ABSTRACT

Title of Dissertation: COMPARISON OF AN INTEGRATIVE INDUCTIVE APPROACH, PRESENTATION-AND-PRACTICE APPROACH, AND TWO HYBRID APPROACHES TO INSTRUCTION OF ENGLISH PREPOSITIONS

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Certain semantic categories, such as the polysemous senses of English prepositions, present specific problems for adult second language (L2) learners, whether they attempt to acquire these meanings through implicit learning mechanisms or through explicit mechanisms associated with incidental learning or instruction. This study examined research on categorization and practice, along with results of learner corpus analyses, to arrive at a characterization of the learning problem posed by English prepositions. An experiment then assessed the effectiveness of a novel pedagogical intervention called semantic highlighting (SH), which employed an inductive, integrative approach to the acquisition of procedural knowledge while accounting for some of the distinctive features of the learning problem posed by polysemy and semantic complexity. A between-subject comparison examined the performance of a control group and four treatment groups. One treatment group (D-P) received explicit explanations of the senses of various prepositions, followed by practice with immediate feedback. Another group (SH) received only a practice session in which cues, referred to here as "semantic highlighting" (SH), were used to draw participants' attention to concrete form-meaning mapping as it applied to the target sentences. The other two treatment groups received hybrid instruction with explicit explanations preceding SH practice (D-SH) or with SH practice preceding explicit explanations (SH-D). Acquisition was measured using a fill-in-the-blanks (FB) test and a written sentence-elicitation (SE) test that was scored using a target-language use analysis (Pica, 1984). Two ANCOVAs, using pretest scores as a covariate, showed significant differences between groups on the FB measure ($p < .001$) and SE measure ($p < .001$) at an alpha level of .025. On the FB test, results indicated an advantage for the SH ($p < .001$) group relative to the SH-D group. On the SE measure, the SH group outperformed the D-P ($p = .010$), SH-D ($p = .013$), and D-SH ($p = .002$) groups. The results suggested that the SH treatment, and possibly the D-SH treatment, as well, constitute viable alternatives to a conventional presentation-and-practice approach when teaching complex semantic targets. The results were further discussed in terms of implications for theoretical accounts of explicit instruction and categorization.

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by

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Table of Contents

Acknowledgments…… ii
Table of Contents…… iii
List of Tables…… vi
List of Figures…… vii
Chapter 1: Introduction…… 1
Chapter 2: Cognitive Linguistics and the Usage-based Framework…… 4
Chapter 3: Theoretical Accounts of Polysemy…… 6
3.1 Classical Models…… 6
3.2 Prototypes and Family Resemblance…… 7
3.3 Functional Features and Schemas…… 10
Chapter 4: Evidence of Difficulties in the L2 Acquisition of Polysemy…… 18
Chapter 4.1 Error Analyses…… 20
Chapter 4.2 Effects of Instruction…… 23
Chapter 4.3 Competence Deficits…… 24
Chapter 4.4 Critical Period Effects…… 25
Chapter 5: Factors Leading to Difficulty…… 28
Chapter 5.1 Complexity of Meaning…… 28
Chapter 5.2 Redundancy and Optionality…… 29
Chapter 5.3 Effects of Non-optimal Strategies…… 30
Chapter 5.4 Opacity of Form-meaning Mapping…… 30
Chapter 5.5 L1 Influence…… 31
Chapter 6: Indications of L1 Influence in a Learner Corpus…… 34
Chapter 6.1 Crosslinguistic Comparison of Preposition Use…… 34
Chapter 6.1.1 Theoretical Background…… 34
Chapter 6.1.2 Method…… 35
Chapter 6.1.3 General Research Questions…… 39
Chapter 6.1.4 Results…… 39
Chapter 6.1.5 Discussion…… 63
Chapter 6.2 Analysis of Chinese Learners of English…… 66
Chapter 7: Categorization…… 70
7.1 Theories of Categorization…… 70
7.1.1 Rule-based Accounts…… 71
7.1.2 Prototype Accounts…… 72
7.1.3 Exemplar-based Accounts…… 73
7.1.4 Hybrid Accounts…… 75
7.2 Attention and Categorization…… 77
7.3 Task Orientation, Category Type, and Performance Variables…… 79
7.4 Generalizability of Categorization Findings…… 82
Chapter 8: Explicit Instruction and Practice…… 88
8.1 Cognitive Architectures…… 88
8.1.1 ACT-R (Adaptive Control of Thought—Rational)…… 89
8.1.2 Clarion (Connectionist Learning with Adaptive Rule Induction ON-line).. 92
8.2 AG Research…… 95

8.3 Explicit Instruction and Practice in SLA………………………………….. 100
Chapter 9: Potential Advantages for Instructional Treatments……………………. 109
9.1 Family-resemblance Versus Categories With Clear Criterial Features………. 111
9.2 Integrated Approach Versus Presentation-and-Practice Approach………….. 111
9.3 Inductive Learning to Maximize Proceduralization…………………………. 113
9.4 Holistic Versus Analytic Processing……………………………………….. 114
9.5 Individual Differences and Potential Interactions With Treatments…………. 116
9.6 Possible Synergies Between Instructional Approaches……………………… 117
Chapter 10: Semantic Analysis of Prepositional Senses in Instructional Targets… 119
10.1 Analysis of *To*……………………………………………………………. 123
10.1.1 Transfer………………………………………………………………… 123
10.1.2 Affecting Attitude or Behavior……………………………………….. 124
10.1.3 Perception……………………………………………………………….. 124
10.1.4 Contact………………………………………………………………… 125
10.1.5 Limit…………………………………………………………………… 125
10.1.6 Attachment……………………………………………………………... 126
10.2 Analysis of *For*…………………………………………………………... 126
10.2.1 Oblique Intention……………………………………………………... 126
10.2.2 Purpose………………………………………………………………… 127
10.2.3 Grounds…………………………………………………………………. 128
10.2.4 Situational Valence……………………………………………………. 128
10.2.5 Benefit…………………………………………………………………. 132
10.2.6 Proxy…………………………………………………………………... 132
10.2.7 Exchange……………………………………………………………….. 133
10.3 Analysis of *At*……………………………………………………………. 134
10.3.1 Measure………………………………………………………………… 134
10.3.2 Search for Contiguity………………………………………………… 135
10.4 Analysis of *On* and *In*……………………………………………………. 135
10.4.1 Resemblance to Visual Feature………………………………………. 135
10.4.2 Communicative Media as Support…………………………………… 136
10.4.3 Volitional Exceptional State…………………………………………. 137
10.4.4 Affecting Condition…………………………………………………… 137
10.5 Analysis of *Over* and *Above*………………………………………………. 138
10.5.1 Control………………………………………………………………….. 139
10.5.2 Covering……………………………………………………………….. 139
10.5.3 Preclusion of Potential for Contact or Influence……………………… 140
10.6 Analysis of *With*………………………………………………………….. 141
10.6.1 Instrumentality………………………………………………………… 141
10.6.2 Theme-marking……………………………………………………….. 141
Chapter 11: Hypotheses…………………………………………………………. 143
Chapter 12: Current Study………………………………………………………. 146
12.1 Method…………………………………………………………………….. 147
12.1.1 Participants……………………………………………………………. 147
12.1.2 Materials………………………………………………………………. 150
12.1.3 Measures………………………………………………………………. 167
12.1.4 Procedure……………………………………………………………… 175

12.1.5 Analysis……………………………………………………………….….... 178
12.2 Results…………………………………………………………………………. 179
12.2.1 FB Descriptive Results……………………………………………………... 179
12.2.2 SE Descriptive Results………………………………………………………181
12.2.3 FB Inferential Statistics…………………………………………………… 186
12.2.4 SE Inferential Statistics…………………………………………………….. 198
12.3 Discussion………………………………………………………………………203
Chapter 13: General Discussion and Conclusion……………………………………...211
13.1 Summary of Findings……………………………………………………… 211
13.2 Implications………………………………………………………………… 218
13.3 Additional Considerations…………………………………………………. 220
13.4 Future Directions…………………………………………………………… 224
Appendix A: English Preposition Use in NS Corpora (first half)………………… 233
Appendix B: English Preposition Use in NS Corpora (second half)……………… 234
Appendix C: English Preposition Use in ICLE (Germanic Languages)…………... 235
Appendix D: English Preposition Use in ICLE (Romance Languages)………….. 236
Appendix E: English Preposition Use in ICLE (Slavic Languages)………………. 237
Appendix F: English Preposition Use in ICLE (Non-Indo-European Languages)…238
Appendix G: Questionnaire……………………………………………………… 239
Appendix H: Fill-in-the-Blanks Test (Form A)…………………………………… 240
Appendix I: Fill-in-the-Blanks Test (Form B)……………………………………. 248
Appendix J: Sentence Elicitation Measure Items (Form A)………………………. 256
Appendix K: Sentence Elicitation Measure Items (Form B)……………………… 259
Appendix L: Sentence Elicitation Measure Answer Sheet (Form A)…………….. 262
Appendix M: Sentence Elicitation Measure Answer Sheet (Form B)……………. 266
Bibliography………………………………………………………………………. 270

List of Tables

Table 1 *ICLE Subcorpora Used in the Learner Corpus Analysis*……......... 38
Table 2 *Patterns of Preposition Use in the ICLE Chinese Subcorpus*…….. 68
Table 3 *Occurrence of Prepositional Senses in Treatments and Two Experimental Measures*…………………………………………… 174
Table 4 *Sequencing of Experimental Tasks in Study*……............................ 175
Table 5 *Descriptive Statistics for Fill-in-the-Blanks Pretest*……................. 180
Table 6 *Descriptive Statistics for Fill-in-the-Blanks Posttest*……................. 180
Table 7 *Descriptive Statistics for Sentence Elicitation Pretest's TLU Analysis*……... 183
Table 8 *Descriptive Statistics for Sentence Elicitation Posttest's TLU Analysis*……... 183
Table 9 *Descriptive Statistics for Sentence Elicitation Pretest*……............. 186
Table 10 *Descriptive Statistics for Sentence Elicitation Posttest*……...........186
Table 11 *Boundary Conditions (Lower Bound) for Significant Effects of Treatment Type on FB Posttest Scores*…………………………………195
Table 12 *FB Pretest to Posttest Gains for the Five Experimental Groups*.. 198
Table 13 *SE TLU Pretest to Posttest Gains for the Five Experimental Groups*…….. 202
Table 14 *Status of Eight Hypotheses Based on Experimental Findings*…... 208

List of Figures

Figure 1. Iconic representation of the schema for the proto-scene for *in*………… 13
Figure 2. Iconic representation of the schema for *in* when vantage point has shifted to interior of landmark……………………………………………. 14
Figure 3. Total frequency per million of prepositions in NS corpora and the ICLE…………………………………………………………………… 40
Figure 4. Frequency per million of preposition *of* in NS corpora and the ICLE… 42
Figure 5. Frequency of *in* in NS corpora and the ICLE…………………………. 43
Figure 6. Frequency of *to* in NS corpora and the ICLE………………………….. 44
Figure 7. Frequency of *for* in NS corpora and the ICLE…………………………. 46
Figure 8. Frequency of *with* in NS corpora and the ICLE……………………….. 47
Figure 9. Frequency of *without* in NS corpora and the ICLE……………………. 48
Figure 10. Frequency of *on* in NS corpora and the ICLE………………………… 51
Figure 11. Frequency of *at* in NS corpora and the ICLE………………………… 52
Figure 12. Frequency of *from* in NS corpora and the ICLE……………………… 53
Figure 13. Frequency of *into* in NS corpora and the ICLE………………………. 54
Figure 14. Frequency of *about* in NS corpora and the ICLE……………………… 55
Figure 15. Frequency of *through* in NS corpora and the ICLE…………………… 56
Figure 16. Frequency of *over* in NS Corpora and the ICLE……………………… 57
Figure 17. Frequency of *between* in NS corpora and the ICLE………………….. 59
Figure 18. Frequency of *after* in NS corpora and the ICLE………………………. 60
Figure 19. Frequency of *under* in NS corpora and the ICLE……………………… 61
Figure 20. Frequency of *against* in NS corpora and the ICLE……………………. 62
Figure 21. Frequency of *during* in NS corpora and the ICLE……………………. 63
Figure 22. Iconic image used to convey basic schema for *to* in explicit presentations………………………………………………………………….. 152
Figure 23. Iconic image used to convey basic schema for the oblique intention sense of *for* in explicit presentations………………………………………. 153
Figure 24. Instructional slide from explicit presentation showing how the abstract schema for the oblique intention sense of *for* is instantiated in an actual sentence……………………………………………………….. 154
Figure 25. Example slide from explicit presentation showing important contrast between easily confused senses: the basic sense of *to* and the oblique intention sense of *for*…………………………………………………… 149
Figure 26. Sample slide sequence for practice phase of D-P condition………… 158
Figure 27. Four-slide sequence used in the instruction for the SH condition…… 162
Figure 28. Example item from the FB test, Form B…………………………….. 168
Figure 29. Sample slide used for sentence elicitation measure (SE Form B, Item 44)…………………………………………………… 171
Figure 30. SE Form B response sheet, Item 44…………………………………… 172
Figure 31. Five experimental groups' percentage correct on FB pretest and posttest………………………………………………………………… 179
Figure 32. Five experimental groups' percentage correct on SE pretest and posttest using TLU analysis……………………………………………… 182
Figure 33. Five experimental groups' percentage correct on SE pretest and posttest using raw scores………………………………………………….. 185

Figure 34. Scatter plot of FB pretest and posttest scores for the five experimental groups……………………………….. 189
Figure 35. Scatter plot showing FB regression slopes for SH and SH-D groups with boundary conditions for effect of Treatment Type……………………… 191
Figure 36. Scatter plot showing FB regression slopes for D-SH and SH-D groups with boundary conditions for effect of Treatment Type……………………… 193
Figure 37. Scatter plot showing FB regression slopes for SH and D-P groups…… 194
Figure 38. A scatter plot of the SE (TLU) pretest and posttest scores for the five experimental groups……………………………………………………….. 200

Chapter 1: Introduction

Some linguistic structures appear to be particularly difficult to learn either implicitly, through exposure to large amounts of input, or explicitly, through instruction (DeKeyser, 2003, 2005). This appears to be particularly true for certain categories of meaning, such as the senses of English prepositions. Learners who rely solely on implicit mechanisms to acquire patterns from the input may be deterred by first-language (L1) transfer effects, which lead to the creation of faulty second language (L2) categories and draw attention to irrelevant aspects of situations during both comprehension and production. L1 transfer and faulty attention allocations may also hamper learners as they employ explicit learning mechanisms to develop and test hypotheses regarding target meanings. Explicit instruction designed to alleviate learners' deficits in this area may have only limited success for semantically complex structures, due to the difficulty in encoding an adequate representation of the target meaning as declarative knowledge (for a related discussion, see DeKeyser, 2005). Even if learners are successful in creating appropriate declarative representations, they may fail to proceduralize this knowledge, due to the complexity of applying an intricate abstract representation to individual instances. Efforts at proceduralization may be further hindered by the typical time gap between explicit instruction and practice aimed at proceduralization.

These difficulties suggest the need for interventions that provide the flexible attention-guiding characteristics of conventional explicit instruction without the related costs in time and attentional resources. A recent artificial grammar (AG) learning study by Sallas, Mathews, Lane, and Sun (2007) included a proceduralization condition that hinted at a possible solution, as it provided sufficient explicit guidance for participants to carry out the practice tasks but did not expend time developing participants' declarative representations of the target grammar. The condition was found to promote accuracy, a characteristic of the crisp representations associated with declarative knowledge, and speed, a characteristic of procedural knowledge. The training condition could be described as inductive and integrative, as it facilitated participants' acquisition of the target structure (in this case, the AG grammar) in an instructional context that integrated the acquisition of declarative knowledge (albeit, in piecemeal form) and its proceduralization. The research presented here tested a similar pedagogical intervention called semantic highlighting (SH) that employs an inductive and integrative approach that takes into account some of the distinctive features of the learning problem posed by polysemy and semantic complexity.

The literature section of this dissertation discusses: (1) the Cognitive Linguistics (CL) and usage-based framework used for the semantic analysis of the prepositional senses targeted in the experiment, (2) the unique problems posed by polysemy, (3) the categorization problem related to developing new second language (L2) concepts corresponding to the polysemous meanings of English prepositions, and (4) the issues of learning and practice, especially as explicated through research on cognitive architectures, implicit and explicit cognitive processes, and L2 acquisition. To shed some light on whether L1 transfer plays a significant role in typical acquisition patterns of prepositions by L2 learners, an analysis of prepositional use was conducted, comparing the use of English prepositions in NS corpora and learner corpora. The paper then reports an experiment that examined the effectiveness of a computer-delivered presentation-then-practice approach to teaching prepositions relative to the SH approach and two hybrid approaches. The final section of the paper discusses the theoretical and practical importance of the study to second language acquisition (SLA), and the study's potential to constrain or support various theoretical accounts outside of SLA in the areas of categorization, implicit and explicit processes, and cognitive accounts of the effects of practice.

Chapter 2: Cognitive Linguistics and the Usage-based Framework

The theoretical framework adopted in this paper is based on certain assumptions regarding linguistic representation, language acquisition (both L1 and L2), and diachronic linguistic change put forth by researchers working within the CL and usage-based linguistics frameworks. As the theoretical orientations of researchers working within these two frameworks largely overlap, they are treated together here.

Broadly speaking, researchers within the usage-based tradition claim that human language processing and representation are best explained via general (versus modular) cognitive mechanisms and processes. Researchers using this framework view knowledge of grammar and meaning as derived from categorized instances of language (Bybee, 2006). The processes of abstraction used when acquiring language are thought to be similar to nonlinguistic processes observed in other areas of human cognition.

Usage-based models tend to view implicit learning as quite powerful (N. C. Ellis, 2005). Human beings, as they acquire language (both L1 and L2), are said to store a great deal of seemingly extraneous detail about frequency, recency, and context associated with individual usage events (Beckner et al., 2009; Bybee & Beckner, 2010). This large database of information is then used incrementally to extract patterns.

Language is viewed as consisting of a phonological pole and semantic pole (Langacker, 1987); hence continuity is posited between cognitive processes associated with small linguistic units (e.g., affixes) and larger units at the level of a particular clause or even a segment of discourse. Many typical language-related cognitive operations, whether applied to lexical items, word classes, or grammatical structures, are not viewed as purely linguistic but instead represent special instances of general cognitive operations.

For example, Croft and Cruse (2004), in one of the more explicit statements of this notion, provide a detailed list of "linguistic construal operations" under the four headings: (1) attention/salience, (2) judgment/comparison, (3) perspective/situatedness, and (4) constitution/gestalt (p. 46). Usage-based research, particularly research identified with the CL tradition, has enjoyed perhaps its greatest success in its convincing accounts of the "construal operations" that motivate the extension of the particular meaning of a linguistic structure to related senses (i.e., polysemy).

Chapter 3: Theoretical Accounts of Polysemy

As pointed out by a number of authors (Cuyckens & Zawada, 2001; Taylor, 2003c), the intense theoretical interest in polysemy began in earnest with the advent of Cognitive Linguistics (for an overview, see N. C. Ellis & Robinson, 2008; for a collection of seminal writings, see Geeraerts, 2006). In order to clarify the unique learning problem posed by polysemy, it is first necessary to provide a cursory overview of theoretical approaches to the analysis of meaning, in order to highlight the distinguishing features of the CL approach. Polysemy, in this dissertation, is defined as “the association of two or more related senses with a single linguistic form” (Taylor, 1995, p. 99).

3.1 Classical Models

Early approaches to meaning are often referred to as the *dictionary model* or the *classical model*. Generally hostile to psychological approaches to meaning, these models are associated with the philosopher Gottlob Frege (1848-1925), who influenced the later thought of many key figures, such as Bertrand Russell, Alfred Tarski, and Richard Montague. A key contention of many early philosophers dealing with the semantics of words was that lexical meaning (e.g., the word “bachelor”) can be explained in terms of features that are necessary and sufficient conditions (e.g., human, male, and unmarried). It was also often claimed that these features constituted a limited number of primitive terms. The view of meaning put forth in the “dictionary model” implies that features cannot be added or deleted, that they are not hierarchical, that a definition has clear-cut boundaries, and that linguistic and nonlinguistic meanings are distinct. This view received a formal treatment in the feature semantics of Katz and Fodor (1963). While not fully explicit, this general theory of meaning has remained deeply rooted in many theories of meaning (Violi, 2001). The theoretical implications of the so-called dictionary model have come under attack from research showing intersubject and intrasubject variability and the use of fuzzy boundaries and graded notions of typicality (for a discussion, see Evans & Green, 2006; Komatsu, 1992).

3.2 Prototypes and Family Resemblance

Serious weaknesses in the "dictionary model" became apparent in the wake of a series of studies in the late 1960s and early 1970s by Posner and Keele (1968), Reed (1972), Labov (1973), and Rosch (1973, 1975). These and other researchers demonstrated that many common categories[1] had fuzzy boundaries. They showed, moreover, that many of the features used to classify items as central members of a category were neither necessary nor sufficient (e.g., the feature of *flying* as used to categorize birds). In place of a list of criterial features, these researchers put forth the idea that the coherence of categories was based on a prototype.

According to Rosch (1978), prototypes reflect a psychological predisposition towards cognitive economy. Categories are useful in providing maximal information for the least cognitive effort by picking out useful correlations within experience (e.g.,

[1] As discussed by Goldstone and Kersten (2003), the categorization literature has often distinguished the terms *category* and *concept*. A *category* is generally defined as the set of entities that is being grouped together. The term *concept*, on the other hand, refers to the "mental representation of a class or individual" with the focus being on "what is being represented and that information that is typically used during categorization" (E. E. Smith, 1989, p. 502). As Goldstone and Kersten point out, a point of theoretical contention within the literature is whether categories or concepts should be the focal construct. Context models, for example, tend to focus on categories. In practice, there is a widespread tendency for researchers in the area of categorization to conflate these two meanings, using the term *category* for both. Even researchers who maintain the distinction tend to use the term *categorization* for the related cognitive process of forming or using a concept in place of alternatives (e.g., *conceptualization*, *concept use*, or *concept learning*). To avoid inevitable terminological complications when citing the ideas of other authors, the term *category*, unless otherwise noted, has been used in this paper in a general way to refer to both a mental concept and the items picked out by the concept.

bundles of features, such as flying, feathers, and chirping, associated with birds). More specifically, she claimed that it is adaptive for humans to attend to stimuli dimensions at a level at which cues are maximally informative.[2] The preferred level, according to Rosch, is the "basic" level (e.g., the level of concepts such as *chair*) instead of the superordinate level (e.g., the concept of *furniture*) or the subordinate level (e.g., the level of *arm-chair*). The basic level is said to most accurately reflect correlational features in the environment and thereby provide the greatest cue-validity. It is at this level that within-category similarity is maximized relative to between-category similarity. The basic level was also found to be linguistically the most frequently coded and most readily codable level of categorization (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976, Experiment 2).

Rosch (1978) did not put forth prototypes as a psychological construct. She was actually open to the idea that prototypes may constitute epiphenomena, which do not directly reflect mechanisms associated with processing or representation. In terms of cognitive implications, prototypes, whose effects could be observed on a wide range of psychological measures, were viewed as a constraint for theoretical models; they were an *explanandum*, not an *explanans*.

In addition to prototypes, researchers looked to family resemblance[3] and semantic networks as a way to capture the fact that every member of a category does not necessarily share a feature with the category prototype. In this paper, a *family*

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[2] For a more formal discussion of these ideas, see Corter and Gluck (1992). They claim that category utility is maximized (1) to provide accurate predictions regarding features associated with category instances and (2) to allow for efficient communication regarding features of category instances. The utility of categories for prediction is also a dominant theme in Anderson's (1991) work on categorization.

[3] According to Komatsu (1992), family resemblance views are typically associated with five characteristics: (1) centrality of typicality (items more central are felt to be more typical), (2) abstraction across instances, (3) weighted attributes (with attributes shared by many members of the category conferring greater degree of family resemblance), (4) linear separability, and (5) retention of central tendencies (either through resemblance of an object to category members and dissimilarity with noncategory members, or through similarity of an object with the central tendency of a category).

resemblance relationship is defined as in Rosch and Mervis (1975), as a set of items for which "each item has at least one, and probably several, elements in common with one or more other items, but no, or few, elements" in common with all items (p. 575). Rosch and Mervis (1975, Experiment 1) demonstrated that within-category similarity determined by item attributes elicited from participants had high correlations with participants' typicality ratings for items within a category.

This influential body of research was originally conducted to explain non-linguistic categorization, but its conclusions were soon extended to work on linguistic categories, especially in the work of Lakoff. Focusing on the principles of extension within family resemblance structures, Lakoff (1987b) put forth his related idea of *radial categories* using, as examples, the classification system in the Australian language Dyirbal and his analysis of the polysemous Japanese classifier *hon*. His analysis showed that while extensions of meaning within polysemy networks are motivated by a relationship between the original and extended sense, these extensions cannot be predicted a priori.

Lakoff further showed that meaning extensions, as they branched away from a core sense (or in diachronic terms, from an original sense), often ceased to have a feature in common with some other senses within the network. From his perspective, related senses connect to the same network of representations, but are distinctly listed within that network. The existence of family resemblance as a distinct form of semantic representation with behavioral and neurological implications has received some empirical support in experiments using priming and a relatedness judgment task (Williams, 1992), an fMRI study (Tracy et al., 2003), and from a study using both behavioral and magnetoencephalographic measures (Pylkkänen, Llinas, & Murphy, 2006).

3.3 Functional Features and Schemas

Much research on prototypes and radial categories has focused on spatial terms in various languages, including spatial terms occurring as prepositions in English (Brugman, 1988; Dewell, 1994; Evans & Tyler, 2004a; Tyler & Evans, 2004). Yet prepositions, including the frequently occurring set of prepositions generally associated with spatial meaning, often convey additional information involving nonspatial meaning, such as information related to function (Coventry & Garrod, 2005; Vandeloise, 2005). In typical situations involving spatial prepositions, these functional aspects tend to correlate with topological position. For example, an object positioned within a bowl (a topological relationship) will also be under the control of the bowl, so that when the bowl moves, the object automatically moves as well. In other cases, the typical experiential correlation will not hold: in which case, category assignment (e.g., the decision regarding which preposition is appropriate) must be determined by weighing the importance of the topological and functional aspects of the scene.

