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Section I

Theoretical Implications

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1 Embodiment in Metaphor and (Not?) in Bilingual Language

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ABSTRACT

In this chapter we look at the role that sensory motor activation plays in the understanding of figurative and bilingual language. The chapter is divided into three basic parts. First we examine what is known about the evolution of human language, with reference to figurative and bilingual language activities, emphasizing the emerging conceptualization that sensory-motor brain areas have played a vital role. In the next section we examine how this emerging conceptualization that language might be embodied has been translated into our understanding of online comprehension tasks in general and, increasingly, in grounding our understanding of figurative language. The last section examines how the notion of embodied cognition has been viewed in our understanding of bilingual language, noting the near absence of a relevant literature. We conclude by indicating some aspects of the archival bilingual processing literature that could benefit from taking an embodied perspective.

Keywords: bilingual embodiment, embodied cognition, figurative language, language evolution, metaphor processing

The classic approach in both the study of bilingualism and of figurative language has taken an amodal computational perspective. From this perspective, these models have been based on the assumption that the basic representational aspects of language are tied to symbols, which themselves are not tied to direct experience with the environments in which they have developed and in which they are expressed. In contrast, starting about a decade or so ago, an alternative approach has emerged in which language comprehension is directly and inextricably tied to a relationship between bodily experiences and language. In this chapter we will engage in a form of *science fiction* in which we examine what modern biological psychology, cognitive science, and cognitive neuroscience suggest about the embodiment of language in general, the inroads that embodied cognition has made into our understanding of figurative

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language, and the seeming lack of the same in our understanding of bilingual cognition. We end by suggesting some possible ways to look at questions relevant to the bilingual experience from an embodied perspective.

The Evolution of the Modern Human Brain and Human Language Abilities

The human brain has evolved considerably over the 5 to 6 million years since we diverged into the lineages that led to our species, *Homo sapiens*, and to that of the modern-day chimp (our closest living relative). Anthropologists (e.g., Walker & Shipman, 1996), linguists (e.g., Bickerton, 1990) and psychologists (e.g., Pinker, 1994) alike have examined the fossil and artifact record as a means of understanding the evolution of language, often taken as the most important precursor to the development of culture. The emphasis has been largely on the emergence of grammar and here, implicitly or explicitly adopted the classic amodal approach to cognition.

Interestingly, the discussion of language has taken place in intellectual silos, with, for instance, little cross talk between those interested in bilingualism and those interested in metaphor or irony. Even though the basic research questions asked by inhabitants of each silo appear to be similar, they differ in important ways. Researchers in both camps, for instance, are interested in the nature of the underlying meaning representation and the processes that work on that representation. However, in one case the question is framed as the distinction between the literal and nonliteral or between metaphors as expressions versus metaphors as conceptual structures and, in the other, as whether bilingual language users share the same basic structures as monolingual users, or whether language activation in one language automatically activates meaning in the other. With respect to generalizability, scholars from both silos argue for the importance of linguistic flexibility, but in one case the emphasis is on whether being bilingual creates expertise that enhances domain-general cognitive control (and hence facilitated performance on tasks ostensibly unrelated to language use *per se*) and, in the other, the notion that metaphor is a tool that can be used to think creatively. Here we take the position that insight from the metaphor literature, especially from recent examinations of embodiment in metaphor, might provide insights into the other silo and provide unexplored avenues for future research into bilingualism. Theories of embodied cognition posit that just as physical acts (e.g., combing one's hair) or emotions (e.g., feeling happy) are tied to sensory-emotive-motor neural systems, these systems

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are involved even when one is not doing the acts or feeling the emotions but is merely thinking, reading, or hearing about them.

