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Not all ambiguous words are created equal: An EEG investigation of homonymy and polysemy

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ABSTRACT

Event-related potentials (ERPs) were used to investigate the time-course of meaning activation of different types of ambiguous words. Unbalanced homonymous (“pen”), balanced homonymous (“panel”), metaphorically polysemous (“lip”), and metonymically polysemous words (“rabbit”) were used in a visual single-word priming delayed lexical decision task. The theoretical distinction between homonymy and polysemy was reflected in the N400 component. Homonymous words (balanced and unbalanced) showed effects of dominance/frequency with reduced N400 effects predominantly observed for dominant meanings. Polysemous words (metaphors and metonymies) showed effects of core meaning representation with both dominant and subordinate meanings showing reduced N400 effects. Furthermore, the division within polysemy, into metaphor and metonymy, was supported. Differences emerged in meaning activation patterns with the subordinate meanings of metaphor inducing differentially reduced N400 effects moving from left hemisphere electrode sites to right hemisphere electrode sites, potentially suggesting increased involvement of the right hemisphere in the processing of figurative meaning.

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1. Introduction

In everyday life, successful communication occurs even when we must attribute correctly a speaker’s intended meaning to words that convey a wide array of possible interpretations, that is, lexical ambiguity. Theoretical linguistics distinguishes between two types of lexical ambiguity, homonymy and polysemy. The first type of lexical ambiguity, homonymy, is observed in lexical items that “accidentally” carry two distinct and unrelated meanings[2] (Weinreich, 1964). For example, in the sentences “John lay down on the bank of the river” and “The Royal Bank is the largest bank in Montreal”, the word “bank” has the meanings “river side” and “financial institution”. Homonymy is assumed to have contrastive meanings which are contradictory in nature. The context and the discourse setting help in their disambiguation selecting the appropriate meaning each time (Weinreich, 1964).

The other type of ambiguity, polysemy, involves lexical senses which relate to the same basic meaning of the word as it occurs in different contexts (Weinreich, 1964). For example, in the sentences “Mary painted the door” and “Mary walked through the door”, the word “door” in the first sentence refers to the “physical object”, whereas in the second sentence it refers to the “aperture”. Yet, the basic meaning of the word is the same in both sentences. Weinreich (1964) referred to these sense distinctions as complementary polysemies (i.e., polysemy) which, unlike senses in contrastive ambiguity, are not contradictory in nature. Rather, one sense seems more appropriate or “focused” for the interpretation of the word in the particular context.

Apart from the distinction between homonymy and polysemy, according to theoretical linguistics, there is a further distinction within polysemy into two types, which are motivated by two distinct figures of speech, namely metaphor and metonymy (Apresjan, 1974). In metaphorical polysemy, in which a relation of analogy is assumed to hold between the senses, the basic sense is literal, whereas the secondary sense was originally figurative when this use of the word emerged. For example, the ambiguous word “eye” has the literal primary sense “organ of the body”, and the secondary sense “hole in a needle”. Metaphorically motivated polysemy seems to be quite unconstrained in that the relatedness

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[2] It should be noted here that the term “meaning” is used to refer to the multiple distinct and unrelated interpretations of a word form such as in the case of homonymy. In contrast, the term “sense” is used to refer to the multiple related interpretations of a word form such as in the case of polysemy.

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in meaning between the primary and the derivative meanings is not always so obvious (Apresjan, 1974).

The other type of polysemy is motivated by metonymy and a relation of contiguity or connectedness is assumed to hold between the senses. Metonymically motivated polysemy respects the usual notion of lexical polysemy, namely the ability of a word to have several distinct but related senses (Apresjan, 1974). The changes of meaning in metonymic polysemy are not accidental, as in homonymy, but systematic or "regular" (Apresjan, 1974), and both the primary and the secondary senses are quite literal. For example, the ambiguous word "rabbit" has the literal primary sense "the animal", and the literal secondary sense "the meat of that animal".

Drawing on the observation that homonymy and polysemy are relative concepts, it seems that some types of metaphorically motivated polysemy are closer to homonymy. On the other hand, metonymically motivated polysemy is a step further away from homonymy and possibly represents "pure" polysemy (Apresjan, 1974). Several types of metonymic changes of meaning (or shifts of meaning), which seem to hold cross-linguistically and are systematic in nature (thus, in a way, predictable and productive), have been identified such as count/mass, container/containee, producer/product, product/institution, figure/ground, and place/people alternations to name just a few (Pustejovsky, 1995).