The sensitivity of native speakers (NSs) to functional features of spatial categories has been demonstrated in a series of cleverly designed experimental studies (Coventry, 1995; Coventry, Carmichael, & Garrod, 1994; Coventry, Prat-Sala, & Richards, 2001; Ferrier, 1996). In a typical experiment of this type by Garrod, Ferrier, and Campbell (1999, Experiment 1), participants were shown various scenes of a glass bowl containing a ping-pong ball. Three factors were manipulated: (1) the position of the ball relative to the bowl (e.g., positions ranging from the bottom to above the rim, along the same vertical axis), (2) the degree to which the ball was surrounded by other balls, and (3) the ball's attachment/nonattachment to an alternative source of control (i.e., a wire stretching down from above). Participants were then asked to rate the appropriateness of statements using various prepositions to describe the scene (e.g., *The ball is above the bowl*, etc.). The authors found that functional considerations (i.e., the existence of other contained objects and an alternative source of control) influenced speaker judgments as soon as the ball was raised above the rim of the bowl. The authors' subsequent experiments similarly showed that functional considerations influenced judgments regarding the felicity of *on*.

As the study demonstrated, multiple cues determine the appropriateness of a preposition; moreover, these cues can sometimes provide conflicting information. Dissociations between typically correlated features are important in understanding the meaning extensions that lead to polysemy. To take an example from Garrod, Ferrier, and Campbell's (1999) first experiment, the functional aspect of control that is entailed by containment in the basic sense of *in* can motivate the use of *in* even when the typical features of containment are absent (compare, for example, the preposition *in* as used in the sentences, *The flag was blowing in the wind*, or *The kids were in trouble*).

Spatial categories and other categories encoded in language involve both typical elements and common relationships between these elements. These relationships can be based on functional affordances and other factors (e.g., causality, part-whole relationships, and so on). This has led to a number of theoretical proposals that have attempted to provide a more systematic account of these relationships.

Johnson (1987) developed the idea that meanings within a polysemy network could be based on *schemas*, which he described as highly abstract recurring structures associated with human perception, movement through space, and the physical manipulation of objects. Johnson stressed that schemas did not consist of propositions or images but rather comprised highly abstract analog structures.[4] According to Johnson, schemas are frequently used as the basis of metaphor, with the metaphor reflecting the same configurations and dynamics present in the original spatial scene. An example of such an extension, relevant to prepositions, would be the extension of the notion of physical support present in the main sense of *on* (e.g., *She's sitting on the sofa*) to the more abstract notion of artifacts' and technological devices' support for our ability to hear or transmit signals or sounds (e.g., *She heard it on the radio*).

In the CL tradition, schemas are believed to underlie polysemy networks, due to changes (often *systematic* changes) in our construal of the gestalt structures of experience. To cite just one example, Johnson (1987) and Sweetser (1990) both describe how the root senses of modal verbs (e.g., *John could already swim at age five*) have been extended to epistemic senses (e.g., *John could be running late*), and to speech acts (*He may be a university professor, but he sure is dumb*).[5]

Senses within the polysemy networks for prepositions are likewise thought to be related to other senses in systematic ways, often involving shifts in the relationships between the landmark (the background element of a scene), the trajector (the generally

[4] Johnson's concept of schemas was inspired, in part, by Kant's (2000) earlier notion of schemas, but his schemas, unlike those of Kant, were dynamic and malleable. As Komatsu (1992) points out, the term *schema* has been used by various researchers to refer to a wide range of theoretical constructs; hence, some caution is warranted in making links between different researchers' discussions involving this term.
[5] This example (originally from Sweetser, 1990, p. 70) is discussed in Johnson (1987, p. 60). Sweetser glosses it as, "I *admit* that he's a university professor, and I nonetheless *insist* that he's dumb" (italics added). In other words, the forces and barriers associated with *may* have been projected onto a conversational realm in which various speech acts are performed.

smaller, mobile, focal element of a scene), and the vantage point (the assumed perspective).[6] In spatial scenes, the landmark typically serves as reference point for locating an object. For example, in the sentence, *The book is on the table*, the table is used to locate the book.

While landmarks and trajectors often appear as physical objects, this does not need to be the case. Viewed broadly, the two concepts merely designate the asymmetrical relationship between conceived entities within a predication. For example, the preposition *before* in, *She left before I arrived*, predicates a temporal relationship in which the trajector and landmark denote processes (example taken from Langacker, 1987, pp. 219, 220).

In a typical meaning network of a preposition, a basic proto-scene gives rise to a polysemy network of distinct, yet related, meanings. The proto-scene is “an idealized mental representation” which occurs “across the recurring spatial scenes associated with a particular spatial particle” (Tyler & Evans, 2003, p. 52).[7] The proto-scene for *in*, for example, involves a trajector located within a landmark containing an interior, a boundary, and an exterior (Tyler & Evans, 2003). In typical situations, the vantage point would be outside the container, as shown in Figure 1.

[6] Talmy (2005) refers to the vantage point as the *secondary reference object*. He further distinguishes between two forms of this object: one that encompasses both the figure (i.e., the trajector) and the ground (i.e., the landmark) and one that is external to them (p. 206).
[7] Although based on a different theoretical perspective, Herskovits’s (1986) notion of “ideal meanings” has parallels with this conception (p. 3).

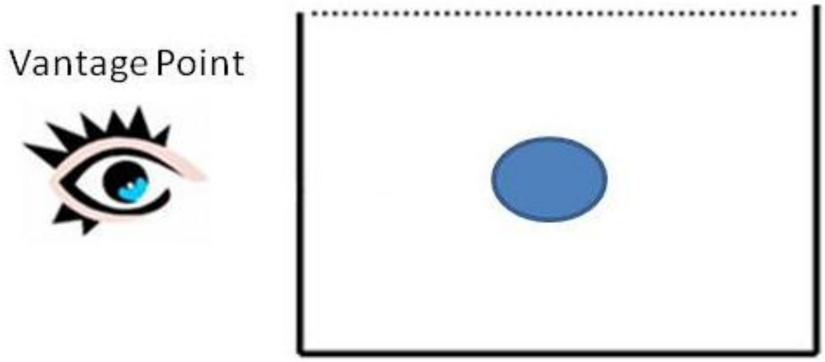

Figure 1. Iconic representation of the schema for the proto-scene for *in*.

Shifts in the construal of the containment relationship can give rise to different senses associated with *in*. Thus the "perceptual accessibility" sense of *in*, as it occurs in phrases such as *in view*, *in sight*, *in earshot*, and *in range*, is based on a spatial configuration in which the vantage point has shifted to the interior of the landmark (e.g., the area where a person is standing) and the trajector is also in the interior of this area (Tyler & Evans, 2003), as shown in Figure 2.

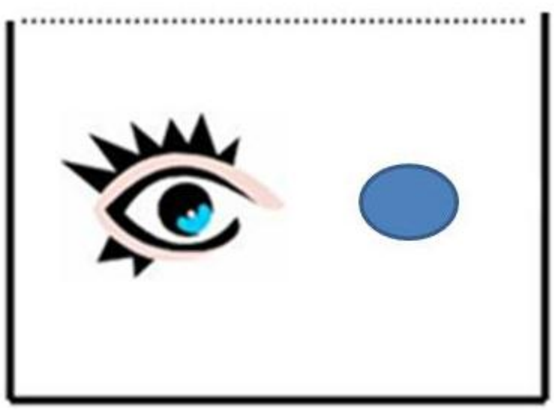

Figure 2. Iconic representation of the schema for *in* when vantage point has shifted to interior of landmark.

Basic schemas can be extended through processes that are motivated by various principles of extension (e.g., metaphor, metonymy, experiential correlations, etc.).[8] The related but distinct set of meanings that forms as a result of these extensions constitutes a polysemy network.

Schemas have been discussed from a wide range of theoretical perspectives. Researchers have described similar structures using terms such as “scripts” (Schank & Abelson, 1977) and “frames” (Minsky, 1975). In his review article on schemas (which he calls “contextual frames”), Bar (2004) argues that the a priori knowledge provided by schemas is crucial to perception, as it allows the visual system to sensitize the visual representation based on a range of expectations regarding typical scenes. He summarizes research in the area, stating that:

> . . . typical arrangements in our environment are represented in context frames, which provide expectations that facilitate the perception of other scenes that can be represented by the same context. Objects and relations that are sufficiently characteristic of the context are extracted and recognized readily, on the basis of global information and expectation-based shortcuts provided by the frame . . . . During recognition, an object can activate a context frame (or a set of frames), and a frame can activate an object (or a set of objects). (p. 619)

In other words, contextual frames (i.e., schemas) allow us to link categorized instances of prior experience to expectations regarding future experience, so that we can respond rapidly to our environment.

[8] Within the CL tradition, there is still some debate regarding which of these principles tend to be most common.

In a seminal study in this area, Biederman, Mezzanotte, and Rabinowitz (1982) briefly (for 150 msec) showed participants scenes in which objects were either in normal relationships to the background or violated expectations related to: (1) interposition (objects' interruption of background), (2) support, (3) probability (i.e., the association of certain objects with certain scenes), (4) position (typical position of objects in scene), and (5) familiar size. Their results indicated that properly formed contextual frames interfered with the perceptibility of objects featuring a violation. It is interesting to note that among the five relationships highlighted as fundamental in the study, at least two (position and support) are directly expressed by prepositions.[9]

This line of research thus suggests that schemas are a powerful and pervasive feature of human cognition. Bar (2004) claims that evidence for the influence of contextual frames is apparent in a number of memory distortions to include visual false memory,[10] boundary extensions,[11] and change blindness.[12] An important theoretical question for SLA involves the question of whether it is possible to manipulate processing, so that L2 learners adopt the appropriate (i.e., nativelike) construal of a scene or situation. This would presumably be important to ensure that learners map target linguistic structures onto the appropriate semantic features in the environment.

Andanova, Tenbrink, and Coventry (2010) posed this question in an experiment that examined how both instruction and the organization of a visual array affected the packaging of information in a spatial description. German NSs described complex scenes in a 3-D dollhouse in which the furniture was arranged in a functional or nonfunctional

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[9] Numerous English prepositions express position, whereas *on* typically expresses support.
[10] For example, false memory reports that include objects contextually related to a scene.
[11] *Boundary extensions* are false reports of memories of content that was outside of a picture.
[12] *Change blindness* refers to the inability to perceive change to a scene due to lack of focal attention. For a discussion, see Simons and Levin (1997) and Rensink, O'Regan, and Clark (1997).

array. The instructional prompt also varied, so that some participants were told that they were describing someone's living room, whereas others were told that they were describing a secondhand furniture store. A third group received no biasing context. Results showed that both visual arrangement and instruction had an effect, but there was no interaction between the two factors. Visual arrangement had a stronger effect, although, as the authors themselves acknowledge, this may have been the result of the experimental design, which only elicited monologic descriptions instead of dialogic interaction.

The experiment demonstrates that instructional prompts, provided directly prior to viewing a scene, can alter the schema that speakers adopt in their perception of the scene, and that this, in turn, can lead to changes regarding which aspects of the scene tend to be expressed in their verbal production. This permeability of construal is taken up again later in the paper as optimal pedagogical approaches to the teaching of prepositions are considered.

In sum, the usage-based framework provides a rich theoretical account of polysemy based on the notions of prototypes, schemas, and semantic networks. One strength of this approach is its ability to explain the meaning extensions associated with polysemy, particularly the polysemy of spatial language, through systematic shifts in construal. These shifts include changes in the allocation of attention to topological and functional features of a schema. The next three chapters examine the L2 acquisition of polysemous L2 structures, focusing on factors that impede acquisition.

Chapter 4: Evidence of Difficulties in the L2 Acquisition of Polysemy

While researchers disagree regarding the extent of polysemy in English, most would allow that some frequently occurring word categories, such as prepositions, are polysemous. However, there have been some contrary perspectives (e.g., Nunberg, 1978; Ruhl, 1989; Van der Gucht, Willems, & De Cuypere, 2007). These “monosemy”[13] accounts (i.e., objections to semantic accounts positing a high degree of polysemy) are diverse; yet they generally reflect the idea that there is a mental “toolbox” of cognitive operations that speakers can bring to bear on their interpretation of words in context.

Van der Gucht, Willems, and De Cuypere (2007), for example, claim that the “covering” sense of *over* (e.g., *Joan nailed a board over the hole in the ceiling*) posited by Tyler and Evans (2003) does not, in fact, exist as a separate sense. They argue, instead, that a single sense of *over* is involved, and that the use of *over* in this case is justified by a shift from a focal to a disfocal perspective. The CL tradition agrees that sense extensions occur as the result of various shifts in construal, but it is argued that at least some of these shifts, which eventually become entrenched as separate senses in a given language, cannot be predicted a priori (Lakoff, 1987b). In other words, the general mental “toolbox” of construal operations that the language user brings to the task of interpreting linguistic utterances cannot predict which extensions of a basic sense are actually sanctioned by a given language.

It should be noted that the claim for a universal mental “toolbox” that would explain away polysemy is an extremely strong theoretical position that is easily falsified. If a particular general construal operation (i.e., a tool from the mental “toolbox”) is used

[13] Strictly speaking, most of these authors do not categorically rule out the existence of polysemy. However, they argue that, in most cases, a word is associated with a single abstract meaning.

to explain one instance of an extension of a word in actual language use, the same construal operation should be available for use on any analogous form. In other words, the presumed ability to shift the focal perspective in *over*, as posited by Van der Gucht, Willems, and De Cuypere (2007), should, it may be argued, also apply to the closely analogous preposition *above*. However, such a shift does not appear to be possible. While it is possible to say *The painting is above the sofa*, it does not seem possible to conceive of any situation in which the resulting interpretation, due to a shift in the focal perspective, would allow us to interpret the sentence as meaning that the painting is positioned physically lower than the sofa.

There also does not appear to be a disfocal shift available for *under*, a preposition that is, for the most part, the polar opposite of *over*. For example, the sentence *Joan placed the board under the hole in the floor* has only one reading. If an analogous "disfocal" construal were available for *under*, the sentence should have a reading in which the board is physically higher than the hole and is thereby covering it. For this reason, a strict monosemy approach appears to be untenable. It makes no sense to argue that a monosemy approach would imply greater cognitive economy (or even theoretical parsimony). After all, even with a general "toolbox" of construal operations, language users would need to keep track of which general cognitive operations are sanctioned for which particular lexical items or constructions in the target language.

It should be noted that, as a typical example of a highly polysemous word class, prepositions are especially important as they occur frequently in both written and oral texts. 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).[14] It may therefore be concluded that even if polysemy were restricted to prepositions, which is clearly not the case, it would be quite pervasive in English.

Polysemy would seem to present a unique problem to L2 learners as it requires mapping multiple meanings to a single form. Homonymous and polysemous constructions are said to be particularly difficult to learn, due to the low contingency of their form-function association (Beckner et al., 2009). English prepositions, as a part of speech widely agreed to be highly polysemous (Tyler & Evans, 2003), should therefore be expected to resist acquisition.

4.1 Error Analyses

Some empirical evidence supports this assumption. Jiménez Catalán (1996), using a learner corpus of 290 essays by Spanish secondary school students, found that in a tally of students' top ten errors, substitution of a preposition was the most frequent error (11.9%), incorrect addition of a preposition the sixth most common (3.2%), and omission of a preposition the seventh most common (3.7%). Similar difficulties have been found among younger learners. Cronnell (1985), in his analysis of Mexican-American third- and sixth-grade student writing, found that prepositions constituted the greatest vocabulary problem in their English production.

Problems with prepositions have also been found in research on advanced learners. Ene (2007), in a detailed analysis of 11 texts by advanced English learners, all graduate

[14] In terms of rank within the total list of English words, many prepositions are among the most frequently occurring words. For example, *of*, *in*, *to*, *for*, *with*, *on* and *at*, used as prepositions, are ranked as the 3rd, 6th, 10th, 12th, 15th, 18th, and 21st most common words respectively (p. 465). These prepositions occur at similar ranks and in the same order in the British National Corpus (Leech, Rayson, & Wilson, 2001, p. 120).

students in the U.S., found that in addition to articles, use of prepositions by these nonnative speakers (NNSs) was associated with a relatively greater number of errors, and that this was particularly the case for the southeast-Asian and Chinese L1 students relative to German and Spanish L1 students.

Other researchers have reported difficulties for Chinese L1 learners. Darus and Ching (2009), in their examination of 70 Chinese-Malay (bilingual) L1 learners of English living in Malaysia, found that prepositions accounted for 9.0% of errors. Their results suggested that learners had difficulties with the one-to-many mappings that occur when a single Chinese or Malay preposition maps onto two English prepositions (e.g., the *at* vs. *in* distinction and the *for* vs. *to* distinction).

Similar difficulties have been observed in NNSs' oral production. Qi and Ding (2011), in their analysis of the formulaic sequences occurring in 56 pairs of monologues from Chinese learners of English in their first and fourth year of college in China, found that nearly 60% of errors involved either prepositions or articles, with many patterns of error persisting in the learners' production, despite a general increase in proficiency. In their explanation of the results, the authors suggest that prepositions (1) are less salient and thus less likely to be noticed during the acquisition process, and (2) are less likely to receive attention during production, due to the online time-pressures associated with speech.

Research suggests that even speakers of languages typologically close to English have difficulty with prepositions. For example, Lennon (1991) conducted a six-month longitudinal study of four advanced German learners of English who were studying at a British university. Having previously studied English, the four students attended regular classes and shared lodging with British students. The database for the analysis included oral picture-story narrations. Over the course of the study, the learners made between approximately one and three or four errors per T-Unit. Most of these errors involved lexis and prepositional choice.

Adverbial particle choice and prepositional errors were lumped together in the study. This category, which primarily contained prepositional errors, accounted for 22% of the errors in the oral corpus, and, in the case of one of the participants, a remarkable 34% of all errors. Although the overall rates of error for all categories showed notable declines for three of the four participants during the six months, prepositional and adverbial error remained relatively steady and actually increased for two of the participants. In other words, even advanced English learners, who spoke a language typologically close to English[15] and who were in an immersion context, experienced difficulty in mastering prepositions, despite the prevalence of this word class in the input.

The error analysis research discussed thus far indicates that prepositions are difficult for L2 learners from many backgrounds. Even so, a certain degree of caution is warranted when interpreting the various tallies of learner error. First, it should be mentioned that learners' achievement of accuracy on certain forms is likely to have only a rough correlation with their underlying semantic competence. In error analysis studies, preposition error is often contrasted with other categories, such as errors on articles; however, English articles present learners with a very limited set of choices, making it possible to achieve a high degree of accuracy with such forms by simply selecting the most frequently occurring option as the default. For such reasons, comparisons between

[15] German even has some fairly obvious cognates that are semantically close to their English counterparts (e.g., *für*, *in*, *über*, *unter*, and *zu*, which are often translated as *for*, *in*/*inside*, *over*/*above*, *under*, and *to*).

sources of errors are only useful as a rough guide pointing to productive areas for theoretical investigation and pedagogical interventions with specific learner populations.

4.2 Effects of Instruction

In addition to purely descriptive accounts of error, researchers on writing have examined the effectiveness of instruction aimed at prepositions. Bitchener, Young, and Cameron (2005), in an examination of the writing of 53 post-intermediate English learners (mostly from mainland China) who had recently immigrated to New Zealand, found that prepositions accounted for 29.2% of all errors, by far the single greatest source of error overall. Furthermore, in their analysis of the effectiveness of written feedback and teacher-student conferences over a three-month period, they found that learners' use of prepositions, unlike their use of definite articles, failed to show significant improvement (accuracy on past tense, on the other hand, followed a U-shaped acquisition pattern).

In their interpretations of the findings, the authors mention that the "treatable" issues involving the simple past and articles involve clear rules, whereas prepositions tend to be more idiosyncratic. It should be added that general improvement on prepositions would require extensive learning, as there are numerous prepositions, which are, in turn, each generally associated with numerous senses. Yet even when the greater learning problem is taken into account, the study suggests that the semantics of prepositions may be less amenable to typical pedagogical interventions involving explicit instruction.

4.3 Competence Deficits

It must also be noted that even when L2 learners demonstrate accuracy in production of prepositions, their achievement may not be fully attributable to their underlying semantic competence related to the target prepositions themselves. Mueller (2011), in a study of Chinese ($N = 30$), Korean ($N = 30$), and Spanish ($N = 30$) learners of English, found that the participants' accuracy on prepositions was affected by the collocational frequency of the phrase in which the preposition was embedded ($p < .001$). In his study, fairly advanced L2 learners completed a fill-in-the-blanks test in which the word co-occurrence frequency (e.g., *happy with*) associated with a "high-frequency" item fell between 6.7 and 33.9 tokens per million words in the American National Corpus (Reppen, Ide, & Sunderman, 2005) while the word frequency of a "low-frequency" item that targeted the same prepositional sense (e.g., *upset with*) fell into a frequency band between 0.04 and 1.8 tokens per million words in the ANC. The finding of greater accuracy on high-frequency collocations held not only for the 90 participants as a group but also for each of the three L1 groups when considered in isolation. The results suggest that L2 learners often rely on syntagmatic knowledge to overcome deficits in their semantic knowledge of prepositional meaning.[16]

[16] An alternative explanation that was not discussed in this study is that learners, through repeated exposure to exemplars of a particular sense, become increasingly proficient at processing those exemplars that contain the most semantic features associated with the preposition's abstract sense. Because the most frequently occurring word sequences would also tend to be those in which there existed more semantic features characteristic of the sense, prototypicality in use and syntagmatic frequency are likely to be conflated. Increased processing fluency would then lead to participants' association of specific word sequences with greater perceptual fluency, and this, in turn, would produce prototypicality gradients (for a related discussion of the implicit mechanisms involved, see P. J. Reber, Gitelman, Parrish, & Mesulam, 2003; E. E. Smith, 2008, p. 14). An additional possibility is that learners are better able to apply their metalinguistic knowledge to more prototypical usage of a target structure (for a study demonstrating this, see Hu, 2002a).

Such findings are consistent with some error analysis research. In her analysis of errors among advanced learners from diverse backgrounds, Ene (2007) found that verbs that collocate with multiple prepositions tend to elicit more errors. This suggests that NNSs are adopting a strategy of learning prepositions based on their co-occurrence with certain verbs, and that the strategy fails when a verb collocates with multiple prepositions.

4.4 Critical Period Effects

Other research has indicated that L2 learners beyond the critical period[17] have difficulty achieving a nativelike end-state in their acquisition of prepositions. For example, Munnich (2002), in a study of Korean and Spanish speakers who had arrived in the U.S. at different ages, showed that the acquisition of the contrasts between *in* and *on*, and the contrasts involving *on*, *over* and *under*, are related to maturation.

His study examined 30 Spanish and 30 Korean NSs who had been in the U.S. for at least five years. The participants' effective[18] age of arrival (AOA) in the U.S. ranged from 9 months to 39 years. The group included 20 early learners (AOA < 8), 20 "mid" learners (AOA = 8 to 13), and 20 late learners (AOA > 13), with each group split between the two L1 backgrounds.

The participants performed an elicitation task and a sentence-rating task based on the same material. Results showed a decline by AOA level, especially among late learners and especially for the *on* versus *in* contrast. His analysis of particular patterns of

[17] For a discussion of the critical period hypothesis in SLA, see Abrahamsson and Hyltenstam (2009), DeKeyser (to appear), DeKeyser, Alfi-Shabtay, and Ravid (2010), and Long (2005).
[18] Some participants, even after arriving in the U.S., only spoke the L1 at home until they began attending school, so their entrance to school was regarded as their age of arrival.

error indicated that AOA-related decline was steepest on items featuring prepositional contrasts that relied on functional information.

Munnich's (2002) study contains a few weaknesses in terms of its semantic analysis of the target forms. To take just one example, the *on-in* contrast that appears in *a city on the coast* and *a city in Florida* is described as related to physical versus manmade boundaries respectively, in spite of the fact that many counter-examples readily come to mind (e.g., *a city on the border of France and Spain* or *a tree on the road to school*). It may be argued that the semantic analysis of targets was not crucial to his study, which established clear differences between NSs' and NNSs' performance on identical tasks. Even so, the unconstrained analysis used in the study bolsters the argument for the need for theoretical constraints (such as the embodiment assumption[19] common in Cognitive Linguistics) to provide more principled accounts of polysemy.

Munnich's study is valuable in establishing critical period effects for semantics. The conclusions are reinforced by the finding of identical declines for speakers of two distinctly different L1s. Viewed broadly, the results would suggest two interpretations. The cognitive mechanisms crucial for nativelike attainment in the area of complex semantics involving polysemy (i.e., family resemblance categories) may be attenuated in learners beyond the critical period. Alternatively, entrenched patterns from the L1 may interfere with L2 acquisition. It is likely that both attenuation of cognitive faculties and L1 entrenchment play a role. Future studies focusing on critical period effects for the

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[19] The embodiment assumption is the hypothesis that human beings' comprehension of meaning is indelibly shaped by their typical sensorimotor experience as they negotiate their environment (C. Johnson, 1999; M. Johnson & Lakoff, 2002; Mandler, 1992). This experience is said to structure representations of conceptual metaphor, radial categories, and other construal operations. A typical example would be children's early acquisition of the primary metaphor MORE is UP. Repeated exposure to containers being filled and objects being stacked leads to an association of verticality with quantity, as reflected in the crosslinguistic tendency to use expressions related to height to express quantity (e.g., *high prices*).

acquisition of semantics will need to view more fine-grained distinctions while taking into account specific patterns of L1 influence.

Chapter 5: Factors Leading to Difficulty

Adult L2 learners' difficulty in untangling the various senses of prepositions, in spite of the high frequency of this word class in the input, suggests two conclusions. On the one hand, learners appear to have problems with the acquisition of prepositions even after receiving massive exposure in the input. This would suggest that mere implicit associative learning and incidental noticing of form-meaning mappings do not lead to full acquisition within many typical older learner populations. On the other hand, textbook materials and lessons that explicitly teach prepositions do not appear to be highly successful, based on the fact that typical learners, many of whom have received English language instruction using such materials, fail to fully acquire the target semantics of prepositions.[20] L2 learners' difficulties in acquiring this word class can be attributed to a number of factors.

