this hypothesis. In one set of behavioral experiments, Bergen (2012) found that the grammatical subject, for instance, the use of *I* versus *you*, influences the perspective from which a language user perceives a scene. Bergen explains this as follows:

> Grammatical person seems to modulate the perspective you adopt when performing embodied simulation. This isn't to say that every time you hear *you*, you think about yourself as a participant in simulated actions. But it does mean that the grammatical person in a sentence pushes you toward being more likely to adopt one perspective or another. What's interesting about this is that in this case, grammar appears not to be telling you what to simulate, but rather, how to simulate—what perspective to simulate the event from. Instead of acting as the script in this case, grammar is acting as the director. (114)

In the light of this discussion, what then is the function of language and, specifically, parametric concepts in embodied cognition? My answer is that parametric concepts, encoded by language, guide the formation of complex simulations for purposes of (linguistically mediated) communication. Parametric concepts guide the *parcellation* (focal adjustments, in Langacker's 2008 terms) of analog (i.e., perceptual and interoceptive) concepts, in the construction of simulations. Parametric concepts encode schematic, or *digitized,* content. Content of this sort is abstracted from analog, or perceptual (and interoceptive) representations. Hence, the parameters THING versus PROPERTY are schemas drawn from embodied experience.

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Let's now examine a more complex example of a parametric concept. Consider the ditransitive construction (Goldberg 1995), as exemplified by the following:

(8) John baked Mary a cake.

Goldberg argues that this example is sanctioned by a sentence-level construction that encodes the schematic semantics in (9):

(9) X (INTENDS TO) CAUSE(S) Y TO RECEIVE Z

Goldberg's point is that the "cause to receive" meaning in (9) arises not from the semantics of *bake,* which is canonically a transitive (rather than a ditransitive) verb, but from the larger construction in which it is embedded. And there is behavioral evidence to support such a contention. Kaschak and Glenberg (2000) reported a study in which they showed sentences to participants using the novel verb *to crutch*. Some sentences employed the ditransitive construction, as in (10a), while others placed the novel verb in the transitive construction as in (10b). They then asked subjects to say which of the sentences were consistent with two inference statements, given below in (11):

(10a) Lyn crutched Tom her apple

(10b) Lyn crutched her apple

(11a) Tom got the apple

(11b) Lyn acted on her apple

The sentence in (11a) provides an inference of transfer of possession. In contrast, the inference arising from (11b) is to act on. Because the verb is novel, it has no inherent semantics associated with it. Hence, if the sentence possesses inherent semantics independently to the verb, as claimed by Goldberg, then we would expect the inference in (11a) to be judged as compatible with sentence (10a), and the inference in (11b) to be compatible with the sentence in (10b). And this is indeed what Kaschak and Glenberg found. In short, the syntactic sentence-level template appears to have a schematic representation associated with it—a complex parametric concept in present terms—which is represented in (9). Parametric concepts of this sort guide or modulate how analog concepts are parcellated, giving rise to a simulation. And a complex parametric concept such as (9) does this, in principle, in the same way as parametric concepts associated with single lexical items such as *red* and *redness*.

In essence, it turns out that working out what a concept is, is not a straightforward matter at all. Body-based representations, stored in different brain regions, form the basis of a species of concepts: analog concepts. Concepts of this kind are grounded in the veridical (perceptual) and phenomenological (interoceptive) experience types from which they arise. But a second species of concept, parametric concepts, appears

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Table 10.2
Parametric versus analog concepts

Parametric concepts	Analog concepts
Specific to language	Specific to the conceptual system
Parametric (abstracted from embodied states, filtering out all points of difference to leave highly schematic properties or parameters)	Analog (albeit attenuated) representations of body-based states
Underpinnings for all linguistic units (where a linguistic unit is a form or parametric content unit of any complexity)	Arise directly from perceptual (conscious) experience and reside in the same neural system(s) as body-based states
	Reactivated or simulated (by language, imagination, etc.) and can be combined to form complex and novel simulations

to be directly encoded by language. Concepts of this kind are far more schematic: they encode parameters—THING versus PROPERTY, DARK COLOR versus LIGHT COLOR. They are abstracted from embodied experience but are not rich analog representations. Moreover, the parametric concepts appear to be deployed to modulate the analog concepts in giving rise to a representation known as a simulation: a complex representation that is constructed in the process of speaking and thinking. This simulation expresses an idea that language is instrumental in facilitating. Table 10.2 summarizes the distinction between parametric and analog concepts.