Although polysemy is much more frequent in language, most psycholinguistic and neurolinguistic studies to date have focused mainly on homonymy (see Simpson, 1994 for a review). With respect to homonymy, most models agree that the multiple, unrelated meanings are represented separately in the mental lexicon; however, the representation of polysemy in general, and of its two subtypes – metaphor and metonymy – in particular, has been very controversial. The question we address here, using electrophysiological correlates, is how the multiple, closely related senses of polysemous words, both metaphors and metonymies, are activated and represented in the mental lexicon. Are the multiple related senses of metaphorical and metonymic polysemous words processed just like the multiple unrelated meanings of homonymous words or do they employ a qualitatively different process?

1.1. Behavioural evidence for the distinction between homonymy and polysemy

There is currently an ongoing debate in the literature, based on behavioural studies, on the representation of polysemy. On the one hand, there is evidence that the senses of polysemous words, unlike the meanings of homonymous words, are stored together in the mental lexicon. For example, words with multiple meanings associated with a single derivation (i.e., all the meanings have the same etymology) are accessed faster than words with an equal number of meanings that are associated with multiple derivations (i.e., the meanings are associated with different etymologies; Jastrzembski, 1981). In addition, several other studies suggest that homonymous and polysemous words are represented and processed differently (Frazier & Rayner, 1990; Klepousniotou, 2002; Klepousniotou & Baum, 2007; Klepousniotou, Titone, & Romero, 2008; Pickering & Frisson, 2001; Williams, 1992). For example, Frazier and Rayner (1990) found that participants' eye movement patterns differed for polysemous and homonymous words in that polysemous words required shorter fixation times. They argued that because the meanings of homonymous words are mutually exclusive, selection of the appropriate meaning must occur before processing can proceed. In contrast, because the different senses of polysemous words are not mutually exclusive and may share a core representation, all possible meanings can remain activated so that selection and disambiguation, if necessary, is delayed. Further evidence for the facilitatory effects of the interrelatedness of multiple senses on the processing of polysemous words is observed in the processing advantage for lexical decisions for words with many senses, a trend for a disadvantage for words with many meanings (Rodd, Gaskell, & Marslen-Wilson, 2002) and the inability to suppress priming effects of the contextually irrelevant central meaning of polysemous words even over long prime-target delays (Williams, 1992).

In contrast with the notion that homonymy and polysemy are represented and processed differently, a number of experiments support the opposite view, namely that polysemy functions just like homonymy. In particular, an influential study by Klein and Murphy (2001) found no evidence that polysemous words embedded in phrasal contexts (e.g., *daily paper* vs. *shredded paper*) function differently from homonymous words (but cf. Klepousniotou et al., 2008). Their results showed that contextual consistency facilitated comprehension while contextual inconsistency inhibited comprehension. Similar findings were obtained from a series of off-line experiments as well (Klein & Murphy, 2002). Critically then, based on the findings of the studies undertaken by Klein and Murphy (Klein & Murphy, 2001, 2002), the separate representations view is supported for both homonymy and polysemy; namely, the multiple senses of polysemous words have separate representations just like the multiple meanings of homonymous words.

1.2. Behavioural evidence for the distinction within polysemy into metaphor and metonymy

As described above, polysemy is not a uniform phenomenon; rather, according to theoretical linguistics (Apresjan, 1974), polysemy is divided into metaphor and metonymy. Importantly, studies to date (Klepousniotou 2002; Klepousniotou & Baum, 2007; Klepousniotou et al., 2008) that exploited the distinction within polysemy into metaphor and metonymy, both in context and isolation, yielded further information about lexical ambiguity processing. In particular, in a study directly comparing homonymous, metaphorically polysemous and metonymically polysemous words, Klepousniotou (2002) found that metonymically polysemous words demonstrated stronger facilitation effects and were processed significantly faster than homonymous words, while metaphors fell somewhere in the middle between homonymy and metonymy. The distinction of metaphor and metonymy within polysemy was further supported in a set of lexical decision experiments focused on the so-called "ambiguity advantage" effect (i.e., an assumed processing advantage for ambiguous than unambiguous words) by comparing the processing of balanced homonymy, unbalanced homonymy, metaphorical polysemy, and metonymic polysemy to unambiguous frequency-matched control words (Klepousniotou & Baum, 2007). Although no processing advantage was found for homonymy (both balanced and unbalanced), a processing advantage was evident for all polysemous words – metaphorical and metonymic – (i.e., they were processed faster than unambiguous words), suggesting a "sense-relatedness advantage" effect. In addition, even in the presence of a processing advantage, metaphorically polysemous words took longer to process than metonymically polysemous words, providing further support to the theoretical linguistics division of polysemy into metaphor and metonymy.

Finally, in another study (Klepousniotou et al., 2008), participants judged whether ambiguous words embedded in word pairs (e.g., *tasty chicken*) made sense as a function of a cooperating, conflicting, or neutral context using the paradigm of Klein and Murphy (2001). The ambiguous words were independently rated as having low, moderate, and highly overlapping senses/meanings to map onto a homonymy to metonymy continuum. The effects of sense/meaning dominance were also examined. The results indicated

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