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Second Language Acquisition of English Prepositions

Charles M. Mueller

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Prepositions are ubiquitous in English, but this word class can be particularly challenging for L2 learners. A large body of research, mostly conducted in the last three decades, has shed light on factors underlying this difficulty, and has put forth related recommendations for effective pedagogical approaches. The current paper provides a concise review of key trends within this literature. The paper begins with an overview of key analytical concepts used to discuss the semantics of prepositions, to include schematic spatial configurations and embodiment. The paper then discusses learners' difficulties and factors that may explain such difficulties. The next section examines interlanguage representations of prepositional knowledge, contrasting fine-grained semantic representations with syntagmatic knowledge based on rote learning. The subsequent section examines crosslinguistic influence, to include factors underlying transfer, general tendencies toward under- and over-suppliance, and learners' difficulties in adjusting the weighting of functional features. The next section then briefly examines possible critical period effects as put forth as an explanation for non-nativelike ultimate attainment. The final section delves into recent work on pedagogical approaches, with an emphasis on attempts to convey prepositional semantics using simple diagrams based on cognitive linguistic frameworks.

Analysis of Prepositions in Cognitive Linguistics

Much of the research on the semantics of prepositions (e.g., Tyler & Evans, 2003) has adopted the theoretical framework of cognitive linguistics (e.g., Croft & Cruse, 2004; Langacker, 1987; Talmy, 2005). A representative example is Tyler and Evans (2003) seminal work, which systematically analyzes prepositional meaning in terms of a *landmark* (also called the *ground*), a *trajector* (also called the *figure*), and a *vantage point*. In this system of analysis, the *trajector* is the object that is being located in respect to another (typically larger) object. In a scene that involves movement, the trajector is usually the object that is moving and is the focus of attention. The *landmark* is typically a larger object that is used to locate the trajector. For example, the table, in the sentence *The plate is on the table*, serves as the landmark element, and the plate is the trajector. The vantage point is the imagined perspective from which the scene is being viewed. Tyler and Evans claim that English prepositions are generally polysemous, and that the various senses of a preposition tend to occur in semantic networks in which the preposition's "proto-scene" (which is not necessarily its most

frequent sense) is extended to other senses, which may, in turn, be further extended to yet other senses (Tyler & Evans, 2003, p. 52).

Much of the early work on the semantic of prepositions focused on topographical features. This approach has been criticized by researchers within the cognitive linguistics tradition (Cienki, 1989; Tyler & Evans, 2003) since such descriptions fail to provide an adequate account of the semantic range of prepositions. Herskovits (1986) gives the example of a lightbulb that is hanging downward from a light socket, noting that we would typically describe this in English as a bulb "in the socket" (p. 16). The preposition *in*, in this case, captures salient functional features of the relationship between the trajector and landmark, namely, the functional role of the socket in ensuring that the bulb remains in a fixed location. In other words, *in* reflects a generalization over the containment schema: the use of containers to maintain objects in a fixed place so that they can be easily located, or in this case, so that the trajector element (the lightbulb) can remain in place so as to perform its technological function of providing light.

Another key concept within cognitive linguistics that is relevant to the analysis of prepositions is *embodiment* (Gibbs, 2005, 2017; Varela et al., 1991). This is the notion that "language and thought" are grounded in human beings' "subjective, felt experiences of their bodies in action" as they engage in recurrent "dynamic interactions" with their environment (Gibbs, 2005, p. 9). Functional features are related to embodiment. As applied to language, embodiment implies that speakers create semantic categories that reflect typical human interactions with entities within typical situations. Native speakers' sensitivity to functional features has been demonstrated in a number of experimental studies (e.g., Coventry et al., 1994; Coventry & Prat-Sala, 2001). For example, Garrod et al. (1999), in their first experiment, showed participants various scenes in which a glass bowl contained a table tennis ball. Three factors were manipulated: (1) the position of the ball relative to the bowl, (2) the degree to which the ball was surrounded by other balls, and (3) the ball's attachment to an alternative source of control (i.e., a wire hanging down from above). The participants were asked to rate the degree to which various prepositions could appropriately describe the scene. Findings showed that functional considerations significantly altered participants' intuitions regarding the appropriateness of the prepositions.

