2 Languages are grounded in the body

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The existence of many different languages has led to the suggestion that word-meaning connections are arbitrary. This is partly true, but from the perspective of language learning, the embedding of languages in a particular context and its enactment by the community are more important. Analyses of language in use reveal that seemingly "arbitrary" expressions are less random than they might appear. The phenomena known as "conceptual metaphors" reveal how language is used to extend thinking. Many conceptual metaphors are connected to how the human mind-body functions. The chapter concludes with a few comments on the implications of the aforementioned for education.

The evolution of the first language

The human body has evolved to learn the languages heard in the infant's environment. Unlike for reading, history, geography, or many other school subjects that require extensive experience to achieve mastery, our bodies evolved to learn languages. This learning begins prior to birth. Newborns are able to distinguish the cadences of their mothers' voices (Bader-Rusch, 2003; Moon et al., 2013). Infants' hearing systems quickly learn to recognise, discriminate, and categorise sounds that are present in their environment, which results in less attention being paid to sounds that are not meaningful (e.g., Imada et al., 2006). At 2 years, they can produce novel utterances, and by 5, they can communicate information about the here and now, recall the past, and hypothesise about the future. Only extreme disability and/or abuse can prevent a child from learning their first language. The same cannot be said of second language acquisition, which is characterised by significant individual variation (e.g., Cook, 2016, pp. 135–54; Ellis, 2004). Adult immigrants who learn a language after puberty frequently "sound foreign" in terms of both pronunciation and grammar, whereas their young children do not. Such differences indicate that young children have richer perceptual detectors than adults but also that such openness is not efficient in the long term. Honing the perceptual field down to the language(s) encountered in early childhood can be assumed to have an evolutionary advantage, not least because of the strong social bonds that are formed and maintained through language.

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Noam Chomsky's attempts to explain this phenomenon in the 1960s had a significant impact on the field of linguistics (for a summary, see Chomsky, 2002). Chomsky was fascinated by children's production of grammatical forms they had never heard, as this indicates that language is not learned solely through imitation. He proposed that humans are born with a "Language Acquisition Device" (LAD) which enables infants to latch onto specific features of the languages in their surroundings. He further proposed that there must be a Universal Grammar (UG) underlying all languages, which the LAD is designed to detect. The concept of the LAD was inspired by the appearance of computers. Chomsky's idea was that the infant brain has a sensitivity to certain phonetic, grammatical, syntactical, and semantic features. A limited number of examples suffice to "throw a switch" in the LAD that would enable them to learn rapidly. His studies of children's grammatical development, known as "generative grammar", were partially aimed at uncovering UG. We now know that there is no neurological evidence to support the existence of the LAD (Kauppinen, 2020, pp. 193–7). As Michael Arbib (2012, pp. 285–6) explains,

> [T]he very diversity of human language makes it clear that, whatever the extent of biologically based universals that may unite human languages, most of what defines any specific language is rooted in a cultural, rather than biological, process of historical evolution.

However, he claims that the human brain evolved to be "language ready" (Arbib, 2002, p. 24). Studies of children's grammar have proven useful for both educators and phonologists, but innatist claims following Chomsky are unsupported by evidence.

More productive evolutionary accounts of language acquisition draw on two different kinds of data. One is to investigate archaeological (i.e., skeletal and fossilised) remains to investigate the impact of language on the body. Given the vital role of the throat for breathing and eating, using it for language can be considered a high-risk activity. Archaeological remains indicate that language emerged around 100,000 years ago and can be seen in changes in the throat mechanisms (Donald, 1999; Kauppinen, 2020, pp. 193–7). Interestingly, this bodily change is still visible today in the second type of evidence used to support evolutionary theories: comparisons between primate bodies. Newborn humans, like monkeys, have a larynx that is lower than the larynxes of people who can speak. They need to learn to swallow without choking (hence the need to pat babies' backs after feeding). Fairly rapidly, babies learn to separate the different functions of the throat, thereby allowing language to emerge.

