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Evolution of Semantics

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One of the most important functions of language is to facilitate the 'transmission' of thought from one language user to another. A number of scholars, including Sperber and Wilson (1995), and Tomasello (1999, 2003), have observed that verbal communication requires both a code – which is to say a language-system involving conventional symbols, pairings of form and meaning – and intentional mechanisms such as inference-reading abilities. While both these aspects are essential for verbal communication, communication can, in principle, occur in the absence of a code. Indeed, as we shall see, intentionality and the ability to recognize communicative intentions are likely to have been necessary prerequisites for the evolution of symbolic representation in language.

To function as a means of communication, an important prerequisite of a code, which is to say a language-system, is to be able to encode and externalize humanly-relevant concepts and combinations of concepts. Semantic knowledge, therefore, concerns the range and nature of humanly relevant concepts that can be expressed in language, and the way language serves to combine concepts in order to convey complex ideas. In this article, we explore (i) possible cognitive preadaptations for the development of semantic knowledge, and (ii) the range and nature of conceptual structure as encoded in language, and suggestions as to the way that this structure may have evolved.

Unlike some other aspects of language, there is scant evidence we can draw on in attempting to reconstruct the evolution of semantic knowledge. After all, we are, in essence, attempting to reconstruct the evolution of human cognition. To do this, we are

relying on indirect evidence drawn from primatology and comparative psychology, paleontology, evolutionary anthropology, and evolutionary psychology. Nevertheless, in view of some recent developments in linguistics, both in terms of uncovering and better understanding semantic phenomena, and recent theory-construction, we can now construct some plausible paths of semantic evolution that will at least facilitate further inquiry.

Cognitive Preadaptations for Semantic Knowledge

Language is characterized by being representational or 'symbolic.' That is, a language consists of a structured set of 'symbolic units' consisting of form and meaning components. While this definition represents the received view for lexical items, a growing body of scholarship argues that grammatical patterns can also be thought of as being inherently symbolic in nature (Langacker, 1987). Symbolic units consist of two further units: a phonological unit and a semantic or conceptual unit. The semantic unit, which is what we are concerned with here, has been variously termed a 'lemma' (Levelt, 1989) or a 'lexical concept' (Evans, 2004). In this section, we approach the evolution of semantic knowledge in a general way by considering the cognitive preadaptations that may have paved the way for the emergence of semantic knowledge.

The Importance of Motor Evolution

Donald (1991, 1999) has argued that there were two essential prerequisites for the evolution of symbolic units. One defining characteristic of language is that it can represent a particular idea or entity in the absence of a concrete cue: the design feature of language known as 'displacement.' For this representation to occur, hominids had to gain conscious access to their own memories (Donald, 1999). A second and crucial preadaptation for the emergence of language was the development of voluntary motor control. That is, hominids must have developed the ability to attend to their own action patterns, and to select, trigger, and 'edit' action pattern sequences. According to Donald, this development gave rise to 'mimesis,' a form of nonlinguistic representation. Mimetic action is representational in that it relies on perceptual resemblance to represent itself. For instance, hominid tool use, which can be traced back 1.5 million years, may have employed mimetic representation not only for showing and learning how to employ a tool, but through 'editing' motor routines through rehearsal, to improve the way in which the tool was used. Forms of representation such as mime, dance, ritual acts, and some kinds of music are also mimetic, serving as a form of communication that is nonlinguistic in nature. According to Donald, mimetic action was the earliest form of communication, upon which the later development of language may have been built.

While voluntary control of the musculature must have been important in the rise of this early and basic form of communication, and presumably also facilitated the later development of phonetic abilities and phonological systems, for Donald, linguistic representation is of a different kind from mimetic representation. While mimetic representation is holistic, a key characteristic of semantic knowledge, as represented by the inventory of lexical concepts available in the languages of the world, is that symbolic units serve to 'parse' sensory or perceptual experience into component parts, e.g., tree versus rock versus mountain, and even to encode a particular perspective with respect to which a component is viewed. For, instance, 'shore' and 'coast' both encode the same strip of land at the edge of the sea, but do so from different perspectives. Thus, for Donald, the importance of mimetic representation was that it created an appropriate cultural context, what he terms 'mimetic culture,' in which communication took place, and more precise disambiguation could occur with the advent of linguistic representation.