10.6 Access Semantics

Having distinguished between analog and parametric concepts, we now require an account of the respective contributions of parametric and analog concepts to the meaning-construction process. In other words, we need an account of how parametric concepts *access* analog concepts. To do this, in this section I develop a theory of *access semantics*. An access semantics accounts for how semantic structure (made up of parametric concepts) interfaces with, and thereby activates, the requisite aspects of nonlinguistic knowledge representation—that is, conceptual structure (made up of analog concepts)—which inheres in the conceptual system, giving rise to a simulation.

10.6.1 LCCM Theory

In Evans (2009, 2013) I have developed a theoretical account of lexical representation and semantic composition dubbed the theory of lexical concepts and cognitive models, or LCCM theory for short. LCCM theory is a theory of access semantics. The claim at its heart is enshrined in the distinction between its two foundational theoretical constructs—the *lexical concept* and the *cognitive model*: there is a qualitative distinction between these theoretical constructs, which are central to meaning construction.

This distinction relates, ultimately, to the bifurcation between analog and parametric concepts, which respectively structure cognitive models and lexical concepts.

In keeping with the thrust of the argument developed in the foregoing, LCCM theory assumes the linguistic system emerged, in evolutionary terms, much later than the earlier conceptual system. The utility of a linguistic system, on this account, is that it provides an executive control mechanism facilitating the deployment of conceptual representations in service of linguistically mediated meaning construction. Hence, *semantic* representations in the two systems are of a qualitatively distinct kind. I model semantic structure—the primary representational substrate of the linguistic system—in terms of the theoretical construct of the lexical concept. A lexical concept is a component of linguistic knowledge—the semantic pole of a *symbolic unit* (in, e.g., Langacker's 1987 terms)—which encodes a bundle of various types of highly schematic *linguistic content* (see Evans 2006, 2009, 2013). In particular, linguistic content includes information relating to the selectional tendencies associated with a given lexical concept—the range of semantic and grammatical correlates of a given lexical concept (see Evans 2006, 2009). Hence, lexical concepts are parametric concepts.

While lexical concepts encode highly schematic linguistic content, a subset—those associated with open-class forms—are connected, and hence facilitate access, to the conceptual system. Lexical concepts of this type are termed *open-class lexical concepts*.[4] Such lexical concepts are typically associated with multiple areas in the conceptual system, referred to as *association areas*.

The range of association areas to which a given lexical concept facilitates access is termed an *access site*. LCCM theory assumes that the access site for a given *open-class lexical concept* is unique. As lexical concepts facilitate access to a potentially large number of association areas in the conceptual system, any given open-class lexical concept, in principle, facilitates access to a large *semantic potential*. However, only a small subset of this semantic potential is typically activated in *interpretation* of a given utterance.

Although the linguistic system evolved to harness the representational power of the conceptual system for purposes of communication, the human conceptual system, at least in very broad outline, is continuous with that of other primates (Barsalou 2005; Evans 2013, especially chapter 2, 2014), and shows a range of broad similarities with that of other species (Hurford 2007). In contrast to the linguistic system, the conceptual system evolved primarily to facilitate functions such as perception, categorization, inference, choice, and action, rather than communication. In LCCM theory, *conceptual structure*—the semantic representational substrate of the conceptual system—is modeled by the theoretical construct of the cognitive model. A cognitive model is a coherent body of multimodal knowledge grounded in the brain's modal systems, and derives from the full range of experience types processed by the brain, including sensorimotor

