

Embodiment and Experientialism

© 2003 Tim Rohrer

Colorado Advanced Research Institute, Boulder, Colorado

Department of Cognitive Science, University of California at San Diego

rohrer@cogsci.ucsd.edu

Final Draft 11-1-03 for the Handbook of Cognitive Linguistics

Citation information:

Rohrer, Tim C. "Embodiment and Experientialism," in *The Handbook of Cognitive Linguistics*, Dirk Geeraerts and Herbert Cuyckens, eds., Oxford University Press, forthcoming 2005.

THE BASIC PROBLEM of language is childlike in its simplicity: How can we understand one another? How is it that I can make some noises, you can hear them, and we can arrive at some shared meaning? How can we ever be sure we are really thinking the same thought as a result of our communication?

Two broad approaches to answering this question divide those who study language and semantics. One might, as many traditions of philosophy and linguistics do, choose to answer such questions by positing meaning as something abstract, propositional and symbolic. For example *Está lloviendo* and *It is raining* are taken to be propositional claims which are abstractly equivalent when considered from a symbolic standpoint.

Thus these two expressions, drawn from different languages, have an identical meaning that can be true or false in reference to the current state of affairs actually existing in the world. The more nuanced and complex language of actual speech is thought to result

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
from the logical combination of such atomic propositions. In this model, adopted by most analytic philosophers of language and Chomskyan linguists, semantics is believed to be purely referential and syntactic structures ultimately resolve to logical relations, while pragmatics is seen as the primary source of ambiguity, subjectivity and error. In its more extreme forms, such as that found in proposals by Frege and Plato, an independent and prior realm of universal ideas is postulated to ensure that reference proceeds entirely objectively and completely devoid of ambiguity. Broadly speaking, such approaches can be lumped together as forming the Objectivist tradition.

On the other hand, we might choose to answer such questions with an empirical examination of what *constitutes* shared meaning. Rather than seeking some idealized set of atomic propositions supposedly well-suited to solving problems like ambiguous reference or translation between different languages, we might look at language as it is actually used. For instance we might observe how language is learned and used within the child/parent dyad, and so realise that the single-word utterances naming objects or events (e.g., *Bird!*, *Kitty!*, *Rain!*) are pragmatic requests to establish joint attention between parent and child. These are not simple or pure cases of ostensive reference—the sort of word-world reference relationship Objectivist Semantics would like to take as fundamental—but instead are utterances embedded within a cognitive and social situation wherein one subject wants to direct the intentionality of another. From this standpoint the primary purpose of language is not the objective description of the world, but instead to communicate and share experiences.

A focus on what people find meaningful necessitates investigating the cognitive, physical and social embodiment that shapes and constrains meaningful expression. Such

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

a focus requires evaluating findings from the various cognitive sciences and doing linguistic theory in a way that it is consonant with them. For example, we know from cognitive psychology that people find most categories meaningful in terms of prototypes, not in terms of necessary and sufficient conditions. In Cognitive Linguistics we have developed a theory of radial categorization consonant with both the psychological evidence and wide ranges of linguistic examples. From cognitive neuroscience we know that the physical brain does not process visual information in a disembodied, non-imagistic way, but instead maintains the perceptual topology of images presented to it, and then re-represents increasingly abstract spatial and imagistic details of that topology. In Cognitive Linguistics such findings have motivated a theory of image schemata whose topologies provide links between different clusters of prototypes in radial categories, and whose topologies motivate the cross-domain mappings of systematic conceptual metaphors. Just as in the case of using language to establish joint attention, such factors can and have been shown to shape and constrain what shared meaning emerges when people speak and listen.

One of the most central questions Cognitive Linguistics asks thus has a somewhat Kantian ring to it—how does the bodily apparatus itself shape our linguistic categorization and conceptualization? The spirit of this transition from the Objectivist traditions to a more inclusive cognitive semantics is perhaps best captured in a thought experiment proposed by Langacker to characterize the process of linguistic change known as subjectification. He writes:

Consider the glasses I normally wear. If I take them off, hold them in front of me, and examine them, their construal is maximally objective... they function solely

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

and completely as the *object of perception*, and not at all as part of the perceptual apparatus itself. By contrast, my construal of the glasses is maximally subjective when I am wearing them and examining another object, so that they fade from my conscious awareness despite their role in determining the nature of my perceptual experience. The glasses then function exclusively as part of the *subject of perception*—they are one component of the perceiving apparatus, but are not themselves perceived Of course, such extreme polarization represents an ideal that may seldom be achieved in practice. To some extent, for example, I can perceive my glasses even while wearing them while looking at something else, and to that extent their perceptual construal is slightly objective and less than fully subjective. Subjectivity/objectivity is often variable or a matter of degree, and it is precisely such cases that hold the greatest interest linguistically.

(Langacker 1990: 316)

Langacker's point in this passage is double-edged. At one level of analysis he endeavors to change the scope of which utterances are to count as both legitimate and paradigmatic for a theory of meaning—expanding the scope from the atomic propositions of the maximally objective descriptions privileged by Objectivist semantics to include expressions in which degrees of both subjectivity and objectivity are expressed in how a situation is construed by a speaker (e.g. *I insist that she is innocent.*). Yet at a meta-level of analysis Langacker's example of the glasses illustrates another central concern of Cognitive Linguistics. When we take off our glasses and examine them as an object, and then put them back on and attend to how our glasses, now functioning as a part of our perceptual apparatus, change other objects of our perception, we are performing an act

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
profoundly analogous to what we do as cognitive linguists. In Cognitive Linguistics, we
examine how our ‘glasses’—that is, our physical, cognitive and social embodiment—
ground our linguistic conceptualizations.

At this point several of the most difficult and hotly contested theoretical concepts
in Cognitive Linguistics are already on the table. In the remainder of this article I survey
the many ways in which the term ‘embodiment’ has been cashed out by various
researchers in Cognitive Linguistics. I then retrace some of the history of the
embodiment hypothesis and show how its scope expanded to encompass topics as diverse
as the grounding of meaning, the motivating factors of semantic change, experientialism,
experimental cognitive psychology and cognitive neuroscience. I close by offering a
theoretic framework inspired by related work in the philosophy of cognitive science, and
intended to serve as a useful organizational tool for situating and making connections
between these varying research projects.

1. The senses of embodiment

In its broadest definition, *the embodiment hypothesis is the claim that human
physical, cognitive and social embodiment ground our conceptual and linguistic systems.*
The hypothesis is intended as an empirical one, albeit lodged at such a level of theoretical
abstraction to be difficult to prove or disprove with a single study or experiment. As such
it is a very live question as to whether the embodiment hypothesis is an empirical
scientific hypothesis, a general theoretic orientation, a metaphysics, or some combination
of all of these. However, the evidence which led to the hypothesis was empirical

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers evidence, and new bodies of empirical evidence are continually being added to the list of research supporting the hypothesis.