A number of evolutionary theorists have compared the development of babies with other primates. Giacamo Rizzolatti and Corrado Sinigaglia (2008), as well as Arbib (2012), have focused on the mutuality of gestures, actions, and emotions, as well as neurological evidence to propose *the mirror system hypothesis*. This hypothesis proposes that mirror neurons allow all primates to learn by imitating, but only humans are capable of the level of imitation needed

to support the breakthrough into language. Michael Tomasello (2019) noted that children are better at copying than chimpanzees. He describes his theory as "new Vygotskian" as he highlights the role of interaction in learning, identifying what he terms the "9-month revolution" when infants start to use their hands to point out things they want information about—e.g., noticing a toy (Tomasello, 2019). From an embodied perspective, the key point about the studies comparing primates is that human language emerges in the context of a broad range of gestures, non-words (e.g., "uh oh"), exaggerated facial expressions, and joint attention. Language emerges *after* initial communication has been established through a sequence starting with turn-taking (e.g., mutual gaze, smiling, laughing), gesture (e.g., pointing to identify a shared point of attention), pantomime (e.g., acting out a routine associated with going to bed), and protosign (conventionalised gestures, such as blowing to indicate that the food is hot). In short, words (protospeech) emerge in a context where the whole body is being used to communicate. It is first shared and then gradually develops as a tool for thinking.

The evolutionary advantages of human language are obvious. While many animals and birds can communicate what is happening in the here and now (e.g., warnings that predators are coming), few animals seem able to communicate information about past events. (Many species mourn, which indicates the capacity to reflect on the past.) "Deferred imitation"—acting out an event that happened earlier—starts to appear in children's play from about their first birthday. Although infants may imitate behaviours (e.g., actions related to their sleeping routine) earlier, at the age of 1, children begin to playfully imitate behaviours which they know are "wrong", such as a change in the sleeping routine and then laugh to show that they know this is "wrong". This type of play appears to be a prerequisite for language development.

Language as embodied, embedded, enactive, and extended

In the previous section, I rejected what is known as the *code metaphor*. This term describes the belief that language is somehow "inside" us and/or that the brain produces linguistic forms. Adopting a 4E approach to language requires researchers to examine how the whole human body in its lived environment produces meaning through language, and also how language extends our possibilities for meaning-making beyond the here and now. Stephen Cowley (2014) summarises:

> [E]mbodiment links phenomenal experience to verbal patterns as, during ontogenesis, humans become actor-observers. In so doing, speaking and cooperating come under a degree of collective control. People gain skills in using a multi-scalar linguistic resource that allows embodiment to evoke impersonal products as people manage later events.
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> (p. 2)

Cowley highlights the human body acting in the world, but as already noted, language also changes the body. Evolutionary archaeologists have discerned when pre-humans began to use language from its impact on bodily remains. The lowering and enlarging of the larynx are *embodied* features of language that can be detected from remains. Other changes in the body are also evident, for instance, the lengthening of the vocal cords during puberty, resulting in a slightly deeper voice that is easier to hear. These changes also limit the range of sounds a person can hear and produce, which is the key reason why it is so difficult to gain "native-like" pronunciation in a language learned post-puberty. There is a two-directional embodied process: the body produces language, and language production shapes the body.

Language is also *embedded* in a rich context of shared attention, gestures, and other bodily movements. In *Learning How to Mean*, Michael Halliday (1975) highlighted the child's active role in this process. His empirical evidence showed how early language is divided into functional units rather than grammatical units. These functional units are typically a combination of vocal utterances and gestures: the child might grab a hand to mean "come here" and use their own words to ask for drinks or a specific game. Conversation emerges as the child offers a sound in a gestural context, and the adult responds by extending the speech and providing the desired action.

Language is *enacted* as caretakers treat the infant as a conversational partner, combining voice, gesture, gaze, and contact with the surroundings. At around 12–14 months, infants develop the capacity to use language to move beyond the here and now, recalling events in the past, anticipating events in the future, and expressing humour through deliberate misalignment.