4. See Evans (2009) for the rationale for this position.

Lexical representation

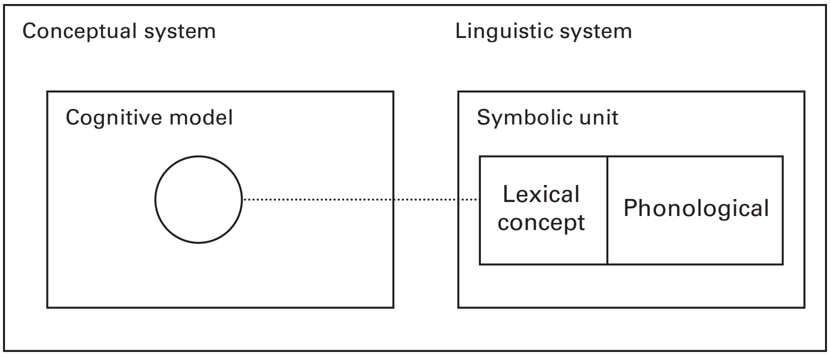

Figure 10.4
Relationship between a lexical concept and a cognitive model.

experience, proprioception, and subjective experience, including affect.[5] Hence, cognitive models are analog in nature, and as such constitute analog concepts.

The conceptual content encoded as cognitive models can become reactivated during the simulation process. Simulation is a general-purpose computation performed by the brain to implement the range of activities that subserve a fully functional conceptual system. Such activities include conceptualization, inferring, choice, categorization, and the formation of ad hoc categories.[6]

In LCCM theory, simulations are effected by a subset of lexical concepts—*open-class lexical concepts*—facilitating access to the conceptual system via a number of association areas (see figure 10.4). Each association area corresponds to a (part of a) cognitive model, as captured in figure 10.4. The range of association areas to which an open-class lexical concept corresponds makes up its access site.

10.6.2 Cognitive Model Profile

An important construct in LCCM theory, and one that is essential to providing an account of meaning construction, is that of the *cognitive model profile*. As an open-class lexical concept—a noun, verb, adjective, or adverb—facilitates access to numerous

5. The term *cognitive model* is used elsewhere in cognitive science, for instance in terms of computational modeling (e.g., in John Anderson's ACT-R theory of cognition), and is widespread in this other sense. My use of the term is not being deployed in the same way.

6. For discussion and findings relating to the multimodal nature of conceptual representations and the role of simulation in drawing on such representations in facilitating conceptual function, see, for instance, Barsalou (1999, 2008), Glenberg (1997), Gallese and Lakoff (2005), and references therein.

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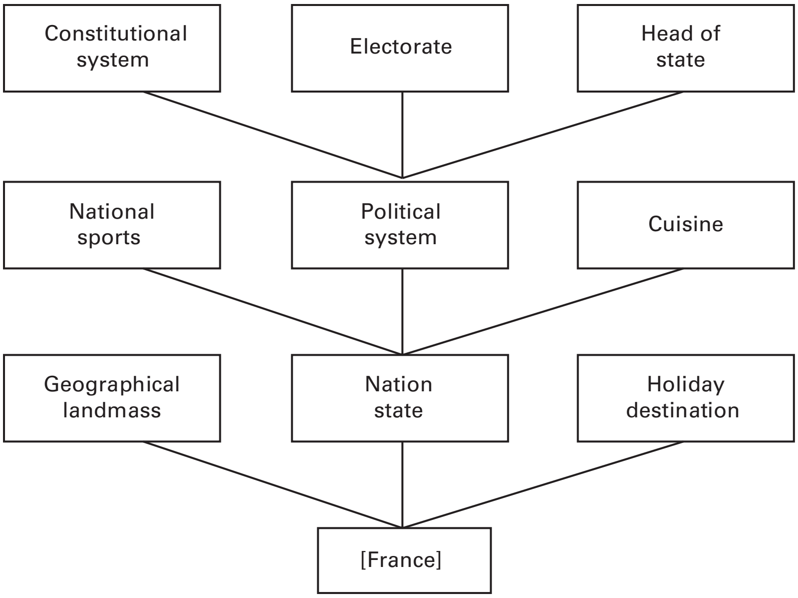

Figure 10.5
Partial cognitive model profile for the lexical concept [FRANCE].

association areas within the conceptual system, it facilitates access to numerous cognitive models. Moreover, the cognitive models to which a lexical concept facilitates access are themselves connected to other cognitive models. The range of cognitive models to which a given lexical concept facilitates direct access, and the range of additional cognitive models to which it therefore facilitates indirect access, are collectively termed its cognitive model profile.