By my latest count the term ‘embodiment’ can be used in at least twelve different important senses with respect to our cognition. Because theorists often (and sometimes appropriately, given their purposes) conflate two or more of these senses, it is important to get a clear picture of as many of the different dimensions of variability as possible. This list is not intended to be entirely exhaustive of the term’s current usage, nor are the dimensions necessarily entirely independent of each other nor even entirely distinct from one another. Thus it is important to note that *this survey is not intended to be a prescriptive definition of the term*, but instead is intended only to catalogue the contemporary usages of the term in a way that reveals the most relevant dimensions to which one must be responsive in order to develop a general theoretic framework for the embodiment hypothesis of Cognitive Linguistics.

1. Confusion about the use of the term ‘embodiment’ in Cognitive Linguistics begins with two often conflated senses that stem from Lakoff and Johnson’s (1980: 112) initial formulation of the embodiment hypothesis as a constraint on the directionality of metaphoric structuring. More accurately, this sense of ‘embodiment’ could be termed the *directionality of metaphor mappings*. In this strong directionality constraint they claim that we normally project image-schematic patterns of knowledge unidirectionally from a more embodied source domain to understand a less well-understood target domain. In other words, they claimed that each and every mapping between the elements of the source and the

elements of the target was unidirectional; the logic of image-schema was projected from the source to the target, and not from target to source.

2. Yet in its original formulation the embodiment hypothesis also contains a generalisation about the kinds of basic conceptual domains which were generally serving as source domains for conceptual metaphors, rather than as explicitly referring to the directionality of projection for each and every element mapped within a particular metaphor. We might call this second sense of embodiment *the directionality of explanation* in order to distinguish it from the previous sense. This sense is stated more clearly in Lakoff and Turner's 'grounding hypothesis,' in which they argued that meaning is grounded in terms of choosing from a finite number of semantically autonomous source domains (Lakoff & Turner 1989: 113-120).
3. 'Embodiment' is also used as a shorthand term for a counter-Cartesian *philosophical* account of mind and language. Descartes took problems within geometric and mathematical reasoning (such as the meaning of the term 'triangle') as model problems for the study of mind and language, and concludes that knowledge is disembodied—that is, fundamentally independent of any particular bodily sensation, experience, or perspective. His thought experiments strongly influenced the traditions of analytic philosophy and Objectivist semantics. From this perspective, the philosophy of language typically consists of (i) mapping the reference relations between idealised mental objects of knowledge and the objects or 'states of affairs' in the real world (as in Truth-conditional Semantics), and (ii) in discussing the logical internal structure of the relations which hold between these

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

mental objects ('syntax'). Of course, Descartes was by no means unique nor alone within Western philosophy in claiming this position (held in varying forms by Pascal, Russell, the young Wittgenstein, Quine, Chomsky and many, many others), but Descartes' extraordinary clarity has garnered him the laurel of becoming metonymic for that package of assumptions (Lakoff & Johnson 1980, 1998; Geeraerts 1985; Johnson 1987; Rohrer 1998; Johnson & Rohrer forthcoming).

4. 'Embodiment' is also used to refer to the *social* and *cultural* context in which the body, cognition and language are perpetually situated. For example, such context can include factors such as governmental language policy, cross-cultural contact/aversion, or the influence of historical scientific models and theories on individual language learners (Geeraerts & Grondelaers 1995). Similarly, the context can include the *cultural artifacts* that aid and manifest cognition—many of which are not only constrained by but are also extensions of the body (Hutchins 1995, 1998; Fauconnier & Turner 2002; Johnson & Rohrer forthcoming).
5. 'Embodiment' has a *phenomenological* sense in which it can refer to the things we consciously notice about the role of our bodies in shaping our self-identities and our culture through acts of conscious and deliberate reflection on the lived structures of our experience (Brandt 2000, 1999). The conscious phenomenology of cognitive semiotics can be profitably contrasted with the cognitive unconscious of cognitive psychology (see sense 9 below).
6. 'Embodiment' can also refer to the particular subjective vantage point from which a *perspective* is taken, as opposed to the tradition of the all-seeing, all-knowing, objective and panoptic vantage point. While this sense of the term can be seen as

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers partly philosophical (as in Nagel 1979: 196-213; Geeraerts 1985, Johnson 1987; Rohrer 1998), the idea of considering the embodied viewpoint of the speaker has linguistic implications as well as in the role of perspective in subjective construal (Langacker 1990; MacWhinney 2003).

7. In yet another important sense ‘embodiment’ can refer to the *developmental* changes that the organism goes through as it transforms from zygote to fetus, or from child to adult. One prominent area of such work would be research on ‘normal’ language acquisition, while another would be research on developmental disorders of language (MacWhinney 1999; Tomasello 1992; Johnson & Rohrer forthcoming). As an example of a cognitive cross-cultural language acquisition study, Sinha and Jensen de López (2000) research embodiment by investigating the acquisition course of spatial relation terms in body-part locative languages in order to determine whether such terms were first acquired as names for body parts or as spatial relations terms, or whether these two senses were acquired independently of each other.
8. An equally important temporal sense of the term ‘embodiment’ refers to the *evolutionary* course the species of organism has undergone throughout the course of its genetic history. For example, an account of the gradual differentiation of perceptual information into separate multiple maps each representing a different frame of reference in the visual system of mammalian evolution would be an evolutionary explanation of multiple frames for spatial reference. Or on an even grander scale: human beings have presumably not always had a language capability, and so evidence from studies on the evolutionary dimension of embodiment may

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers often prove crucial to understanding why, for example, language processing in the brain does not appear to be exclusively concentrated as an autonomous module but instead draws on numerous subsystems from the perceptual modalities (see for treatments Deacon 1997; Edelman 1992; Donald 1991; MacWhinney 1999; Johnson & Rohrer forthcoming).

9. Additionally ‘embodiment’ can mean what Lakoff and Johnson (1998) have recently called the *cognitive unconscious*. Here ‘embodiment’ refers to the ways in which our conceptual thought is shaped by many processes below the threshold of our active consciousness, as revealed through experimental psychology. Gibbs (1994, 1992, 1986, 1980) provides important reviews of the interface between experimental cognitive psychology and Cognitive Linguistics.
10. In a *neurophysiological* sense, the term ‘embodiment’ can refer to measuring the particular neural structures and regions which accomplish feats like metaphoric projection, the integration of image schemata, object-centred versus viewer-centred frames of reference in the visual system, and so on (Rohrer forthcoming, 2001a; Coulson 2002; Johnson & Rohrer forthcoming).
11. ‘Embodiment’ can also refer to *neurocomputational* models of language, particularly with respect to conceptual metaphor or spatial language. Such neural networks may be said to be embodied in several different ways. First, they may more or less closely model the actual neurobiology of the neural circuitry whose function they seek to emulate. Second, they may use as their input structures the output from maps of better understood embodied neural structures, typically from within the perceptual modalities (Regier 1992, 1995; Bailey 1997; Narayanan 1997;

Lakoff & Johnson 1998). Third, they can be taken to be models of experiential activity at a conceptual or psychological level of processing (Zlatev 1997; 2003; this volume).