The Importance of Intention-Reading Skills

Another important preadaptation for the development of semantic knowledge is likely to have been the emergence of the ability to read intentions. According to Tomasello (1999), this sort of ability was the crucial preadaptation required for the evolution of symbolic abilities such as language more generally. Research in developmental psychology reveals that during early ontogeny, shortly before a year old, human infants begin to experience themselves as 'intentional agents.' That is, they perceive themselves as beings whose attentional and behavioral strategies are goal-directed. Accordingly, human infants also come to see others with whom they identify, conspecifics, as intentional agents. Crucially, it is shortly after this ontogenetic 'breakthrough' that language begins to emerge (Tomasello, 2003). Later, from around the age of three, human infants begin to develop the notion of themselves and conspecifics as 'mental agents.' This development constitutes the emergence of the 'theory-of-mind,' in which children develop the ability to conceive that others can hold different views from their own.

The importance of viewing oneself and conspecifics as intentional agents is far-reaching. From this view, it follows that others are intentional agents who possess

mental states that can be directly influenced and manipulated. For instance, pointing at an object can cause one intentional agent – who recognizes the person doing the pointing as an intentional agent attempting to direct attention – to follow the direction of pointing and thus share a 'joint attentional frame' (Tomasello, 1999, 2003). Thus, from this perspective, the importance of a lexical concept being associated with a particular linguistic form is in the utility of the symbolic unit in affecting the mental state of another in some way, such as by coordinating behavior. In other words, language, and the lexical concepts encoded by language, require intention-reading skills, which derive from the awareness that conspecifics represent intentional agents whose mental states can be influenced and manipulated by language.

A number of scholars view intention-reading abilities as an outcome of earlier evolutionary developments. For instance, Whiten (1999) argued that intention-reading skills constitute the outcome of the emergence of what he termed 'deep social mind.' This result can be characterized by cooperative behaviors including the sharing of food, monogamous reproduction – which has been claimed to be the ancestral pattern for humans – and behavior such as communal hunting. Indeed, Whiten argued that intention-reading abilities would have been essential for coordinating activities such as hunting, success at which requires being able to read the intentions of cohunters, and possibly also the prey.

Intention-reading skills most likely evolved by reading observables, such as direction of gaze, direction of motion, and so on. Thus, intention-reading skills are likely to have emerged from behavior-reading skills. On some accounts, chimpanzees are capable of rudimentary intention-reading abilities. Thus, intention-reading might be more than 6 million years old (Byrne, 1999), the time when hominids and chimpanzees separated.

Some scholars have argued that intention-reading in hominids can be viewed as a consequence of a long chain of evolutionary development. For instance, Savage-Rumbaugh (1994) suggested that bipedalism may have set in chain a series of evolutionary developments that gave rise to the cognitive ability to take the perspective of others (intention-reading). For instance, while chimpanzees and gorillas are distinguished from orangutans by a kind of quadrupedal locomotion termed 'knuckle-walking,' early hominids, the australopithecines, who emerged sometime between 4 and 5 million years ago, were distinguished by bipedalism. According to Savage-Rumbaugh, knuckle-walking and bipedalism were distinct and independent solutions to traversing open terrain and transporting infants. However, a consequence of bipedalism, but not knuckle-walking, is that the parent would have had to pay more attention to the infant, which is carried in the arms. In particular, the parent must remember to pick the child up after it has been put down. This consequence may have led to the later evolution of being able to take the perspective of others.

Table 1 Human intention reading abilities

Human intention reading abilities include . . .
The ability to coordinate or share attention, as when an infant and adult both attend to the same object
The ability to follow attention and gesturing, as when an infant follows an adult's pointing or gaze, in order to attend to an object
The ability to actively direct attention of others, such as drawing attention to a particular object or event, for instance, through pointing
The ability of culturally (imitatively) learning the intentional actions of others, such as imitating verbal cues in order to perform intentional actions such as declarative, interrogative or imperative speech functions

Similarly, Byrne (1999) argued that there may be more remote evolutionary antecedents for intention-reading abilities. One hypothesis is that our relatively large brachiating ancestors, for whom a fall would have been deadly, may have accomplished arboreal locomotion by advance planning. The mental representation of self as an entity moving through space would have prefigured representational abilities in general, and would have facilitated planning a trajectory of motion. Self-representation, and the ability to consciously plan one's movements are cognitive achievements that imply intentionality, and the later evolution of intention-reading skills. The suite of intention-reading skills evident in modern humans is summarized in Table 1.