To illustrate, consider the cognitive model profile for the lexical concept I gloss as [FRANCE], associated with the form *France*. A partial cognitive model profile for [FRANCE] is represented in figure 10.5.

Figure 10.5 is an attempt to capture the sort of knowledge that language users must presumably have access to when speaking and thinking about France. As illustrated by figure 10.5, the lexical concept [FRANCE] provides access to a potentially large number of cognitive models.[7] Because each cognitive model consists of a complex and structured body of knowledge, which, in turn, provides access to other sorts of knowledge, LCCM theory distinguishes between cognitive models that are directly accessed via the lexical concept—*primary cognitive models*—and those that form substructures of directly

7. The bracket notation used here, [FRANCE], represents the linguistic content that is encoded by the vehicle "France."

accessed models—*secondary cognitive models*. These secondary cognitive models are indirectly accessed via the lexical concept.

The lexical concept [FRANCE] affords access to a number of primary cognitive models, which make up the *primary cognitive model profile* for [FRANCE]. These are hypothesized to include GEOGRAPHICAL LANDMASS, NATION-STATE and HOLIDAY DESTINATION. And I reiterate, a cognitive model represents a coherent body of complex information, multimodal information, gleaned through sense perception, interoceptive experience, and propositional information achieved via cultural learning, language, and other channels. Each of these cognitive models provides access to further cognitive models. In figure 10.5, a flavor of this is given by virtue of the various secondary cognitive models that are accessed via the NATION-STATE cognitive model—the *secondary cognitive model profile*. These include NATIONAL SPORTS, POLITICAL SYSTEM, and CUISINE. For instance, we may know that in France, the French engage in national sports of particular types, for instance, football, rugby, and so on, rather than others: the French don't typically engage in American football, ice hockey, cricket, and so on. We may also know that as a sporting nation, they take part in international sports competitions of various kinds, including the FIFA World Cup, the Six Nations rugby competition, the Rugby World Cup, the Olympics, and so on.

That is, we may have access to a large body of knowledge concerning the sorts of sports French people engage in. We may also have some knowledge of the funding structures and social and economic conditions and constraints that apply to these sports in France as well as France's international standing with respect to these particular sports, and further knowledge about the sports themselves, including the rules that govern their practice and so forth. This knowledge is derived from a large number of sources, including direct experience and cultural transmission (including language).

With respect to the secondary cognitive model of POLITICAL SYSTEM, figure 10.5 illustrates a sample of further secondary cognitive models that are accessed via this cognitive model. In other words, each secondary cognitive model has further (secondary) cognitive models to which it provides access. For instance (FRENCH) ELECTORATE is a cognitive model accessed via the cognitive model (FRENCH) POLITICAL SYSTEM. In turn the cognitive model (FRENCH) POLITICAL SYSTEM is accessed via the cognitive model NATION-STATE. Accordingly, NATION-STATE is a primary cognitive model, while ELECTORATE and POLITICAL SYSTEM are secondary cognitive models.

Finally, it is worth highlighting a point that has been implicit in the foregoing. LCCM theory assumes that cognitive models involve content at varying degrees of abstractness, and of different types. For instance, being able to simulate the view from the top of Mont Saint-Michel on a midsummer evening, while on vacation in France, involves processing sensorimotor aspects of a scene, as well as knowledge of the affective experiences that accompany this view—pleasure, joy, awe, and so on. In addition, such information is subject to abstraction, giving rise to schematic categories, such as