Once language has developed to the extent that it can refer beyond the setting, language can *extend* cognition, making it possible to think about abstract concepts. Literacy extends cognition even further, partly because it reduces pressure on the memory systems and partly because it is more precise. Becoming literate also changes our bodies: The pathways in the brain are affected by learning to read (Wolf, 2008). For instance, learning that the letters p, b, d, and q are discrete involves overcoming object permanence that allows us to recognise physical objects irrespective of the angle from which it is viewed. This capacity for extending cognition by producing permanent language (writing) is worth celebrating but has distracted attention from the fully embodied, embedded, and enactive aspects of language.

The 4E nature of language not only affects the way in which it is learned but is also evident in how it is used (e.g., Matheson & Barsalou, 2018). Languages are symbolic systems that enable humans to extend cognition through time and context. Early work by Ferdinand de Saussure (1916/2011) drew attention to the arbitrary nature of the connection between the form of a word, known as the "signifier" (e.g., "open"), and the concept it represents (e.g., the shop is open for business). The arbitrary nature of language is also evident in the existence of many languages. Instead of the word "open", the card on a shop door might read "auki", "öppen", or "offen", or show a green

square. The mirror system hypothesis summarised earlier accounts for this through the grounding of language in communicative situations. As the shop sign example shows, language is embedded in a context, often one that allows thinking beyond the here and now (the shop is open at this moment when the sign is visible but will cease to be open at some point in the future).

The capacity of languages to extend cognition is evident in abstract concepts. Abstract concepts, by definition, cannot be touched, seen, tasted, heard, or smelled, and yet we have words for "freedom", "guilt", and "angular momentum", which allow these concepts to be communicated. When communicating abstract ideas, individuals typically use concrete situations or examples (Barsalou & Wiemer-Hastings, 2005). Some of these may, quite literally, involve the body. For instance, when talking about "angular momentum", a speaker may shape their hand to form a particular angle and then move it. Teachers who pay attention to their use of such gestures can communicate mathematical concepts more easily, and encouraging pupils to do the same improves learning (e.g., Nathan, 2022, pp. 66–8). Combining mathematics education—especially geometry, fractions, and symmetry—with dance has proven effective (Senior, 2016). In addition to thinking about how bodily movements might be used to improve education on seemingly abstract topics, 4E research into human languages has revealed a great deal about how abstract concepts are formed, as well as how they are processed and communicated.

Language in use: Conceptual metaphors and categorisation systems

Markus Kiefer and Natalie Trumpp (2012) reject the dichotomy between concrete and abstract concepts to argue that "abstract concepts are embedded into concrete situations that express the content of the abstract concept" (p. 19). One of their examples is "guilt", a concept experienced in the body as an emotional state. Guilt is described as "weighing a person down", as having a "load" on our shoulders. The internal experience of guilt is experienced and communicated through concrete analogies. As such, languages are neither entirely symbolic nor fully arbitrary because they are grounded in the body.

The grounding of language in the body has been extensively investigated in relation to conceptual metaphors. A conceptual metaphor (or "cognitive metaphor") refers to the understanding of a concept through analogy to something from another domain. One of Saussure's (1916/2011, pp. 88–9) classic metaphors describes language in terms of chess (see also Geeraerts, 2009, pp. 48–50). Chess pieces are symbolic: We cannot determine the rules of play from observing the pieces. Even when we know the rules, the behaviours of each piece are determined by the context of other pieces. For language, "each linguistic term derives its value from its opposition to all the other terms", and "the system is always momentary; it varies from one position to the next" (Saussure, 1916/2011, p. 89). This metaphor makes the limited nature of arbitrariness accessible: Each chess piece can only move in a restricted number

of ways. However, we should also note how the metaphor fails: The aim of chess is to beat one's opponent. The aims of language production are decidedly more varied.