5.1 Complexity of Meaning

As mentioned by DeKeyser (2005), specifically in reference to grammatical difficulties, a key source of difficulty is complexity of meaning, particularly when the meaning involves novelty and abstractness. Languages often have adpositions, lexical items, or grammatical particles that closely correspond to the central spatial senses of English prepositions. However, languages differ in the ways in which they extend these basic senses to noncentral spatial and nonspatial senses.

[20] The failure of pedagogical materials in this area may be partly due to weaknesses in the semantic analyses that have formed the basis of such materials. Tyler and Evans (2001, 2003), for example, have cogently argued for a principled semantic account of prepositions based on the Cognitive Linguistics (CL) theoretical framework, and some recent studies (e.g., Tyler, Mueller, & Ho, 2011) have demonstrated that pedagogical materials based on a CL analysis promote acquisition. Even so, the possibility remains that explicit instruction involving presentation-and-practice does not optimally promote the acquisition of prepositions.

For example, the Russian preposition *za*, which is often glossed as *behind*, is extended to a wide range of senses glossed as *over*, *outside*, *beyond*, *after*, *for*, *at*, *by*, and *near* in standard Russian-English dictionaries (for an analysis of the sense using a Cognitive Linguistics framework, see Shakhova & Tyler, 2010). Even when spatial terms closely parallel one another, as is the case with English *in* and *on* and these two prepositions' Chinese counterparts, the functional extensions will often differ to some extent (Zhang, Segalowitz, & Gatbonton, 2011).

5.2 Redundancy and Optionality

DeKeyser (2005) also mentions the problems of redundancy and optionality. Strictly speaking, prepositions are probably never completely optional; however, there are many cases in which the subtle differences in meaning are virtually impossible to discern without a detailed analysis. For example, most English speakers, including linguistically adept NSs, would probably find it difficult to explain the difference between, *She called the doctor,* and *She called for the doctor*. The L2 learner attempting to ferret out this subtle difference through observation and hypothesis testing would probably conclude that the sentences are completely synonymous. Linguists working with large corpora, on the other hand, may discern constraints on the landmark element (e.g., *the doctor,* in the example), and note that *for* tends to be used in situations in which the landmark has a prototypical response.

5.3 Effects of Non-optimal Strategies

Learners may also be hindered by faulty assumptions and non-optimal learning strategies. Difficulties in ascertaining the meaning of the prepositions occurring in natural input may lead learners to assume that the meanings are highly arbitrary, and as a result, these learners may no longer engage in hypothesis testing aimed at deducing the target sense. Learners may also adopt a strategy that primarily focuses on memorizing collocational patterns. This is likely to improve linguistic production; moreover, such chunks may provide a useful foothold as learners subsequently acquire the precise semantics of the target sense (Elio & Anderson, 1981; Wulff, Ellis, Römer, Bardovi-Harlig, & Leblanc, 2009). Even so, such strategies may prove to be inadequate if the learners' implicit learning mechanisms, acting alone, are unable to induce the precise semantic contribution of a target prepositional sense.

5.4 Opacity of Form-meaning Mapping

DeKeyser (2005) mentions, as another source of difficulty, the opacity of the form-meaning relationship, as when the same form stands for multiple meanings. The example DeKeyser mentions (e.g., "-s" in English as used in pluralization and the marking for third person) suggests that problems of homonymy are what is intended, but a similar case could be made for polysemous forms. Of course, it could also be argued that the relationship between the senses of a target preposition may actually aid acquisition if the L2 learner is able to use knowledge of one meaning to learn the extensions to related senses. In many cases, however, related senses may prove to be problematic if they create confusion as the learner struggles to understand how to place examples of preposition use gleaned from the input into discrete, coherent semantic categories that are congruent with NS categories.

The opacity of form-meaning mapping associated with polysemy may also hinder acquisition by robbing L2 learners of important cues. In L1 word learning, the existence of a novel linguistic label can cue learners to the existence of an unlearned category (Markman & Wachtel, 1988). If adult learners are capable of making similar inferences, polysemous L2 structures may be problematic, as they complicate such inferences in situations in which one sense of a word is known but other senses are unknown. In other words, polysemy would prevent learners from taking advantage of attentional contrasts; that is, the directing of attention to attribute values that have not already been associated with a category (for a discussion, see Kersten, Goldstone, & Schaffert, 1998).

Polysemy may also present special problems for rule-based learning, as the single-form-to-multiple-meanings mapping allows for a plethora of hypotheses that could fit the data. This is especially problematic if learning is accurately modeled by Bayesian inference;[21] in which case, the learner must track the constantly shifting likelihood of an implausibly large number of hypotheses.

5.5 L1 Influence

L2 learners do not come to the L2 learning process as blank slates. Instead, they bring with them deeply entrenched patterns based on the accumulation of previous experience using their L1. These patterns, which reflect the brain’s optimization for the L1, have profound effects on L2 acquisition (Beckner et al., 2009). Much of the

[21] For examples of Bayesian learning models applied to category learning, see Anderson and Matessa (1992) and Kruschke (2011).

knowledge from the L1 is likely to be facilitative, enabling learners to rapidly acquire L2 patterns based on close L1 analogs. In some cases, however, commitment (generally unconscious) to L1 patterns predisposes learners' cognitive processing to ignore certain elements of the input that are essential to the L2 target linguistic representation and the corresponding linguistic processing (N. C. Ellis & Sagarra, 2010, 2011; MacWhinney, 1997; Slobin, 1996).

According to Talmy (2000), the world's languages can be divided into verb-framed languages (e.g., Japanese, Korean, Spanish, Turkish) and satellite-framed languages (e.g., English, Dutch, German, Swedish, and Chinese).[22] Speakers of the two types of languages have been observed to differ in terms of the features within an event (e.g., path) that they tend to select for encoding into language (Slobin, 2004). Because prepositions are often combined with verbs in expressing events, this division has direct relevance to prepositions.

Slobin (1991) has shown that the entrenched patterns of speakers' L1s predispose them to structure experience in a particular way when "thinking for speaking." In a study to determine if such patterns appeared crosslinguistically, Slobin examined the narratives of children (various ages) and adults from a wide range of L1 backgrounds. The participants were asked to tell the story depicted in a popular picture book about a boy and a frog. Analysis of the information expressed by speakers from the various L1s revealed that certain typological differences in the L1s correlated with marked preferences for expressing specific information using particular linguistic devices. Moreover, the influence of language typology was distinct for each semantic domain. Thus English and German three-year-olds were similar in preferring to follow verbs of

[22] This binary division has been questioned by a number of researchers (e.g., Zlatev & Yangklang, 2004).

motion with a locative elaboration, whereas their Spanish and Hebrew counterparts used bare verbs of motion about a third of the time. In terms of the use of aspect, on the other hand, English and Spanish NSs followed one pattern, while German and Hebrew NSs followed another.

Slobin notes that many of the linguistically encoded perspectives that differ across languages “are precisely the sorts of things that make it so hard to master the grammar of a second language” (p. 22). Slobin concludes that each language “has trained its speakers to pay different kinds of attention to events and experiences when talking about them” and that these entrenched patterns of attention, which began in early childhood, are “exceptionally resistant to restructuring in adult second-language acquisition” (p. 23). If Slobin is correct, and “thinking for speaking” has a profound effect on both L1 linguistic choices and the ability to acquire specific semantic contrasts in an L2, learners from diverse L1 backgrounds would be expected to differ in their ability to acquire the semantics of different English prepositions.

Chapter 6: Indications of L1 Influence in a Learner Corpus

As a key step toward determining the relative merits of alternative pedagogical interventions targeting the semantics of prepositions, it would be useful to have a better understanding of the specific learning problem posed by prepositions. Broadly speaking, L2 learners' acquisition of prepositions can occur in one of two ways: (1) L2 learners may all traverse a similar course of acquisition that is independent of their L1, or (2) their L2 acquisition may be affected by particular features of their L1. These are, of course, extreme positions: acquisition is likely to involve both general processes and L1-influenced factors. Moreover, these factors are likely to interact with individual differences and other factors.

6.1 Crosslinguistic Comparison of Preposition Use

To determine whether L2 use of prepositions in general shows signs of L1-specific factors, an exploratory corpus analysis was conducted, comparing prepositional use in a learner corpus with that found in NS corpora.

6.1.1 Theoretical Background

This analysis of crosslinguistic influence was based on Jarvis's (2000) definition of L1 influence as "any instance of learner data where a statistically significant correlation (or probability-based relation) is shown to exist between some feature of learners' IL[23] performance and their L1 background" (p. 252). The definition has the advantage of including, in addition to patterns of error or accuracy, instances of underuse and overuse of particular forms. To determine crosslinguistic influence, Jarvis (1998,

[23] Interlanguage.

2000) claims that three types of evidence need to be presented: (1) intragroup homogeneity (i.e., learners who know the same language tend to exhibit the same linguistic behavior), (2) intergroup heterogeneity (i.e., this linguistic behavior is not common to all L2 learners of the language), and (3) crosslinguistic performance congruity (evidence that the behavior is, in fact, motivated by some feature in another language).

6.1.2 Method

The present examination of learner corpora, being broad in nature, focuses primarily on determining whether broad intergroup heterogeneity can be found for patterns of preposition use. Due to its general and coarse nature, the analysis is of a purely exploratory nature and precludes a fine-grained analysis of intragroup homogeneity and the particular L1 features that lead to crosslinguistic performance congruity. Even so, it is felt that the examination is valuable in determining whether L1 learners' production of prepositions, outside of experimental contexts, shows evidence of L1-specific patterns.

Variables such as proficiency level or language aptitude can constitute confounds within such an investigation, as they may interact with crosslinguistic influence. These confounds have been avoided, to a large extent, through the use of similar subcorpora (e.g., corpora in which learner proficiency is similar and thus represents a single level) and by obtaining a sample of sufficient size so that other potential confounding variables (e.g., learner aptitude) may be expected to be distributed normally (and equally) across samples.

The NS corpora used for the comparison will be the Brown Corpus (Francis & Kučera, 1982), the written and spoken sections of the British Nation Corpus, (Leech et al., 2001), the Corpus of Contemporary American English (COCA) divided into its academic, magazine, newspaper, and fiction subsections (M. Davies, 2008-), the TIME Corpus (M. Davies, 2007), and the British Academic Spoken English corpus.[24] These corpora have been selected for a number of reasons: (1) they have been carefully compiled to represent texts within a specific area, (2) they contain a sufficiently high word count to ensure representativeness, (3) they are computer searchable, and (4) they are tagged for part of speech (POS), enabling searches for the occurrences of words as prepositions.

The Brown Corpus (Francis & Kučera, 1982) is a million-token collection of diverse written texts. It contains 500 texts distributed across 15 genres, all published in 1961. The British National Corpus (Leech et al., 2001) has 96,986,707 tokens with 10% from spoken texts and 90% from written texts. The BNC counts were obtained through the BNC web accessed via http://bncweb.lancs.ac.uk/. The COCA corpus (M. Davies, 2008-) is a 425 million-word corpus of works published between 1990 and 2011. For the analysis, this corpus has been split into its academic (81 million words), popular magazines (86 million words), newspapers (81 million words), fiction (81 million words), and spoken (85 million words) sections. The TIME Corpus (M. Davies, 2007) consists of 100 million tokens taken from *Time* magazine articles from 1923 to 2006. The 1,644,942-token BASE corpus was developed from transcripts of 160 video-recorded lectures and 40 seminars at the University of Warwick and University of Reading between 2000 and 2005. The lectures are distributed across four broad disciplinary groups. The above

[24] This corpus was developed at the Universities of Warwick and Reading under the directorship of Hilary Nesi and Paul Thompson. Corpus development was assisted by funding from BALEAP, EURALEX, the British Academy and the Arts and Humanities Research Council.

corpora include both British and American English. In their corpus analysis of prepositional use, Mindt and Weber (1989) found similar distributions of the core prepositions in both American and British corpora suggesting that the two varieties of English do not differ markedly in this area.

The data for English learners were taken from Version 2 of the International Corpus of Learner English (ICLE, Granger, Dagneaux, Meunier, & Paquot, 2009). This corpus consists of 6,085 texts and 3,753,030 words. The learner corpus analysis examined the texts by language subcorpus. The total word counts for each subcorpus was slightly lower than raw counts in most cases, as the search query for each subcorpus was restricted to results of speakers who: (1) listed the L1 as their mother language, (2) reported speaking the language at home, and (3) came from a country in which the language was spoken by a large segment of the population. The choice to limit the queries in this way stemmed from concerns that L1 speakers from more diverse backgrounds may exhibit crosslinguistic influences that are not characteristic of the L1 population represented by the subcorpus. The search queries used for each ICLE subcorpora and the resulting subcorpora word counts are shown in Table 1.

The analysis will cover 18 of the most frequent prepositions in English, based on the token counts in the Brown corpus. The examined prepositions will be *of*, *in*, *to*, *for*, *with*, *on*, *at*, *from*, *into*, *about*, *through*, *over*, *between*, *after*, *under*, *against*, *during*, and *without*. The 18 prepositions are discussed in approximate order from most to least frequently occurring, but for purposes of explication, *with* and *without* have been presented sequentially. Precise token counts for the 18 prepositions, as well as those for *by*, *within*, and *above* can be found in Appendices A-F.

Table 1

ICLE Subcorpora Used in the Learner Corpus Analysis

Search Query			Word Count
Native Language	Language at Home	Country	
Dutch	Dutch	Belgium, The Netherlands	227,126
German	German	Austria, Germany	196,910
Norwegian	Norwegian	Norway	209,587
Swedish	Swedish	Sweden	184,894
French	French	Belgium	192,284
Italian	Italian	Italy	209,129
Spanish	Spanish	Spain	197,070
Russian	Russian	Russia	217,036
Czech	Czech	Czech Republic	185,677
Polish	Polish	Poland	230,276
Bulgarian	Bulgarian	Bulgaria	199,249
Chinese (Mand,[1] Cant.[2])	Chinese (Mand,[1] Cant.[2])	China, HongKong	488,042
Finnish	Finnish	Finland	187,762
Turkish	Turkish	Turkey	193,140
Japanese	Japanese	Japan	198,241
Tswana	Tswana	Botswana, South Africa	198,347

[1] Mandarin
[2] Cantonese

6.1.3 General Research Questions

The learner corpus analysis was essentially an inquiry into the validity of the following assumptions:

1: Because prepositions are particularly difficult for learners (based on empirical findings from various studies of learner error), learners will tend to avoid using them in many contexts, employing alternative forms instead. This will lead to a general pattern of underuse relative to NSs.

2: NS English corpora that contain the same type of texts (e.g., written or spoken) will tend to show minimal variation in terms of the relative frequency with which the most common prepositions are used.

3: NNS corpora that contain the same type of texts will vary from NS corpora of the same type.

4: NNS corpora that contain the same type of texts will vary from each other.

5: NNS corpora that represent genetically related languages will be more similar to one another.

Because this analysis is purely exploratory, no attempt was made to reach definitive conclusions regarding these questions. For this reason, these research questions have not been presented as hypotheses to be confirmed or disconfirmed.

6.1.4 Results

Figure 3 shows the overall frequency of prepositions per million words in various NS corpora and various subcorpora within the ICLE.

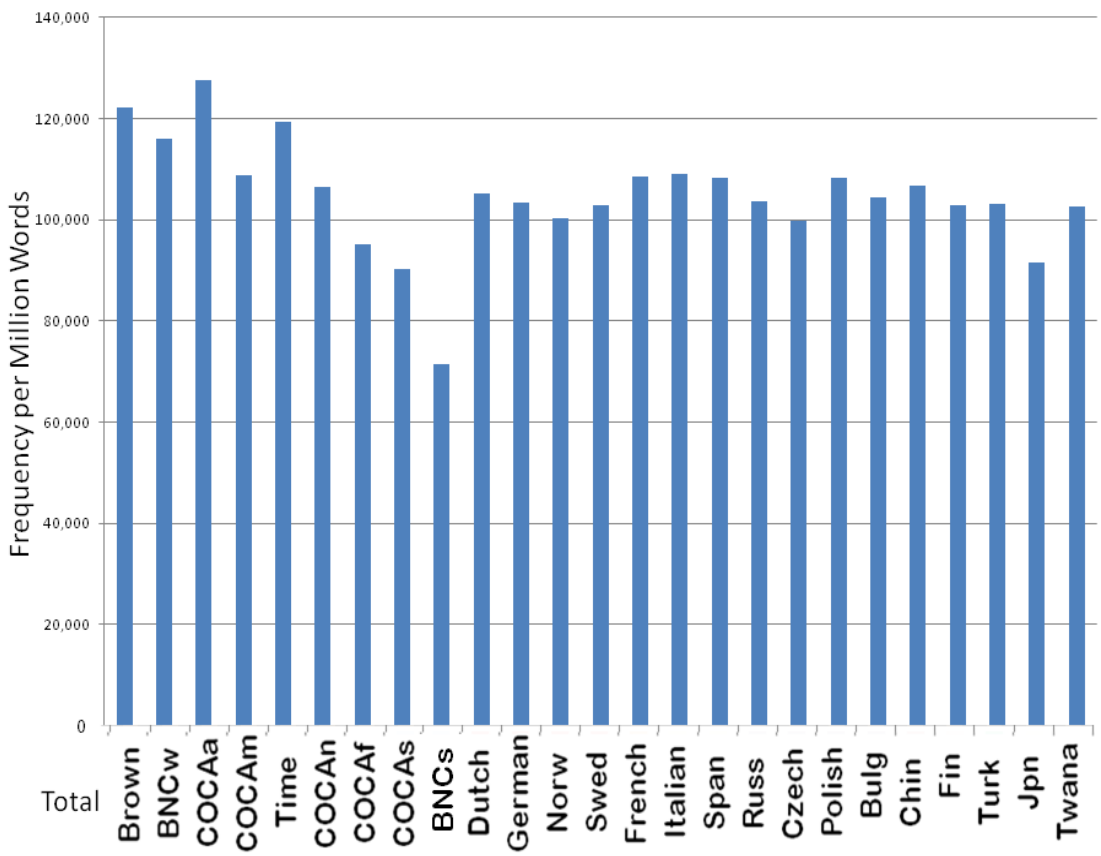

Figure 3. Total frequency per million of prepositions in NS corpora and the ICLE.

In NS production, prepositions occur more frequently in written than in oral texts. The number of prepositions within learner corpora is fairly similar, but is slightly lower in the Japanese subcorpus. This may be partly explained by the fact that Japanese postposed locatives map poorly onto their English counterparts and tend to have fewer extended meanings. The COCA Newspaper and COCA Magazine corpora exhibit a rate of preposition use most similar to that found in the learner corpora. This may reflect the fact that student essay responses to topics are most similar in style to texts within newspaper editorials and popular magazines. The overall preposition counts for the NS corpora are not completely reliable in this comparison, due to the different methods for tagging prepositions in each corpus and different criteria for determining what to count as a preposition. The ICLE subcorpora, on the other hand, were all tagged using the same automated system and should therefore provide reliable data for comparisons.

The following figures show the use of the most common prepositions among NS and learner corpora. As seen in Figure 4, *of*, by far the most common English preposition, appears much more in writing, particularly academic texts, than in NS speech. As would be expected, it exhibits greater frequency of use by French, Italian, and Spanish learners, probably due to the tendency to map it onto *de* (French, Spanish) and *di* (Italian), and perhaps due to a corresponding tendency among speakers of these L1s to underuse the Saxon genitive *–'s* and thus overuse *of*. Gonzalez Pueyo (1995) claims that Spanish speakers will tend to use *of* in place of *in* and *on* in certain circumstances.

Russian and Polish speakers also use *of* with greater frequency. Japanese, on the other hand, has a postposition (i.e., -*no*) that maps well onto the Saxon genitive, but lacks a prepositional form similar to *of*. This may explain the relative low use of *of* observed in the Japanese corpus.

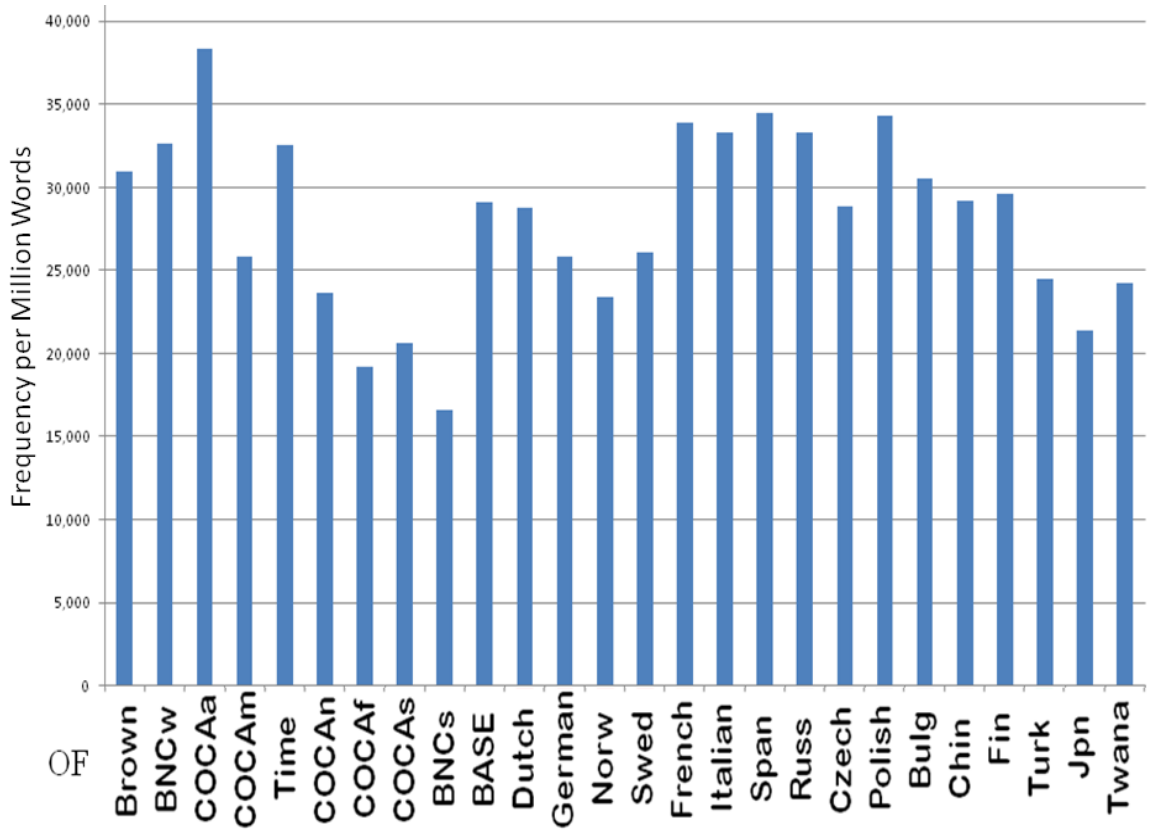

Figure 4. Frequency per million of preposition *of* in NS corpora and the ICLE.

The notion of containment, expressed in English by *in*, and the notion of support, expressed by *on*, tend to be some of the first locative notions receiving linguistic expression in English (Brown, 1973) and many other languages (Johnston & Slobin, 1979). It thus comes as no surprise that many languages contain spatial terms with core meanings similar to English *in* and *on*.

As shown in Figure 5, *in* appears to be remarkably similar in terms of frequency of occurrence within both NS and NNS written texts, appearing slightly less in some of the Slavic languages and in German. Among Indo-European languages, both Italian and Spanish show fairly frequent use of *in*. Gonzalez Pueyo (1995) claims that Spanish speakers often use *in* in contexts in which *on* or *at* are required.

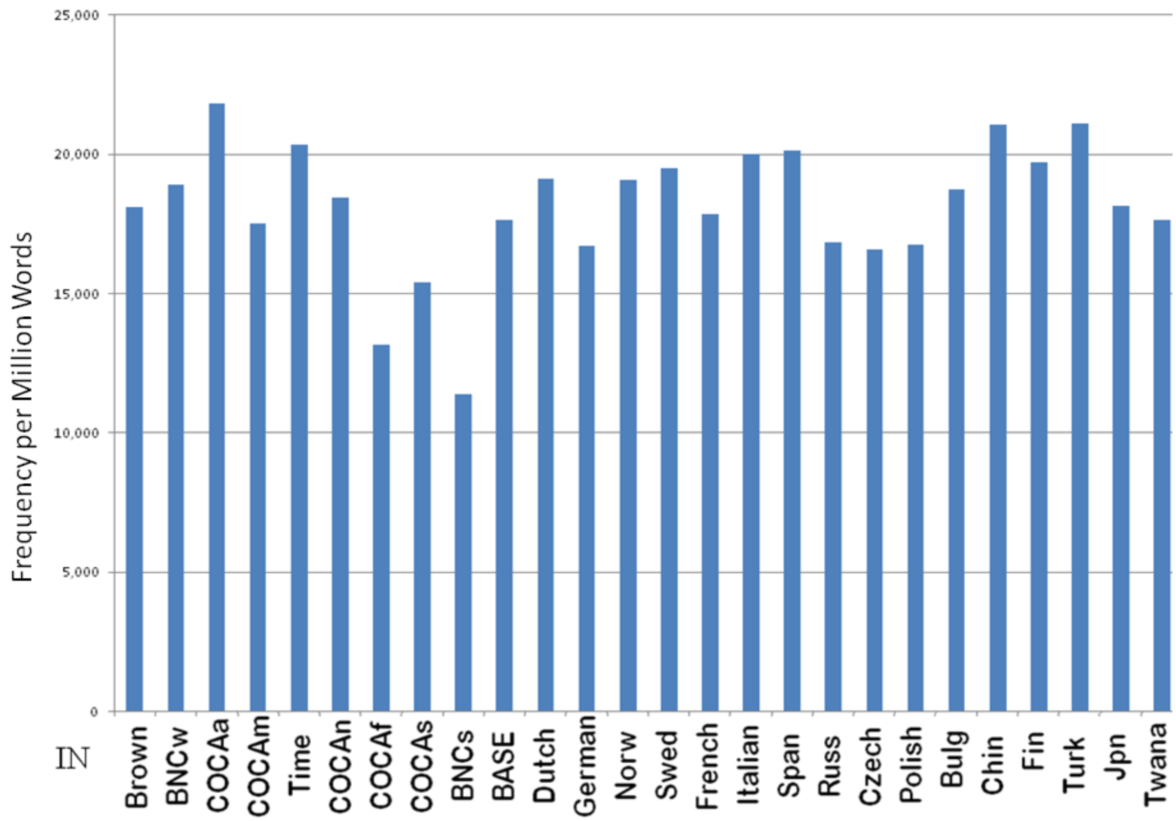

Figure 5. Frequency of *in* in NS corpora and the ICLE.