Within prepositional networks, landmarks and trajectors are often physical objects, yet this is not always the case. In many instances, prepositions form figurative expressions in which the landmark and trajector elements are extended, often metaphorically or metonymically, to refer to abstract situations. For example, the preposition *in*, as it occurs in the sentence, *I'll arrive in 15 minutes*, evokes a metaphorical construal of a situation where time is conceived of as a landscape stretching out in front of the speaker, and the speaker's arrival is predicted to occur within that landscape (Gentner et al., 2002; Matlock et al., 2005). Empirical research has shown that relative to other word classes, prepositions are far more likely to be metaphorical (Steen et al., 2010).

Difficulty in the L2 Acquisition of Prepositions

English prepositions occur frequently in both written and oral discourse. In the Brown Corpus (Francis & Kučera, 1982), a million-word collection of diverse written

texts, prepositions account for 12% of all tokens and thus occur more frequently than adjectives, pronouns, and adverbs (p. 547). Among the 20 most frequently occurring words in the Brown Corpus, nearly half (i.e., 9) are prepositions. Ceteris paribus, this high frequency would predict that prepositions (or at least, *frequently occurring* prepositions) should be relatively easy to learn; however, as noted by numerous researchers (e.g., Gilquin & Granger, 2011; Littlemore & Low, 2006), prepositions often pose a challenge to L2 learners.

This difficulty has been confirmed in numerous studies of L2 learners' errors. For example, Jiménez Catalán (1996), in an examination of a learner corpus of 290 essays by Spanish secondary school students, found that among the participants' top errors, substitution of a preposition was the most frequent (11.9%), incorrect addition of a preposition the sixth most common (3.2%), and omission of a preposition the seventh most common (3.7%). Similarly, Cronnell (1985), in an analysis of Mexican-American third- and sixth-grade student writing, found that prepositions posed the greatest vocabulary problem for students in their English production. Even highly proficient learners have been shown to experience problems. Ene (2008), in an analysis of texts written by advanced English learners, found numerous preposition errors, particularly among southeast-Asian and Chinese L1 students. She found that most of these errors occurred with nouns or verbs that could collocate with multiple prepositions (e.g., *plan to*, *plan about*, *plan on*).

Issues with prepositions also affect L2 academic writing. Lee et al. (2020) examined Korean university students' use of lexical bundles in their academic English. They found that preposition-based bundles occurred less frequently in learner English than in texts by native speakers. They noted that although the lexical bundle preposition error rate was quite low (7.1%), this was likely due to the fact that these L2 writers made use of only a very limited set of lexical bundles.

Learners of L1s with many English cognates can be expected to learn English with greater ease due to the possibility of positive transfer from their L1. Even so, some research shows that prepositions continue to present challenges even for speakers of languages typologically close to English. Lennon (1991) conducted a longitudinal study of four advanced German learners studying at a British university in which the participants provided narrations of picture stories. He found that 22% of the errors in the corpus were due to inaccurate prepositions or, in a small number of cases, mistakes with adverbial particles (e.g., *got up* in place of *got off*). Lennon also found that prepositional and adverbial particle errors showed less improvement over the six-month course of the study.

The difficulties discussed thus far can be attributed to the collusion of several factors. First, polysemy is a perennial problem in L2 acquisition as it requires the learner to associate multiple meanings with a single form. This reduces the contingency of the form-meaning association, making the mapping more difficult to learn (Beckner et al., 2009; Ellis et al., 2015). Prepositions, along with other function words, also tend to be unstressed (Swan, 2017, Section 27). As a result, they are phonologically less salient and thus more difficult to acquire (Collins et al., 2009). Finally, prepositions often receive inadequate treatment in pedagogical materials, which sometimes ignore the ways in which more central meanings are extended to abstract senses.

Types of Knowledge

When considering L2 acquisition of specific areas of language, it has been widely recognized that researchers need to approach L2 learners' internal representations of a language as a dynamic system of its own that exists apart from the target language (Selinker, 1972, 1992), while keeping in mind that the task of characterizing this system if fraught with complexity (Bley-Vroman, 1983). Nonnative Speakers' (NNSs) prepositional semantics can be characterized in a number of ways based on theoretically posited encoding mechanisms and processes, representational formats of the linguistic knowledge, and retrieval processes. To better understand acquisitional processes, it helps to consider key theories of how categories are formed and accessed.