The Importance of Personality Types

This issue concerns the idea that the earliest lexical concepts may have related to personality traits (King *et al.*, 1999). Recent research suggests that personality traits are stable across time and between contexts, correlate with verbal and nonverbal behaviors, and can be reliably judged by human observers. Moreover, King *et al.* (1999) argued that such behaviorally-signaled personality traits as reliability, dominance, and trustworthiness are directly relevant to complex social interactions involving competition, cooperation, sharing, sexual selection, and so on. King *et al.* (1999) suggested that it is the context-independent nature of such complex personality traits, and their importance for hominids that suggests such traits may have been encoded as the earliest lexical concepts.

For instance, studies that have sought to teach chimpanzees to manipulate symbolic units have found

that for symbol use to succeed, meaning must be decontextualized. Consider the example of an apple. If a symbol is applied to this referent, it is not clear which properties of the scene the symbolic form relates to. For instance, it could refer to the apple's color, shape, or that it is an item of food. Until the referent has been experienced in a number of contexts, it is not clear which aspect of the referent is being indexed, and thus what the lexical concept is that is being associated with the form. As personality traits are context-independent and readily identifiable by observers, then an early linguistic form that indexed a particular personality trait might have served as an early lexical concept. That is, personality traits achieve the displacement aspect of lexical concepts by virtue of being inherently context-independent. For this reason, symbolic representation in language may have taken personality traits as the first lexical concepts.

The Nature and Evolution of Semantic Knowledge

In this section, we examine the nature of semantic knowledge in more detail. That is, we examine how humans organize the world and their experience of the world into concepts. We also speculate on possible evolutionary bases of semantic knowledge of this kind and the cognitive mechanisms underlying this knowledge.

Concept Formation

'Semantic structure' constitutes the meaning system directly expressed by and encoded in language. In other words, semantic structure is the form that conceptual structure takes for expression in language. Thus, in order to get a sense of the nature of semantic knowledge, for instance, the nature and range of lexical concepts, we must begin by examining the nature of conceptual structure. In this section, then, we consider the basic units of concept structure, 'concepts.' We consider the following question: Where do concepts come from?

For psychologists, concepts are the basic units of knowledge and are essential both for 'categorization' – the ability to identify individuals, entities, and instances – and 'conceptualization' – the ability to construct alternative perspectives (Barsalou, 1992). To illustrate the notion of conceptualization, consider the sentences in (1) and (2). Each provides a different conceptualization of the concept Book:

(1) That book is heavy.

(2) That book is boring.

While the example in (1) relates to the book 'as tome,' the example in (2) relates to book 'as text.'

Since the work of the French philosopher René Descartes in the 17th century, who developed the principle of Mind/Body dualism, there has been a common assumption within philosophy and, more recently, the other cognitive sciences, that conceptual structure can be studied without recourse to the body, and hence without recourse to 'embodiment.' In modern linguistics, this 'objectivist approach' has been most evident in the approach to meaning known as 'Formal Semantics.' Proponents of this approach assume that it is possible to study meaning as a formal or computational system without taking into account the nature of human bodies or human experience. This position is problematic from an evolutionary perspective as it entails that a new discontinuous cognitive adaptation was required for conceptual structure. Conceptual structure, on this account, is assumed to employ what has been termed an 'amodal' (nonperceptual) form of representation. Amodal representation is distinct from the 'modal' or perceptual forms of representation that presumably had to exist prior to the emergence of conceptual structure, in order to represent 'percepts' (Barsalou, 1999).

The last two decades or so have seen a shift from modeling conceptual representation in terms of amodal systems, towards a more perceptual-based or 'embodied perspective.' An embodied perspective takes the view that concepts derive from percepts, and thus, conceptual structure is fundamentally perceptual in nature. Within linguistics, this general perspective has been advocated most notably by Lakoff and Johnson (1980, 1999; Lakoff, 1987), and also by Jackendoff (1983, 1992, 2002).

In general terms, the idea is that concepts have an embodied character. This idea constitutes the thesis of embodied cognition (see Ziemke, 2003 for discussion).

The idea that concepts are embodied assumes that we have a species-specific view of the world, due to the nature of our physical bodies.