As with *in*, *to* (shown in Figure 6) occurs with similar frequency in most of the NS and NNS written texts, appearing slightly more frequently in the NS written texts and in the Tswana subcorpus.

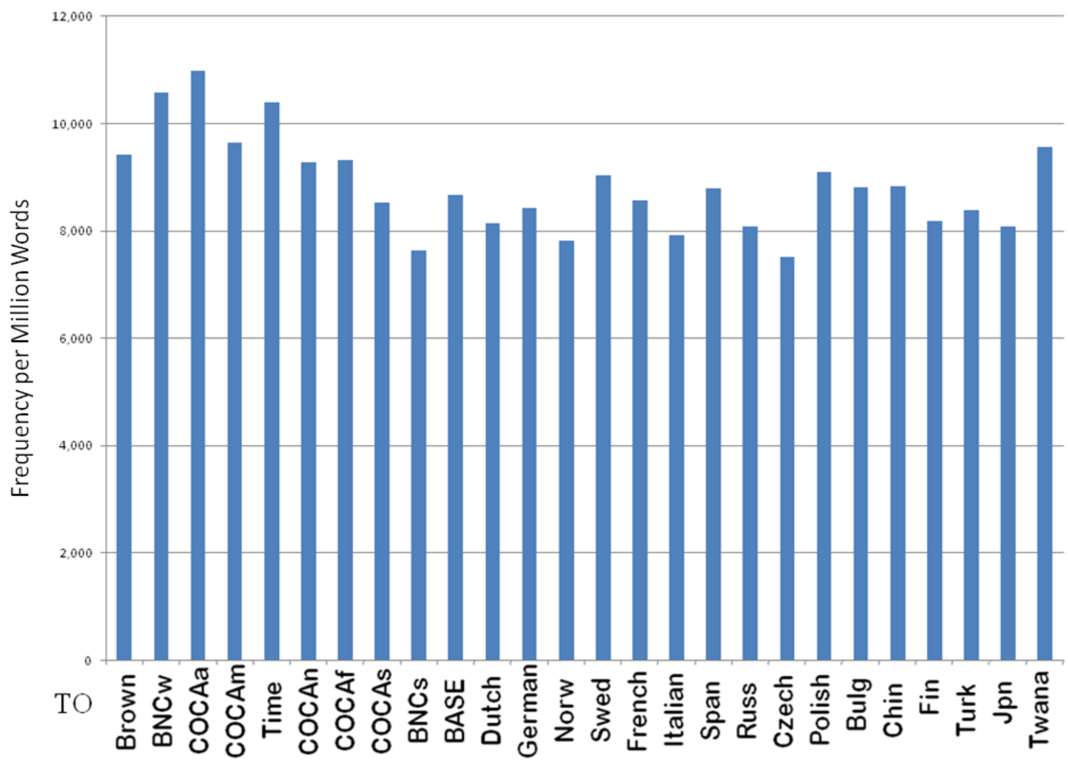

Figure 6. Frequency of *to* in NS corpora and the ICLE.

As shown in Figure 7, *for* occurs with varying frequency in many of the NNS subcorpora. In several of the languages (e.g., Norwegian, Turkish, Tswana), it occurs more frequently than in any NS corpus. It is markedly underused by Spanish speakers. Many of the senses of English *for* are covered by the Spanish prepositions *por* and *para*, but these prepositions also convey meanings that tend to be expressed by other English prepositions (e.g., *by*).[25] The poor mapping between English *for* and Spanish counterparts may prevent Spanish learners from mapping the English preposition onto existing L1 semantic categories.

[25] For example, *por* is often translated with English *by* when it is used in passive constructions (e.g., the use of *por* in the phrase, *el Senado de Estados Unidos, controlado por el partido demócrata*, which translates into English as *the Senate of the U.S., controlled by the Democratic Party*).

Crosslinguistic influence of Swedish on Swedish and Finnish L1 speakers' use of *for* was examined in a study by Odlin and Jarvis (2004). They mention that Swedish has a closely analogous preposition *för*, whereas Finnish lacks an analogous form and therefore expresses the same ideas using a wide assortment of linguistic means. In their examination of the participants' (all adolescents) elicited narratives of a silent film, the authors found that Swedish speakers, as well as Finnish speakers who knew Swedish, exhibited much greater use of *for* in their English production relative to Finnish speakers who knew no Swedish. As can be seen in Figure 7, the raw counts for the groups in the ICLE corpus are virtually identical.

To determine whether knowledge of Swedish influenced the ICLE counts, the ICLE subcorpus was divided into the portion written by Finnish speakers listing Swedish as a second language and Finnish speakers who did not report knowing Swedish. The Swedish-speaking Finnish L1 group had 9,197 *for* tokens per million, whereas the group who knew no Swedish had 7,999 *for* tokens per million. Because the former sample was exceedingly small (only 5,980 words), the number is not entirely reliable. However, it is interesting to note that the trend would support Odlin and Jarvis's (2004) findings regarding greater use of *for* among Swedish-speaking Finnish speakers relative to those who knew only Finnish.

Turning to the overall counts for Finnish speakers (subtracting those who knew Swedish) and Swedish speakers, the data do not support the notion that Swedish L1 learners of English exhibit greater use of *for*. The discrepancy between the ICLE data and the Odlin and Jarvis (2004) findings may reflect differences in the mode of production (oral versus written) and the age of the two populations.

Another possibility is that the close correspondence between the two forms is actually hindering Swedish speakers as they acquire meaning extensions of *for* that do not occur with Swedish *för*. In other words, Swedish speakers may assume that the two forms match closely and, as a result, overlook certain senses of English *for*. As Odlin and Jarvis (2004) mention, Swedish *för* is not used to express destinations[26] and duration. Because the temporal use of *for* in English is quite common, Swedish speakers who fail to acquire or produce this sense would be expected to exhibit lower frequency of use.

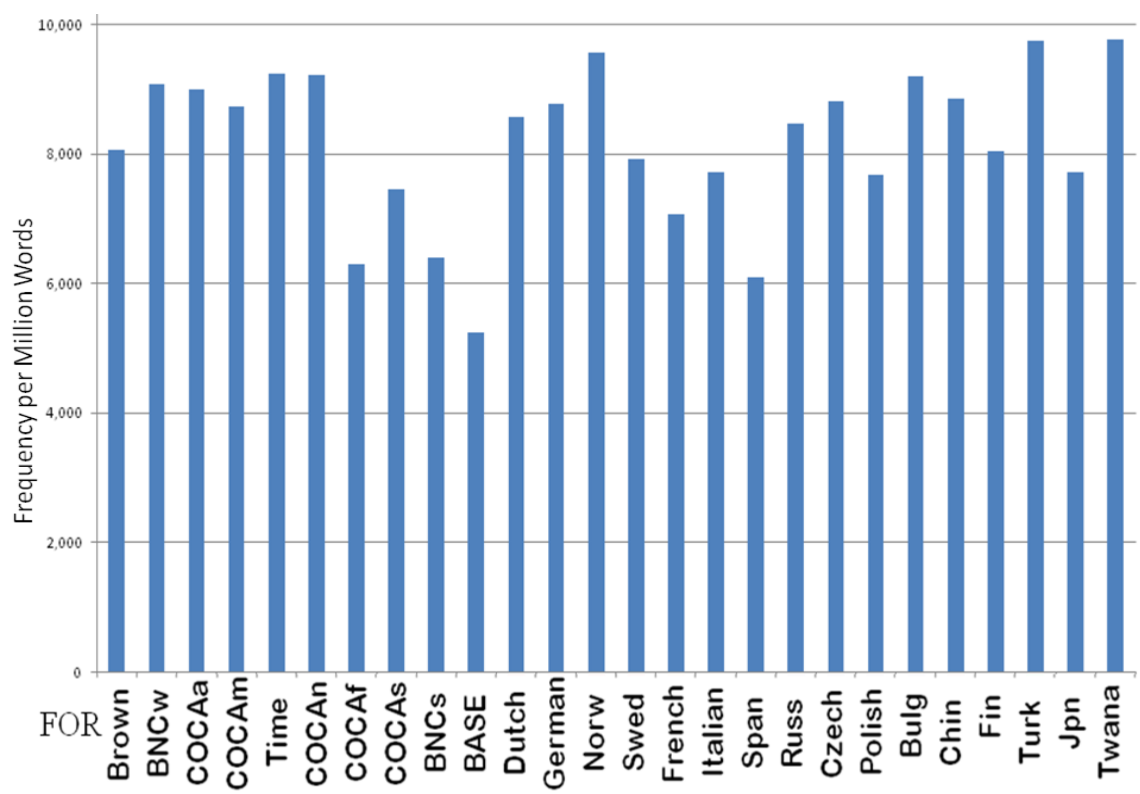

Figure 7. Frequency of *for* in NS corpora and the ICLE.

[26] The "oblique intention" sense of *for* discussed in Chapter 10.2.1 appears to be what is intended.

Both *with* and *without*, shown in Figure 8 and Figure 9, show striking underuse by Chinese speakers, who exhibit frequencies of use less than half that of speakers of many other languages. It should be noted that Chinese speakers also use *within* much less (113 tokens per million words) than do speakers of many of the Indo-European languages (compare, for example, Dutch, German, Norwegian, Swedish, and French, which have 207, 229, 339, 357, and 281 tokens per million respectively).

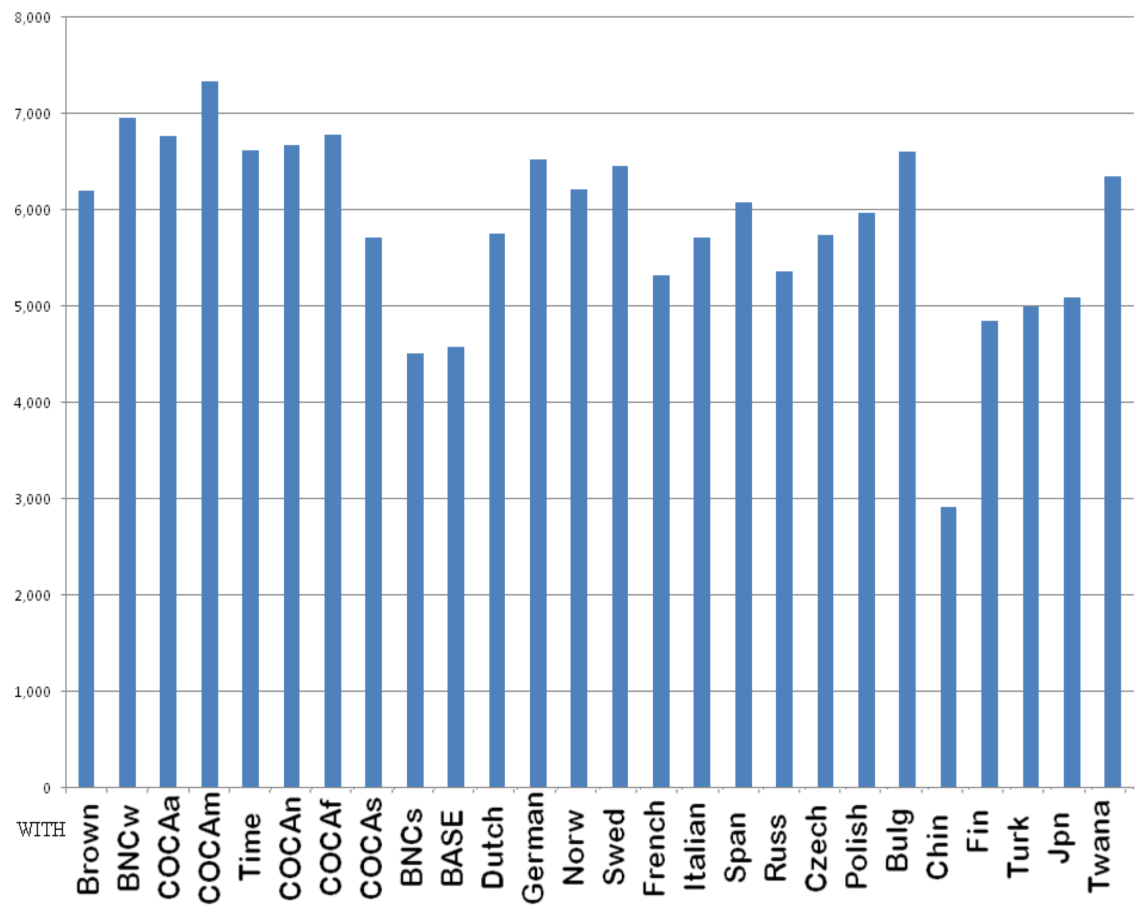

Figure 8. Frequency of *with* in NS corpora and the ICLE.

Without (Figure 9) exhibits one of the most striking patterns, occurring much more often in the NNS subcorpora (with the exception of the Chinese subcorpus). The anomaly occurs even if the searches are conducted without use of POS tagging in the query, so the discrepancy cannot be attributed to the way in which the ICLE and other corpora have been tagged. The Russian and Italian subcorpora are particularly striking, exhibiting more than three times the frequency than all NS written corpora. The discrepancy between the Chinese subcorpus and other L1 subcorpora is also odd.

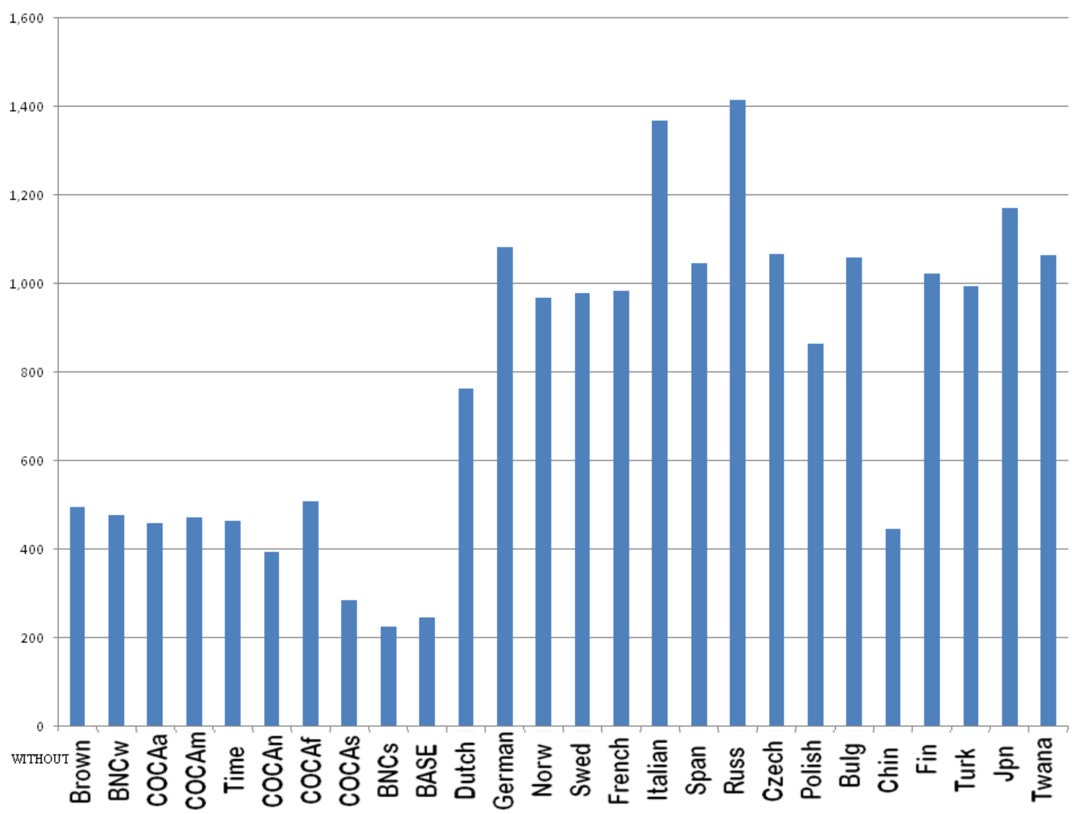

Figure 9. Frequency of *without* in NS corpora and the ICLE.

Unlike most prepositions, *on* (shown in Figure 10) is used with similar frequency across most of the English written genres. *On* exhibits underuse by Spanish speakers. Spanish *en* covers much of the semantic space as English *in* and *on*, so Spanish speakers appear to map Spanish *en* to English *in*, which occurs with greater frequency than *on*.

Cronnell (1985), in his analysis of third- and sixth-grade Mexican-American students' writing, found that students often used *in* when *on* was clearly intended. It is interesting to note that Munnich (2002), in his study of critical period effects in a group of Spanish and Korean L1 learners of English, found the *on* and *in* distinction especially difficult for NNSs arriving in the U.S. after age 13.

The German and Chinese subcorpora both show a tendency to use *on* as frequently as the NS written corpora. In the case of Chinese speakers, this may be due to the tendency to map *on* onto Chinese *shàng*,[27] which occurs with great frequency in Chinese and has numerous extensions to noncentral senses. Zhang, Segalowitz, and Gatbonton (2011), conducted a study comparing native Chinese (monolingual or highly Chinese dominant) and native English speakers' elicited descriptions of 116 drawings depicting relationships covering a range of situations that are usually described in English by the prepositions *against*, *in*, *near*, *on*, *over*, *under*, and so on. The authors compared English NSs' use of the containment-related preposition *in* (including in the count *within* and *inside*) and the Chinese NSs' use of its Chinese equivalent *lǐ*,[28] including in the count its more formal equivalents *zhōng*,[29] *nei*,[30] and *zhīzhōng*.[31] They also compared the English NSs' use of *on* and the Chinese NSs' use of its close equivalent, *shàng*. They found that whereas English speakers used *in* and *on* with roughly equivalent frequency to describe the experimental targets (44.3% and 43.1% of responses, respectively), the native Chinese speakers used *in*-equivalents when describing 29.7% of the pictures and used *on*-equivalents for 62.2% of pictures. Using a 90% consistency cut-off for both

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[27] 上.
[28] 里.
[29] 中.
[30] 内.
[31] 之中.

languages, they identified 13 pictures for which the Chinese NSs used *on*-equivalents whereas English NSs used *in*, and only one picture (*food on a plate*) for which the opposite pattern appeared.[32] Many of the differences involved negative space (e.g., *hole in the wall*, *crack in the cup, gap in the fence*, etc.). In addition*, nail in board*, *flower in hair, fruit in a tree, bird in a tree*, *cork in bottle,* and *light bulb in socket* also evoked *shàng*, the Chinese equivalent for *on*.

In the latter two examples, the functional notion[33] of control is prominent in English, leading to the use of *in*. The observed pattern would predict that Chinese would generally overuse *on*, as observed in the ICLE data. It is interesting to note that a corresponding underuse of *in* was not apparent in the ICLE data, but this may be related to the underuse of *at* observed in the Chinese subcorpus.[34]

Both German and Dutch show greater use of *on* than most of the other learner groups. It has been pointed out that these two languages have a more fine-grained division of the semantic space covered by English *on*, breaking it up into *op* and *aan* (in Dutch) and *auf* and *an* (in German). These two L1 groups would presumably find it easy to go from a many-to-one mapping when learning English (for a discussion of many-to-one mapping, see MacWhinney, 1992; Stockwell, Bowen, & Martin, 1965).

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[32] The authors surmise the Chinese pattern may reflect the greater depth typical of Chinese plates.

[33] As Coventry and Garrod (2005) point out, extra-geometrical factors, commonly referred to as "functional features," affect the comprehension of prepositions. Typically, these features relate to how objects typically interact with the environment or reflect inferences related to the dynamic aspects of scenes. For example, containers typically control the motion of their context (e.g., when a container moves, its contents also move). For this reason, *in* (the preposition associated with containment in English) is typically regarded as more appropriate for context in which the landmark controls the trajector. For example, *The lightbulb is in the socket* is an acceptable English sentence due to the socket's control over the lightbulb. This is in spite of the fact that a socket does not resemble a typical container. A sentence such as *The bottle is in the cap*, on the other hand, sounds odd, as caps do not typically exert functional control of the location of the bottle.

[34] In other words, Chinese speakers may prefer *in* to *at* in instances in which both are felicitous (e.g., *She's in school* versus *She's at school*) and in instances in which *at* is clearly preferred by NSs. Darus and Ching (2009) mention the *at*-versus-*in* distinction as a source of error among Chinese-Malay (bilingual) learners of English.

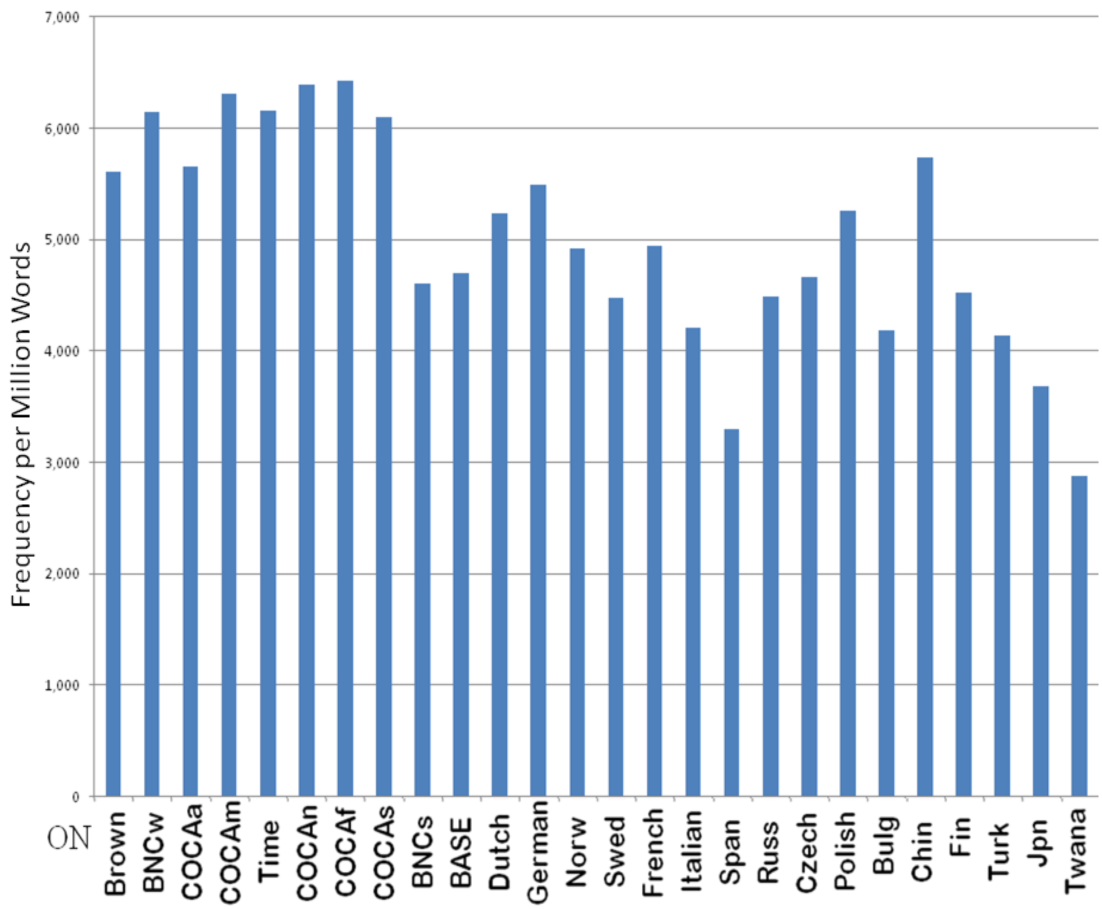

Figure 10. Frequency of *on* in NS corpora and the ICLE.

As seen in Figure 11, the frequency of *at* varies greatly among the different NS corpora. It appears to be markedly underused by NNSs (with the exception of German and Tswana speakers), especially by speakers of Chinese and Finnish. Two authors (Cuyckens, 1985; Knas, 2006) have mentioned that the semantic space covered by English *at* maps poorly onto Polish prepositions, a fact that might explain the low use in Polish.