The chess metaphor draws attention to itself as an artificial comparison. However, most embodied metaphors are so naturalised, we do not even notice that they are metaphors. For example, nine-tenths of the population is right-handed, and so the word that means "right" also means "correct" in many languages. In contrast, "left" is often associated with somewhat negative ideas (e.g., "left over", "left out"). Research into extended metaphors by, most notably, George Lakoff and Mark Johnson (1980) indicates that language draws heavily on bodily experiences to conceptualise abstract ideas. As Lakoff explains, "[R]eason has a bodily basis" (1987, p. xi). Claims building on this line of enquiry are fundamentally experiential (for an overview, see Haser, 2005, pp. 4–7). The underlying idea is that humans imaginatively exploit the knowledge they gain from bodily experiences to conceptualise abstract ideas. For instance, the decimal system is an abstraction based on the physiology of the digits on our hands. In cognitive linguistics, attention is drawn less to the decimal system and more towards the use of the term "digit" to refer to both a number and to a finger or thumb. These conflations—metaphors—provide lines of enquiry into *how* we think.

As indicated by the title of Lakoff's *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind* (1987), all forms of categorisation (not only metaphor and metonymy) provide insight into how ideas are processed. This is sometimes referred to as "prototype theory", which recognises that some items within any given category are central, while others are borderline. For example, "apple" is a prototypical example of the category "fruit", but "tomato" lies on the border between "fruit" and "vegetable". Note how both "fruit" and "vegetable" are defined by experiences of eating. Nuts and mushrooms are also edible and produced for the same purposes as apples, but we tend not to think of them as prototypical examples of either fruit or vegetables. "Toadstools" are distinguished from "mushrooms" primarily on the basis of the human digestive system, not the features of the fungi. Moreover, Lakoff observes how rapidly the human mind endeavours to produce classifications. The title of his book appears to have a random list of words—women, fire, and dangerous things—but we read the list as suggesting that these items have something in common: "the chain of inference—from conjunction to categorisation to commonality—is the norm" (Lakoff, 1987, p. 5). Later, he discusses Dyirbal (an Aboriginal Australian language) which does have a category that combines these things: "balan" (pp. 92–104). As fascinating as his discussion of Dyirbal is, the important point in terms of understanding how language is grounded in the body is not that this is a category that exists in a natural language but rather the rapid chain of inference among non-Dyirbal speakers. Simply placing the words in a list causes us to seek commonalities and conclude that the speaker considers women to be fiery and dangerous.

Lakoff notes that although many of our categories appear to be based on the things that are being classified, "a large proportion of our categories are not categories of *things*; they are categories of abstract entities" such as the palatability of mushrooms and toadstools (1987, p. 6). If we accept that our categories do indeed reveal how the mind works, the importance of political correctness in speech becomes more urgent. Take, for example, the widespread metaphor that LIGHT IS GOOD and DARK IS BAD (e.g., "Her face lit up" vs "I was in a dark place"). Humans have poor night vision, and so darkness is a time of elevated risk. Thus the metaphor appears to be driven by relevant, real human experiences. However, the categorisation system of the mind can also affect how we interpret what we see. Studies of visual perception demonstrate that what we see is determined by our mindset (Balcetis, 2006; Balcetis & Lassiter, 2010). So while LIGHT IS GOOD and DARK IS BAD may make sense in relation to daylight, the extension of the metaphor into other areas can be problematic. For instance, describing a person as "fair" could either mean that they are honest or that they have light-coloured hair. Language affects what we pay attention to.

The experiential approach to understanding how metaphors function has been challenged by, amongst others, Verena Haser (2005). One of her concerns is that Lakoff and Johnson's ideas can be falsified by evidence, such as the existence of competing metaphors. For instance, she challenges the metaphor THEORIES ARE BUILDINGS by noting that one can refer to a key proponent of the theory as a "father" or as "fathering" the theory (Haser, 2005, pp. 216–24). Haser is correct in her assertion that all metaphors break down. A theory is not actually a building; light (or its absence) has no moral value; chess and language are not the same. Cognitive linguists following Lakoff and Johnson do not suggest that metaphors are fixed; they simply highlight the tendency to use bodily experiences to communicate abstract ideas.