Within the literature on categorization, there has been an ongoing debate regarding which theories best account for empirical data. There is also a debate regarding the extent to which the abstract experimental paradigms used in this field of research are valid reflections of categorization processes in the real world. While the traditional account of categories based on definitions and criterial features is no longer considered plausible by most in the field, researchers continue to argue for diverse accounts, most of which are based on prototype theories, exemplar theories, or the theory paradigm.

Prototypes (Hampton, 2006; Rosch & Mervis, 1975) are based on statistical knowledge regarding the properties possessed by members of a class. Their cognitive efficiency is thought to be derived from the fact that they represent the maximal number of features that are similar to other class members while possessing the minimal number of features similar to items outside of the class (Rosch, 1978). For example, a prototypical bird flies, is small, builds a nest, and so on, whereas birds at the periphery of the category (e.g., penguins) may lack these features while possessing features common to other contrasting categories (e.g., they swim like fish). In empirical research, category prototypes have been identified based on several behavioral measures that show a so-called *typicality effect*. For example, more prototypical members of a category are described as more typical of a category, and are named first, named more rapidly, and identified (as members of a category) more quickly and more accurately (Rips, Shoben, & Smith, 1973; Rosch, 1973a, 1973b, 1975). These effects have been shown to persist even when overall frequency of newly learned items' occurrence is controlled (Rosch, Simpson, & Miller, 1976). Moreover, prototypes are thought to be the members of a category that are learned first due to the saliency of their key attributes (Rosch, 1973b).

Exemplar categorization (Brooks, 1978; Medin & Schaffer, 1978) involves the classification of items based on a small set of individual items retrieved from long-term memory. It should be noted that the stored items need not constitute a fixed set. For example, classification may be based on exemplars that are recalled due to the use of heuristics such as recency or frequency. Both prototype and exemplar classification are ultimately based on similarities, and both cognitive processes have been proposed as underlying categorization in language (e.g., Logan, 1988; Taylor, 2008).

The theory paradigm holds that categorization and related processes are based on knowledge akin to theories. Just as scientific theories provide us with explanations of phenomena, our concepts are thought to include causal and functional propositions (e.g.,

knowledge that birds' wings enable them to fly). While much of the research on categorization has involved debates between proponents of prototypes, exemplars, and occasionally, theory paradigms, it has also been suggested by some researchers (e.g., Machery, 2009) that these three types of categorization may all occur as distinct processes, which perhaps operate synergistically or as alternatives. In the latter case, preference for a particular type of categorization may be cued by factors such as the type of cognitive task or the task conditions.

Among these three views on categorization, prototypes have been the primary focus of research on interlanguage semantics. An interesting line of research has sought to establish NSs'and NNSs' prototype representations of target linguistic forms based on the typicality effect. In a typical investigation of this type, Hayashi (2009) asked 114 Japanese learners and 24 English NSs to write one sentence for each of the three prepositions *at*, *in*, and *on*. The NNSs were divided into three groups: first-year, second-year, and third- or fourth-year university students. Prepositional senses were divided into spatial, temporal, abstract, and other senses. Analysis of the sentences produced by the participants showed that NSs considered the spatial senses to be most prototypical, although it must be noted that 25% of their sentences for *at* involved temporal meaning. Only the first-year students displayed notable divergence from this general pattern, producing more sentences in which *at* had a temporal sense (47.5%) than sentences involving a spatial sense (42.5%). The prototypes for *at*, *in*, and *on* for the participants in higher grades showed increasing convergence with those of NSs.

Hayashi's (2009) results were largely in line with a similar study by Rice (1996) that examined NNSs' prototypes for the same three prepositions. In his discussion of his results, Hayashi notes that a large proportion of the NNS participants' sentences using the temporal meaning of *at* could be translated using Japanese *-ni*, while many of the sentences using the spatial sense of *at* could be rendered using Japanese *-ni* or *-de*. Hayashi thus suggests that the participants, in their acquisition of prepositions, may be affected by a default strategy in which target language forms are first mapped onto the semantics of a single L1 form (cf. Andersen, 1984; Tanaka, 1983). These acquisitional patterns reflecting cross-linguistic influence will be taken up again later in this paper.