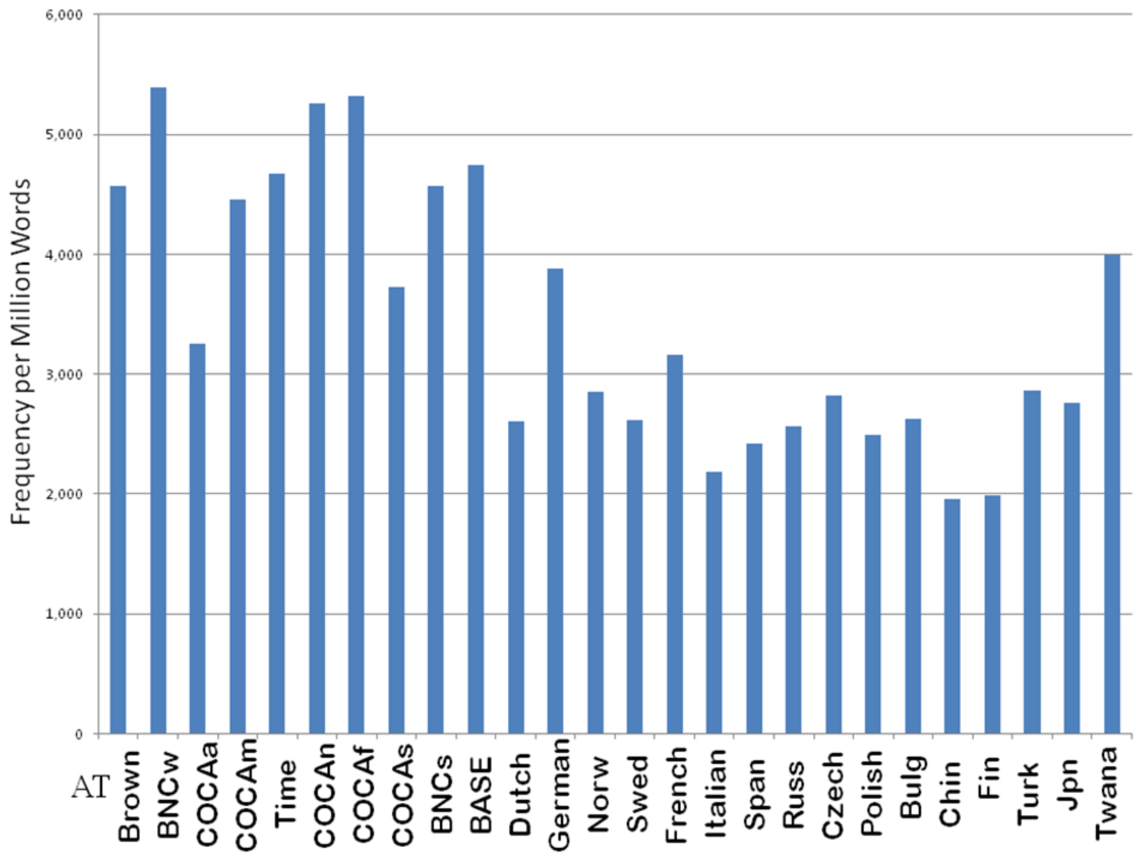

Figure 11. Frequency of *at* in NS corpora and the ICLE.

As seen in Figure 12, the Chinese subcorpus is the only to use *from* at frequencies similar to those of most NS written corpora. Spanish tends to markedly underuse *from*. As is the case with *in* and *on*, Spanish learners probably experience difficulties mapping a single L1 form (i.e., *de*) onto two L2 forms (*of* and *from*) and select the more common *of* as the default.

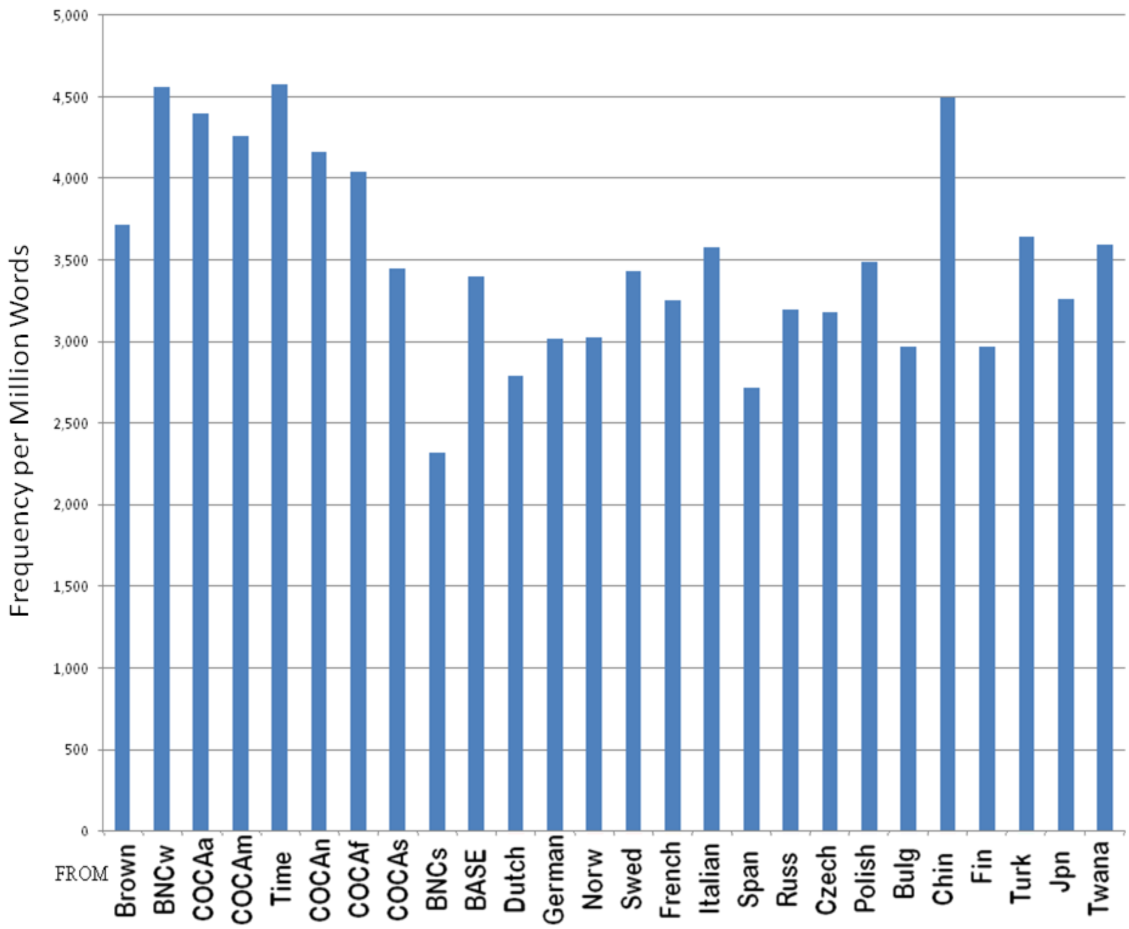

Figure 12. Frequency of *from* in NS corpora and the ICLE.

The greater use of *into* (shown in Figure 13) in NS fiction is striking. *Into* appears to be underused by speakers of Romance languages, Turkish, Japanese, and Tswana.

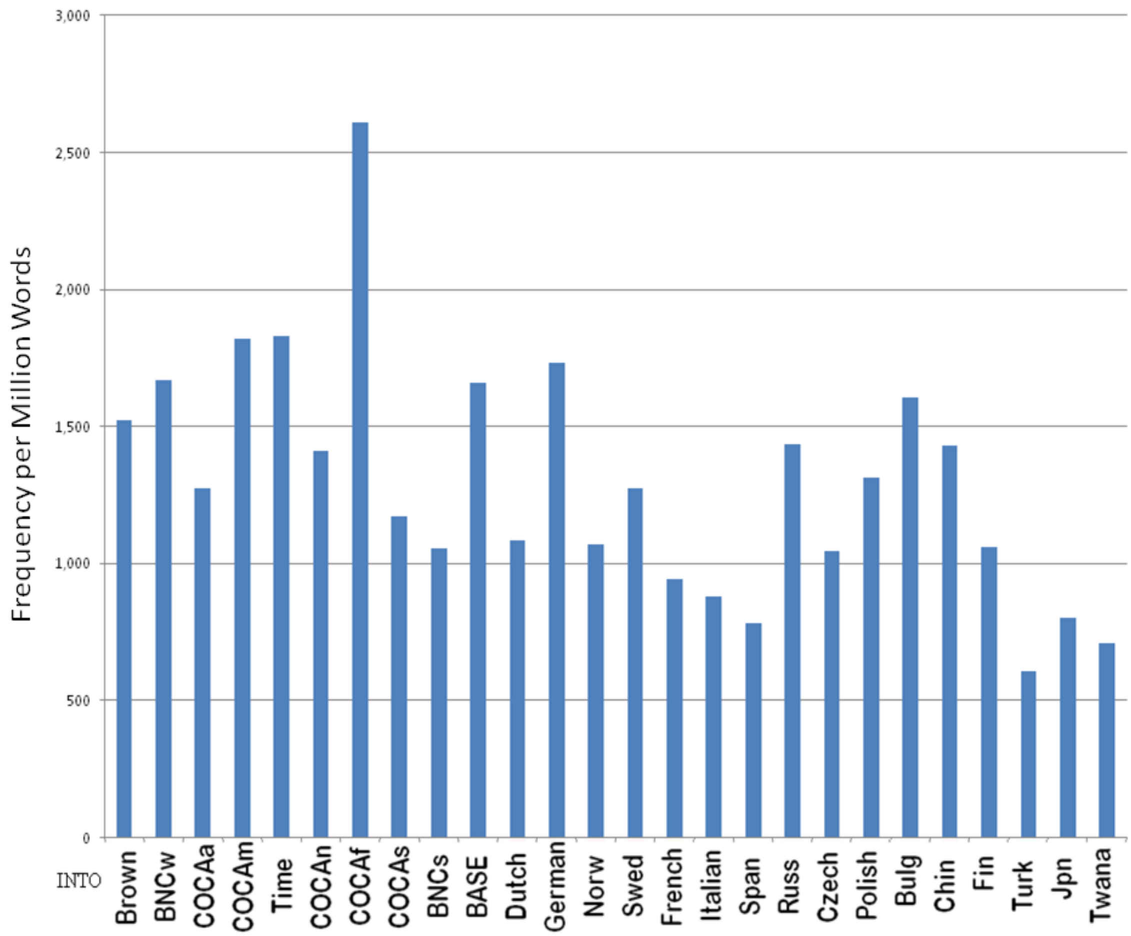

Figure 13. Frequency of *into* in NS corpora and the ICLE.

In NS corpora, *about* (shown in Figure 14) is associated with oral texts. With the exception of French, Bulgarian, and Chinese, it appears frequently in the NNS subcorpora. The high use among NNSs may reflect poor knowledge of more formal alternatives (e.g., *concerning*, *regarding*, etc.), which may account for the low use of *about* in the NS written corpora.

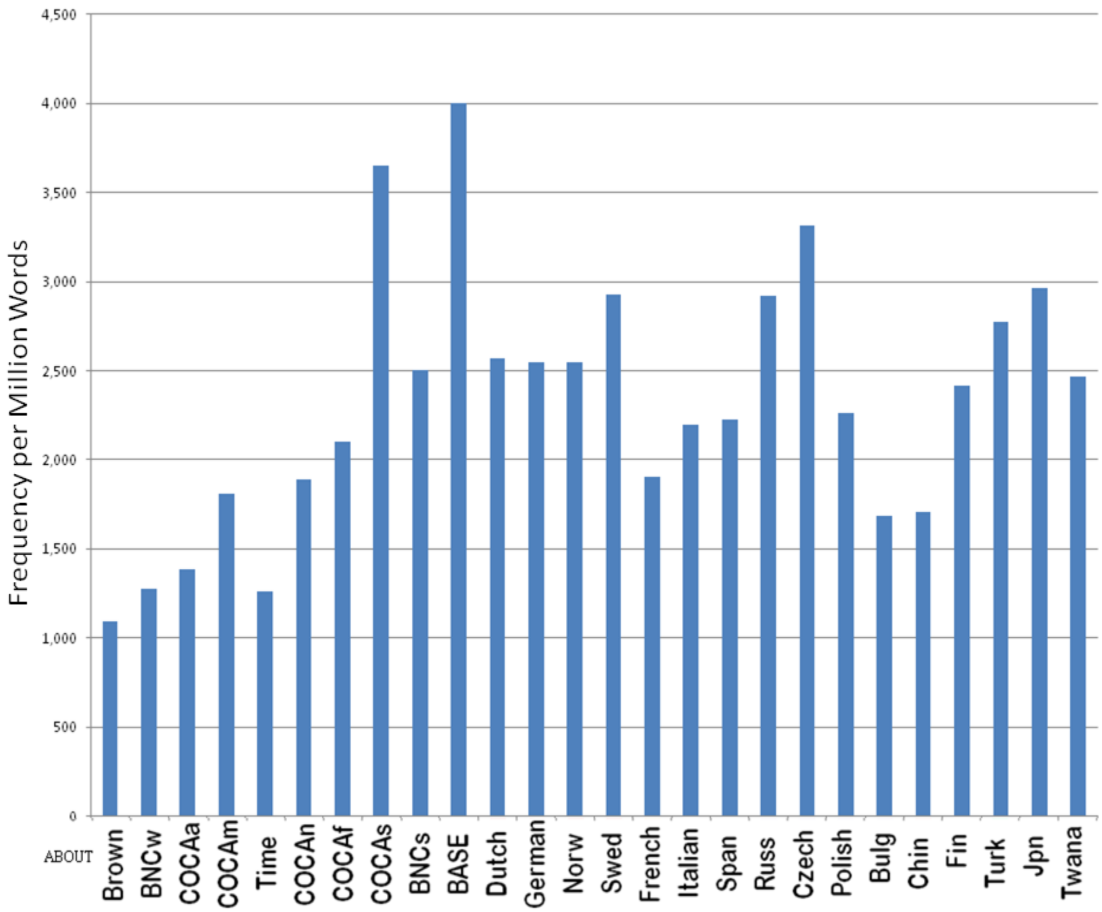

Figure 14. Frequency of *about* in NS corpora and the ICLE.

As seen in Figure 15, *through* shows a great deal of variation in different subcorpora. In particular, it occurs frequently in the Romance language subcorpora but infrequently in the Russian and Turkish subcorpora.

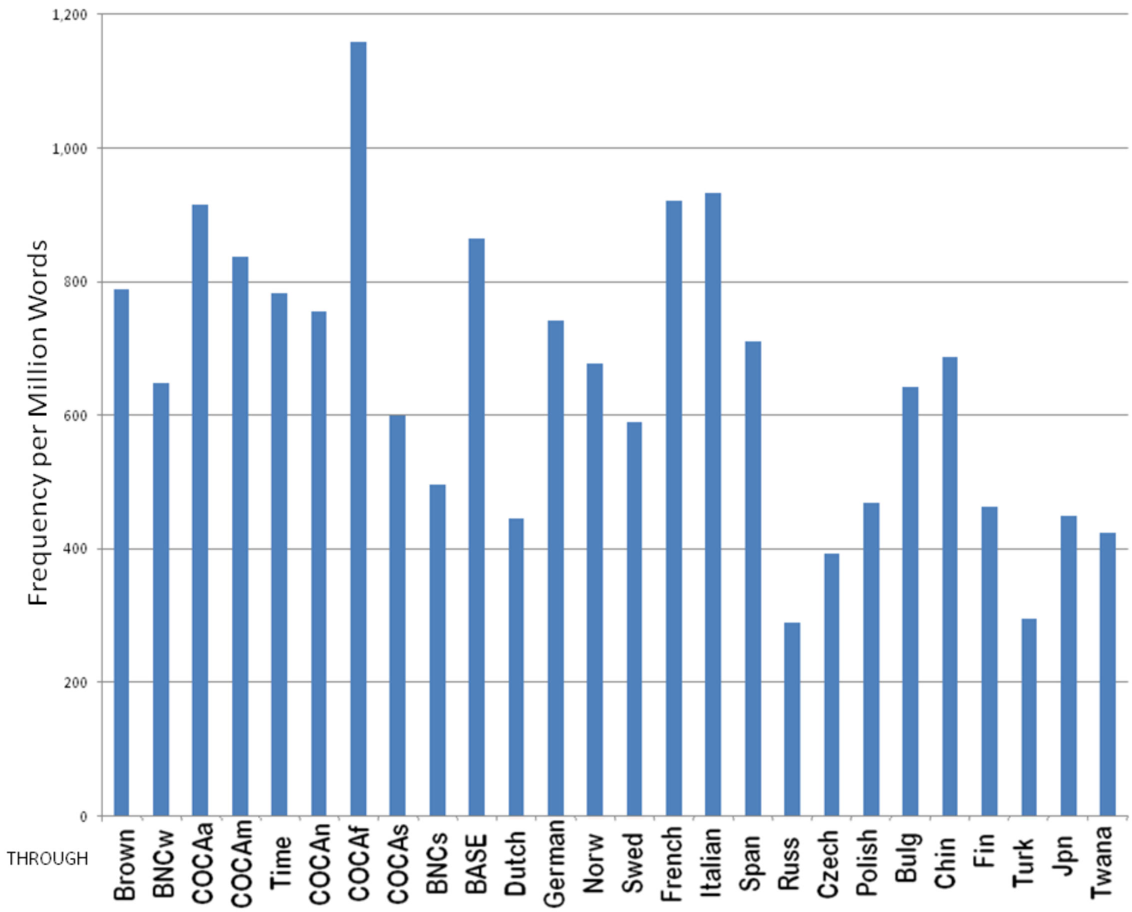

Figure 15. Frequency of *through* in NS corpora and the ICLE.

Over is often cited as a prime example of a highly polysemous English preposition, so it would be expected to resist acquisition by learners. As seen in Figure 16, most of the NNS subcorpora show a marked underuse of this preposition. Gonzalez Pueyo (1995) claims that Spanish speakers will tend to use *on* in situations in which *over* is required. Japanese, and to a lesser extent Russian and German, are striking exceptions to this pattern.

The frequent use of *over* by Japanese speakers is particularly interesting, as Japanese speakers show a general tendency to underuse English prepositions. The anomaly could be related to the tendency for Japanese to conflate scenes that are linguistically distinguished by *on* and *over* in English (Levinson & Wilkins, 2006).

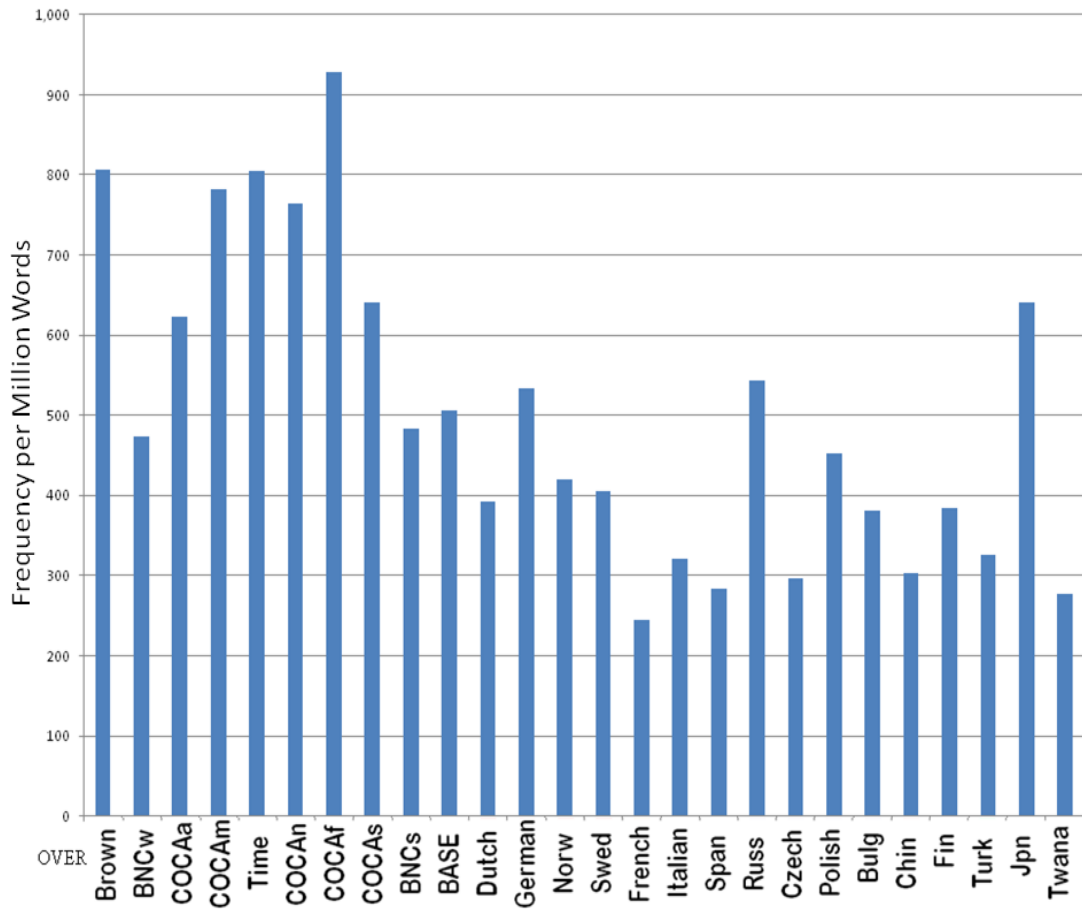

Figure 16. Frequency of *over* in NS Corpora and the ICLE.

As shown in Figure 17, *between* seems to be associated primarily with academic texts (especially academic written texts) in English. The preposition shows strikingly disproportionate distributions across the NNS subcorpora, appearing with more than sevenfold greater frequency in the French subcorpus relative to the Tswana subcorpus.

The other Romance languages also show a tendency to use *between* with greater frequency.

Because *between* is often used in comparisons, which figure prominently in essay prompts, a secondary analysis was performed on the results to determine whether the French use of *between* was an artifact of the particular data collection procedures. Thus a separate analysis was conducted of the three Belgian institutions from which the French subcorpora results were taken. The token counts for *between* as a preposition in the Université catholique de Louvain, Université libre de Bruxelles, and Université de Liège portions of the subcorpus were respectively 2,031, 1,389, and 927 per million tokens. The secondary analysis, while indicating variance among divisions of the subcorpus (likely due in part to the smaller, and thus less reliable, samples from the latter two universities), shows that even the lower count from the Université de Liège far exceeded that of most other subcorpora. If the French subcorpus is split between argumentative essays and literary essays, the token counts for *between* (as a preposition) remain high (1430 and 2673 tokens per million, respectively).

It is interesting that the French use of *among* (395 tokens per million), which is semantically close to *between*, is also higher than the use of *among* in most of the NS written corpora (cf. 315 and 252 tokens per million in the Brown and BNC Written corpora, respectively).

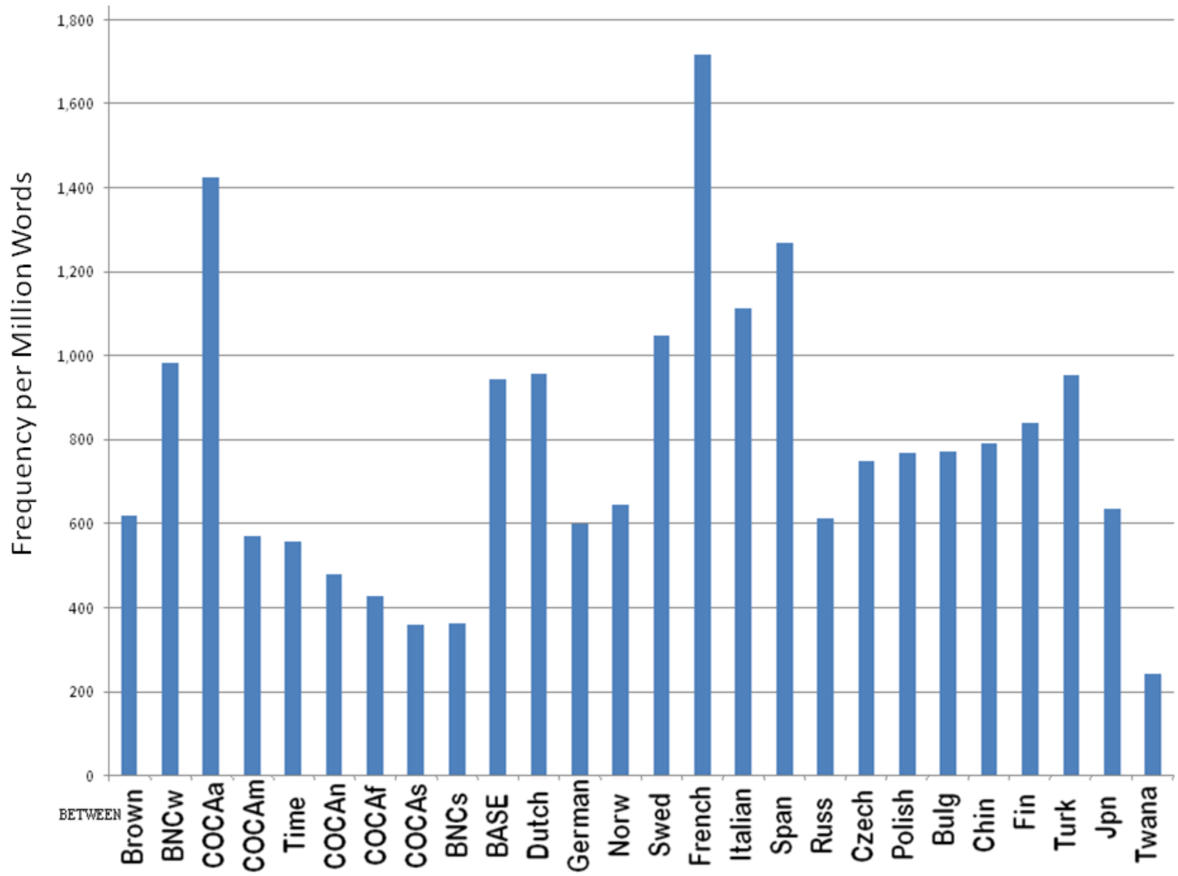

Figure 17. Frequency of *between* in NS corpora and the ICLE.

As seen in Figure 18, *after* occurs much more frequently in written texts in NS corpora. Several of the NNS subcorpora (e.g., German, Dutch, Chinese, and Turkish), on the other hand, exhibit greater use of *after* than all the NS corpora. Several other NNS subcorpora, and the Romance languages in particular, show less use of the preposition.