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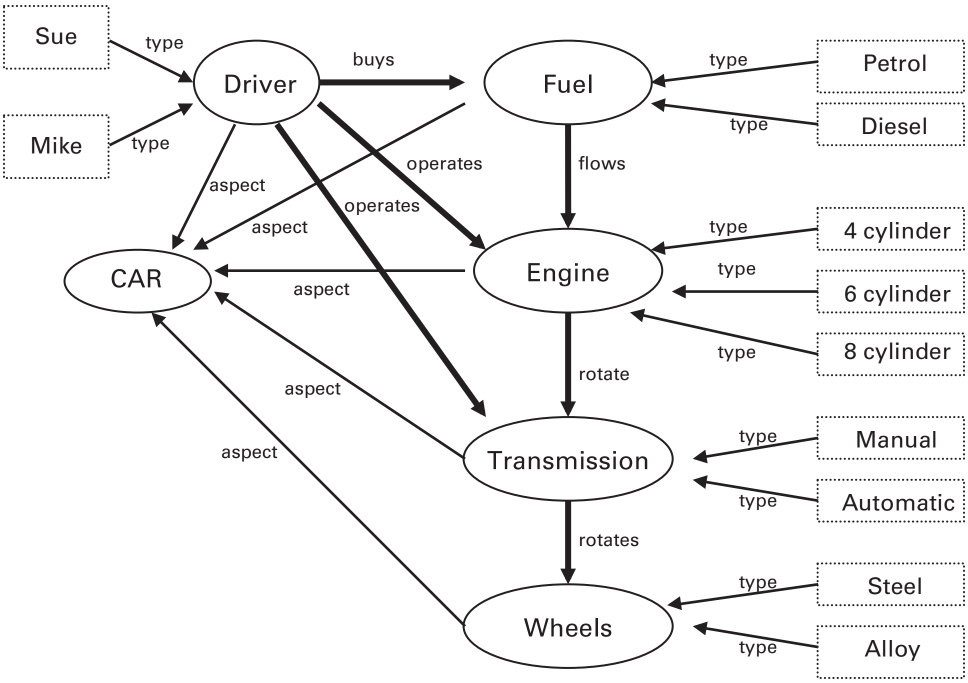

Figure 10.6
Knowledge structure for CAR concept.

"beautiful places I have seen," which may come to form part of the cognitive model profile for [FRANCE], but may also become linked to other cognitive model profiles. Moreover, cognitive models may contain information relating to entities, both individuals and types, as well as relational information. For instance, a cognitive model profile for [CAR] will include knowledge of various sorts, including, in various levels of detail contingent on the individual's knowledge base, the component parts of a car and the relations between them, as illustrated schematically in figure 10.6. Moreover, as language interfaces with the conceptual system via access sites, cultural knowledge mediated by language can come to form part of the representations associated with cognitive models. In short, LCCM theory holds that analog (body-based) content is supplemented by propositional information derived from linguistically mediated content, thus fleshing out the representations in the conceptual system.

10.6.3 Activation of Cognitive Models in Meaning Construction

The way meaning construction proceeds is by virtue of integration of parametric concepts, which give rise to a linguistic context that facilitates activation of aspects

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of cognitive model profiles. The outcome, then, of language understanding is activation of nonlinguistic cognitive models, guided and constrained by linguistic context. Consider the following linguistic examples:

(12a) France is a country of outstanding natural beauty.

(12b) France is one of the leading nations in the European Union.

(12c) France beat New Zealand in the 2007 Rugby World Cup.

(12d) France voted against the EU constitution in the 2005 referendum.

In each of these examples, the semantic contribution associated with the form *France* is slightly distinct. That is, the semantic contribution provided by *France* varies across these distinct utterances. The key insight of LCCM theory is that the reason for this variation is due to differential activation of nonlinguistic knowledge structures, the cognitive model profile, to which the lexical concept associated with *France* affords access.

The *informational characterization* associated with [FRANCE] in each of these examples concerns France as a geographical landmass in (12a), France as a political entity, a nation-state, in (12b), the fifteen players who make up the French rugby team in (12c), and in (12d), that proportion of the French electorate who voted "non" when presented, in a recent referendum, with the proposal to endorse a constitution for the European Union. In order to provide these distinct interpretations, this lexical concept must serve as an access site for a cognitive model profile that, at the very least, includes the sort of information indicated in figure 10.5.