One obvious way in which our embodiment affects the nature of experience is in the realm of color. While the human visual system has three kinds of photoreceptors or color channels, other organisms often have a different number. For instance, the visual system of squirrels, rabbits, and possibly cats, makes use of two color channels, while other organisms, for instance, goldfish and pigeons, have four color channels (Varela *et al.*, 1991). Having a different range of color channels radically alters how the world of color is perceived. This difference affects our experience of color in terms of the range of colors accessible to us along the color spectrum. Moreover, while some

organisms can see in the infrared range, humans are unable to see in this range (Jackendoff, 1992). It's clear, then, that the nature of our visual apparatus – an aspect of our physical embodiment – determines the nature and range of our visual experience. The position that different organisms have different kinds of experiences due to the nature of their embodiment is known as 'variable embodiment.'

The position that our experience is embodied – that is, structured in part by the nature of the kinds of bodies/neuro-anatomical structure we have – has consequences for conceptual structure. This corollary follows because the concepts we have access to, and the nature of the 'reality' we think and talk about, is a function of our embodiment. In other words, we can only talk about what we can perceive and think about, and the things that we can perceive and think about derive from embodied experience. Hence, the human mind must bear the imprint of embodied experience.

Some psychologists have made specific proposals as to how embodied experience gives rise to concepts. For instance, the developmental psychologist Jean Mandler (2004) suggested that through a process of 'perceptual meaning analysis,' percepts come to be recoded as concepts. Mandler argued that this process occurs alongside percept formation and begins virtually from birth. However, she viewed percepts and concepts as wholly distinct forms of representation. Another view has been proposed by Barsalou (1999). He argued that a concept is akin to a remembered perceptual state, which he termed a 'perceptual symbol.'

From an evolutionary perspective, if it is correct that concepts are fundamentally perceptual in nature, then by virtue of early hominids gaining conscious access to the contents of their own memories, little additional complexity in terms of cognitive development is required for a rudimentary conceptual system to have emerged. This corollary follows as concepts, on this account, are something akin to 'remembered percepts.'

The Nature of Lexical Concepts: The Natural Partitions Hypothesis

Having examined conceptual structure, we now turn to semantic structure.

Linguists have traditionally classified lexical concepts into those that are encoded by 'open' versus 'closed class forms.' Open class forms include, for English, nouns, verbs and adjectives, while closed class forms include determiners, prepositions, conjunctions, and so on. The basic insight is that it is much harder to add new members to the closed class set than to the open class set. A related insight is that open class forms tend to have much richer denotational meaning, while closed class forms are associated with lexical concepts that have more schematic or relational meaning. That is, they provide connections to other lexical concepts that have a more referential meaning.

However, since at least the early 1980s, the strict separation between closed and open class concepts has been called into question. This query stems from the observation that the division between open and closed class concepts constitutes more of a continuum rather than a strict bifurcation. For instance, Gentner (1981) pointed out that verbs, which are normally thought of as being open class, are highly relational in nature, a feature associated with closed class elements.

More recently, Gentner and Boroditsky (2001) have elaborated on this view, suggesting that open class lexical concepts exhibit 'cognitive dominance.' This contrasts with closed class concepts that exhibit 'linguistic dominance.' These notions relate to the similar idea expressed by Langacker (1987), who used the terms 'conceptually autonomous' versus 'conceptually dependent.' The basic idea is that lexical concepts associated with prototypical open class (autonomous) forms obtain their reference independently of language, which is to say from the world, while prototypical lexical concepts associated with closed class or relational forms obtain their reference from language. Moreover, whether a form is cognitively dominant (or autonomous) or linguistically dominant (or dependent) is a matter of degree. A proposed continuum is given in Figure 1.

In order to account for the cognitive dominance of prototypical open class lexical concepts (i.e., nouns), Gentner (1981) proposed the Natural Partitions Hypothesis. This idea holds that concepts that are encoded as prototypical open class elements such as

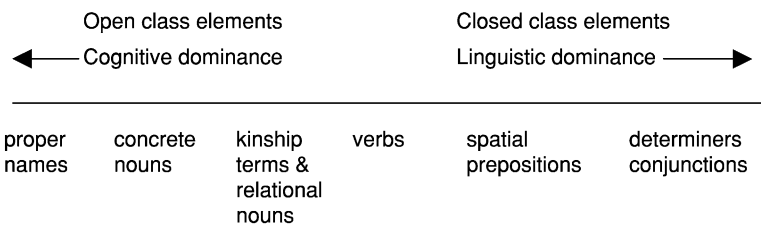

Figure 1 Division of dominance among form classes of lexical concepts. (Adapted from Gentner and Boroditsky, 2001: 216.)

individuals and objects are 'individuated.' That is, entities of this kind constitute densely bundled collections of percepts. Thus, an entity such as a rock or a tree 'stands out.' In Gestalt Psychology terms, a rock constitutes the figure in the figure-ground organization of a given scene. The Natural Partitions Hypothesis states that certain aspects of the world are given by the world. These entities are typically encoded crosslinguistically by nouns, and are acquired first by children. On this account then, bundles of percepts are 'given' by the world, and are simply labeled by language.