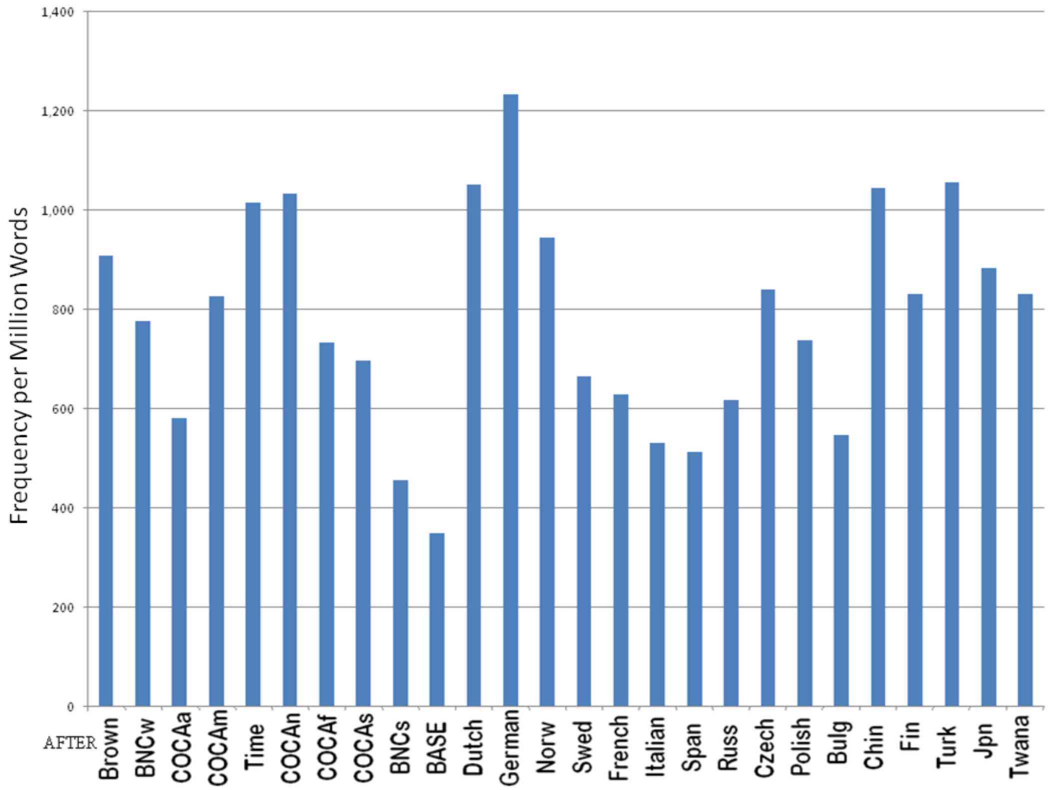

Figure 18. Frequency of *after* in NS corpora and the ICLE.

As can be seen in Figure 19, *under*, when viewed relative to its appearance in the NS written corpora, tends to be underused by all the learner subcorpora. In the case of the German languages, the underuse (relative to written NS corpora) is unexpected, as these languages have cognates that are phonologically similar to *under* (Dutch *onder*, German *unter*, Norwegian *under*, Swedish *under*).

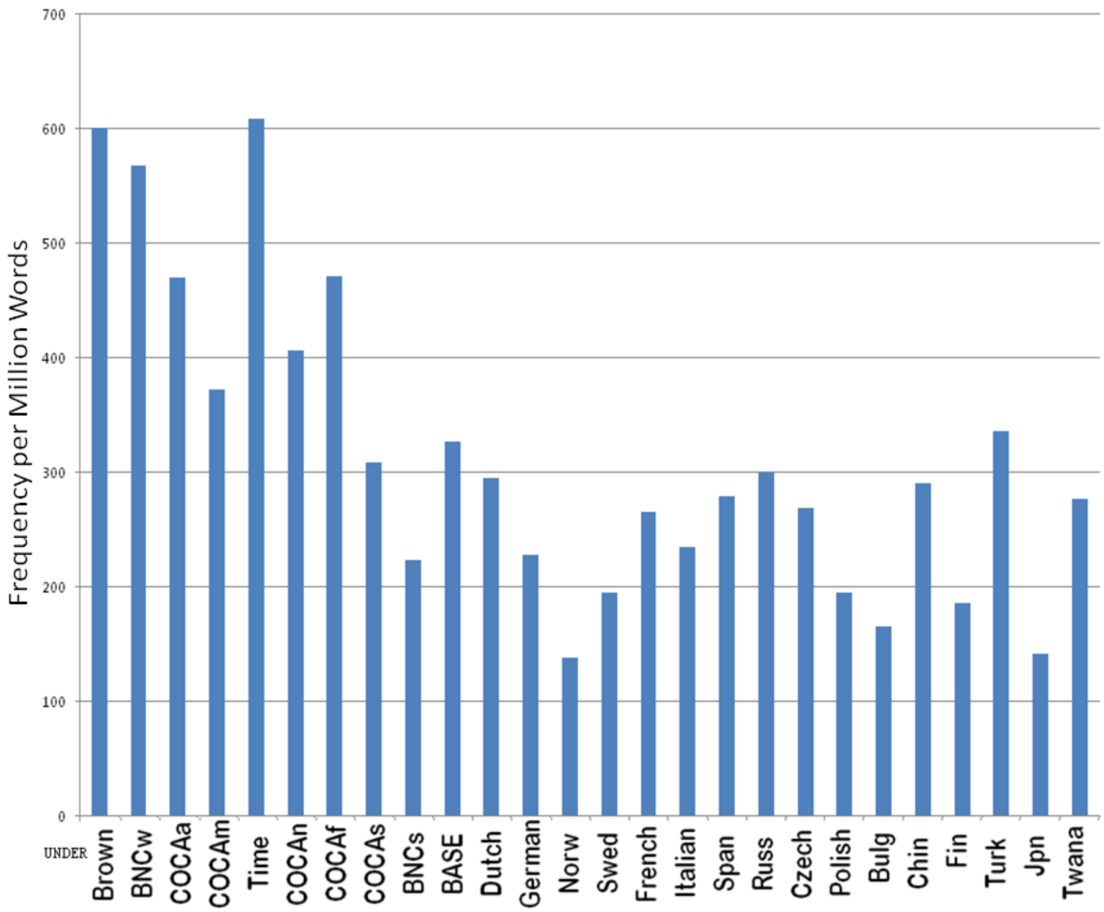

Figure 19. Frequency of *under* in NS corpora and the ICLE.

As seen in Figure 20, *against* occurs much more frequently in the Dutch, Italian, and Finnish subcorpora. It is somewhat lower in the Bulgarian subcorpus. The lack of consistency within the Germanic, Romance, and Slavic language groups is notable. Ijaz (1986) noted a tendency for the ESL learners in her study (which included those with a German L1 background) to overuse *against*. The German and Dutch prepositions that correspond to English *against* (German *gegen*, Dutch *tegen*) both have numerous extensions of meaning that do not occur in English *against*, so learners from these L1s may tend to overuse this preposition.

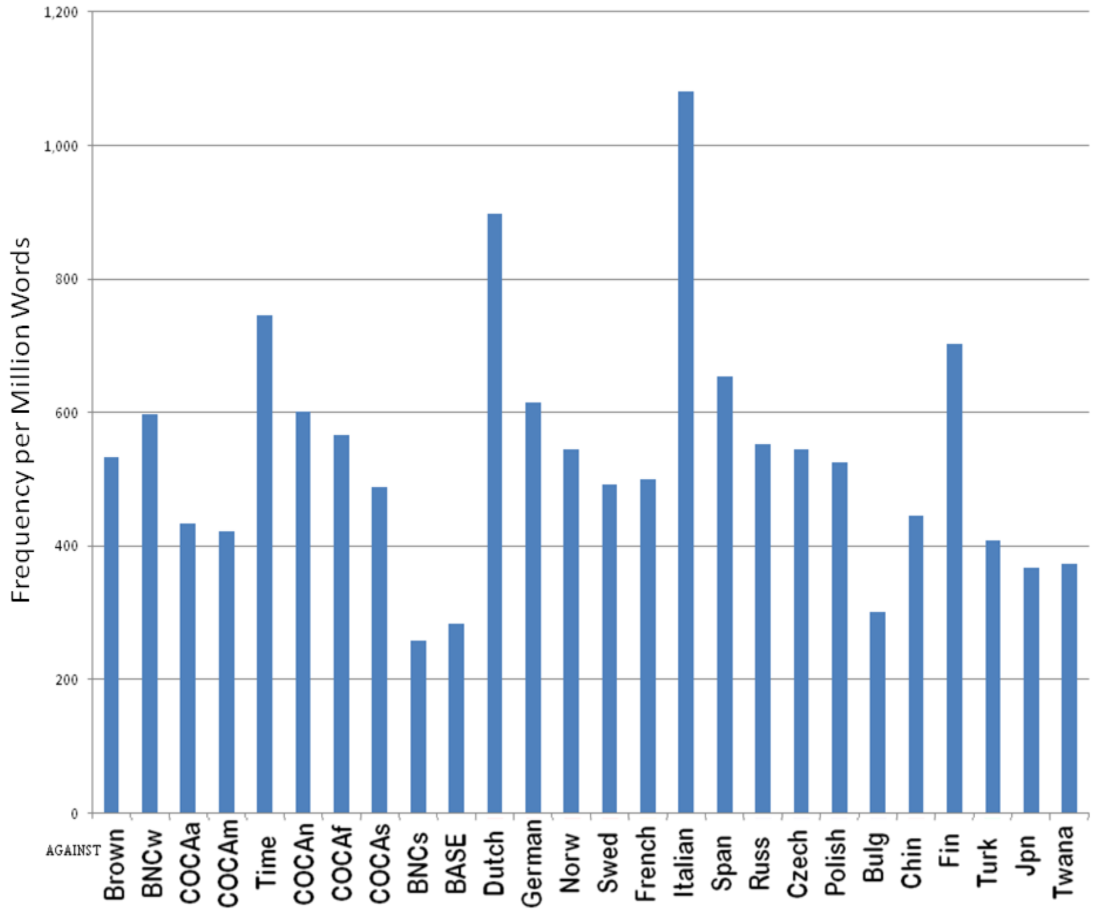

Figure 20. Frequency of *against* in NS corpora and the ICLE.

As seen in Figure 21, the Bulgarian and Japanese subcorpora stand out for their low use of *during*.

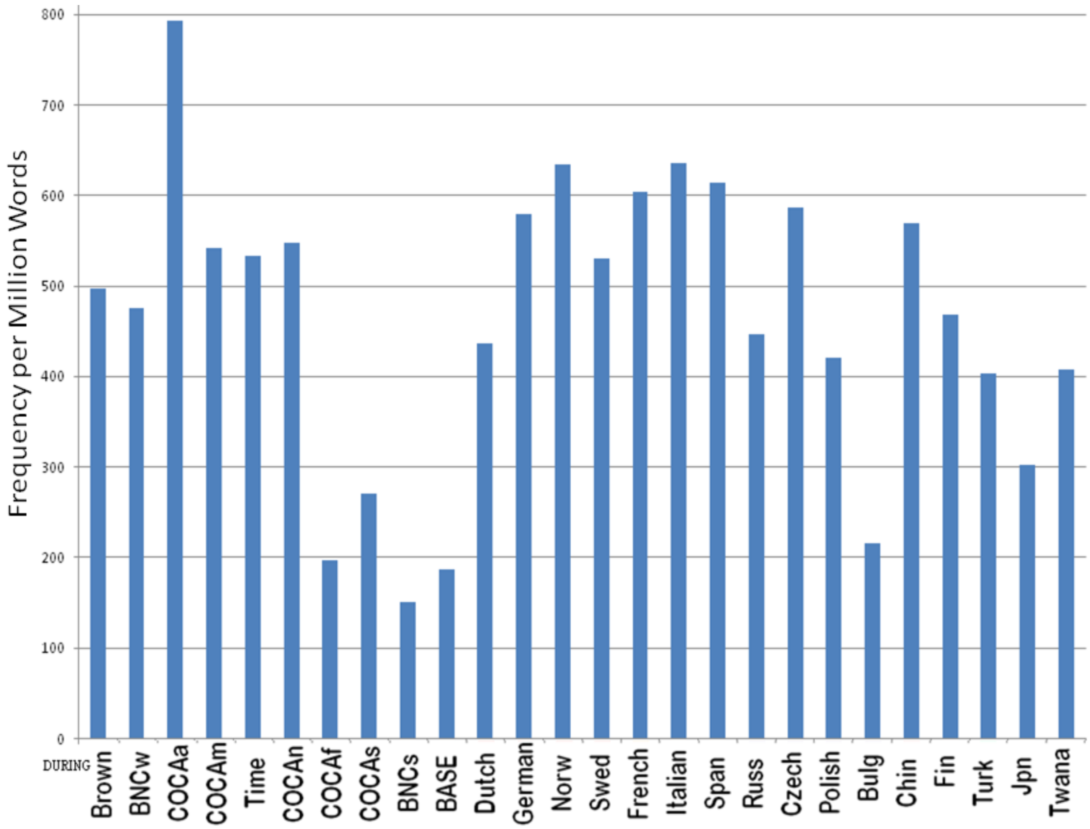

Figure 21. Frequency of *during* in NS corpora and the ICLE.

6.1.5 Discussion

The NS corpora generally indicate that the use of prepositions can vary greatly depending on whether the texts are written or oral. Academic writing and speech also tend to contrast sharply with more informal speech and writing. Among the various text genres, fiction appears to be highly idiosyncratic in terms its frequencies of prepositional use. It may be conjectured that learners' difficulties in acquiring certain prepositional senses is, in part, due to their exposure to a limited range of text genres, and the infrequency with which certain prepositional senses appear within the genre of texts that they most frequently encounter.

Within the learner subcorpora, there is a marked tendency for certain prepositions to be overused or underused by learners of particular L1s. There are clear patterns of oversuppliance of particular prepositions (*between* by French speakers, *with* and *without* by Italian and Russian speakers, *on* by Chinese speakers, *about* by Czech speakers, *after* by German speakers, and *against* by Italian and Dutch speakers). There are also conspicuous patterns of avoidance (*for* and *on* by Spanish speakers, *with* by Chinese speakers, *into* by Turkish speakers, *through* by Russian and Turkish speakers, *during* by Bulgarian speakers, *between* by Tswana speakers, and *at*, *from* and *over* by most of the observed L2 populations).

Within transfer research, there has traditionally been some debate regarding the possibility of crosslinguistic transfer when the relevant semantic information is expressed by prepositions in one language and by postposed bound morphology in the other language. Fluctuations in English preposition use among speakers of languages with postposed bound morphology that performs functions similar to English prepositions (e.g., Finnish, Turkish, and Japanese) is consistent with Jarvis and Odlin's (2000) research showing that this morphology affects patterns of crosslinguistic transfer among speakers of Finnish, a language with postposed morphology.

The observed inter-population variance among NNSs can provide neither proof of, nor explanatory adequacy regarding, L1 influence, due to the coarse nature of the sampling. It could be that underuse or overuse correlates with discourse-level factors such as information organization,[35] or it could depend upon nonlinguistic factors, such as a preference for certain patterns of reasoning or preferred expressions, which entail the

[35] For a study of how information structure may exert a crosslinguistic influence, see Carroll, Murcia-Serra, Watorek, and Bendiscioli (2000).

use of particular prepositions. Another possibility is that some prepositions are avoided due to NNSs' difficulties pronouncing certain sounds (e.g., Chinese NNSs' difficulty pronouncing the linguadental in *with*). It is even more probable that the observed NNS variance in prepositional use is due, in part, to differences in each L1 population's acquisition of those grammatical structures, lexical items, and constructions that serve as semantically close alternatives to specific prepositions.

With these caveats in mind, a minimal case may be made that the findings are broadly compatible with the view that L2 acquisition of prepositions (and by extension, the learning of particular senses of prepositions) is markedly influenced by L1-specific factors. Indeed, the overly broad analysis used here, which only examines the use of prepositions without information on the particular prepositional senses that learners produce, is likely to underestimate the differences between NS and NNS production, as well as the differences among L1 groups.

While tangential to the current research, the lack of correspondence between the use of certain English prepositions by some learners whose L1s have close genetic affinities, especially the Germanic languages (Dutch, German, Norwegian, and Swedish) and Slavic languages (Russian, Czech, Polish, and Bulgarian), is somewhat surprising. This may stem from the fact that the semantics of the prepositions, lexical items, and grammatical structures within the various L1s that tend to be mapped onto English prepositions are highly dynamic diachronically. This has certainly been the case in English, a language in which many prepositions (e.g., *with* and *for*) have shifted significantly over the course of several centuries, and have, as a result, given birth to a number of novel semantic extensions (see Farrell, 2009; Tyler & Evans, 2003).[36]

6.2 Learner Corpus Analysis of Chinese Learners of English

Because Chinese L1 learners of English constituted the population sampled in the experiment that is discussed in Chapter 12, it was important to gain an understanding of this population's typical patterns of English preposition use. To determine the level of error among this L1 group, an analysis was conducted of the Chinese subcorpus of Version 2 of the International Corpus of Learner English (ICLE, Granger et al., 2009). The ICLE Chinese subcorpus consists of 982 essays and 490,617 words. One large batch of these essays came from students at the English Language Center in Hong Kong Polytechnic University and the others came from students at the University of Portsmouth (UK). The majority of students were from mainland China. They were undergraduate students who were mostly in their 20s. Their proficiency levels ranged from high intermediate to advanced. They were, therefore, very similar to the participants used in the experiment reported in Chapter 12.

Prepositional use was identified using the part of speech (POS) tagging that is available as part of the built-in concordancer that comes with the ICLE corpus. The error analysis examined all prepositional use to determine whether errors were common and whether there were patterns of undersuppliance or oversuppliance. This analysis was part

[36] *With*, discussed by Farrell (2009), originally covered some of the semantic space that is now covered by the preposition *against*. Vestiges of this meaning can be seen in the compound *withstand* and perhaps in collocations such as *fight with*. *For*, discussed in Tyler and Evans (2003), originally meant *in front of* or *before* (cp. *forehead*).

of the initial research aimed at determining the ideal instructional targets for the experiment presented in the current study.

The corpus search query limited results to Chinese learners of English from mainland China who listed Chinese or Chinese Mandarin as their L1. The first 1,030 preposition tokens were examined and coded as: (1) correct, (2) incorrect, or (3) questionable. Tokens in the third category often involved instances in which it was not clear whether the error was primarily due to the preposition or was due to other elements of the sentence in which the preposition was embedded. Tokens involving errors were also coded in terms of the preposition that was apparently intended based on the sentence context. The analysis indicated 100 errors (9.7% of total tokens) and 46 questionable tokens (4.5% of total tokens). The analysis thus suggests that prepositions continue to be a major source of error for Chinese learners at fairly advanced levels.

Errors were further analyzed in terms of oversuppliance (the preposition mistakenly used in place of a more appropriate alternative) and undersuppliance (the preposition intended but replaced by an inappropriate alternative). Because typical errors involved both the suppliance of the wrong preposition and the failure to supply the correct preposition, the errors were usually counted in both categories under different prepositions. The results for the most frequently occurring prepositions in English (excluding *of* and *with*) are shown in Table 2. The percentage rates of undersuppliance are essentially ratios of underuse relative to the L2 writers' total use of the preposition. In other words, for every correct use of *for*, the corpus listed 4.7 instances in which *for* appears to have been intended but was replaced with an inappropriate preposition.

The small sample precludes any definitive conclusions, but the error analysis suggests a marked tendency to oversupply some prepositions while undersupplying others. *To*, *in*, and *about*, in particular, tend to be oversupplied by Chinese NNSs, whereas *for*, *from*, and *at* tend to be undersupplied. This may be partly attributable to L1 influence, particularly the existence of close Chinese analogs to some English prepositions and the lack of such L1 analogs for others.

Table 2

Patterns of Preposition Use in the ICLE Chinese Subcorpus

Preposition	Total Use	Oversuppliance		Undersuppliance	
	Tokens	Tokens	Percent	Tokens	Percent
In	355	26	7.3%	10	2.8%
To	126	23	18.3%	5	4.0%
For	3	0	0.0%	14	466.7%
On	92	21	22.8%	17	18.5%
At	46	3	6.5%	26	56.5%
By	50	6	12.0%	3	6.0%
From	82	2	2.4%	6	7.3%
Into	18	3	16.7%	2	11.1%
About	36	7	19.4%	1	2.8%

In sum, the previous three chapters have established that English prepositions pose a challenging problem to L2 learners from a wide range of L1 backgrounds and proficiency levels, regardless of whether these learners are in immersion or non-immersion environments. A number of potential reasons for this difficulty were considered, including crosslinguistic influence. A broad corpus analysis of the written production of NNSs from various backgrounds was examined. A more fine-grained corpus analysis of Chinese NNSs' written production showed similar patterns. The observed variation, including both overproduction and underproduction of certain prepositions by specific L1 groups, was consistent with theoretical positions (e.g., Slobin, 1991) that assume a pervasive influence of learners' L1 on L2 acquisition of specific core semantic distinctions.

The following two chapters will examine the cognitive literature on categorization and the literature on explicit instruction and practice. The review will attempt to clarify the learning problem associated with complex family resemblance categories, such as English prepositions, as a step toward identifying an optimal pedagogical approach.

Chapter 7: Categorization

To overcome L1-based biases related to "thinking for speaking," along with the other obstacles to acquisition mentioned in Chapter 5, learners must develop the ability to place situations they encounter into discrete categories and relate these categories to specific linguistic forms. This process of categorization is not, of course, unique to prepositions, but is rather a basic cognitive process intimately associated with the cognitive representation and acquisition of linguistic units (MacWhinney, 1989; Taylor, 2003a).

In his influential work on categorization in language, Taylor (2003a) reviews research showing that patterns of categorization, particularly in the form of prototype effects, can be found throughout language in areas as diverse as phonology, the lexicon, metonymy, metaphor, morphology, syntax, and intonation. Taylor's work would suggest that general cognitive research on categorization is important to research on semantic learning, as it constrains SLA theories regarding both the types of representations that L2 learners develop and the processes L2 learners employ to develop new linguistic categories. To understand how categorization research may inform SLA hypotheses regarding representation, acquisition, and optimal pedagogical interventions, it is useful briefly to review the key findings in the general cognitive literature on categorization.

7.1 Theories of Categorization

Extensive research has been conducted on categorization. The standard paradigm in this area is to combine behavioral data with the results of computational implementations of a model. In some cases, one or more computational models may be tested on existing data sets. Theories of categorization can be broadly viewed as attempts to account for the inherent tension between the need for cognitive economy (i.e., the usefulness of a category as an abstraction) versus the need for informativeness (Komatsu, 1992).

Categorization models are often roughly classified as rule-based (e.g., Anderson, 1991; Levine, 1975; Miller & Laird, 1996; Trabasso & Bower, 1968), prototype or schema-based (e.g., Harris & Rehder, 2011; Hummel & Holyoak, 2005; Minda & Smith, 2011; Posner & Keele, 1968; Reed, 1972), exemplar-based (e.g., Kruschke & Johansen, 1999; Medin & Schaffer, 1978; Nosofsky, 1986), or hybrid (e.g., Anderson & Betz, 2001; Ashby, Paul, & Maddox, 2011; Iba & Langley, 2011; Minda & Miles, 2010).

An additional set of theories, described as "explanation-based" (for a good oveview, see Komatsu, 1992), have attempted to account for the coherence of categories by focusing on functional and causal relationships. Formal accounts of these theories have been omitted here, but it should be noted that such accounts are relevant to a number of CL theories of linguistic representation, including Lakoff's (1987b) ideas regarding Ideal Cognitive Models and M. Johnson's (1987) conceptualization of schemas and the embodiment assumption (for a discussion, see MacWhinney, 1999; Rohrer, 2006, 2007).

7.1.1 Rule-based Accounts

Due to the wide range of rule-based accounts, it is difficult to find elements common to all such models (Kruschke, 2005). Generally speaking, each model lists a procedure for generating rules: these are then (1) generalized (if found to be successful),

(2) constrained or abandoned (if unsuccessful), or (3) augmented with exceptions. Quite often, these models will contain an algorithm for testing rules of increasing complexity. For example, the rule-plus-exception (RULEX) model of Nosofsky, Palmeri, and McKinley (1994) initially searches for perfect one-dimensional rules followed first by imperfect one-dimensional rules, and secondly by conjunctive rules. One advantage of such models is that they can deal with complex rules (e.g., either-or-but-not-both rules) that are often problematic for other models.

7.1.2 Prototype Accounts

A *prototype* is "a cognitive representation that captures the regularities and commonalities among category members" (Minda & Smith, 2011, p. 40). Early research on prototypes involved the study of dot pattern learning (e.g., Homa & Cultice, 1984; Posner & Keele, 1968). In this paradigm, the training sets involved patterns of dots that were shifted away from an untaught prototype. The research demonstrated that participants often performed as well on the prototype as on instructed items. If testing was delayed, performance on instructed items tended to decline, whereas performance on the prototype remained robust.[37] Moreover, items that were more similar to the prototype tended to be endorsed more strongly. A similar series of seminal studies, conducted by Labov (1973) and Rosch (1973, 1975), focused primarily on the categorization of natural artifacts (e.g., cups and mugs, furniture, etc.) and natural kinds (e.g., birds, fruit, etc.).

[37] As Komatsu (1992) points out, this finding has posed problems (although perhaps not insurmountable problems) for models, such as the General Context Model discussed below, that assume that abstract information is not learned or stored during category learning, and that abstraction is simply an epiphenomenon that appears as instances are accessed to make classification decisions.

These studies convincingly demonstrated the inadequacy of the Aristotelian view of categorization based on bundles of necessary and sufficient features.

Prototype theories of categorization claim that the mind stores representations of commonalities among category members. Depending on the theory, these regularities can take different forms to include notions of central tendency, frequently occurring features, or ideal category members.[38] According to Minda and Smith (2011), a prototype model performs a classification in two steps: (1) the comparison of the to-be-categorized item with stored prototypes (generally represented as the mean or mode of feature values) to determine similarity, and (2) a probability-based decision based on the item's similarity to a prototype divided by similarity to all prototypes.

7.1.3 Exemplar-based Accounts

Medin and Schaffer's (1978) landmark study seriously challenged prototype theories. The four experiments in the study used visual stimuli that differed on a fixed set of dimensions (e.g., shape, size, color, or number). In their second experiment, the stimuli were split forming a "5-4" design: two categories consisting of (1) five training items belonging to one prototype and (2) four training items belonging to an opposing prototype. The prototypes were formalized as a "1" or "0" value on a binary dimension. In other words, an item with a "1" value on all four dimensions (i.e., an item that had the shape, size, color, and numerosity associated with the Category A prototype) would perfectly match the Category A prototype, and an item with a "0" value on all four dimensions would perfectly match the Category B prototype. All four dimensions carried at least some information, and the categories were linearly separable (i.e., perfect

[38] For a computational model of prototype categorization, see Minda and Smith (2001).

categorization was possible if the attention allocation to each dimension was set within certain narrow parameters).