The Evolution of the Lingual Brain

A *standard* version of language evolution has held that the growth of language abilities over time was somewhat discontinuous and especially was associated with two important cultural changes, both associated with corresponding increases in brain size (see Bickerton, 1990; Lieberman, 1991). From this perspective, the first of these evolutionary crossroads started approximately 1.8 million years ago with the emergence of *Homo* e*rectus*, the first hominid to spread out of Africa, and with a brain size that would put it within the low-end of variability that is found in modern humans. Bickerton has speculated, as did Walker and Shipman (1996), that *Homo erectus* might have developed what he calls *protolanguage*. Protolanguage, Bickerton argues, is nonsyntactic with the form, *Me Tarzan, Jane run*. Presumably comprehension would be very context-dependent so that to understand the utterance one would have to be aware of the situation in which it is being produced. The evidence Bickerton employs to bolster his speculation is that protolanguage speech in modern humans can be found under special situations, such as with the creation of pidgin languages or with adults deprived of language as children during a critical period of development. Walker and Shipman employ anthropological evidence, such as evidence of coordinated hunting activities, to support the notion that *Homo erectus* had protolanguage.

The second phase is associated with the emergence of *true* grammatical language, which they claim is coincident with the emergence of our species. By about 200,000 years ago *Homo sapiens* had the anatomical structure to support language production, especially modification to the vocal tract. Somewhere between 50,000 to 25,000 years ago, there was an explosion in human symbolic expression available in the physical record, with symbolic representations involving carvings, beads, fanciful imaginative creatures, and well-known cave paintings. It is argued that by that time in our evolutionary history those humans had developed syntactic-based language, had the cognitive abilities to communicate nonliterally, and demonstrated symbolic activities. From this perspective, by that time humans had the flexibility to talk and conceptualize free of the immediate context. Presumably, we would now be able to go beyond stating *Me Tarzan, Jane run* to talk about the *when*, *where*, *how* and often in the nonliteral manner characteristic of modern language (for instance describing, *I will run toward Jane tomorrow* or *I, Tarzan, saw Jane*

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run away from danger or *Jane, I am no good for you and if you had any sense you'd run as far away from me as you can,* or maybe even *Jane you should know I have had a run of good luck in hunting this past season and would make for a passably good mate*).

In recent years, this two-stage version of language evolution has been challenged by novel advances in the neurosciences and in comparative animal studies. Two important characteristics of this challenge are that more emphasis is given to the continuity of language evolution and, second, to grounding our understanding of language evolution with *embodied cognition*. One such independent line of inquiry into understanding the unique cognitive and linguistic characteristics of the human brain is based on cataloging the conceptual abilities of monkeys and apes, including those of our nearest living relative, the chimpanzee. In essence, this line of research has attempted to find evidence that nonhuman animals possess some cognitive capabilities important for language (and, by implication, that these functions were available for evolutionary selection and adaptation in a distant shared ancestor). Among such characteristics would be the ability to imitate the actions of conspecifics or behaviors that provide evidence for *Theory of Mind* (ToM), or beliefs about the mental states with which one is interacting. Premack (2004) indicates that nonhuman primates possess a set of pragmatic communicative functions. The suggestion that nonhuman primates may share some of these abilities suggests that some components of nonliteral speech are not dependent on the emergence of so-called true or syntax-based language. The ability to represent the mental states of interlocutors is especially important with the use (and understanding) of nonliteral language because what one expresses literally with such language often will not correspond with what one is intending. One could expect the same argument should be advanced in bilingual communication, given the increased possibility of miscommunication when one is talking in one's second language (L2) or to a bilingual person in his or her L2.

With respect to brain locus of ToM, there is emerging evidence in the literature of the involvement of many neural systems. Evidence from people with autism (who perform poorly on ToM tasks) and from studies of nonhuman primates implicates subcortical circuits (in the amygdala) as being the core or central to a ToM system, with secondary systems in the frontal lobe (that subserve executive functioning), areas of the right temporal-parietal cortex important for visuospatial processing, and language-related regions of the left hemisphere (Siegel & Varley, 2002). A viable possibility is that ToM involves a simulation in which motor or emotion facial cues exhibited by an interlocutor evoke analogous areas in one's own brain. As will be discussed shortly, there is evidence that ToM

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plays a role in metaphor processing even when people are not in interactive communication (Bowes, 2013).