When examining learners' acquisition of grammar and function words, it is often difficult to determine whether learners have, through rote memorization, simply acquired the ability to use the target structure as part of fixed phrases or have more native-like representations that allow for more productive employment of the target forms. Mueller (2011) directly examined this issue as it relates to prepositions. His study examined the performance of Chinese-L1 (n = 30), Korean-L1 (n = 30), and Spanish-L1 (n = 30) learners of English on a fill-in-the-blank test in which participants had to supply the appropriate preposition from a wide range of choices. The learners were mostly graduate students attending a university in the U.S. The study's key innovation was the inclusion of two test items targeting each prepositional sense. The preposition in the high-frequency item occurred with a frequently collocating noun or verb (e.g., *control over*). The preposition in the low-frequency item occurred within a collocation that had much lower frequency (e.g., *influence over*). Frequencies were confirmed using the American National Corpus (Reppen, Ide, & Sunderman, 2005). Results showed that for all three groups, accuracy on items was affected by the collocational frequency of the phrase in which the preposition was embedded ($p < .001$).

Mueller's (2011) results suggest that L2 learners, even at high levels of proficiency, often rely on syntagmatic knowledge to overcome deficits in their semantic knowledge of prepositional meaning. The findings were consistent with some error analysis research (e.g., Ene, 2007) suggesting that verbs that collocate with multiple prepositions tend to elicit more errors among L2 learners. This suggests that NNSs are adopting a strategy that involves the rote learning of prepositions based on their co-occurrence with certain verbs, and that the strategy fails when a verb collocates with multiple prepositions.

As an initial hypothesis, it might be assumed that learners, in their acquisition of prepositions, progress from cognitively basic to extended meanings, yet research suggests that the picture is not so simple. For example, Lam's (2018) study of adult learners of Spanish concluded that a host of other factors to include collocational patterns, frequency, saliency, and cross-linguistic transfer are needed to account for patterns of acquisition.

Crosslinguistic Influence and the Acquisition of Prepositions

Jarvis and Pavlenko (2008) define *crosslinguistic influence* as "the influence of a person's knowledge of one language on that person's knowledge or use of another language" (p. 1). Early interests in crosslinguistic influence was fostered by work by Lado (1957) and others (e.g., Stockwell et al., 1965) who felt that difficulties in L2 acquisition could be largely predicted by differences between the L1 and L2 (which were thought to cause *negative* transfer) and similarities (which were thought to facilitate *positive* transfer). After an initial flurry of activity, research on transfer waned as SLA researchers failed to find confirmation for some of the stronger predictions regarding the role of transfer. In the last three decades, crosslinguistic influence has re-emerged as an active area of SLA research, largely due to the work of Odlin (e.g., 1989, 2003) and Jarvis (e.g., 2000, 2016).

Transfer can affect language acquisition in various ways. Broadly speaking, it can involve meaning or form. Meaning-related transfer can be triggered by similarities between L1 and L2 semantic categories; whereas form-based transfer is triggered by phonological similarities (or orthographical similarities, in the case of writing) between the target language and previously acquired languages. Form-based similarities are said to be more influential at the early stages of L2A. For example, Lowie and Verspoor (2004) have shown that Dutch learners of English are initially able to benefit from positive transfer due to formal similarities between L1 and L2 prepositions. However, they note that this positive transfer only played a role for prepositions with relatively lower frequencies of occurrence. This suggests that implicit and explicit learning based on frequent exposure to target forms in the input drowns out the effects of transfer.

Other research has demonstrated interactions between prototype effects and transfer. Highly salient core semantic categories (which, due to their salience, tend to be similar crosslinguistically) tend to be subject to positive transfer while remaining relatively immune from negative transfer (Tanaka, 1983). On the other hand, subtle differences between semantic categories tend to be difficult to learn. In the case of prepositions, these differences often involve the weightings ascribed to key semantic dimensions. For example, Ijaz (1986) suggests that German learners of English, in their understanding of English *on*, show a tendency to underestimate the relevance of contact

between the trajector and landmark while overemphasizing the relevance of the trajector's movement. Ijaz attributes this interlanguage pattern to subtle differences between English *on* and German *auf*. While similar in many ways to English *on*, *auf* corresponds to motional meanings of English *up* when used for situations in which the landmark and trajector are noncontiguous.