The differential interpretations associated with the examples in (12) arise as follows. In (12a) the interpretation associated with the form *France*, which relates to a particular geographical region, derives from activation of the GEOGRAPHICAL LANDMASS cognitive model. That is, individual language users have knowledge relating to the physical aspects of France, including its terrain and its geographical location. In this example, the utterance context activates this part of the cognitive model profile accessed by the lexical concept [FRANCE]. In the second example, the utterance context activates a different part of the cognitive model profile to which the lexical concept [FRANCE] affords access. In this example, the informational characterization relates to the cognitive model of France as a POLITICAL ENTITY. This is due to activation of the NATION-STATE cognitive model. The use of *France* in the example in (12c) relates to the group of fifteen French individuals who play as a team and thereby represent the French nation on the rugby field. In the example in (12d), the form *France* relates not to a geographical landmass, political entity, nation-state, nor group of fifteen rugby players who happen to be representing the entire population of France. Rather, it relates to that portion of the French electorate that voted against ratification of the EU constitution in a ref-

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erendum held in 2005. Accordingly, what is activated here is the ELECTORATE cognitive model.

This last example provides an elegant illustration of the way in which activation of a cognitive model provides a situated interpretation of a lexical concept by giving rise to an access route through the semantic potential. In this example, interpretation requires that an access route be established through the cognitive model profile accessed via the lexical concept [FRANCE] in a way that is consistent with the lexical concepts associated with the other linguistic forms and units in the utterance. The interpretation associated with *France* in this example has to do with the French electorate, and specifically that part of the French electorate that voted against ratification of the EU constitution. In other words, [FRANCE] in this example achieves an informational characterization that is facilitated by activating the cognitive models shown in bold in figure 10.7.

10.6.4 Matching

My final illustration speaks directly to the criticism leveled by Mahon and Caramazza (2008) against embodied/grounded approaches to concepts. They argued that an embodied account of concepts can't deal with the variable properties evoked by *beautiful* in these sorts of examples:

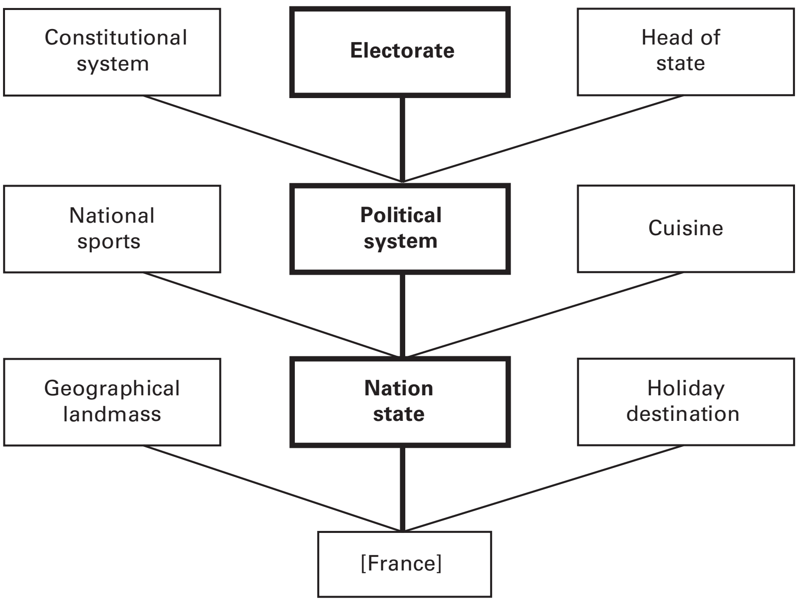

Figure 10.7
Access route established by the interpretation of [FRANCE] in the utterance "France voted against the EU constitution."

(13a) a beautiful face

(13b) a beautiful sound

(13c) a beautiful idea

On the contrary, accounting for the variable sensorimotor and affective information evoked by *beautiful* in these examples turns on the issue of meaning construction, rather than (solely) on an account of knowledge representation. As such, it is guided by the linguistic context.