12. Finally, the terms ‘embodiment’ and ‘embodied cognition’ are now also widely used in Cognitive Robotics. While it is often associated there with humanoid robot projects, it can also refer to cases where the work done by the robot depends on the particular *morphological* characteristics of the robot body (morphology is used here in its biological and not its linguistic sense). For example, Cornell University’s Passive Dynamic Walker uses no motors and no centralized computation but instead relies on gravity, mechanical springs and cleverly designed limb morphology to ‘walk.’ By exploiting the capacities of the morphology, cognition is offloaded onto the body—a design principle that is consonant with both evolutionary theory and embodiment theory within Cognitive Linguistics (Pfeifer & Scheier 1999; Collins, Wisse & Ruina 2001; Bertram & Ruina 2001; Brooks 1997).

This descriptive list illustrates that the scope of the embodiment hypothesis requires thinking through evidence drawn from a multiplicity of perspectives on embodiment, and therefore drawn from multiple methodologies. Of course almost no researcher or research project can attend to all these different senses of the term and produce sound scientific findings; but research projects that build bridges or perform parallel experiments across these differing dimensions are of particular interest.

Once the descriptive work has been done, however, it can be seen that many of these senses cluster about at least two poles of attraction. As I show in subsequent sections, critiques of the embodiment hypothesis have given rise to two broad usages of

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers the term ‘embodiment’. These two could be well described as ‘embodiment as broadly experiential’ and ‘embodiment as the bodily substrate’. Thus in one cluster the term refers to dimensions that focus on the specific subjective, cultural and historical contextual experiences of language speakers. Senses 3-6 of my enumeration of the term’s usages would typically cluster in this realm, while senses 8-12 would often cluster about the pole which emphasizes the physiological and neurophysiological bodily substrate. But not all the senses can be so clearly clustered, given that the attention to temporal character which characterizes the developmental (7) and evolutionary (8) dimensions can place them about either pole. For example, Sinha and Jensen de López (2000) show how both culturally specific experiential child-rearing practices and physiologically universal bodily interactions with space affect the course of language acquisition for terms which can indicate both spatial relations and body parts (e.g. ‘head’ and ‘foot’). At a minimum, an adequate theoretic framework for Cognitive Linguistics will have to acknowledge both the experiential and embodied substrate senses of ‘embodiment’ and provide a non-reductionistic of reconciling research which measures in all these different dimensions.

2. Origins of the Embodiment Hypothesis

To understand how the differing readings of embodiment have emerged, it is helpful to examine the genealogy of the term within a single strand of Cognitive Linguistics. Here I will trace it in terms of metaphor theory—elsewhere I have discussed its genealogy and application in terms of spatial and linguistic frames of reference (Rohrer 2001a). For some time, the conceptual metaphor and embodiment hypotheses

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers were nearly inextricable. Beginning in the late 1970s with a mass of empirical linguistic examples of metaphor, Lakoff and Johnson (1980) discovered that much of the ordinary language we use to characterize a wide variety of experiences is systematically shaped by a relatively small number of metaphors. Their work called into question the traditional distinction between the deeply conventionalized, 'dead' metaphors on one hand and the more creative literary 'live' metaphors on the other hand. In a series of electrifying examples, they showed that linguistic expressions which were supposed to be 'dead metaphors' are in fact part of larger systematic metaphors which also have very noticeable 'live' metaphorical extensions. They argued that the 'live' metaphorical expressions are the inferential and creative extensions of an underlying metaphor, while the 'dead' metaphorical expressions comprise the core of the metaphor—so well understood that they are hardly noticeable to us as we listen to everyday speech. They dubbed this more systematic notion of metaphor 'conceptual metaphor' both in order to distinguish it from the prior tradition of 'linguistic metaphor' (or 'literary metaphor'), and in order to emphasize that metaphors are a matter of cognition and conceptual structure rather than a matter of mere language.

Yet the systematicity of conceptual metaphors was neither the most important nor the most controversial discovery stemming from their groundbreaking research. What was even more intriguing was the fact that the relatively small number of conceptual metaphors draw primarily on domains stemming from bodily experience, and that these bodily source domains do the vast majority of the work of structuring more abstract human concepts. In its earliest formulation the embodiment hypothesis came from a

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
generalization about the directionality of metaphoric projection. Metaphors tended to
characterize the abstract in terms of the concrete:

First, we have suggested that there is *directionality* in metaphor, that is, we
understand one concept in terms of another. Specifically, we tend to structure the
less concrete and inherently vaguer concepts (like those for emotions) in terms of
more concrete concepts, which are more clearly delineated in our experience
(Lakoff & Johnson 1980: 112).

In the immediately subsequent section Lakoff and Johnson (1980: 117-119) identified
three sources for these more concrete concepts. They argued the more concrete concepts
are the ‘natural kinds of experience’ comprised of ‘experiential gestalts’ more basic than
other concepts, as they are the natural products of our bodies, our interactions with the
physical environment, and our interactions with other people in our culture. Reserving
judgment for future research, they also indicated that while some of these natural kinds of
experience might be universal, others might very well vary from culture to culture. They
explicitly pointed out that they were using the terms ‘nature’ and ‘natural’ in a sense
which encompasses at least the possibility of cultural variation, and not in the sense of the
standard ‘nature/culture’ distinction. Lakoff and Johnson conclude this section by
arguing that these more concrete concepts can be used in the ‘metaphorical definition’ of
more complex concepts. In short, they argue that these three natural kinds of experience
—experience of the body, of the physical environment, *and* of the culture—are what
constitute the basic source domains upon which metaphors draw. All of these factors are
cognitively represented, though they may also be physiological or sociocultural in origin,
and this fact led to the appellation ‘*cognitive linguistics*’ (Fesmire 1994). From the

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
outset, then, the term ‘embodiment’ was intended to cover research on both the
experiential and bodily substrates of language.

3. Elaborations and Extensions of the Embodiment Hypothesis

Over the ensuing twenty years the notions of experientialism, embodiment and a
directionality to conceptual metaphor have received much scrutiny, generated much
controversy and consequently received much elaboration. More systematic surveys
undertaken during the mid-1980s at Berkeley and elsewhere showed that bodily source
domains were prevalent not only for the semantics of English, but also for languages as
distant from it as Japanese and Mixtec. However, it is equally important to note that the
languages *did* vary cross-culturally as to what *particular* bodily source domains were
used to understand what particular target domain, and with respect to how these patterns
were represented linguistically.

With respect to historical semantic change, Sweetser has argued that the direction
of such change is motivated by the embodiment hypothesis. For instance, she
documented a directionality within Indo-European languages for metaphors such as
KNOWING IS SEEING, arguing that the terms which came to be the ordinary ones for
abstractions such as knowing were at an earlier time restricted to embodied perceptual
capabilities, such as seeing, grasping, hearing, smelling, tasting, and feeling. In a now
standard example, she traces the transition of the Indo-European root **weid* (see) through
the Greek *eidon* (to see) and, in its perfective form, *oida* (sight, know), to the English
terms *idea*, *wit* and *witness*, which retain none of their visual sensibility to most native

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers English speakers (Sweetser 1990: 23-48). By observing how a wide range of embodied perceptual terms systematically lose their perceptual connotations as they acquire their intellectual meaning, she proposed that there exists a large scale temporal constraint on the directionality of semantic change. In the following quote she compares this new constraint with the well-established constraint in linguistics on the directionality of phonological shifts from /b/ to /p/ and /g/ to /k/:

If we are willing to look at such large-scale, systematic historical connections between domains of meaning, it becomes evident that not all of semantic change is as whimsical and perverse as has often been assumed. True, prediction of any individual change remains impossible and seems unlikely to become possible in the future. Phonological and morphological change cannot be predicted on an individual basis either, so surely no one expects specific-case predictions for semantic or syntactic change. However, in many semantic domains it seems possible to determine what would be natural as opposed to unnatural directions of change, just as in phonology we know that voiced stops would be likely to devoice in final position or to become fricatives in intervocalic position, rather than the other way around (Sweetser 1990: 46-47).