So far, the discussion has focused on transfer related to specific features of prepositions, but more general patterns of acquisition must also be considered to fully account for crosslinguistic influence on prepositional use. In contrast with many languages, English has a profusion of prepositions, which are used to convey a wide range of meanings. The same word forms with related senses also do double-duty as components in particle verbs such as *hang out* and *sleep in* (see Luo, 2019). Prepositional meanings may be conveyed by similar adpositions in other languages, but quite often, the same meanings, if expressed at all, are conveyed through other parts of speech. This can pose challenges to L2 learners who must acquire general knowledge regarding which meanings tend to be lexicalized and grammaticalized in the target language (Slobin, 1991).

Mueller's (2012) study suggests that some acquisition patterns may reflect the lack of close analogues to certain English prepositions in learners' L1s. One prominent pattern is learners' tendency to avoid certain prepositions when writing English. Mueller found that avoidance was especially common for the preposition *at*, which seems to lack an analogous equivalent in many languages. To provide empirical support for such avoidance, Mueller (2012) compared frequencies for various English prepositions in NS corpora with their frequencies in the International Corpus of Learner English (Granger, Dagneaux, Meunier, & Paquot, 2009), a corpus of essays written by L2 learners of English. Among participants from 16 L1 backgrounds, Japanese learners showed a particularly strong tendency to avoid prepositions. This probably reflects that fact that Japanese post-positions (the closest Japanese equivalent to English prepositions) tend to convey very general meaning. Moreover, learners from various L1s demonstrated a tendency to overuse or, more commonly, underuse particular prepositions. For example, Chinese participants avoided *with* and *without*; Italian and Tswana speakers avoided *on*; Spanish speakers avoided *from*; Turkish speakers avoided *into*; and Russian speakers avoided *through*. In a few cases, certain L1 groups used certain prepositions more than NSs. Mueller's study should be viewed as exploratory. The discrepancies he noted could be artifacts of the essay prompts, or it could be that the genres of writing in the NS corpora diverged excessively from that of the ICLE essays, rendering comparisons invalid. Hopefully, future researchers can perform more fine-grained comparisons that delve into the particular L1 features that could explain discrepancies in preposition use among NSs and NNSs from particular L1 groups.

Critical Period Effects

Some research (e.g., Hayashi, 2009) suggests that adult L2 learners' representations of the semantics of English prepositions eventually converge, to a large extent, with those of NSs. Yet, it is still not clear whether some prepositional uses fail to be perfectly acquired. Prepositions are generally regarded as function words (i.e., words denoting abstract structural relationships) as opposed to content words. This raises the

possibility that this class of words, like some grammatical words, resists full acquisition by adult learners.

A number of studies examining the so-called "critical period" for language acquisition (e.g., Coppieters, 1987) have shown that adult NNSs fail to master some subtleties of an L2. Generally, these studies show that while prepubescent learners, given sufficient time in an L2 environment, master the semantics of most grammatical forms, older learners' ultimate attainment, even after many years, exhibits subtle (and often not so subtle) divergence from NS norms (DeKeyser, 2000; Johnson & Newport, 1989, 1991). Some other studies (Birdsong, 1992; Ioup et al., 1994) have put forth empirical findings to support the counterargument that some NNSs, even when learning an L2 as an adult, manage to achieve native-like proficiency.

Munnich (2002) conducted one of the few studies to examine critical period effects and the acquisition of the semantics of prepositions. He analyzed the linguistic performance of Korean and Spanish speakers who had arrived in the U.S. between the ages of nine months and 39 years. The 60 participants were divided into even groups based on age of arrival (AOA) in the U.S. His groups thus consisted of 20 early learners (AOA < 8), 20 preadolescent learners (AOA = 8 to 13), and 20 late learners (AOA > 13). The participants performed an elicitation task and a sentence-rating task. His results demonstrated a decline by AOA level. In particular, the late learners experienced difficulty with contrasts between *on* and *in*, especially when the choice of preposition relied heavily on functional information.