A second line of evidence can be found in the study of human and nonhuman genomes. Fisher and Marcus (2005) review some of these data. Genomic sequencing "yields a catalogue of almost every sequence differences that distinguishes a human from a chimpanzee" (p. 10), our closest living hominid relative. Using these data and those derived from within-species diversity in human populations, one can sometimes make inferences about which allele represents the state that was present in the common ancestor shared by humans and chimps. Examining people with language disorders provides a strategy in identifying specific genes to examine in more depth. For instance, there is evidence that children affected with a FOXP2 gene mutation have problems with speech articulation, even for those with normal nonverbal intelligence. Modeling data estimates that the gene was subject to evolutionary selection about 200,000 years ago, about the time that modern humans emerged, although some estimates push back that date considerably earlier (see Newbury, Fisher, & Monaco, 2010). As Fisher and Marcus state, ". . . a compelling hypothesis is that earlier forms of the gene were important for shaping cortical and subcortical sensory-motor networks; circuits which were subsequently recruited on more than one occasion, to sub-serve learning and production of complex combinatorial sequences of movements" (p. 17). The FOXP2 gene is known to encode a transcription factor that regulates the expression of other genes, including a gene on Chromosome 7, the CNTNAP2 gene, which has been shown to be associated with a range of disorders, including autism. Interestingly, the gene is also associated with personality dimensions, such as openness to experience (Newbury et al., 2010).

A third line of evidence comes from scientists who use brain imaging technology on modern humans to make inferences about our hominid ancestors. For instance, Stout, Toth, Schick, and Chaminade (2008) employed *positron emission tomography* (PET) scans to examine modern expert stone tool makers using the older *Oldowan* and the later *Ache lean* techniques found in the archeological record from roughly 2.6 million to about 250,000 years ago. For the more sophisticated stone tool creation, an increasing engagement of neural circuits was found with visuomotor coordination and hierarchical action organization. There is an overlap with neural circuits found with language, "strongly suggesting that these behaviors share a foundation in more general human capacities for complex, goal-directed action and are likely to have evolved in a mutually reinforcing way" (p. 1947). Interestingly, some of this circuitry is in the right hemisphere homologue of Broca's area and the authors note further

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that the right hemisphere "plays an important role in language processing particularly with respect to large scale phenomena such as metaphor, figurative language, connotative meaning, prosody and discourse comprehension" (p. 1947). This is not to suggest that metaphor was being employed in the early Stone Age but rather than the incipient capabilities were available for evolutionary adaptation even in nonhuman hominid species.

All these quite disparate lines of evidence point to a relation between language and motor activities. Fogassi and Ferrari (2012) review the available evidence from an evolutionary perspective. Work with monkeys has demonstrated that neurons in the premotor cortex (Brodmann's area, F5) are activated during goal-related activities and conclude that all "these studies strongly demonstrate that the main role of the motor cortex is coding goals" (p. 310). A major discovery has been the identification of mirror neurons in F5 and in the inferior parietal lobe. Mirror neurons discharge both when the monkey performs a given activity and, importantly, when it observes the same or similar activity performed by another monkey or by a human experimenter. Some research has shown that these neurons discharge even when only listening to the sound produced by that activity. Imaging techniques have shown the presence of mirror neurons in humans, including areas 44 and 45 in the inferior frontal gyrus, which in the left hemisphere corresponds to Broca's area. As Fogassi and Ferrari (2012) stated,

> Summing up, in monkey premotor cortex there are several features that can preadapt this cortical sector for the evolution of a sophisticated communicative system. The core of these features consists in encoding the production and perception of both oro-facial and forelimb gestures in the same cortical area. This double control, once integrated with vocalization, would have constituted the basis for a communicative system with an increased complexity and efficiency, and a higher level of flexibility in transferring information to conspecifics (p. 322).

They go on to state, "... there is much evidence that language and gestures share a common motor code, thus supporting several theories proposing that at cortical level some of the properties and organization of the motor system have been exploited within the vocal domain" (p. 325). And they claim further

> Both the order of a motor series and the organization of natural action sequence can be coded by cortical single neurons. The premotor-parietal motor system plus the prefrontal cortex can provide a substrate for sequential organization and hierarchical combination of motor elements. We posit that such an organization has been exploited in other domains including some aspects of the syntactic structure of language (p. 326).