The direction of semantic change is for languages to utilize terms for perception as terms for knowing, rather than from terms for knowing to terms for perception. We understand knowing as seeing, but not seeing as knowing. Historical semantic change may thus be said to be strongly motivated by the embodiment hypothesis, though it may not be exactly predicted by it—much in the same way the historical phonological shifts exhibit motivated regularities.

In the preface to *The Body in the Mind* Johnson (1987: xii-xiii) presented six converging bodies of evidence for the embodiment hypothesis understood as a directional constraint on meaning. This list included not only cross-cultural research on metaphor and historical semantic change but also work on prototypes in categorization, the framing of concepts, polysemy, and inferential patterns in metaphor. Near the same time, other research in Cognitive Linguistics (such as Ron Langacker's (1987) cognitive theory of grammar as motivated by spatial relations) contributed to an increasing focus on the role of the body in shaping linguistic and conceptual structure generally, and not just within a thread of semantic theory. In work that also appeared that same year, George Lakoff (1987) characterized the experientialism (or experiential realism) at the core of the embodiment hypothesis as including

everything that goes to make up the actual or potential experiences of either individual organisms or communities of organisms--not merely perception, motor movement, etc., but especially the internal genetically acquired makeup of the organism and the nature of its interactions in both its physical and social environments (Lakoff 1987: xv).

Experiential realism, as Lakoff defined it, was to be in direct contrast with the traditional philosophic conception of meaningful thought and reason as the manipulation of symbols that correspond to an objective reality that is independent of the particular kind of embodiment of the organism. By 1987 the embodiment hypothesis had explicitly grown to become much more ambitious in scope than in its more humble origins as a generalization about the directionality of metaphors. Physiology, temporal development, and organism-environment interactions as well as linguistic evidence were explicitly

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers expected to play a role in an increasingly broad theoretical hypothesis which purported to explain an ever larger amount of linguistic phenomena.

The enlarging scope of the embodiment hypothesis led to criticisms that its central tenets were underspecified. For example, the idea of embodied ‘experiential gestalts’ as natural kinds of experience needed further explanation. Building on work done at Berkeley by Talmy (1985: 293-337) on the role of force-dynamic patterns in shaping syntactic constructions, Johnson developed a theory of *image schemata*. He defined an image schema as a recurrent pattern, shape or regularity in, or of, our actions, perceptions and conceptions. He argued that “these patterns emerge primarily as meaningful structures for us chiefly at the level of our bodily movements through space, our manipulation of objects, and our perceptual interactions” (Johnson 1987: 29). For example, the containment schema structures our regular recurring experiences of putting objects into and taking them out of a bounded area. We can experience this pattern in the kinesthetic modality with physical containers, or we can experience this pattern visually as we track the movement of some object into or out of some bounded area or container. These patterns can then be metaphorically extended to structure non-physical, non-tactile and non-visual experiences. In a particularly striking set of examples, Johnson traced many habitual notions of containment we might experience during the course of a typical morning routine: We wake up *out of* a deep sleep, drag ourselves *up out of* bed and *into* the bathroom, where we look *into* the mirror and pull a comb *out from inside* the cabinet. Later that same morning we might wander *into* the kitchen, sit *in* a chair at the breakfast table and *open up* the newspaper and become lost *in* an article. Some of these experiences are spatial and physical but do not involve the prototypical containment

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
image schema (as in the example of sitting *in* a chair) while some of these experiences draw on purely metaphorical extensions of containment (as in the example of getting lost *in* the newspaper article).

Such image schemata are *preconceptual* embodied structures of meaning in at least two important ways. First, image schemata are developmentally prior to conceptual thinking, at least insofar as conceptual structure is accessible to us by means of language. Johnson drew on work by the developmental psychiatrist Daniel Stern (1985) and the developmental psychologist Andrew Meltzoff (summarized 1993). Stern argued that the activation, build-up and release of emotional tension is among the earliest and most foundational of our prelinguistic experiences:

For instance, in trying to soothe the infant the parent could say, “There, there, there ...” giving more stress and amplitude on the first part of the word and trailing off towards the end of the word. Alternatively, the parent could silently stroke the baby’s back or head with a stroke analogous to the “There, there” sequence, applying more pressure at the onset of the stroke and lightening or trailing it off toward the end ... the infant would experience similar activation contours no matter which soothing technique was performed (Stern 1985: 58).

As infants we experience these patterns of feeling (image schemata) before we develop a linguistic self, and these image schemata are not unique to any one perceptual modality but have a structure which is shared across them.

Second, Johnson argued that image schemata are preconceptual in that they can underlay multiple different conceptual metaphors. We can extend—by means of metaphor—these directly emergent experiences to characterize non-spatial experiences

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers such as falling *into* a depression or getting lost *in* the newspaper. Further we can project the inference patterns of the containment schema into the metaphorically structured domain. For example, just as we reason that the deeper an object is in a container it will be harder to get it out, we reason that the deeper someone is in a depression the harder it will be to get them out of their depression. It is important to note that image schemata serve as the preconceptual basis for metaphors in both a developmental and structural sense. The embodiment hypothesis is thus not only a hypothesis about how image schemata and conceptual metaphors structure adult cognition, but about the ontogenetic acquisition of metaphoric structure as humans develop from infants to adults.

Though calling patterns which are supposed to be cross-modal ‘images’ may seem to be a little misleading, Johnson fortuitously chose the term ‘image schemata’ in accordance with burgeoning research in the cognitive sciences on the role of images in our embodied mental conceptualization. In the early 1970s the psychologists Shepard and Metzler (1971) asked experimental subjects to determine whether a pair of two-dimensional pictures of three-dimensional objects were identical. They discovered that subjects rotated these objects mentally at a fixed speed of approximately 60 degrees each second, suggesting that humans manipulated the images as a whole. Their discovery touched off a powder keg of controversy, as the then-prevalent view of the mind as a symbol manipulation system favored a theory in which perceptual images were decomposed into image-independent propositional representations, much as they would have been represented in the computers of that time.

Shepard and Metzler’s (1971) original work on visual imagery was one of the key factors which led to a revolution in the cognitive sciences’ conception of mind and brain

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers as organized in terms of image-like wholes, a revolution that was most dramatically borne out by convergent evidence from cognitive neuroscience. In particular, researchers using neuroimaging and neuroanatomical techniques have been able to isolate regions of the cortex which maintain topologically consistent images of (for example) the visual field as perceived, top-down visual imagery, and spatial (i.e. non-visual or tactile) imagery. As the Shepard and Metzler results suggest, humans have topologically mapped neural circuitry for the visual perception and the visualization of spatial form. Similarly, starting in the 1930s the neurosurgeon Wilder Penfield and colleagues had shown that the somatosensory and motor regions of the cerebral cortex topologically map the body. Such image-like maps are considered to be topologic because they preserve the contours of perceptual experience.