The study's innovation was the construction of items that differed in terms of their similarity to their category prototype and their similarity to other exemplars in the same or competing category. For example, the first stimulus (1 1 1 0) in Category A (often referred to as the "A1" stimulus) shared all but one feature with the Category A prototype (i.e., 1 1 1 1), whereas the second stimulus (1 0 1 0) in Category A (often referred to as the "A2" stimulus") shared the same number of features with both category prototypes (i.e., 1 1 1 1 and 0 0 0 0). In spite of the fact that A1 shared more (i.e., three) features with the Category A prototype than did A2, the exemplar-based account predicts better classification on A2, due to the fact that this exemplar is similar to two other Category A exemplars and is similar to no Category B exemplars. A1, on the other hand, is similar to only one Category A exemplar, but is similar to two Category B exemplars. It is therefore predicted to be more difficult.

Based on the results of four experiments, Medin and Schaffer (1978) argued that the participants' observed patterns of categorization were consistent with an exemplar-based account, but were inconsistent with prototype accounts. As will be discussed in more detail in Chapter 7.4, some researchers have questioned the broad interpretation of results from this paradigm, while others have claimed that exemplar-based processing is fully consistent with the prototype account.

7.1.4 Hybrid Accounts

A number of researchers (e.g., Anderson, 1991; Ashby & Maddox, 2011) have predicted that the field of categorization will eventually gravitate toward hybrid models to account for the full range of observed data. One influential attempt in this area is the Competition of Verbal and Implicit Systems (COVIS) model (Ashby & O'Brien, 2005; Ashby et al., 2011; Ashby & Valentin, 2005). Inspired by recent neurological findings, the model posits a hybrid neural network of both symbolic and connectionist components. In the COVIS model, tasks for which it is possible to verbalize relatively simple rules that optimize accuracy are handled by a rule-based explicit system of processing that depends on working memory and executive attention. This system generates and tests hypotheses and tends to be used whenever possible as it provides for rapid and flexible learning. Due to its attentional requirements, the explicit system is strongly impaired by dual-task conditions.

According to the COVIS model, a second, procedural system, mediated by the basal ganglia,[39] is preferred when dealing with a wide range of tasks, including information-integration tasks. In experiments, a sample operationalization of this type of task would be the learning of a category that combines the relative size of circles with the tilt of a line running through each circle. The COVIS model provides a computational implementation that fits well with various behavioral data. Hybrid models like COVIS generally include an algorithm that selects the process to employ (Anderson & Betz, 2001) or the outcome to use (Ashby et al., 2011). An important prediction that has been confirmed in experiments using the COVIS model is that the procedural system requires

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[39] For a discussion of the basal ganglia's role in proceduralization and dissociations between declarative and procedural knowledge, see Knowlton, Mangels, and Squire (1996).

immediate feedback within about 2.5 seconds; in contrast, the explicit system is unimpaired even if feedback is delayed as much as 10 seconds (Maddox, Ashby, & Bohil, 2003).[40]

Some researchers advocating hybrid models have claimed that categorization systems are based directly upon distinct memory systems. E. Smith and Grossman (2008), for example, examined both behavioral and neuroimaging research, including both normals and patient studies, to argue that the results can be explained in terms of working memory (WM), explicit long-term memory (LTM), and implicit LTM.

WM[41] is said to be primarily associated with rule-based categorization, which involves (1) selective attention to each criterial attribute mentioned in the rule, (2) determination of whether the value matches, and (3) amalgamation of the outcome. Explicit LTM, on the other hand, is associated with the similarity-based categorization that underlies comparisons of a stimulus with either an exemplar or prototype representation. Implicit LTM, which is associated with priming and related phenomena, is related to categorization based on a sense of perceptual fluency. The authors suggest that information-integration tasks, such as those associated with the COVIS model, recruit a type of implicit memory. As the authors note, there is some evidence that the WM and explicit LTM systems, as well as the two LTM systems, may work concurrently and synergistically.

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[40] If these findings generalize to language acquisition, their implications are important, as they would suggest that a large portion of negative feedback within natural discourse would fall outside the 2.5 second cognitive window and would therefore be likely to have little effect on implicit mechanisms related to category induction. Doughty (2001), in her discussion of language acquisition in naturalistic contexts, has presented cogent arguments suggesting that the cognitive window may, in fact, be longer.

[41] A general framework for working memory was developed by Baddeley and Hitch (1974). The model's basic components consist of a central executive, a phonological loop, and a visuospatial sketchpad. More recently, Baddeley (2000) has proposed the addition of a fourth component, a multimodal episodic buffer.

While less parsimonious than single-process models (e.g., the Generalized Context Model), the view that categorization relies on multiple memory-based components is better able to account for a number of dissociations between brain regions used for different categorization tasks, as found in neuroimaging research (Koenig, Moore, Glosser, Grossman, & Smith, 2007; Koenig et al., 2005; Patalano, Smith, Jonides, & Koeppe, 2001). Particularly problematic for many single-process models is the finding of a dissociation between performance on prototype extraction tasks on shifted dot patterns and performance on recognition measures for previously viewed stimuli (Knowlton & Squire, 1993).[42]

7.2 Attention and Categorization

Attention is crucial to human categorization, as it allows individuals to focus on relevant category features while ignoring irrelevant features, enabling them to deal with situations that tax the limited capacity of attention (Kruschke, 2005).[43] From early on, researchers in the field of categorization understood that individuals were not likely to treat the relevant dimensions of a to-be-categorized item similarly, and that factors that affected the attentional value of a cue would have an effect on how fast a cue was learned (Trabasso & Bower, 1968). For this reason, models of categorization have typically included mechanisms for adjusting attentional weights or have acknowledged that such mechanisms would be required in a fully specified version of the model.

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[42] Recently, there have been some attempts to account for the dissociation using adaptive clustering schemes, such as that put forth in the SUSTAIN model (Gureckis, James, & Nosofsky, 2011; Love, Medin, & Gureckis, 2004; McDonnell & Gureckis, 2011). See also Zaki and Nosofsky (2001).

[43] The ability to adjust attention to competing cues is widely observed even in non-mammalian species, such as pigeons (Wasserman, 1974) and honey bees (Shapiro & Bitterman, 1998), suggesting that the related cognitive mechanisms are strongly adaptive.

Attention mechanisms are central in Kruschke and Johansen's (1999) influential RASHNL model, which is based on the hypothesis that individuals rapidly ("rashly") shift attentional weights and subsequently learn attention biases based on the relative success of a given attention allotment. In the model, the actual attentional shifts and the learning of shifts are distinct, making it possible to shift attention quickly without radically changing the cognitive representation of a category.

When forming new categories, individuals must avoid overwriting previous knowledge. Attentional weighting does this by picking out salient dimensions that differentiate new from old categories. An important finding in this area is that the order in which stimuli are categorized affects the representation of the item categories. For example, when individuals learn two categories that share a feature, there is a tendency, known as the highlighting effect, to attend to the shared feature when learning the first category but to focus on the distinctive unshared feature while learning the second category (Kruschke, 2009; Medin & Edelson, 1988). The resulting attention allocations depend on context. In other words, the greater attention allocation toward the distinctive feature only holds true within the context of the second category.

Categorization research in the area of attention may be relevant to transfer phenomena affecting the types of meaning that tend to be expressed in a particular language. To take an example relevant to prepositions, some languages tend to focus more on path of motion when selecting aspects of a situation that are to receive linguistic expression, while others focus more on manner of motion (Slobin, 2003; Talmy, 1985). The development of a new L2 category that involves highly informative dimensions (e.g., path) that were also highly informative in one's L1 would presumably facilitate the learner's acquisition of the L2 category.

There is empirical evidence suggesting that L1 attentional biases affect L2 acquisition of prepositional senses. Ijaz (1986), in a study comparing various NS and NNS (non-native speaker) groups, found that the semantic boundaries that even advanced NNSs ascribed to various prepositions differed markedly from those ascribed by NSs, due to the learners' tendency to attend more to certain dimensional features. For example, native German speakers' understanding of English *on* revealed that they tended to give too little weight to the dimension of contact as a semantic cue, while overemphasizing movement. Ijaz attributes this bias to the influence of German *auf*, which readily maps onto English *on* but also corresponds to motional meanings of English *up*. Ijaz found especially strong crosslinguistic effects for noncentral prepositional senses.

In exemplar theories, attention essentially serves to reduce the psychological distance between a stimulus and a previously encountered exemplar (Kruschke, 2005), whereas attention shifts in prototype models generally reallocate attention toward the features that are most diagnostic of the prototype. Many researchers claim that feedback is essential at some point in learning, although it may be possible to refine the weights during practice without feedback.[44]

7.3 Task Orientation, Category Type, and Performance Variables

A number of researchers have also examined interesting ways in which instruction variables associated with analytical and incidental learning interact with

[44] For example, Blair, Watson, and Meier (2009), in an eye-tracking experiment in which participants learned to classify fictitious organisms, found that the optimization of attention occurred after the category was learned, during a training phase in which no feedback was provided.

category type to produce optimal or non-optimal learning. In a groundbreaking study modeled on Reber's earlier work with artificial grammars (AGs), Brooks (1978) showed that participants encountering overly complex categories performed poorly in subsequent card-sorting tasks if they were provided, in advance, with a rule-search prompt, whereas learners who had viewed the same material under the guise of a paired-associates task, paradoxically performed better when later told that the cards needed to be sorted into discrete categories. Brooks reasoned that the non-analytical participants, who had presumably paid more attention to overall features of the stimuli due to their initial orientation to the task, were better able to recall individual exemplars and use processes of analogy to categorize new items. In other words, participants who adopted a more holistic orientation to the task later exhibited judgments guided more by similarity of items to previous exemplars than by criterial attributes.

In his "lepton" study described later in the same article, Brooks instilled an analytical orientation in one group by telling them to categorize fanciful animals, which differed on a range of dimensions, as either "leptons" or "non-leptons." A second group simply associated each animal with a typical name (e.g., "Sam"). A third group received both lepton-discrimination training and name-association training simultaneously. The first group, while able to transfer their lepton-discriminating skills to new exemplars, was poor at recalling the animals' living environments (i.e., presence/non-presence of water and warm/hot climate) and associating these with transfer items, whereas the second group, which presumably had a more holistic orientation, could recognize backgrounds and associate them with transfer items.

Brooks argued that (1) variations in concurrent task requirements, (2) differences in the features of stimulus sets (i.e., the internal structure of the category being acquired), and (3) changes to performance variables (e.g., limited time for analysis) will all affect the preferred mode of categorization. When applied to the SLA context, these factors, respectively, have direct relevance to: (1) instructional variables (e.g., explicit instruction versus less obtrusive pedagogical techniques), (2) target structure variables (e.g., simple or complex grammar rules), and (3) target tasks (or, in experimental contexts, performance measures) that vary in terms of time pressure and other factors.

Kemler Nelson (1984)[45] conducted similar experiments demonstrating that incidental learning and intentional learning led to different representations of the target category. In her first experiment, an "intentional" group was told to look for a rule for associating schematic faces differing on four binary dimensions, with either a policeman's or doctor's uniform. Results showed that the intentional learners tended to use the criterial dimension that perfectly predicted the category, whereas the incidental learners used the presence of multiple dimensions that were probabilistically associated with the category prototype.

In her second experiment, which involved more differentiated features on each dimension, the incidental group performed a cover task in which there was no incentive to pay close attention to the stimulus for the purpose of later recall. Instead, participants simply responded as to whether the face conformed to their stereotypes about the profession (policeman or doctor). In addition, both the incidental and intentional groups

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[45] The Kemler Nelson results have led to numerous replications and related research examining holistic and analytic categorization in a range of tasks and among different populations. This research has examined, for example, the influence of concurrent and speeded tasks (J. D. Smith & Shapiro, 1989), the applicability of the results for populations suffering from depression (J. D. Smith, Tracy, & Murray, 1993), and categorization by nonhuman primates (Couchman, Coutinho, & Smith, 2010).

were divided through the addition of an instruction variable related to whether participants were explicitly told to attend to global or specific features (or neither). As was found in the first experiment, the incidental group's performance indicated that they were using similarity with the prototype instead of the criterial features that were clearly being used by the intentional group. Overt instructions to attend to global or particular features, on the other hand, had no observed effect.

It should be noted that the results did not indicate an absolute split between the information that participants used. The analytical group showed indications that they were using some of the family resemblance information associated with the category prototypes. Incidental learners also exhibited some minor influence from the criterial feature. Kemler Nelson's third experiment, which focused on intentional and incidental groups' performance on linearly- and nonlinearly-separable categories, also suggested that the observed pattern of results for the incidental group in the three experiments reflected a more holistic orientation resulting in judgments based on overall similarity between tested items and previously encountered exemplars.

7.4 Generalizability of Categorization Research

The intersections between the theoretical findings related to categorization and theories of L2 processes are likely to yield important insights constraining SLA theories. By the same token, SLA research may serve as a testing ground for theories on categorization. However, several factors may limit the generalizability of the categorization findings. As Komatsu (1992) points out, much of the work in this area has considered the categorization of everyday objects, and it is not clear whether the findings can be applied to events or other abstract concepts (e.g., the abstract relationships expressed through prepositions).

In addition, there has been some criticism of single-mechanism exemplar-based models, which have been so popular in the field for the last three decades. Smith and Minda (2000), in particular, have provided an extensive critique (for an opposing view, cf. Nosofsky & Zaki, 2002), noting that Medin and Schaffer's (1978) 5-4 paradigm, which has become highly popular in the categorization literature, provides an excessively small pool of exemplars, is not learned well, and has poor category differentiation, a factor that may lead participants to focus on predictive dimensions while memorizing exceptions. Analyzing 30 data sets (and various subsets) from previous studies, they show that the A2 advantage does not exist, and furthermore, that in the six studies where it does appear, the result is difficult to explain using exemplar-based models because the assumed attention distributions associated with the "advantage" in these studies would be more congruous with prototype models than with exemplar models.

The contrived nature of the Medin and Schaffer (1978) categories may be especially problematic if the findings are to be generalized to the area of language. The artificial nature of the Medin and Schaffer categories may prevent prototype formation, forcing the experimental participants to rely solely on memory of individual exemplars or perhaps on ad hoc categories that generalize across only a subset of exemplars instead of the prototype posited by the experimenter.

Langacker (2009, 2010) suggests as much when he acknowledges that exemplar theory may be essentially correct, but argues that this does not pose a problem for accounts favoring schema induction, as the accounts are essentially equivalent.[46] Bybee (2006) has expressed the same idea based on evidence from diachronic changes in language. According to Bybee, these changes ultimately reflect cognitive processes in individual speakers. Speakers are said to represent instances of language as exemplars, which, via repetition, become increasingly entrenched. The representation of exemplars (i.e., tokens) in memory is said to be rich, including information such as implied meaning and context of use. Exemplars that are similar eventually form clusters (i.e., categories), and certain exemplars that are strengthened as they are encountered in the input can develop into central members of a category. Usage-based accounts, such as Bybee's, suggest that category formation is a reflection of a general cognitive ability to represent situations at varying levels of schematicity (see also Langacker, 1987; Tuggy, 2007).[47]

As discussed above, evidence for single-process exemplar-based models tends to be based on highly contrived categories; moreover, it is unlikely that a single process can account for the full range of data in the categorization literature. For this reason, this study's analysis of the learning problem posed by polysemy and the viability of potential pedagogical solutions is primarily based on the COVIS model and highly compatible accounts (e.g., Minda & Miles, 2010; E. E. Smith & Grossman, 2008) that have linked categorization to characteristics of human memory systems.

The COVIS model's distinction between tasks amenable to either explicit or implicit learning is of interest to SLA theory, as it has direct relevance to predictions

[46] The SUSTAIN model provides an intriguing formal account of how a computational model can parsimoniously produce general abstraction while remaining sensitive to item-specific knowledge (Love et al., 2004; McDonnell & Gureckis, 2011).

[47] This conception of language suggests that the initial processing of unanalyzed chunks of language may be a necessary first step toward unconsciously deriving the subtle semantic regularities that underlie a pattern. This view has found empirical support in research demonstrating that chunk learning plays an important role in both L1 (Lieven, Pine, & Baldwin, 1997) and L2 acquisition (Myles, Hooper, & Mitchell, 1998; Weinert, 1994).

related to the difficulty of both target linguistic structures and language-related tasks. It is argued in this paper that L2 learners' acquisition of many English prepositional senses, especially those senses without close L1 counterparts, is similar to an information-integration task in that the target category (an abstract sense of the preposition) often involves a complex range of features with optimal attention weightings that are interrelated. For example, the topological dimension in the main sense of *over* (as opposed to *above*) implies that the trajector and landmark are in close proximity (e.g., *I don't like people* [the trajector] *looking over my shoulder* [the landmark]). In typical human interaction with the environment, human beings must be close to objects in order to manipulate and affect them. Thus, from a functional perspective, proximity implies that the trajector is able to affect the landmark directly. However, proximity and the potential for influence are not always conflated within human experience. When the weighting of the functional element (i.e., the ability to exert an effect) is sufficiently strong, the weighting of the proximity dimension can be reduced. For this reason, *over* can be preferred to *above* in sentences such as, *I hate those noisy airplanes* [the trajector] *that keep flying over my house* [the landmark].

The two categories of *spatial proximity* and *functional influence* may be easy to verbalize, but even linguistically sophisticated NSs would probably find it difficult to state precise rules for how these factors interact in determining the felicity of *over* in situations in which both are relevant or have different degrees of relevance. Moreover, even if learners develop nativelike intuitions regarding topological and functional features' interaction in terms of a specific prepositional sense, there is evidence that this knowledge would not transfer well to other English prepositions. Research has shown, for example, that the prepositional pairs *over* and *under* versus *above* and *below* differ in the relative weighting given to their functional dimensions (Coventry et al., 2001).

Finally, it should be noted that categorization models based on similarity of features to set criteria (the classical model), an abstract representation (e.g., prototype models), or previously viewed exemplars (e.g., the General Context Model) all fail to account for human knowledge of how independent features interact with one another (Komatsu, 1992). There have been attempts (Barsalou, 1987; Johnson-Laird, 1983; Lakoff, 1987a, 1987b) to develop richer “explanation-based” approaches in which information regarding both features and their relationships is stored within a cognitive representation of a category. In a sense, the “embodiment” assumption common in CL accounts and M. Johnson’s (1987) conceptualization of schemas can be viewed as attempts to provide explanation-based constraints and constructs for theories of categorization related to semantic representation.

It must be conceded that much of the general cognitive literature on categorization, although useful in constraining SLA theory, may not be entirely generalizable to the context of language for several reasons. Many of the categories used in experiments in this area tend to be artificial and unrealistic. While this may be true of a few categories in everyday life, most categories, especially linguistic categories, tend to label perceptual or functional characteristics that are highly salient and informative.

It must also be noted that the bulk of categorization models seek to explain *perceptual* (typically, visual) classification, and it is not clear how well they generalize to categorization tasks (such as typical language tasks) in which categorization involves other modalities as well. For these reasons, some caution is warranted when extending the general categorization results to SLA. Even so, the mechanisms involved in linguistic categorization are likely to be similar. In their discussion of the generalizability of the COVIS model, Ashby and Ennis (2006) suggest that processes similar to those posited by the COVIS model should be able to explain categorization involving other modalities, as the procedural learning that occurs within these modalities would also project onto similar areas of the brain (i.e., slightly different regions of the basal ganglia).

Chapter 8: Explicit Instruction and Practice

The previous chapter argued that the learning problem posed by English prepositions was best viewed as a categorization problem. It furthermore claimed that highly polysemous semantic structures such as prepositions are best characterized as family resemblance categories. The categorization literature suggests that these categories, which are not amenable to descriptions using clear criterial features, are acquired poorly in typical situations involving rule-based learning.

The following sections turn to the literature on explicit learning and practice to identify optimal instructional parameters for complex semantic categories. Specifically, the following sections examine (1) theoretical models relevant to instruction and practice, (2) related research that has examined artificial grammar (AG) learning, and (3) research on explicit instruction and practice within SLA contexts.

8.1 Cognitive Architectures

Hybrid models of categorization such as COVIS claim that categorization can occur through implicit or explicit mechanisms associated with distinct cognitive operations and representations. To better understand how such mechanisms may interact to produce learning, two general cognitive architectures, ACT-R (Anderson et al., 2004) and Clarion (Sun, 2002, 2007) are discussed below as they provide broad theoretical accounts of how practice can lead to learning.

8.1.1 ACT-R (Adaptive Control of Thought—Rational)

The ACT-R architecture (Anderson, 1993; Anderson et al., 2004; Anderson & Lebiere, 1998) is a highly influential general model of cognition that is capable of accounting for a number of cognitive phenomena to include fan effects (Anderson & Reder, 1999), the power law of learning (Anderson, 1990), and in the last decade, various findings specifically related to language processing and L1 acquisition (Budiu & Anderson, 2004; Taatgen & Anderson, 2002). ACT-R represents the latest developments based on earlier ACT models (e.g., Anderson, 1983). The model's fundamental assumption is that human knowledge can be broadly broken down into declarative knowledge (i.e., knowledge that we are aware of and can typically describe) and procedural knowledge (i.e., unconscious knowledge displayed in behavior).

The ACT-R model consists of two memory modules and two perceptual models. The memory modules comprise (1) an intentional module that interacts with a goal buffer, and (2) a declarative module that interacts with a retrieval buffer. The goal state within the intentional module is equivalent to working memory.[48] A central production system coordinates the behavior of both modules with input from the perceptual modules (i.e., a visual buffer associated with the visual module and a manual buffer associated with the manual module). The content of each buffer consists of a chunk, and each buffer is able to retrieve only a single chunk at a time. The central production system matches, selects, and executes a production; this, in turn, changes the state of the buffers and thus alters the state of the system. Within the declarative memory module, chunks are activated based on (1) a base-level activation that reflects the chunk's past usefulness, (2) the weighting

[48] The goal module maintains local coherence within a specific problem-solving episode, whereas long-term memory promotes personal and cultural coherence (Anderson et al., 2004).

of elements that are part of the current goal, and (3) the strength of the association between the current goal and items within declarative memory. Greater activation is associated with more rapid retrieval and higher probability of retrieval.

In ACT-R, procedural knowledge is represented in the form of productions. Proceduralization occurs as productions are collapsed, a process known as *production compilation*. Newly formed productions that are more parsimonious compete with previous productions and end up being preferred, due to their greater utility (typically resulting from less “cost” in terms of the time requirement associated with the production’s execution). Production compilation thus results in “skilled knowledge structures that map goals, results of memory retrieval, and perceptual input onto actions” (Taatgen, Huss, Dickison, & Anderson, 2008, p. 549). As knowledge is proceduralized, it becomes more robust, in that it requires fewer attention resources. At the same time, the knowledge becomes less flexible and more closely tied to specific contexts.

Skill acquisition theories generally model learning in terms of top-down processes. The acquisition of general knowledge is viewed as the basis for the development of more specific proceduralized knowledge that has advantages of faster memory access and fewer errors. It should be pointed out that in ACT-R (as opposed to earlier versions of the ACT model), representations that form the basis for later proceduralization need not be stored in long-term memory. For example, a student studying math may proceduralize knowledge that was presented as a rule or formula in a textbook (Anderson & Fincham, 1994). This is relevant to the SH treatment discussed in Chapter 12.1.

Although skill acquisition models tend to view declarative knowledge as the typical basis for subsequent proceduralization, some experimental evidence suggests that the two forms of memory can be dissociated. For example, Willingham, Nissen, and Bullemer (1989, Experiment 1) demonstrated that adults with normal cognitive functioning can develop procedural knowledge, as observed through speed-up in responses on a serial reaction time (SRT) task occurring prior to their development of declarative knowledge (see also Nissen & Bullemer, 1987).[49] The study also showed that participants who could verbalize the rules (i.e., had developed declarative knowledge) performed better on the task. The results could be interpreted as evidence for a synergy between declarative and proceduralized learning even when proceduralization occurs first.[50] It could also suggest that procedural knowledge facilitates the development of declarative knowledge.[51]

Evidence for procedural learning as opposed to associative learning comes from experiments that contrast task instructions focusing on memorization with task instructions involving a rule. For example, Anderson and Fincham (1994) told participants to memorize number-letter sequences such as “35a44.” Participants were later told the rule used to generate the final two numbers. Results showed that participants developed an increasing asymmetry, reflecting the direction in which the rule was practiced after learning the rule, indicating the shift to proceduralization. As participants’ learning increased following practice with the rule, their performance did

[49] Anderson and Lebiere (1998) suggest that research findings demonstrating proceduralization without declarative knowledge may be explained by subjects’ forgetting of the declarative rules by the time of report.
[50] This is relevant to the SH-D condition of the experiment in the study. For a discussion of research demonstrating that implicit learning often precedes the development of explicit knowledge, see Doughty (2003).
[51] Empirical data suggesting synergetic effects can be found in Williams (2005, Experiment 1). Participants who demonstrated greater implicit awareness of a target contrast involving animacy marking earlier in the experiment seemed to be more likely to develop explicit knowledge of the same contrast later on in the experiment (p = .058), although it must be noted that the results fell short of conventional reliability at a level of $p < .05$.

not seem to be affected by similarity of items to past examples, a finding that contradicts predictions of Logan's (1988) instance-based model. Logan's model predicts initial use of a rule followed by a speed-up in performance as more instances are stored, a process that allows for retrieval of instances without use of the rule. It should be noted that Logan's model has similarities to exemplar-based categorization models (e.g., the Generalized Context Model discussed in Nosofsky, 2011).

In a later study, Anderson, Fincham, and Douglas (1997) used a similar paradigm to examine differences in performance on items that varied in terms of whether they had been studied and whether the rule was tested in the same direction as it had been learned. Based on the results, the authors posited a four-stage model of skill acquisition, not strictly sequenced, that involved (1) analogy to study examples (a declarative structure), (2) development of abstract rules (an abstract declarative structure), (3) use of production rules (corresponding to Logan's algorithmic stage), and (4) retrieval of examples. The authors point out that the final two stages are consistent with Logan's (1988) instance-based model. It should be noted that the authors' general interpretation of their findings in this study differs somewhat from the assumptions of the hybrid categorization model put forth by Anderson and Betz (2001). In the latter study, the model assumes that exemplar-based processing (which corresponds to retrieval of examples) and rule-based processing are selected based on their past usefulness on a similar set of problems.