Effects of Instruction

Much of the analysis of the semantics of prepositions has been conducted by scholars working within the framework of Cognitive Linguistics (CL), so it comes as no surprise that investigations into pedagogical approaches to prepositions have also nearly all adopted this framework. The empirical work in this area has typically involved experiments comparing conventional instructional methods with CL-based approaches. The latter often involve the use of simple schematic diagrams designed to highlight the relevant features (e.g., landmark and trajector configurations) that motivate key semantic contrasts. CL-based research using diagrams has examined the acquisition of English modals (Tyler, Mueller, & Ho, 2010), double-object constructions (Tyler, Ho, & Mueller, 2010), causative verbs (Mueller & Tsushima, 2019), conditionals (Jacobsen, 2018), and prepositions (Arnett & Deifel, 2015; Boers & Demecheleer, 1998; Buescher & Strauss, 2015, 2018; Cho, 2010; Lam, 2009; Matula, 2007; Song et al., 2015; Tyler et al., 2011).

As an example of the latter, consider LeTexier's (2019) study comparing the effectiveness of CL-based versus translation-based instruction targeting polysemous Spanish spatial prepositions. His participants were English-L1 *ab initio* learners. He found that both pedagogical approaches resulted in gains on an immediate posttest; however, the CL-based approach resulted in greater long-term production knowledge. Moreover, he found that the CL-based approach was particularly effective for overcoming some of the disadvantages experienced by learners with lower working memory.

Research showing the effectiveness for CL-based approaches has led to some recent research that has examined the effectiveness of such approaches when

implemented as online lessons. For example, Wong et al. (2018) examined the usefulness of computer-delivered CL-based lessons that provide feedback in the form of schematic diagrams, metalinguistic rules, or information regarding the correctness of participants' responses. Among the three treatment groups, only the schematic diagram group received instruction explaining the links between spatial and nonspatial senses. Their results indicated that all three groups improved, as measured by a fill-in-the-blanks test and a translation test. On the latter, the schematic diagram group outperformed the correctness feedback group.

A recent study by Zhao et al. (2020) combined behavioral measures of computer-delivered CL-based instruction with electrophysiological (ERP) measures. The study examined the effects of instruction on two groups of Chinese-L1 university students. One group received CL-based feedback and the other only received correctness feedback. During the instruction, participants saw a picture paired with two contrasting sentences, only one of which correctly described the picture. They were asked to select the correct picture, after which they were given immediate feedback. The correctness feedback simply informed participants whether their response was correct, whereas the CL-based feedback showed a relevant schematic diagram of the prepositional sense along with a short explanation. The instruction targeted spatial and extended senses of the prepositions *in*, *at*, and *over*. Measures included a processing-based acceptability judgment test (AJT) and a translation test, both given as both pre- and post-tests. During the AJT test, participants were shown correct, incorrect, and distractor sentences as their responses and brain imaging data were recorded. In the results, the group receiving CL-based feedback significantly outperformed the group receiving only correctness feedback on the translation test. Further analysis showed that this advantage was only true for the lower-proficiency participants. Participants' reception of CL-based feedback also led to greater changes in brain potentials related to sensitivity to semantic violations (e.g., responses when participants read sentences with inappropriate prepositions).

In general, research shows that instruction using schematic diagrams to convey the semantics of prepositions based on the CL framework is more effective than conventional approaches. Several studies suggest that this is especially true for lower proficiency learners and with learners with lower working memory (which is generally associated with lower language learning aptitude). While this body of research has reported fairly consistent results, it should be interpreted with caution. In some cases, such as the Zhao et al. (2020) study, the CL-based instruction and the comparison group's instruction seem to differ not only in terms of type of instruction but also in terms of the amount of content. On the other hand, the authors' use of ERP measures is to be lauded as an exciting innovation in this area, as it provides some evidence for actual changes in processing among NNSs even after a short session of CL-based instruction.

Relevance of Previous Research Findings for Future Research and Pedagogy

In the future, researchers investigating the acquisition of prepositions can refine their methodological approaches in several ways. First, there is need for precision when discussing the central meaning of a preposition. For some researchers (e.g., Correa-Beningfield, 1985; Rice, 1996), centrality is operationalized in terms of a prototype.

Quite often, NSs' prototype could be expected to coincide with the central member of a polysemy network, but this need not be the case. It is logically possible for a central sense to lose its prototype status within the minds of language users even though it continues to motivate (directly or indirectly) all extant senses within a network. Centrality can also be confused with frequency since more central senses tend to be (but are not always) more frequent when frequency is operationalized through corpus analysis.