Haser's critique is most valuable in her call for empirical evidence that might allow the hypotheses to be falsified. Raymond Gibbs and his colleagues have found innovative ways to provide such evidence. As they explain,

> Empirical research is needed to establish connections between embodiment and metaphor in thought and language. Only by explicitly attempting to find how patterns of embodied experience relate to metaphoric thought and language, and doing this in a way that a hypothesis can, in principle, be falsified, can a strong case be made for, or against, embodied metaphor. … Yet there is a large amount of empirical evidence from linguistics and psychology that demonstrates how metaphor gains much of its conceptual and expressive power from the systematic mappings of embodied source domains onto more abstract target domains of experience.
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> (Gibbs et al., 2004, p. 1207)

Empirical evidence of the kind Gibbs et al. and Haser call for has been provided by Madalina Bucur and Costanza Papagno (2021). They produced a meta-analysis of 32 studies using brain activation imaging to investigate whether different parts of the brain were used to process abstract and concrete concepts. Their study deliberately excluded literal and figurative sentences, and focused exclusively on the data related to single words (verbs and nouns). Their cluster analyses of the areas activated in response to individual words demonstrate at least partially segregated brain areas for concrete or abstract processing; this segregation was strongest for nouns. This was surprising because so much of language combines the concrete with the abstract. For instance, the words "chair", "tree", and "ball" appear to be concrete, but they can also be used in an abstract sense: "chairing a meeting", "tree diagram", and "having a ball".

Bucur and Papagno removed literal and figurative sentences from the data, which may explain their findings. Accounts of how polysemous words and metaphorical language are processed are needed. For instance, Raposo et al. (2009) found clear neurological differences in the processing of "kick the ball" and "kick the bucket": Processing the former indicated activation in the sensorimotor system, whereas processing the latter did not. Their example is particularly interesting in that it is perfectly possible to kick a bucket. The idiom originates from kicking a bucket under a condemned man on the gallows, thereby causing him to hang from the noose. However, the phrase is more commonly used today as a coarse way to describe a person's death, and thus "kicking" in this context has little to do with the actions of the feet, with the result that the brain activation in response to the phrase does not stimulate the sensorimotor system.

Implications for education

Studies of how languages emerged and how children learn languages emphasise the role of the whole body in meaning-making through language. The main takeaway from this for both L1 and L2 language education is that separating words and grammatical forms from their embedded, enacted contexts lowers children's chances of success. When a caretaker reads a book to a child, they will adjust their reading to the child's responses, enacting through their voice, touch, and gaze while the book provides additional visual support. When the level of enactment is lowered—for instance, when listening to a recording of a book—the quality of the communication is lowered. The challenge for language teachers, especially L2 teachers who must model a language culture that is not their own, is to find ways to impart as much of the additional information as possible.

The second takeaway from evolutionary accounts of language learning relates to the way maturation reduces the enabling conditions for language learning. Infants rapidly learn to focus their attention on salient aspects of the language in their surroundings and dismiss what Arbib refers to as "ignorable

details" (2012, p. 291). As a result, by the time children start school, their perception skills have already narrowed, and this process continues through to puberty. Post-pubertal learners find it very difficult to perceive aspects of a language that are salient in the target language but not in the speakers' L1. On a policy level, this finding supports plans for the early introduction of L2 education. On an individual level, teachers will need to focus on exercises that help learners perceive those aspects of the language that are only salient in the target language.

The research on how abstract language is grounded in the body also has implications for education. Metaphors and categorisation practices reveal that abstract ideas are deeply grounded in our experiences of the world through the senses. Using gestures that draw on these connections (e.g., shaping the hands to form angles when teaching mathematics) helps children learn more efficiently, and for children to learn to make such bodily connections themselves is even more effective (Nathan, 2022).

Research that starts at the other end—investigating language—indicates that although words may be stored differently, accessing and using language inevitably leads to more complex scenarios in which the sensorimotor system is involved in meaning-making. The willingness of humans to seek connections between seemingly disparate concepts (such as women, fire, and dangerous things) when they are presented as a list can be used to promote imaginative, critical thinking but may inadvertently lead people to form inappropriate connections. Both these findings are important for textbook designers and teachers planning classroom activities.

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