The Natural Partitions Hypothesis offers an intriguing insight into a possible order of evolution among lexical concepts – which is to say concepts encoded by language. That is, we might speculate, based on this, that the very first lexical concepts were those for individuals, including animals (and possibly classes of animals) and objects. Concepts of this kind have the most cognitive dominance. That is, they have highest conceptual autonomy. Other lexical concepts may have evolved later.

Further, there is a correlation between the position of a lexical concept on the continuum of dominance (see **Figure 1**) and the form class associated with the lexical concept. Although this correlation is not exact, for instance, 'destruction' and 'destroy' encode a similar concept employing different lexical classes (noun versus verb), it is plausible that the evolution of lexical classes (or 'parts of speech') emerged due to distinctions in the relative dominance or autonomy being further, later, encoded by morphosyntactic properties of language.

Lexical Concepts and Concept-Combination

From an evolutionary perspective, being able to form concepts and express them via language, while a remarkable achievement, doesn't begin to approach the range and complexity of the semantic structure available to modern Homo Sapiens. Lexical concepts are only a subset of our semantic knowledge. Another important aspect of semantic knowledge concerns our ability to combine lexical concepts in order to give rise to new and different kinds of conceptual structure. Moreover, it is a striking fact that concept combination produces complex concepts that are not simply the sum of the individual parts that comprise the derived concept. For instance, the complex concept Petfish is not simply the intersection of the concepts Pet and Fish. Rather, the concept Petfish has its own concept-internal structure, known as 'category structure.'

For instance, while most people would rank mackerel, which is silver in color, as a good example of the Fish category, a cat or a dog would be rated as a good example of the Pet category. Yet, a good example of a Petfish is a goldfish. Not only is a goldfish not silver, it is not soft and cuddly either. An important task in developing an evolutionary perspective on semantic knowledge is to account not only for the way in which lexical concepts are formed, but also for the mechanisms responsible for concept combination.

A recent approach to concept combination of this kind argued that complex concepts result from a process of 'conceptual integration' (Fauconnier and Turner, 2002; Turner and Fauconnier, 1995). This process involves what is termed 'selective projection' of content from each of the concepts that give rise to the complex concept, as well as additional material derived from background knowledge, such as knowledge that the kinds of fish we keep in fishbowls are typically goldfish. This process is termed 'completion.' Thus, the complex concept, known as a 'conceptual blend,' has structure associated with it that is found in neither of the 'input' concepts that give rise to it. This structure is diagrammed in **Figure 2**.

Clearly, some form of conceptual integration allows humans to combine and manipulate concepts in order to produce more complex ideas. Fauconnier and Turner argued that the emergence of cognitively modern human beings, during the upper paleolithic era, somewhere in the region of 50 000 years ago, points to the development of a new cognitive ability: our ability to perform conceptual integration. While anatomically modern humans appear to have existed from at least 100 000 years ago, the upper paleolithic stands out. This period witnessed the emergence of new social and technological breakthroughs, including the development of projectile points made from bony material for use in hunting, the manufacture of personal adornments, the development of sophisticated art, evidence of belief systems such as religion and magic, plus manmade shelters were built for the first time, sewn clothing was worn, and sculptures were produced. Fauconnier and Turner argued that what made advances such as these possible, was that humans had evolved the ability to perform complex conceptual integrations. This process, then, may have facilitated composing and elaborating concepts to produce new and more elaborate conceptual structures.

Polysemy

Another striking aspect of semantic knowledge is the phenomenon of 'polysemy.' This aspect constitutes the way in which a range of related lexical concepts can be expressed using a single form. For instance, the English preposition 'over' has a number of distinct but related lexical concepts associated with it.