Similar topological maps of perceptual experience have been found for the other sensory modalities, such as pitch maps for auditory experience. We now know that these topological maps are refined into more selective maps which respond to higher order and more selective kinds of contour patterns, but the current state of cognitive neuroscience stops short of specifying maps or cells which fire given the particular sets of contour patterns Johnson identifies as image schemata, especially when considered as cross-modal perceptual structures. At present the possible neurophysiological instantiations of image schemata, even as to their basis in just one perceptual modality, remain an intriguing area for future research. Yet the embodiment hypothesis' image schemata proposal is still both highly consistent with the known facts about neurophysiology, particularly the ways in which the visual system and other perceptual modalities map

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
perceptual experience, and highly consistent with the kinds of structures we observe in
linguistic conceptualizations.

4. Contemporary Formulations of the Embodiment Hypothesis

In their recent work Lakoff and Johnson have turned much of their attention away from embodiment defined broadly as experientialism and toward investigating how the bodily substrate shapes language, although they would certainly argue for the importance of continued research on the cultural and social dimensions. Here it is crucial to see that their current neural conception of the embodiment hypothesis is much more than the simpleminded argument that our conceptual structure must have *some* neural instantiation. Nor is it that the case that the embodiment hypothesis is exclusively or even primarily just about the ways in which linguistic conceptualization takes place on a neural level utterly detached from the physical body and social context. Introducing their most recent formulation of the embodiment hypothesis, Lakoff and Johnson observe that while even the traditional view of the disembodied mind maintains the minimal position that concepts must have some neural representation, the embodiment hypothesis must go much farther:

Advocates of the disembodied mind will, of course, say that conceptual structure must have a neural *realization* in the brain, which just *happens* to reside in a body. But they deny that anything about the body is essential for characterizing what concepts are (Lakoff & Johnson 1998: 37).

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

This version of the embodiment hypothesis takes its argumentative form by making an analogy to work in cognitive science which argues that conceptual and perceptual processes share many of the same physiological and neurophysiological subprocesses.

To see the analogy clearly, consider some more examples drawn from the literature on mental imagery. In an experiment done by Stephen Kosslyn and colleagues (1993), the subjects were either (i) asked to form a mental image within a grid on a computer screen or (ii) presented with an equivalent visual image on a computer screen. By comparing the two experimental conditions in a brain-imaging PET study, these researchers were able to show that many of the same areas of the brain were active both under the imagery and the perceptual task conditions. The Kosslyn group's results show that a 'top-down' volitional task such as mental imagery (visualization) utilizes these same subprocesses as a 'bottom-up' task like visual perception. Similarly, language may well share common subprocesses with the portions of perceptual systems.

This idea of shared bodily subprocesses which underlie both cognition and perception is at the core of the present formulation of the embodiment hypothesis. The analogy between the form of the argument for the embodiment hypothesis and the form of the foregoing argument about visual imagery and visual perception can be made explicit: Just as visual imagery shares and builds upon the processes the brain and body use to perceive visual images, so conceptual structure generally shares and builds upon perceptual processes. Of course the argument that *perceptual* and *conceptual* structure share the same subprocesses is much more ambitious in scope than the foregoing argument about two kinds of tasks which take place in one modality (i.e. vision).

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

However, Lakoff and Johnson currently formulate the embodiment hypothesis in precisely this fashion:

The embodied-mind hypothesis therefore radically undercuts the *perception/conception* distinction. In an embodied mind, it is conceivable that the same neural system engaged in *perception* (or in bodily movement) plays a central role in *conception*. That is, it is possible that the very mechanisms responsible for perception, movements, and object manipulation could be responsible for conceptualization and reasoning (Lakoff & Johnson 1998: 37-38).

What is crucial to the argument of the embodiment hypothesis is that the *same* neural mechanisms which are responsible for ‘lower-level’ activities like perception and movement are taken to be *essential* to ‘higher-level’ cognitive abilities, namely to our reasoning and conceptualization. Thus on their view Lakoff and Johnson argue “that the very properties of concepts *are created* as a result of the way the brain and body are structured and the way they function in interpersonal relations and in the physical world” (1998: 37). The way these properties are created is by means of conceptual metaphors which project cross-domain image schematic patterns which in turn are drawn from the more specific structures within visual perception, locomotion, object manipulation, and so on. At some of the ‘top levels’ of investigation—studies on language and categorization in linguistics and philosophy—the research which has already been done on the metaphorical structuring of provides the largest bodies of evidence in favor of the embodiment hypothesis. There is considerable evidence that we do categorize and organize our linguistic structure in ways which are shaped by these kinds of phenomena. What remains to be done, however, is the project of establishing how *specific* neural and

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
physiological mechanisms are recruited to provide that conceptual organization, and how they develop and vary in differing physical environments and cultures.

Though they admit that much of their current research paradigm is far less a neurophysiological model and more a computational model of how what such mechanisms might be, Lakoff and Johnson summarize recent efforts in the neurocomputational modeling of metaphor and semantic structure that show how low-level image schematic structure can be preserved by structured connectionist models which draw on known neural structures for the types of information taken as inputs. For example, Terry Regier (1992, 1995) has investigated how spatial relations terms such as up, down, above, et. al. can be learned by structured connectionist networks that utilize low-level schematizations which have plausible neural analogues in the neuroanatomy of visual perception. Although the other research (Bailey 1997; Narayanan 1997) in this approach to the neurocomputational modeling of language, resting on mathematically reducible analogues to 'pure' neural network models, is even more distant from identifying its plausible neural analogues, Lakoff and Johnson also cite that work as support for the embodiment hypothesis. Although thus far they have largely omitted the discussion of actual neurophysiology in favor of discussing such computational models, that deficiency speaks more about the paucity of the current research on the neurophysiology of meaning. They are quite explicit in acknowledging both its importance and their inability to do full justice to the neurophysiological issues at this early stage of the research.

Over the course of this brief history of the embodiment hypothesis, I have traced the evolution of several senses of that term. I have traced its gradual evolution and

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers expansion from simply a hypothesis about the grounding of conceptual metaphors to one which has grown increasingly large in scope throughout its dialogue with other branches of cognitive science. This increase in scope has led to the present confusion as to what exactly the term ‘embodiment’ is to mean within Cognitive Linguistics. For example, some theorists have argued for a return to a more culturally situated theory of embodiment (Zlatev 1997; Sinha 2000), while others press onward with attempts to ask what embodiment means in its physiological and neural senses (Lakoff and Johnson 1998). What we have lacked is a coherent framework which can tie these differing senses of the term together. While Lakoff and Johnson (1998: 112-113) offered a three-tiered proposal with cognitive, neurocomputational, and neurobiological levels of investigation, the usefulness of their proposal is limited by its tight focus on their particular research program, the Neural Theory of Language. In the following section I argue for adopting a more sophisticated and widely used theoretic framework from the cognitive sciences as an aid in clarifying the full range of current research of Cognitive Linguistics.