The challenge, in the examples in (12), is to account for how the conceptual content for *beautiful*, and *face* are integrated. This involves, in LCCM terms, a process of *matching* across cognitive model profiles accessed by the relevant open-class lexical concepts. Moreover, this matching is based on conceptual coherence across the cognitive model profiles to ensure that the "correct" cognitive models become activated, leading to a simulation.

To begin to illustrate, consider a partial cognitive model profile for the open-class lexical concept [BEAUTIFUL]—see figure 10.8. Primary cognitive models that are accessed by [BEAUTIFUL] range from assessments relating to the receipt of or awareness of visual pleasure, particularly physical appearance, often related to perceived sexual attractiveness, to the awareness of nonvisual but physical pleasure, such as aural pleasure, as in the appreciation of music, or pleasure derived from touch, for instance. The lexical concept [BEAUTIFUL] also affords access to a cognitive model having to do with nonphysical pleasure, which I gloss as AESTHETIC PLEASURE. This relates to an appreciation for such things as art and literature from which pleasure are derived.

In the examples in (12), the linguistic context, a noun phrase (NP), gives rise to the parametric concept [A NONSPECIFIC THING WITH A PARTICULAR ATTRIBUTE]. This schematic semantic representation drives the matching process. That is, the two open-class lexical concepts, for instance [BEAUTIFUL] and [FACE], afford access to their respective cognitive model profiles. But they do so in a way that is consistent with the parcellation provided

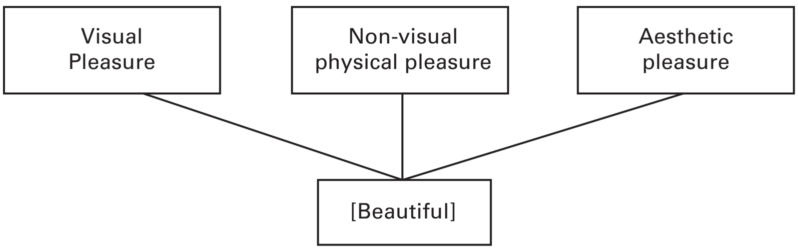

Figure 10.8
Partial cognitive model profile for the lexical concept [BEAUTIFUL].

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by the parametric concept: whatever cognitive model [BEAUTIFUL] activates, this must be interpretable as an attribute associated with *face*. And vice versa, the cognitive model activated by [FACE] must be coherent with its property *beautiful*.

The process involved is thus one of matching, guided by the parametric concept. As such, because a face is a physical entity that can be seen, conceptual coherence is achieved when the VISUAL PLEASURE cognitive model is activated. In short, the language constrains the matching process involved in activation of nonlinguistic concepts, in service of linguistically mediated simulations.

10.7 Conclusion

I began this chapter by asking this question: Do linguistic units (e.g., words) have semantic content independently of the human conceptual system? Some recent theories of embodied (or grounded) cognition, for instance LASS theory, developed by Barsalou and colleagues (2008), have tended to assume that the value of language is in providing syntactic organization that facilitates the assembly of nonlinguistic concepts, and hence simulations. On this view, language has no semantic contribution independent of nonlinguistic concepts. In contrast, some psycholinguists (e.g., Taylor and Zwaan 2008, 2009) and linguists (e.g., Bergen 2012) take the view that language shapes the nature of simulations, by providing a level of focus on how the simulation should be constructed. The implication of such a view, I suggest, is that language must have a level of semantic content independent of nonlinguistic concepts. The distinction between the two, between semantic structure versus conceptual structure, I have argued, can be operationalized in terms of the distinction between what I refer to as parametric information (or concepts) and analog information (or concepts). Lexical concepts, the concepts specific to the linguistic system, are parametric, providing a level of schematic information. On this view, a lexical concept, made up of parameters, is the semantic pole of a linguistic unit, where a linguistic unit is a symbolic assembly of form and (schematic) meaning. In addition, lexical concepts facilitate access to nonlinguistic concepts, which, in LCCM theory terms, are labeled cognitive models. Cognitive models consist of analog information.

