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Acquiring concepts and features of novel words by two types of learning: direct mapping and inference

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ABSTRACT

This study examined the semantic representation of novel words learnt in two conditions: directly mapping a novel word to a concept (Direct mapping: DM) and inferring the concept from provided features (Inferred learning: IF). A condition where no definite concept could be inferred (No basic-level meaning: NM) served as a baseline. The semantic representation of the novel word was assessed via a semantic-relatedness judgment task. In this task, the learned novel word served as a prime, while the corresponding concept, an unlearned feature of the concept, and an unrelated word served as targets. ERP responses to the targets, primed by the novel words in the three learning conditions, were compared. For the corresponding concept, smaller N400s were elicited in the DM and IF conditions than in the NM condition, indicating that the concept could be obtained in both learning conditions. However, for the unlearned feature, the targets in the IF condition produced an N400 effect while in the DM condition elicited an LPC effect relative to the NM learning condition. No ERP difference was observed among the three learning conditions for the unrelated words. The results indicate that conditions of learning affect the semantic representation of novel word, and that the unlearned feature was only activated by the novel word in the IF learning condition.

1. Introduction

We are constantly encountering and learning novel words throughout our lifespan. Thus, it is important to understand the processes involved in word learning. Learning a word involves knowing the phonological, orthographic, syntactic and semantic knowledge of the word. In the present study, we focus on how the semantic knowledge of a word is acquired, i.e., how to build form-meaning association of the word. This association can be built by directly mapping the novel word to its meaning, or in a relatively indirect way. Below we introduced different types of word learning in existing literature.

When we face a novel word, one way to get its meaning is to look up the definition in a dictionary. Researchers have suggested that word meaning could be rapidly acquired by a direct mapping between a novel word and a definition. Perfetti, Wlotko, and Hart (2005) taught participants the meaning of unfamiliar real words by directly giving the definitions of the words (e.g., *Clowder* is a collection or a group of cats). In a semantic-relatedness-decision task, they presented semantically related or unrelated words after the presentation of learned words. They found that participants responded faster for related words as compared to unrelated words. In addition, the related words elicited a smaller N400 than the unrelated words. The amplitude of the N400 has been taken as an index of the difficulty of retrieving or integrating semantic information into contexts (for recent reviews, see Kutas & Federmeier, 2011; Lau, Phillips, & Poeppel, 2008). The easier to retrieve or to integrate information in a given context (be it words, sentences, or discourses), the smaller the N400 is. The N400 effect suggests that participants could obtain the meaning of the word by directly mapping the definitions with the novel words.

Word meaning can also be learned in an indirect way in which learners inferred the meaning from information provided in learning situations. The ways of providing information varied across different learning types. For example, in a fast mapping paradigm (Carey & Bartlett, 1978; Markson & Bloom, 1997; Sharon, Moscovitch, & Gilboa, 2011), the novel word appeared together with two objects (e.g., *zebra* and *numbat*). Only one object's name (e.g., *zebra*) was known to learners. Researchers found that learners could correctly infer that the novel word (i.e., *numbat*) referred to the unknown object because it is generally assumed that one object have only one name (Markman, 1990). For fast mapping, learners inferred the word meaning by making a logical hypothesis (Halberda, 2006).

Learners also inferred word meaning from the frequent co-occurrence of a novel word and objects, such as in associative learning (Breitenstein & Knecht, 2002; Breitenstein et al., 2007;

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Dobel et al., 2010) and cross-situation learning (Smith, Smith, & Blythe, 2011; Yu & Smith, 2007). In the associative learning, participants listened to a novel word (e.g. *enas*), and then saw an object (e.g. *tree*). Each novel word was presented many times, occurring together with one object (e.g. *tree*) at a high frequency and with other objects (e.g. *book, car*) at a very low frequency. After days of training, the learners could gain the correct meaning of the novel word. In the cross-situation learning, more than one novel word and more than one referent appeared simultaneously, which increased the referential uncertainty. Even so, learners could gain the correct word-referent mappings on the basis of the co-occurrences of words and referents across multiple trials (Yu & Smith, 2007). In both learning types, learners utilized the co-occurrence frequency between novel words and referents to infer the meaning of the novel words.

In addition to the inference from co-occurrence frequency of novel word and object, learners can also infer meaning of novel words from linguistic context (Batterink & Neville, 2011; Nagy, Herman, & Anderson, 1985; Swanborn & De Glopper, 1999). This has been termed as contextual learning. Participants read and comprehended the sentences or texts to infer the novel word's meaning. The meaning of learned novel words was usually tested in a semantic relatedness judgment task or lexical decision task (Borovsky, Elman, & Kutas, 2012; Borovsky, Kutas, & Elman, 2013; Mestres-Missé, Rodriguez-Fornells, & Münte, 2007, 2010). Researchers found that the learned novel words could prime their corresponding real words (Batterink & Neville, 2011; Mestres-Missé et al., 2007) as well as semantically related words (Borovsky et al., 2012), as indicated by faster reaction time and reduced N400 compared to unrelated words. In the contextual learning, the novel word's meaning was inferred from the meaning

Table 1
Examples of learning discourses and testing targets.

Learning discourses in the learning phase	
1. Direct mapping (DM)	
房份这种乌龟是爬行动物。	(Fangfen,as a kind of turtle, is a reptile.)
它背部隆起，	(It has a convex dorsal part,)
背上有坚固的甲壳。	(its trunk is encased in a hard shell.)
房份头和四肢能缩入壳中。	(Fang fen's head and four legs can hide in the shell.)
2. Inferred learning (IF)	
房份是爬行动物。	(Fang fen is a reptile.)
它背部隆起，	(It has a convex dorsal part,)
背上有坚固的甲壳。	(its trunk is encased in a hard shell.)
房份头和四肢能缩入壳中。	(Fang fen's head and four legs can hide in the shell.)
3. No meaning (NM)	
房份是爬行动物。	(Fangfen is a reptile.)
它背部光滑，	(It has a smooth dorsal part,)
背上有黑色的绒毛。	(with some black villus on it.)
房份头和四肢都较小。	(Fang fen's head is small and four legs are short.)
Prime and Target in the testing phase	
Corresponding concept (CC):	房份 (fangfen) – 乌龟 (turtle)
Feature-related word(FR):	房份 (fangfen) – 长寿(long-lived)
No-related word(NR):	房份 (fangfen) – 鲤鱼(carp)

Note: The examples were originally in Chinese, with the critical words underlined. The English translations are given after the original Chinese materials in the parenthesis.

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