5. The Levels of Investigation Theoretic Framework

In developing a broader theoretic framework for use in Cognitive Linguistics (Figure 1), I have made use of Posner and Raichle’s (1994) schematisation of the levels of investigation in cognitive science. The most basic organising criterion of this theoretic framework is the scale of the relative physical sizes of the phenomena which produce the different kinds of social, cognitive or neural events to be studied. Physical size is mapped on the y-axis, providing a relative distribution of the ‘higher to lower’ levels of cognitive

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

processes. To provide clarification, the next column provides examples of what the relevant physiological structures are at a given physical scale. For example, at the communicative, cultural and social level we study language as it used between people, and hence multiple central nervous systems; alternatively, it is possible to measure one individual's (and hence one central nervous system's) performance on linguistic tasks. I describe the 'Level of Investigation' in accordance with the kinds of cognitive processes studied at that order of physical size. A general name of each level is indicated by boldface type.

In order to preserve Posner and Raichle's insight that it is profitable to consider how (Figure 1) the inquiries change at various levels of investigation, the 'Tasks' column of this theoretic framework specifies for Cognitive Linguistics in particular some typical relevant experimental or explanatory tasks. The next column lists some of the relevant theoretic constructs operative at each level of investigation, while the final column presents some of the various methods used to study phenomena at each level.

Size	Physiological Structures	Level of Investigation	<i>Typical Cognitive Linguistics Theory Explanatory Tasks</i>	<i>Sample Operative Theoretic Constructs</i>	<i>Sample Methods of Study</i>
1 m and up	Multiple Central Nervous Systems	Communicative and cultural systems in anthropology, language, science and philosophy	Uses of widespread cultural metaphors in interpersonal communication; syntactic and semantic change	Complex conceptual metaphor, conceptual blends, disanalogy, subjectification	Linguistic analysis, cross-linguistic typology, discourse analysis, cognitive anthropology
.5 m to 2 m	Central Nervous Systems	Performance domain; Cognitive, conceptual, gestural and linguistic systems as performed by individual subjects	Understanding metaphors, extending metaphoric inferences to novel cases, facilitation of related information; use of slang; testing choice of syntactic form given extralinguistic semantic task	Complex conceptual metaphor, conceptual blends, disanalogy, primary metaphor, metaphor mappings, inference generalizations	Verbal report, observational neurology and psychiatry, discourse analysis, cognitive and developmental studies examining reaction time (RT)
10 ⁻¹ m to 10 ⁻² m	Gross to medium size neural regions (anterior cingulate, parietal lobe, etc.)	Neural systems	Activation course in somatosensory, auditory, and visual processing areas when processing conceptual metaphor or multimodal perceptual experiences	Conceptual metaphor mappings, primary metaphor, conceptual blends, disanalogy, image schemata, topological maps	Lesion analysis, neurological dissociations, neuroimaging with fMRI and PET, ERP methods, neurocomputational simulations
10 ⁻² m to 10 ⁻⁴ m	Neural networks, maps and pathways	Neuroanatomy; Neural circuitry in maps, pathways, sheets	Neuroanatomical connections from visual, auditory, somatosensory regions to language areas	Image schemata, primary metaphor, topographic maps, convergence zones	Electrocellular recording, anatomical dyes, neurocomputational simulations
10 ⁻³ m to 10 ⁻⁶ m	Neurons, Cortical columns	Neurocellular systems; Cellular and very small intercellular structures	Fine neuroanatomical organisation of particular structures recruited in lang. processing	Orientation-tuning cells; ocular dominance columns	Electrocellular recording, anatomical dyes, neurocomputational simulations
Less Than 10 ⁻⁶ m	Neuro-transmitters, ion channels, synapses	Subcellular systems; subcellular, molecular and electrophysical	None—beyond theoretical scope	Neurotransmitter, synapse, ion channels	Neuro-pharmacology, neurochemistry, neurophysics

Figure 1. Theoretic framework for the embodiment hypothesis in cognitive science as applied to Cognitive Linguistics

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

This framework can be used to structure studies various topics of interest to cognitive linguists, such as metaphor, mental imagery, categorisation, frames of reference, emotions and so on. This type of theoretic framework is now fairly common within much of cognitive science, but Cognitive Linguistics has been slow to give explicit attention to the problem of how we are to theoretically situate and reconcile these different levels of investigation.

I have explicitly included a level of cultural and communicative analysis. By choosing to include a level situated at a meter and up physical size scale, I mean to highlight that human beings should be considered not just in terms of the physiological size of their central nervous systems, but also in terms of the standard scale of their interactional distance in speaking with one another. Language is not learned in isolation nor are words uttered in a vacuum, and research in Cognitive Linguistics should include this level of investigation. Investigations at the cultural level are occasionally given short shrift by some strains of cognitive science, but this has been and should remain a strong point of Cognitive Linguistics.

While this chart of the framework gives a good overview of the relationship between body, brain and culture, it is not as illustrative for issues pertaining to evolutionary and developmental time scales, which may be considered at any of these levels. For example, both diachronic semantic change and the evolution of larynx are important to Cognitive Linguistics. However, this failing is more a limitation of the imagery of a two-dimensional chart than of the theoretic framework itself. If we were to add another axis for time perpendicular to the surface plane of the chart, we could the imagine this framework as a rectangular solid. I have omitted representing this

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers
dimension because such an illustration would make it difficult to label the levels, but I
make it explicit here because both the developmental and evolutionary time courses of
these phenomena is a central dimension to understanding them, and their bearing on
language.

Elsewhere I have discussed the details of the pragmatic application of this
framework to issues such as spatial frames of reference (Rohrer 2001a), but for a briefer
example consider some of the research done on the embodiment and conceptualization of
anger. Kövecses (1986, 1995) has argued that the conceptual metaphor ANGER IS THE HEAT
OF A FLUID IN A CONTAINER has a physiological basis in universal bodily experiences such as
the elevated skin temperatures of the anger response, as measured by Ekman (1982,
1999). However, in a more experientialist vein, Geeraerts and Grondelaers (1995)
critiqued Kövecses' research as ahistorical and acultural, arguing that historical
lexicography shows that these metaphors have been inherited from the humoral theory of
medieval Western science. Yet their critique seems at least partially rebutted by several
cross-cultural analyses of the metaphors for anger in non-Indo-European languages, such
as Matsuki's study of Japanese (1995), where somewhat similar HEATED FLUID metaphors
have been found.

Note that this controversy, centering on the question of change across time and
culture, evokes the 'universalist-relativist' philosophical debate on objectivity; however,
and as the American pragmatist philosopher John Dewey (1917) noted, such debates are
notoriously unhelpful to the continued inquiry that characterizes a *genuine* objectivity. A
more pragmatic response might be to see these studies as the result of using differing
methodologies at different levels of investigation to study the embodiment of anger.