Research also needs to distinguish between NSs' and NNSs' knowledge of prototypes, network centrality (the "proto-scene" in Tyler and Evans, 2003), and sense frequency, on the one hand, and chunk-based knowledge, on the other. Syntagmatic knowledge can be viewed as a crutch that allows L2 learners to achieve accuracy even when their interlanguage lacks precise knowledge of the target prepositional sense (Mueller, 2011). Yet at the same time, it should be acknowledged that the practical pedagogical issue arises from learners' lack of semantic knowledge; syntagmatic knowledge is not, in itself, a problem. Such knowledge, after all, is possessed by native speakers who use unanalyzed chunks to speed production and rapidly process input (Vogel Sosa & MacFarlane, 2002; Wray, 2002).

At a more fundamental level, research in this area may also benefit from greater integration with research on categorization (for a general account, see Taylor, 2003). Cognitive linguists have focused on prototypes, but discussions surrounding the acquisition and representation or form-meaning mappings may benefit from research conducted within the theory paradigm (Murphy & Medin, 1985; Rehder, 2006). This work, much of which focuses on the role of causation in categorization, seems to be particularly compatible with theories of embodiment, which emphasize the importance of bodily action and goal-directed activities. In fact, much of the research on the relevance of functional features in NSs' representations of prepositional semantics provides direct support from the theory paradigm, which maintains that knowledge of categories is quite rich and multi-dimensional.

Even exemplar-based categorization should be considered as providing potentially rich insights into learning. In particular, researchers should be open to the possibility that *initial* development of a semantic category is strongly affected by exemplars. This would be consistent with the suggestions of some researchers (e.g., Smith & Minda, 2000) who have argued that exemplar categorization simply reflects default strategies when categories have few members and are poorly differentiated. If this is the case, exemplar categorization may be the default during early L2 learning of a category. If so, the appropriateness of a preposition may initially be determined by the similarities between the target preposition's context (e.g., the collocating verb or noun) and a small set of exemplars that the learner retrieves from long-term memory.

In regard to pedagogy, the results suggest possible benefits of using simple diagrams to convey CL-based insights into the semantics of prepositions (Liu & Tsai, 2021). Yet care must be taken to ensure that the diagrams are readily understood and are rapidly processed by L2 learners. The occasional failure to show advantages for CL-based instruction over some conventional approaches in empirical studies (e.g., Mueller & Tsushima, 2019) when the comparison treatment is closely matched for time on task may be due to learners' relative unfamiliarity with cognitive linguistic approaches to meaning, and conversely, with their familiarity with conventional approaches such as instruction relying on L2 to L1 translation.

Of course, conventional instruction has often relied heavily on the provision of translation equivalents when teaching prepositions. In addition, some instructors, if they are unfamiliar with the CL literature, assume that most prepositional use is unmotivated. They therefore advise students to rely on rote memorization of prepositions as they co-occur with certain verbs and nouns. While translation and chunk learning undoubtedly have their place in L2 learning, caution is warranted. Translation equivalents are not exact. Learners who fail to appreciate the degree of mismatch between L1 and L2 semantic categories may stagnate in their development of prepositional knowledge. Chunk learning is also an imperfect strategy since many verbs and nouns can take multiple prepositions, with the choice motivated by important differences in intended meaning. Compare, for example, the differences among the following three sentences:

(1) *They whistled at the girl walking by.*
(2) *He whistled to his girlfriend across the street*.
(3) *He whistled for a cab*.

Due to the differences in prepositional choice (i.e., *at*, *to* and *for*), the understanding of whistling is markedly different in the three sentences, ranging from the offensive whistling in the first sentence, the communicative whistling in the second sentence, and the purposeful whistling in the third. These differences also appear when *at*, *to*, and *for* occur with other verbs related to communication (e.g., *yell*). For this reason, rote learning of verb-preposition combinations would seem to be less effective than instruction focusing directly on prepositional meaning. Chunk-based strategies are also doomed to fail at higher levels of acquisition as learners attempt to use prepositions with low frequency verbs and nouns. A strategy of learning collocational patterns for every newly acquired lexical item would thus seem to be both quixotic and futile.

Pedagogical approaches to prepositions should therefore be aimed at identifying problematic areas for a given L1 group, and then targeting the problematic senses with a focused treatment that shows how extended meanings are related to more central meanings in a motivated manner (Boers & Demecheleer, 1998). Effective instruction for this part of speech is critical in light of the high frequency of prepositions in both spoken and written English.

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