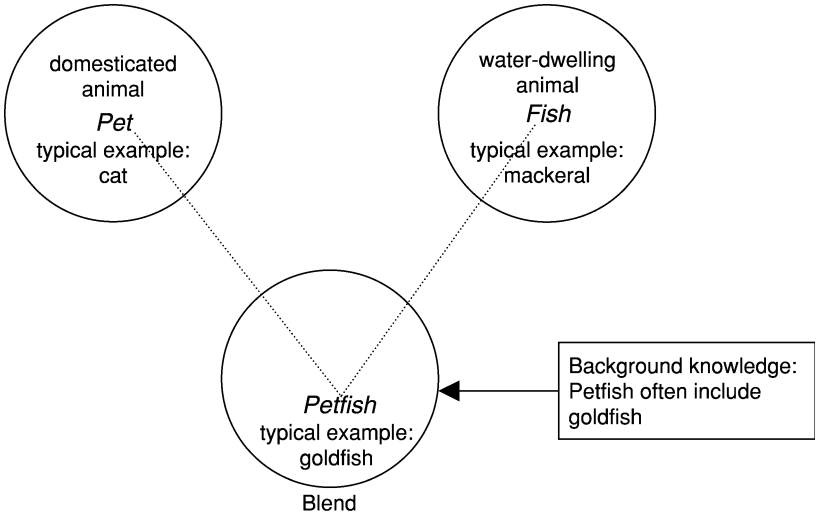

Figure 2 Conceptual integration for the composite concept *goldfish*.

Consider some of the distinct lexical concepts proposed by Tyler and Evans (2003):

(3a) The picture is over the sofa ['above']
(3b) The picture is over the hole ['covering']
(3c) The ball is over the wall ['on-the-other-side-of']
(3d) She has a strange power over him ['control']
(3e) The government handed over power ['transfer']
(3f) She prefers wine over beer ['preference']
(3g) The relationship is over ['completion']
(3h) The relationship evolved over the years ['temporal']
(3i) The fence fell over ['reflexive']
(3j) They started the race over ['repetition']

Recent research has argued that polysemy, far from being merely a 'surface' phenomenon, is in fact conceptually real. That is, polysemy patterns reflect distinct lexical concepts, stored as different senses in the mental lexicon (Evans, 2004; Lakoff, 1987; Tyler and Evans, 2003). Accordingly, from an evolutionary perspective, the challenge is to explain how the proliferation of lexical concepts, i.e., polysemy, arises.

A recent perspective is that polysemy emerges from the interaction between language use and contexts of use, due to the conventionalization of situated (or invited) inferences (Traugott and Dasher, 2002; Tyler and Evans, 2003; Evans, 2004). For instance, the 'covering' meaning associated with 'over' may have derived from contexts of use in which, in a given spatial scene, an element placed above another entity thereby covered it. Through a process of decontextualization, the 'covering' meaning was reanalyzed as being a distinct meaning component. Once this reanalysis occurred, it could be used in novel ways unsupported by the original spatial scene that gave rise to the inference in the first place (Tyler and Evans, 2003).

From an evolutionary perspective, the importance of polysemy and meaning-extension is that it illustrates how language, in conjunction with human experience, can give rise to new lexical concepts. Moreover, this particular phenomenon of meaning-extension illustrates how language can flexibly increase its repertoire of lexical concepts without increasing the number of linguistic forms.

Abstract Concepts

Another important aspect of semantic structure relates to so-called abstract concepts. These include lexical concepts such as Truth, Justice, or Theory. Concepts of these kinds are abstract in the sense that they cannot be straightforwardly accounted for in terms of perceptual recording, precisely because it's not clear what their perceptual basis is, and even whether they have one. Indeed, abstract concepts provide a significant challenge if we are to attempt to provide an evolutionary account maintaining the thesis of embodied cognition.

An influential framework that provides an account that is based in perceptual or embodied experience is the 'conceptual metaphor theory' of Lakoff and Johnson (1980, 1999). Lakoff and Johnson argued that abstract concepts are grounded in embodied experience, and thus our perception of the world, even if the grounding is not direct. This grounding is achieved by virtue of 'conceptual metaphors,' which are long-term conceptual mappings that serve to project structure from a 'source concept,' which relates to perceptual experience onto the abstract concept, the 'target concept.' For instance, we commonly understand the abstract concept of Quantity in terms of the more perceptually concrete concept of Verticality, as evidenced by examples such as the following:

(4a) The price of stocks has **gone up**.
(4b) Her score is **higher** than mine.

In both these examples, an abstract notion of Quantity is understood in terms of physical position or motion on the vertical axis. This understanding is licensed by the conceptual metaphor Quantity Is Vertical Elevation.