The parametric information that makes up lexical concepts can be associated with single word forms, more complex idiomatic units, and even sentence-level constructions. From this view, the parameters encoded in language actively shape, or parcellate, in my terms, the analog content to which a subset of lexical concepts (open-class lexical concepts) facilitate access. For instance, the ditransitive construction, described earlier, stipulates the relationship between the lexical concepts associated with the two NPs in the construction. One entity associated with NP1 is designated as recipient, and the other, NP2, as object of transfer. Although the open-class lexical concepts associated with these NPs access analog information, via the cognitive models that form

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their access sites, the simulations that are constructed arise based on t the parcellation facilitated by the parametric content. In short, my argument is that there must be a distinction between parametric concepts (encoded by language) and analog concepts, associated with cognitive models, if linguistically mediated simulations are to arise in the way claimed.

The consequence of the approach to knowledge representation and meaning construction I develop is this. A grounded cognition approach to concepts has a means of addressing criticisms that an account of abstract concepts, such as BEAUTIFUL, remains intractable in this framework. On the contrary, with a descriptively adequate account of knowledge representation—recognizing the distinction between analog and parametric concepts—and an account of meaning construction—the way in which linguistic and simulation systems interface—such an account becomes conceivable, as I hope to have demonstrated.

Moving forward, I see future research on conceptual structure as having three distinct goals. First, ongoing and future research needs to develop and refine empirically verified accounts of knowledge representation. I have been assuming, based on current knowledge, that cognitive models and cognitive model profiles are based on hierarchical knowledge structures, which are relational, are dynamically updated, and feature conceptual distance between an access site—the cognitive models that interface with the linguistic system. Evidence from linguistics suggests that some types of knowledge indexed by words are more central to word meaning than others. The classic distinction between denotation and connotation is one way in which this has been operationalized (see Allan 1997). The so-called encyclopedic approach to representations underpinning words is another attempt to capture this (e.g., Langacker 1987). Moreover, experimental psychology has offered abundant evidence that knowledge is structured, ranging from classic work on typicality effects within prototype theory (e.g., Rosch 1975, 1978; Rosch and Mervis 1975) to priming studies illustrating relations between word meanings (e.g., Thompson-Schill, Kurtz, and Gabrieli 1998). Psychophysical tasks have also demonstrated that knowledge is relational (see Barsalou 1999 for a review) and is dynamically updated (Elman 2009, 2011). Further research in this view is projected under the aegis of LCCM theory, to develop an empirically robust account of knowledge representation.

A second goal for future research must be to determine the processes that facilitate access to knowledge representation. Part of this investigation must involve the compositional mechanisms that facilitate novel concept formation. For instance, what makes it possible to produce ad hoc concepts such as things to take on vacation, or things to remove from one's house in the event of fire (Barsalou 1983). Equally, how are novel blends produced, such as PET FISH—a nonprototypical fish (not gray), and a nonprototypical pet (not furry)—and mythological creatures such as UNICORNS.

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Fauconnier and Turner (2002; see also Turner 2014) have argued for an integrative process termed *blending* that produces such imaginative feats. Hence, in addition to a model of conceptual structure, we also presumably require the empirical study of the conceptual integration processes that work on knowledge representation (see Coulson 2008 for a survey of preliminary work in this regard).

Third and finally, a future goal must surely be to better delineate and build on the programmatic proposals above, for understanding the way in which the linguistic system interfaces with the conceptual system in service of linguistically mediated meaning construction. One way in which this might proceed is by empirical investigation relating to the constructs of analog and parametric concepts. The claim is that parametric concepts, devoid of a linguistic context, should not result in multimodal brain activation, while analog concepts should. This prediction is something that, ultimately, should be falsifiable. Other areas of research will no doubt need to focus on the way in which linguistic constructions shape and modify simulations that arise. And behavioral and ultimately brain-imaging research will need to be brought to bear on this area.

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