Rohrer: Embodiment and Experientialism (Handbook of Cognitive Linguistics final draft), Page numbers

Applying this theoretic framework, we could seek to identify questions which investigate multiple dimensions. We might then expand the scope of the inquiry from the bodily and performative level of the framework to the communicative and cultural level: ‘Was the humoral theory also physiologically motivated?’, ‘Does this metaphor exist in any Indo-European linguistic evidence which predates the appearance of humoral theory?’, ‘Did the Japanese metaphor arrive via Western contact, or did it emerge independently?’, and ‘To what extent does the Japanese conceptualization rely on shared underlying conceptual metaphors such as THE BODY IS A CONTAINER?’ Alternatively, a cognitive psychologist might frame a further inquiry at the performative level by measuring, via reaction times, heart rates, and/or skin temperature, whether Japanese and Indo-European language speakers exhibit similar physiological responses to differing variants of this metaphor. Or one might also measure whether subjects who were recently taught humoral theory would be quicker to use (or comprehend) passages containing this anger metaphor than other anger metaphors.

Thus this controversy, along with many others in Cognitive Linguistics is not simply a matter of ‘either/or’ position being correct to the exclusion of the other. Instead, and from the perspective of this theoretic framework, the controversy results from measuring different but equally important dimensions of human embodiment. Once we recognize this fact, we can take concrete steps to investigate how these dimensions interact on a particular question. We are as unlikely as ever to resolve the ‘relativism/universalism’ debate, so it is better to situate our questions, specify the scale and scope of our investigations, and look at how the conscious, experiential embodiment and the physiological embodiment interact in language.

6. Conclusions

If the answer to the basic problem of language—how do we share meaning?—could only be as simple and childlike as the question, then there might be no controversy about defining, in precise and narrow terms, what exactly the term ‘embodiment’ means. The actual details of science are rarely neat and tidy however, and even the most widely accepted scientific maxims are only incontrovertible so long as serious attention is placed elsewhere. We have barely begun to investigate the mechanics of how embodiment shapes and constrains meaning, of testing and validating the claims made by Cognitive Linguistics at the psychological and neurophysiological levels, of examining how embodiment shapes cultural artifacts such as watches, dials, and gages, and of how the social and cultural context alters what embodied source domain is being used by a particular speaker. This project has necessarily enlisted anthropologists, sociologists, psychologists and neuroscientists to work alongside linguists. The complexity of the survey that I have given will only be deepened by the details in the chapters which follow.

References

- Bailey, David. 1997. When push comes to shove: A computational model of the role of motor control in the acquisition of action verbs. PhD dissertation, University of California at Berkeley.
- Barsalou, Lawrence. 1992. *Cognitive psychology: An overview for cognitive scientists*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Blasko, D., & C. Connine. 1993. Effects of familiarity and aptness on metaphor processing. *Journal of Experimental Psychology: Learning Memory, and Cognition* 19: 295–308.
- Bertram, J.E.A., & Andy Ruina. 2001. Multiple walking speed-frequency relations are predicted by constrained optimization. *Journal of Theoretical Biology* 209: 445-453.
- Brandt, Per Aage. 1999. Domains and the grounding of meaning. In L. Cifuentes Honrubia, ed., *Estudios de Lingüística Cognitiva*. Alicante: Dept. de Filología Española, Lingüística General y Teoría de la Literatura, Universidad de Alicante.
- Brandt, Per Aage. 2000. Metaphor, catachresis, simile: A cognitive and semiotic approach and an ontological perspective. Ms., Aarhus, Denmark: Center for Semiotic Research, University of Aarhus.
- Brooks, Rodney A. 1997. From earwigs to humans. *Robotics and Autonomous Systems* 20: 291–304.
- Caramazza, Alfonso. 1996. The brain's dictionary. *Nature* 380: 485-86.

- Churchland, Patricia. 1986. *Neurophilosophy: Toward a unified science of the mind-brain*. Cambridge, MA: MIT Press, 1986.
- Collins, Steven H., Martijn Wisse & Andy Ruina. 2001. A 3-D passive-dynamic walking robot with two legs and knees. *International Journal of Robotics Research* 20: 607-15.
- Coulson, Seana & Cynthia Van Petten. 2002. Conceptual integration and metaphor: An event-related potential study. *Memory & Cognition* 30: 958-968.
- Damasio, Antonio, 1995. *Descartes' error: Emotion, reason and the human brain*. New York: Basic Books.
- Damasio, Hanna, et al. 1996. "A neural basis for lexical retrieval." *Nature* 380: 499-505.
- Deacon, Terrence. 1997. *The symbolic species: The co-evolution of language and the brain*. New York: W. W. Norton.
- Dewey, John. 1917. The need for a recovery of philosophy. In Lewis Hahn, ed., *The Collected Works of John Dewey, 1882-1953: Middle Works* 10: 3-48. Carbondale, IL: Southern Illinois University Press.
- Donald, Merlin. 1991. *Origin of the modern mind: Three stages in the evolution of culture and cognition*. Cambridge, MA: Harvard University Press.
- Ekman, Paul. 1982. *Emotion in the Human Face*, 2nd Edition. New York: Cambridge University Press.
- Ekman, Paul. 1999. Basic emotions. In T. Dalgleish and T. Power (Eds.) *The Handbook of Cognition and Emotion* 45-60. Sussex, UK: John Wiley & Sons.

- Edelman, Gerald M. 1992. *Bright air, brilliant fire: On the matter of mind*. New York: Basic Books.
- Fauconnier, Gilles & Mark Turner. 2002. *The Way We Think*. New York: Basic Books.
- Feldman, Jerome, George Lakoff, David Bailey, Srinu Narayanan, Terry Regier, & A. Stolcke. 1996. Lzero: The first five years. *Artificial Intelligence Review* 10: 103-129.
- Fesmire, Steven A. 1994. What is “cognitive” about cognitive linguistics? Lawrence Erlbaum Associates, US. *Metaphor & Symbolic Activity* 9: 149-154.
- Geeraerts, Dirk. 1985. *Paradigm and paradox : explorations into a paradigmatic theory of meaning and its epistemological background*. Leuven, Belgium: Leuven University Press.
- Geeraerts, Dirk & S. Grondelaers. 1995. Looking back at anger. Cultural traditions and metaphorical patterns. In John R. Taylor & Robert E. MacLaury, eds., *Language and the cognitive construal of the world* 153-179. Berlin: Mouton de Gruyter.
- Gibbs, Raymond. 1980. Spilling the beans on understanding and memory for idioms in conversation. *Memory & Cognition* 8: 449–456.
- Gibbs, Raymond. 1986. Skating on thin ice: literal meaning and understanding idioms in conversation. *Discourse Processes* 9: 17–30.
- Gibbs, Raymond. 1992. Categorization and metaphor understanding. *Psychological Review* 99: 572–577.
- Gibbs, Raymond. 1994. *The poetics of mind: Figurative thought, language and understanding*. New York: Cambridge University Press.
- Hutchins, Edwin. 1995. *Cognition in the wild*. Cambridge, MA: MIT Press.