The most recent version of conceptual metaphor theory recognizes two distinct kinds of conceptual metaphors: 'primary metaphors,' which are directly grounded in experience and constitute 'primitive' conceptual mappings, and more complex 'compound metaphors,' which are constructed out of the more experientially basic primary metaphors (Grady, 1997; Lakoff and Johnson, 1999).

For instance, when we understand Theories in terms of Physical Structures, as evidenced by the following examples:

(5a) Is that the **foundation** for your theory?
(5b) The argument is **shaky**.

Grady argues that the motivation for linguistic examples such as these is in fact two primary metaphors, Persisting Is Remaining Erect and Organization Is Physical Structure. These unify to give the compound metaphor An Abstract Organized Entity [such as a theory] Is An Erect Physical Object (Grady, 1997).

Thus, it is only primary metaphors that are grounded in perceptual experience. The motivation for the conceptual associations captured by primary metaphors is due to a tight and ubiquitous correlation in experience. For instance, there is a tight and recurring correlation in experience between quantity and height. When we fill a glass with water, an increase in quantity correlates with an increase in height. Thus, primary metaphors are motivated by 'experiential correlation.'

From an evolutionary perspective, the phenomenon of 'metaphoric' mappings holding between concepts from different parts of 'conceptual space,' known as 'domains,' allows us to account for how perceptual information can be recruited in order to construct more abstract concepts, such as Quantity and Theories. This phenomenon suggests that, in addition to being able to recode percepts as concepts and combine concepts, the conceptual system must have additionally developed a mechanism for projecting structure from one conceptual domain to another in order to create more abstract concepts.

Cultural Evolution

The final issue we examine is that of cultural evolution. Lexical concepts are culturally embedded, and thus, we must briefly look at the role of cultural evolution in providing the conceptual backdrop for the emergence of semantic knowledge.

Consider the evolution of the concept of Money. This concept is one that has been evolving for over 3000 years. Weatherford (1998) identified a number of key mutations in the development of how we conceptualize Money. The first was the invention of coins in Anatolia over 3000 years ago. This development gave rise to the monetary economies that underpinned the classical Greek and Roman civilizations. The second was the development of family-owned credit banks in Renaissance Italy. This development gave rise to capitalist market economies that replaced earlier feudal societies throughout Europe, and the period in which European countries expanded to became global economic powers. The process whereby cultural artifacts or cultural practice undergoes cumulative evolution, resulting in modification or improvement has been dubbed the 'ratchet effect' (Tomasello, 1999). Thus, an important aspect of the evolution of semantic knowledge involves the development and evolution of cultural knowledge.

See also: Cultural Evolution of Language; Descartes, René (1596–1650); Evolutionary Theories of Language: Current Theories; Evolutionary Theories of Language: Previous Theories; Origin and Evolution of Language.

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Evolution of Syntax

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After more than a century of more or less avoiding the subject, linguists have become much more interested in questions about evolution in recent years. Arguably, this interest was kick-started by an important paper by Steven Pinker and Paul Bloom (Pinker and Bloom, 1990). The number of articles in this encyclopedia that are concerned with matters of evolution can be seen as evidence of this increased interest (see cross-references below). Jackendoff (2002: 231–232) suggests two reasons for the increased interest. One is that we now understand much more about evolutionary principles in general and about human origins in particular than we did a century ago. The other is that increased interest in evolution in general inevitably leads to increased interest in the evolution of language in particular and, as Bickerton suggests (Calvin and Bickerton, 2000), it is important for linguists to be involved in this discussion. At the same time, there is some ambivalence about this topic. Linguists are wary of debates on topics where the data is so limited and the discussion therefore has to be quite speculative. Despite this, there have been a number of interesting discussions in recent years and significant progress has been made in this area. There has also been a significant increase in work that considers how syntax in particular might have evolved. This essay begins by considering some general questions about the nature and evolution of language before considering questions about the evolution of syntax, and some of the answers that have been proposed. The two sets of questions are closely linked in ways that echo the connections between studies of language in general and studies of syntax in general.

Language

Before working out how a particular trait evolved, we first need to know what that trait is. There has been considerable disagreement about what 'language' is in the past and there are currently several different views (*see* the articles in this encyclopedia on **Linguistics: Approaches** and **Approaches to Translation, Linguistic**). Language can be viewed as a social or a cultural phenomenon as well as a psychological one.