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In summary, these disparate lines of research suggest an important link between motor brain areas and language that have a cognitive basis that go beyond that necessary to produce the motor sequences found in speech. In a subsequent section, we will examine behavioral data that indicates an important embodied element in language comprehension.

The Evolution of the Bilingual Brain

The discussion of language evolution is almost completely mute on the bilingual capacity of the human brain. This is not surprising if we assume that the brain evolved as a flexible multipurpose language machine capable of picking up whatever language was employed in a given linguistic community, as is the standard linguistic assumption. The speculations that have emerged come from anthropologists and ecological psychologists, who consider the adaptive value of being multilingual.

A basic assumption is that for much of our evolutionary history humans lived in fairly small communities, relatively separated from other human communities. Several adaptive functions have been suggested. Dyson (1979) argues that linguistic diversity evolved as a mechanism to improve the survival of humans during critical times in our history when population numbers fell so dangerously low that our survival as species was in doubt. He argues that the prevalence of different languages in different groups provides increased linguistic or related cognitive opportunities for innovation, necessary for increasing our odds for survival when and if the environment changed. One could argue that Dyson's hypothesis regarding *linguistic diversity* could be expanded to consider the adaptive advantages to being bilingual. Consistent with the evolutionary proposal, there is recent evidence for the cognitive advantages in being bilingual, both for children and in old age (e.g., see Adesope, Lavin, Thompson, & Ungerleider, 2010; Bialystok, Craik, & Luk, 2012, for reviews).

Extending Dyson's hypothesis to include bilingual language abilities does not, however, address a basic evolutionary question. If large-scale cultural contact was not the norm in our evolutionary history, as is believed by evolutionary anthropologists (see Hagen, 2008), what would be the *evolutionary* advantages for having multilingual abilities for communities that did not interact frequently? Most of the (admittedly limited) speculations on this question revolve around the age-related differences in learning one language (i.e., the so-called native language or L1) and an L2, and the importance played by the fact that interactions between groups were somewhat infrequent. One evolutionary school of thought argues that imperfections in L2 use when two groups met could

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serve to signal to both groups that each is dealing with outsiders, marking them as potential threats and, paradoxically, as people with whom one can mate, being sufficiently genetically distant (see Schumann, 2013). Signals of either sort would be adaptive.

Hagen (2008) places the emphasis in bilingual language evolution not on the speech characteristics of late learners of L2, but on the adaptive advantages that are implicit in the ease when L2 is learned early and the difficulty when learned later in age. Basically, the argument suggests that is what is important for the survival of the species must be learned early in life. Thus, just as having the ability to walk almost immediately after birth is important for survival for horses and many other species, the ability to comprehend and use language plays an equally important role in our success as a species. From this perspective, learning to walk for a horse when he or she is 3 years old would be maladaptive and could well lead to species extinction, just as learning to use and comprehend language only later in life would be maladaptive. Schumann (2013) claims the force behind early L1 (or L1 and L2) is an interactional instinct theory, which holds that humans have evolved biological processes "which allow children to attach to, affiliate and bond with caregivers" (p. 205). These processes include the ability to detect and learn patterns of sounds, words, and larger language units.

An impediment in learning L2 later in life is the lack of the necessary culturally rich environmental support found with early learning of L1. Recognizing that L2 learning is more difficult for adults than for children, Schumann (2013) describes general strategies found in numerous cultures employed to overcome limitations in adult L2 learning. These strategies all include one or the other of the following: simplifying the learning task (e.g., having people only learn a single L2 shared by a number of different linguistic communities, such as is often the case with English today), creating a more simple version of L2, leaving L2 learning to a specialized group of people in the culture, and providing specialized training.

Thus, there is a general agreement that early in life one can easily learn both L1 and L2 but that L2 learning is difficult in later life. Taking this perspective, Hagan (2008) bases his evolutionary perspective for the adaptive value of early L2 learning on the following evidence. First, he notes that early L2 learning occurs rapidly, seemingly effortlessly, without formal training and is found as such universally. This, he argues, is not true of other complex tasks we must learn as humans. Second, based on examination of pathological studies (such as recovery rates in aphasia for traumatic events that occur at different times in one's life), brain mapping studies, and other biologically based evidence, he sees the

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