- Hutchins, Edwin. 1999. Blending and material anchors. Ms. San Diego, CA: Cognitive Science Department, University of California at San Diego.
- Johnson, Mark. 1987. *The body in the mind: The bodily basis of meaning, imagination and reason*. Chicago: University of Chicago Press.
- Johnson, Mark and Tim Rohrer. Forthcoming 2004/5. "We Are Live Creatures: Embodiment, American Pragmatism, and the Cognitive Organism." In *Body, Language, and Mind, vol. 1*. Zlatev, Jordan; Ziemke, Tom; Frank, Roz; Dirven, René (eds.). Berlin: Mouton de Gruyter.
- Kosslyn, Steven. *Image and mind*. Cambridge, MA: Harvard University Press, 1980.
- Kosslyn, Steven. *Image and brain: The resolution of the imagery debate*. Cambridge, MA: MIT Press, 1994.
- Kövecses, Zoltan. 1986. *Metaphors of anger, pride, and love: A lexical approach to the study of concepts*. Amsterdam: John Benjamins.
- Kövecses, Zoltan. 1995. Anger: Its language, conceptualization, and physiology in the light of cross-cultural evidence. In John R. Taylor & Robert E. MacLaury, eds., *Language and the cognitive construal of the world* 181-196. Berlin: Mouton de Gruyter.
- Lakoff, George. 1987. *Women, fire and dangerous things*. Chicago: University of Chicago Press.
- Lakoff, George. 1991. The contemporary theory of metaphor. In Ortony, Andrew (ed.) *Metaphor and Thought*, 2nd. ed. New York: Cambridge University Press.
- Lakoff, George & Mark Johnson. 1980. *Metaphors we live by*. Chicago: University of Chicago Press.

- Lakoff, George & Mark Johnson. 1998. *Philosophy in the flesh*. New York: Basic Books.
- Lakoff, George & Mark Turner. 1990. *More than cool reason: A field guide to poetic metaphor*. Chicago: University of Chicago Press.
- Langacker, Ronald. 1987-91. *Foundations of cognitive grammar*. 2 vols. Stanford, CA: Stanford University Press.
- Langacker, Ronald. 1990. *Concept, image, and symbol: The cognitive basis of grammar*. New York, NY: Mouton de Gruyter.
- MacWhinney, Brian. 1999. The emergence of language from embodiment. In Brian MacWhinney, *The emergence of language* 213-256. Mahway, NJ: Lawrence Erlbaum.
- MacWhinney, Brian. 2003. The emergence of grammar from perspective-taking. Ms., Pittsburgh, PA: Carnegie Mellon-University.
- Matsuki, K. 1995. Metaphors of anger in Japanese. In John Taylor and Robert E. MacLaury, eds., *Language and the cognitive construal of the world* 137-151. Berlin: Mouton de Gruyter.
- Meltzoff, Andrew. 1993. Molyneux's Babies: Cross-modal perception, imitation and the mind of the preverbal infant. In *Spatial representation: Problems in philosophy and psychology* 219-235. Cambridge, MA: Blackwell.
- Nagel, Thomas. 1979. *Mortal questions*. New York: Cambridge University Press.
- Narayanan, Sridhar. 1997. KARMA: Knowledge-based active representations for Metaphor and aspect. MS thesis, University of California at Berkeley.

- Ortony, Andrew, ed. 1993. *Metaphor and thought*, 2nd ed. New York: Cambridge University Press.
- Pfeifer, Rolf & C. Scheier. 1999. *Understanding intelligence*. Cambridge, MA: MIT Press.
- Posner, Michael & Marcus Raichle. 1994. *Images of mind*. New York: Scientific American.
- Regier, Terry. 1992. The acquisition of lexical semantics for spatial terms: A connectionist model of perceptual categorization. PhD Dissertation, University of California at Berkeley.
- Regier, Terry. *The Human Semantic Potential*. Chicago: University of Chicago Press, 1995.
- Rohrer, Tim. 1998. When metaphors bewitch, analogies illustrate and logic fails: Controversies over the use of metaphoric reasoning in philosophy and science. PhD dissertation, University of Oregon.
- Rohrer, Tim. 2001a. Pragmatism, ideology and embodiment: William James and the philosophical foundations of cognitive linguistics. In Esra Sandikcioglu and René Dirven, eds., *Language and Ideology: Cognitive Theoretical Approaches* 49-81. Amsterdam: John Benjamins.
- Rohrer, Tim. 2001b. The cognitive science of metaphor from philosophy to neuroscience. *Theoria et Historia Scientiarum* 6.
- Rohrer, Tim. Forthcoming 2004. Image schemas in the brain: fMRI and ERP investigations into embodiment and conceptual metaphor. In Beate Hampe, ed.,

- From perception to meaning: Image schemas in cognitive linguistics.* Berlin: Mouton de Gruyter.
- Shepard, R.N. & J. Metzler. 1971. Mental rotation of three-dimensional objects. *Science* 171: 701-703.
- Sinha, Chris. 2000. Grounding, mapping and acts of meaning. In Theo Janssen & Gisela Redeker, eds., *Cognitive Linguistics: Foundations, Scope and Methodology*. Berlin: Mouton de Gruyter.
- Sinha, Chris and Kristine Jensen de López. 2000. Language, culture and the embodiment of spatial cognition. *Cognitive Linguistics* 11: 17-41.
- Stern, Daniel. *The Interpersonal World Of The Infant*. New York: Basic Books, 1985.
- Sweetser, Eve. 1990. *From Etymology to Pragmatics: Metaphorical and Cultural Aspects of Semantic Structure*. New York: Cambridge University Press.
- Talmy, Leonard. 1985. Force Dynamics in Thought and Language. *Chicago Linguistics Society* 21, pt 2: *Possession in causatives and agentivity* 293-337.
- Talmy, Leonard. 2000. *Toward a cognitive semantics*. Cambridge, MA: MIT Press.
- Tomasello, Michael. 1992. *First verbs: A case study of children's early grammatical development*. New York: Cambridge University Press.
- Zlatev, Jordan. 1997. *Situated embodiment: Studies in the emergence of spatial meaning*. Stockholm: Gotab Press.
- Zlatev, Jordan. 2003. Polysemous or Generality? Mu. In Hubert Cuyckens, René Dirven & John Taylor, eds. *Cognitive approaches to lexical semantics*, Berlin: Mouton de Gruyter.

Biography

TIM ROHRER took his PhD in the philosophy of cognitive science at the University of Oregon in 1998 under the guidance of Mark L. Johnson. Since 1987, when he first saw the potential of using cognitive semantics as a tool to analyze the political rhetoric of international peacemaking negotiations, he has been an active researcher and frequent contributor to the field. In 1994 he founded the online Center for the Cognitive Science of Metaphor at the University of Oregon to disseminate cognitive semantics research on the world wide web. He has recently held a Fulbright Fellowship at the Center for Semiotic Research in Aarhus, Denmark where he collaborated with Per Aage Brandt and Chris Sinha on Embodiment Theory. Tired of talking-about-but-having-no evidence from neurophysiology, he held a NIH fellowship to the Institute for Neural Computation and the Department of Cognitive Science at the University of California at San Diego, where he conducted ERP and fMRI studies on conceptual metaphor. Currently, he is at work on a book tentatively entitled *Sensual Language: Embodiment, Cognition and the Brain* and directs multiple research programs at the Colorado Advanced Research Institute. He gratefully acknowledges his many mentors and support from many granting agencies, and cheerfully accepts all responsibility for any errors herein.