8.1.2 Clarion (Connectionist Learning with Adaptive Rule Induction ON-line)

The Clarion architecture was developed by Sun and colleagues (Sun, 2002, 2007; Sun, Merill, & Peterson, 2001; Sun, Slusarz, & Terry, 2005). It differs from the ACT-R model in that it posits two distinct systems, a top level (i.e., explicit) system, which operates using symbolic representations, and a bottom level (i.e., implicit) system, which uses subsymbolic[52] connectionist representations that can be either exemplar- or prototype-based (Sun et al., 2005).

A further bifurcation separates the systems into (1) an action-centered subsystem (ACS), which controls both external movement and mental operations and is roughly equivalent to procedural knowledge, and (2) a non-action-centered subsystem (NACS), which maintains general knowledge (both implicit and explicit) and is roughly equivalent to declarative knowledge. The NACS, which is under control of the ACS, contains (1) a bottom level that uses associative memory and (2) a top level, consisting of a network with chunks specified through dimensional features.

The model also contains both a metacognitive subsystem, which dynamically monitors and directs operations of the ACS, and a motivational subsystem. Implicit action-centered knowledge is acquired via backpropagation when correct input-output mappings are available and via Q-learning when no input-output mapping is externally provided. Explicit action-centered knowledge is learned through one-shot hypothesis testing.

The model allows for both bottom-up and top-down learning. Bottom-up learning occurs when a chosen action by the bottom level is successful and a corresponding rule is generated and added to the top-level localist network. The rule is subsequently refined. If

[52] The ACT-R model of learning also involves subsymbolic stochastic processes (Anderson & Lebiere, 1998); however, they essentially serve as fine-grained processes that underlie the implementation of symbolic processes. Acquisition of declarative knowledge is viewed as involving the use of past experience to set estimates of base-level activation of chunks, as well as association strengths. Other subsymbolic processes occur in procedural learning as the cognitive system selects a production and determines how fast the production will fire. These subsymbolic processes are therefore orthogonal to the declarative-procedural distinction.

the rule, when applied, is successful, it may be generalized. If unsuccessful, it is reduced in scope (Sun, 1999). Such learning would be consistent with the Willingham, Nissen, and Bullemer (1989, Experiment 1) study, which demonstrated procedural learning preceding declarative knowledge.

In top-down learning, external knowledge is combined with existing knowledge structures at the top level and is then assimilated into implicit, reactive routines at the bottom level. If a task is simple, the top level is likely to be deployed; complex tasks are likely to engage the bottom level, which can better handle complicated information due to its distributed representations. If knowledge is first present at the top level, top-down learning is likely to occur, and vice versa (Sun, 1999). It must be noted that the Clarion model allows for situations in which both explicit and implicit knowledge develop independently (Sun et al., 2005).

To account for the functional role of consciousness, Sun (1999) proposes that the top and bottom levels achieve synergistic effects, due to their contrasting characteristics. Sun (2002) suggests that the bottom level can assist both learning and performance at the top level by providing relevant information and by tracking statistical information. He also notes that implicit information, even if helpful, may be ignored if it contradicts explicit knowledge or explicit mental models. When the top and bottom level are in conflict, the interaction system of Clarion allows input from either system to be ignored. Unlike many researchers in the skill-building tradition, Sun views bottom-up learning as potentially quite powerful.

8.2 AG Research

In most L2 learning situations, the goal is to acquire procedural (and ultimately, automatized) knowledge that is capable of being accessed rapidly and automatically within the tight time constraints of typical language processing. When considering pedagogical interventions targeting prepositional senses, the question arises whether the optimal pedagogical intervention aimed at developing procedural knowledge should engage implicit or explicit learning mechanisms, or if it should perhaps engage both types of learning sequentially or in tandem. In this study, implicit learning will be defined as "learning without awareness of what is learned" (DeKeyser, 2003, p. 314), and explicit learning will be defined as the inverse: that is, learning with awareness of what is learned (DeKeyser, 1995). It should also be noted that implicit learning is orthogonal to the inductive-deductive distinction (DeKeyser, 2003).

A general finding in work on explicit and implicit processes is that instructional targets characterized by simple rules tend to be more easily learned through explicit learning mechanisms (Anderson et al., 1997; Sun, 2002). When presented with complex instructional targets, on the other hand, individuals tend to rely on implicit learning (A. S. Reber, 1967; A. S. Reber & Lewis, 1977). Similar observations have been made in reference to explicit and implicit processes in SLA (DeKeyser, 1995; de Graaff, 1997a).

Studies examining the interaction of implicit and explicit learning have yielded diverse results depending on a number of variables, to include the type of task, type of explicit instruction, and type of measurement. Reber (1976), for example, showed that giving participants rule-search instructions prior to training on an AG instructional set led to worse performance compared to participants who were simply told to memorize instances of the grammar. The rule-search condition is essentially an inductive learning procedure.

Reber, Kassin, Lewis, and Cantor (1980, Experiment 2) compared (1) explicit-implicit, (2) implicit-explicit, (3) implicit-explicit-implicit, (4) explicit, and (5) implicit groups on an AG learning task. In this case, the label "implicit" is perhaps misleading, as it is probably not the case that the practice following explicit instruction engages solely unconscious learning mechanisms. The authors found that the so-called explicit-implicit group outperformed all other groups. This group's performance could be attributed to the benefits of proceduralization. The authors interpret the results as indicating that the instruction made participants aware of the existence and nature of the grammar's structure and enabled participants to focus on key aspects of the exemplars during training. Some findings in the SLA literature have also suggested advantages for explicit instruction over both rule-search and implicit conditions when the target of instruction involves simple rules and acquisition is measured after relatively short periods of instruction using discrete and focused linguistic tasks (Norris & Ortega, 2000).

Research (e.g., Lane, Mathews, Sallas, Prattini, & Sun, 2008) has suggested that implicit and explicit learning may lead to different advantages in terms of speed and accuracy. Domangue, Mathews, Sun, Roussel, and Guidry (2004), in three experiments involving AG learning, showed that task variables could emphasize explicit learning, based on a conscious mental model, or implicit learning, based on memory of instances. Explicit learning led to greater accuracy and slower responding, whereas memory-based training led to more rapid but less accurate responses (Experiment 1). Their second experiment examined (1) an exemplar-diagramming group (ExD), (2) an exemplar-processing group (ExP), (3) an ExD-ExP group, and (4) an ExP-ExD group. The ExP condition involved memorizing exemplars and was designed to elicit implicit learning, and the ExD condition involved tracing an exemplar through a diagram of the grammar.

The experiment showed an accuracy advantage for the explicit group and a speed advantage for the implicit and implicit-explicit groups relative to the explicit group. An interesting finding is that the mixed implicit-explicit group tended to perform more like the implicit group, whereas the explicit-implicit group performed more like a pure explicit group. The authors' third experiment included a group that memorized the grammar but were given no opportunity to practice. This group showed the highest level of accuracy and the slowest levels of responding. The three studies suggest that implicit learning tends to be fast but inaccurate, whereas explicit learning, while accurate, requires extensive practice (i.e., proceduralization) in order to achieve rapid performance, particularly when the initial explicit instruction is not tied to examples.[53]

In their discussion of this study, Sallas, Mathews, Lane, and Sun (2007) suggest that participants in the ExD condition had slow responses as a result of differences between the training task (tracing exemplars through a diagram) and the measure (generating valid AG strings). The results could also be explained in terms of skill acquisition theory, which holds that declarative knowledge and the tasks used to practice that knowledge must be closely aligned for proceduralization to be effective (DeKeyser, 2007b). Sallas, Mathews, Lane, and Sun further suggest that the self-paced training

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[53] The findings would suggest advantages in terms of accuracy and subsequent learning of structures amenable to explicit instruction. When applied to SLA, this would imply that explicit learning without practice is of little immediate use to learners in situations such as speaking and listening where they must typically employ their language rapidly. Krashen (1981) adopts an even stronger position, claiming that explicit learning of this type lacks both short- and long-term facilitative effects.

conditions in the study may have encouraged learning that did not transfer well to speeded tasks.

In their 2007 study, these authors showed that AG learning could be enhanced by the provision of explicit instruction as long as the instruction was provided precisely when needed, and as long as it allowed participants to develop experience-based knowledge. They employed a computerized string-editing task, which was a modified version of the static version used in Mathews et al. (1989). Participants were given limited time to edit an invalid string using a mouse. Feedback was provided during the task. Training aids facilitated encoding of either the diagram of the grammar or a low-level representation of the grammar (letters in Experiment 1, chunks in Experiment 2). The rapid pace of the task made it virtually impossible for learners to simply commit the diagram to memory. Performance was assessed by asking participants to produce strings consistent with the grammar. In Experiment 1, participants in the diagram assistance condition demonstrated greater accuracy and similar speed relative to participants in the other conditions when accuracy was assessed with a strict 100% criterion.

In their second experiment, these researchers examined the role of the display type (animated or static), presentation type (static or animated), and prediction type (immediate or predictive). Performance was assessed using a cued generation and a GJT. The two diagram-animated groups produced more perfect strings in the cued-generation task. The groups were similar in terms of speed. Participants who saw chunks in training were more accurate at identifying chunk errors in the GJT.

The study suggested that a combination of top-down and bottom-up processing may be a particularly powerful way to facilitate the acquisition of expertise. The authors emphasize the importance of the fact that the diagram was used as a means of enhancing proceduralization. Participants did not need to rely on their own declarative knowledge of the model to generate strings. It could be said that the diagram provided during training served as a proxy for a stable and precise long-term memory representation of the AG grammar. This form of integrated training could, therefore, achieve a more efficient use of time on task, as it did not require the acquisition of stable declarative representations of the abstract grammar during an initial phase of training.

The studies discussed thus far suggest that the supposed advantage of implicit learning in the AG learning literature may be due to the tendency to contrast exemplar-memorization and similar tasks, which have been used to operationalize implicit learning, with rule-search tasks, which are thought to engage inductive explicit learning mechanisms, such as hypothesis testing. Participants in the rule-search conditions would seem to be at an inherent disadvantage when compared to individuals in real-world explicit learning situations, as they must begin without knowledge and must look for patterns without information regarding the possible structures that can occur. Moreover, explicit inductive learning is likely to be much more demanding and less efficient than deductive learning based on initial presentations of pedagogical rules, due to the fact that learners, when forced to induce rules solely based on input, often require extensive exposure to exemplars, in order to narrow down the hypothesis space and induce a target rule. It must also be noted that a number of researchers have questioned whether implicit learning in typical AG experiments is truly abstract (DeKeyser, 1995, 2003; Perruchet & Pacteau, 1990, 1991; Redington & Chater, 1996).

8.3 Explicit Instruction and Practice in SLA

The AG literature on the usefulness of various regimens of practice and instruction provides some tantalizing suggestions for research on cognitive processes in SLA and optimal forms of instruction. However, as DeKeyser (1994) has pointed out, direct extrapolation of the AG findings to SLA is problematic, due to key differences between the targeted content in these two areas of research. Unlike real languages, artificial grammars do not express meaning. It follows that the cognitive processes implicated in L2 acquisition will only be partially represented within AG research. For this reason, it will be useful to examine research on instruction and practice as they occur within the SLA context.

It should first be noted that research within SLA has demonstrated that instruction holds some advantages over naturalistic acquisition (Long, 1983). Much SLA research in the last three decades has, therefore, focused on identifying the specific types of instruction that are most effective and on the psycholinguistic underpinnings of these instructional types.

Several key meta-analyses have been conducted on the effects on explicit instruction. For example, Norris and Ortega’s (2000) meta-study of 49 studies came to the general conclusions that (1) focused L2 instruction leads to large target-oriented gains, and that (2) explicit instruction is more effective than implicit types of instruction (see also Goo, Granena, Yilmaz, & Novella, to appear). R. Ellis’s (2002) review of 11 studies concluded that explicit instruction promotes the acquisition of implicit knowledge and that two variables, the appropriate selection of the instructional target and the extent of instruction, appear to be crucial to success.

Spada and Tomita (2010) conducted a meta-analysis of 41 experiments (including some covered in Norris and Ortega's meta-analysis) on the effects of explicit and implicit instruction on simple and complex grammar rules. Using a different metric for determining complexity (i.e., the number of criteria applied to arrive at a target form), they found that explicit instruction was more effective than implicit instruction for both simple and complex rules. Especially large effects were observed for explicit instruction in studies using free constructed response measures.

Some caution is warranted in the interpretation of these results.[54] Doughty (2003) has argued that the case for explicit instruction has, in fact, been overstated, and that the high gains achieved by explicit learners are, to some extent, artifacts of the experimental designs and measurements, which have favored short periods of instruction and discrete-point tests. In terms of declarative and procedural knowledge, discrete-point tests may largely measure declarative knowledge that has only indirect relevance to language use within realistic time constraints.

Another point of contention concerns whether the instructional techniques described as "implicit instruction" are truly invoking cognitive processes that are qualitatively distinct from those implicated in "explicit instruction." Spada and Tomita (2010) list, as examples of "implicit instruction": input flood, interaction, and recasts. While all three of these pedagogical techniques can be used without learners developing explicit knowledge of the form-meaning links that are being targeted, a typical experimental context, as well as a typical classroom environment, is likely to encourage

[54] For a good discussion of the methodological issues involved when measuring implicit and explicit learning and interpreting experimental findings in this area, see DeKeyser (2003).

learners to be highly analytical in their orientation to a lesson. In such cases, learners are likely to learn rules explicitly.

Leaving aside, momentarily, the debate regarding explicit instruction (which has often been equated with *metalinguistic* instruction in SLA), there is wide consensus within the SLA field that pedagogical interventions that draw learners' attention to the form-meaning connection are necessary for optimal (in terms of rate and ultimate attainment) adult L2 learning (Doughty, 2001; Long, 1988, 2007; Long & Robinson, 1998; Schmidt, 2001). N. C. Ellis (2005) claims that "the primary mechanism of explicit learning is in the initial registration of pattern recognizers for linguistic constructions" and that attention is crucial, as it binds features to form newly integrated objects (p. 317). Conscious self-cued and other-cued attention is said to facilitate L2 acquisition by allowing for focused binding.

Within SLA, interventions designed to promote "other-cued attention" include the various instructional techniques associated with Focus on Form (Doughty & Williams, 1998), as well as Processing Instruction (VanPatten, 2004). The development of declarative knowledge regarding the patterns of linguistic form-meaning mapping (i.e., explicit learning) is best viewed as one such intervention, which can in certain circumstances effectively promote appropriate processing (DeKeyser, 2003; N. C. Ellis, 2005).

SLA researchers have explained explicit instruction's positive effects in two ways. Some researchers (Schmidt & Frota, 1986; Sharwood Smith, 1981) have claimed that prior explicit instruction can subsequently focus learners' awareness on criterial attributes of the input.[55] Others (DeKeyser, 2007b; K. Johnson, 1996) have suggested that explicit learning can, via practice, directly promote proceduralization of linguistic patterns. These two functions are not necessarily incompatible. By noticing features of the input, learners are more likely to incorporate these features into processing routines that become proceduralized (and eventually, automatized) with practice.[56]

Within research in this area, there have been some attempts to examine, through the use of highly controlled experimental designs, the interaction between instructional variables and types of instructional targets. DeKeyser (1995), for example, examined the relative effectiveness of explicit-deductive (E-D) versus implicit-inductive (I-I) instruction using a miniature linguistic system involving categorical agreement rules and allomorphy affecting one class of morphemes (counterbalanced between dialects of the language). The allomorphic rules were probabilistic, and were thus hypothesized to be more amenable to implicit learning. The categorical rules, on the other hand, involved rules that were clear and simple; and these were, therefore, hypothesized to be more learnable through explicit instruction. Aptitude was measured and treated as a covariate. On categorical rules, the E-D group was found to perform much better than the I-I group. In fact, the latter group's performance was at chance levels and thus exhibited no clear signs of learning.

It is interesting to note that DeKeyser's I-I group did much better (on par with the E-D group) on sentences involving target forms identical to those used in the practice

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[55] For a study that directly examined the effect of explicit instruction on the subsequent noticing of target forms in the input, see Peckham (2000). Using a Remember-Know protocol to measure instances of noticing, Peckham showed that instruction produced greater noticing than mere exposure for both grammar and vocabulary, with effects being more durable for grammar at longer delays.

[56] For a discussion and a good overview of the relevant research literature, see de Graaff and Housen (2009).

session. In other words, the I-I group appeared to be memorizing unanalyzed chunks. Regarding the prototypical patterns of allomorphs, statistical testing of group performance could not be done, but the results suggested that the I-I group's frequencies of use corresponded more closely to the stochastic patterns present in the input. The study thus argued for the relative benefits of explicit instruction for learning of simple categorical rules.

De Graaff (1997b) also conducted a study of the effects of explicit instruction using an artificial language. The study specifically sought to determine whether explicit instruction was beneficial and whether it had a differential effect on easy and complex grammatical structures. De Graaff found that the participants receiving explicit training outperformed the implicit group. However, he did not observe a clear interaction between treatment type and grammatical structure (i.e., morphology versus syntax), or between treatment type and complexity of form (i.e., easy versus difficult).

In his study, de Graaff (1997b) failed to find a treatment-aptitude interaction (see also Robinson, 1997). As implicit learning is believed to be less affected by aptitude, this suggests that the learners in the implicit condition, to the extent that they did learn during the short treatment, were not learning through implicit schema induction. One possible methodological shortcoming in the study is de Graaff's use of grammaticality judgment tests (one given halfway through the experiment) containing ungrammatical items. Implicit learners' ability (however tenuous) to induce the target forms through implicit schema induction during the relatively short instructional phase would be severely compromised by exposure to ungrammatical items, as these would reduce the salience of the grammatical structure as a cue to its target (for a discussion of the importance of cue contingency and its relevance to implicit language acquisition, see N. C. Ellis, 2006; Rescorla & Wagner, 1972; Wulff et al., 2009).

If it is assumed that there is a positive role for explicit instruction within specific circumstances (e.g., for amenable targets acquired when learners are at an appropriate stage of linguistic development), the next theoretical question is whether explicit instruction's effectiveness can be enhanced through the use of instructional design specifications conducive to the proceduralization (and ultimately, automatization) of learning.

One study that examined these issues was N. C. Ellis's (1993) research on the impact of three training regimes on the acquisition of the complicated soft mutations of Welsh. His study tracked four groups of first-time learners: (1) a "rule" group who trained on explicit rules, (2) a "rule and instances" group shown structured rules paired with two examples, (3) an "implicit" random group, and (4) a "yoked random group," whose exposure was matched to the first two groups.

The lesson was computerized. Blocks were generally repeated until a specific criterion was reached. After memorizing vocabulary words, the rule group underwent training on "protowords"; that is, examples in which only the abstract criterial element (e.g., the initial letter or the initial letter following a specific grammatical structure) was shown. The rule and instances group received instruction in which the abstract rule was presented and then immediately followed by two examples. The random group simply made responses to items that appeared in random order.

The characterization of the group given no rules as "implicit" is problematic. Due to the structure of the experiment, at least some of the more linguistically aware members of the group were probably looking for rules and testing hypotheses as they completed each block of items. For this reason, they are probably more accurately described as an *inductive* group.

Results indicated that the "random" groups displayed a tendency to memorize unanalyzed chunks of language (similar to memorizing formulaic sequences). The unpacking of these sequences was extremely slow and, as N. C. Ellis (1993) notes, probably due in part to the structure of the rule test phases, which made the structure more salient. The "rule" group demonstrated solid learning of rules and showed some transfer of these rules to new structures. However, there were many instances in which the group, in spite of knowing the rule, failed to apply it in practice. This group also showed fewer rejections of ungrammatical sequences on well-formedness tests.[57] Ellis concludes that this group's pattern of transfer was consistent with theoretical perspectives based on explicit-to-implicit transfer (e.g., skill-building models) as well as with the view that explicit instruction has a consciousness-focusing function (p. 313).

N. C. Ellis's "rule and instance" group had clear advantages, and stood out as the only group that evinced clear explicit and implicit understanding of the target structure. While demonstrating explicit knowledge on par with the "rule" group, this group was able to generalize this knowledge in task measures with time pressure and identify incorrect language. Especially important is the finding that this group was best able automatically to transfer their knowledge to an analogical construction when transfer was

[57] Davies and Kaplan (1998) and R. Ellis (1991) provide evidence that calls into question the validity of grammaticality judgment tests. The studies suggest that NNSs use different strategies than do NSs when responding on such measures and that NNSs' judgments are often inconsistent over time. For these reasons, the results of the well-formedness test used in N. Ellis's study should be interpreted with caution. It should be noted that there have also been some more favorable reviews of such tests (e.g., Chaudron, 1983; Mandell, 1999). See also R. Ellis (2005) and Gass (1994).

assessed using measures favoring implicit and explicit knowledge (i.e., tests on the abstract rule). In other words, only this group seemed able to abstract a functional schema for the soft-mutations. In his discussion of the results, N. C. Ellis notes that it is the blend of abstraction and structured exemplars that is likely to be crucial, and that the structuring effect is likely to occur at both the explicit level (by making criterial features more salient) and implicit level.

Robinson (1997) conducted an experiment that examined English learners in implicit, incidental, rule-search, and instructed conditions. He found that the participants in an instructed condition exhibited performance superior to the other three groups on easy grammatical forms and also exhibited superior performance on hard rules compared to the rule-search learners. It should be noted that the learners in the instructed condition received an extra phase of training to learn the rules, so time on task represents a possible confound in the study. Moreover, the training task emphasized metalinguistic parsing of sentences. The fact that the acquired metalinguistic knowledge was useful on a grammaticality judgment test devoid of time pressure is not highly relevant to the more important question of whether explicit instruction would lead to cognitive representations of form-meaning mapping relevant to real-world tasks. In addition, in this study, too, the operationalization of the implicit and incidental conditions is debatable. In Robinson's study, the "implicit" condition involved noting whether words occurred together in an example sentence. The condition was not likely to engage implicit processes in a manner congruous with typical sentence processing.[58]

[58] As noted previously, the validity of grammaticality judgment tests used in research on NNSs has been called into question (W. D. Davies & Kaplan, 1998).

SLA research has provided broad support for the conclusion that explicit instruction for adult L2 learners is effective and that attention-guiding interventions may be necessary to achieve rapid acquisition and advanced levels of proficiency. While much of this research involves measures that are likely to tap into declarative knowledge, which is less relevant to language use within realistic contexts, some of the research (e.g., N. C. Ellis, 1993) shows that explicit instruction can facilitate the creation of knowledge that can be rapidly deployed (i.e., proceduralized knowledge) and shows, moreover, that the knowledge appears to spur acquisition of untaught structures that are learned by analogy.

The mechanism or combination of mechanisms accounting for the apparent effectiveness of explicit instruction has not been fully elucidated in SLA research. Peckham's (2000) study on the link between instruction and noticing provides a rare demonstration that explicit instruction may introduce a useful bias in learners' processing of language in the hours and days following instruction, causing learners to shift attention to otherwise overlooked features of the input.

As is evident in the studies examined, the SLA literature has assumed that the typical SLA learning problem involves pairing a semantic category, which the learner readily identifies, with an L2 form, which the learner tends to overlook due to its redundancy, formal complexity, or other factors. Less attention has been paid to situations in which the contours of the semantic category are difficult for the learner to identify. The following section therefore examines potential advantages of timely explicit instruction interspersed with practice for the acquisition of semantic targets.

Chapter 9: Potential Advantages for Instructional Treatments

The experiment discussed in the following sections of the paper compared the effectiveness of a pedagogical treatment referred to in this paper as "semantic highlighting" (SH) with a conventional presentation-then-practice approach, in which the instruction is segmented into a presentation phase involving detailed descriptions of the semantics of the target form, followed by a practice phase. As this latter instruction developed declarative knowledge which was then proceduralized, it is referred to as the D-P condition in this paper. The experiment also included hybrid approaches, which combined the two treatments.

The four treatments all represent alternative methods for drawing learners' attention to the form-meaning mapping associated with prepositional senses. Research has shown that categorization is influenced by the relative attention given to various features of the input.[59] In SLA, many pedagogical techniques have been devised to draw attention to form-meaning mappings (especially to form), including textual enhancement (Jourdenais, Ota, Stauffer, Boyson, & Doughty, 1995), recasts (Long, Inagaki, & Ortega, 1998), Processing Instruction (VanPatten, 2002), and the use of task variables designed to increase the involvement of linguistic form within a task (Loschky & Bley-Vroman, 1993). Relative to these methods, explicit instruction can be viewed as a more obtrusive means of directing learner attention.

Explicit instruction may have some advantages relative to implicit methods (e.g., input flood) or less obtrusive techniques, due to its ability to effect radical shifts in representations (O'Reilly & Munakata, 2000). Moreover, instruction of some kind

[59] As Trabasso and Bower (1968) point out, the attempt to manipulate the attention values of cues to increase learning has a long history, going back to Hull's (1920) highlighting of Chinese character radicals in his categorization experiments.

appears to be necessary to move learners' attention away from semantic category dimensions that are important in the L1 but are relatively uninformative in the L2, toward cues most relevant in the L2. Both the SH and D-P treatments should, therefore, facilitate participants' attention to relevant dimensions of *meaning*.[60] By doing so, irrelevant dimensions should become de-emphasized.

It was hypothesized that the SH treatment would be more effective for prepositions than the D-P treatment based on a number of research findings discussed above related to categorization, effects of practice, and cognitive modes of representation of categories involving low cue contingency. Specifically, advantages for the SH approach were predicted on the following grounds: (1) more concrete cues, such as those used in the SH treatment, should be more appropriate for learning family resemblance categories, which lack clear and simple criterial features; (2) short cues appearing in close temporal proximity to processing of target forms in working memory should have an advantage over explanations that tax both executive control and working memory buffers; (3) instruction that immediately leads to proceduralization should more efficiently promote proceduralization relative to instruction that expends time developing declarative knowledge representations; (4) instruction that does not focus attention too narrowly on specific criterial features and promotes a more holistic orientation to stimuli should be more appropriate for family-resemblance categories; and (5) instruction that does not tax working memory should prove more effective for learners with lower aptitude, whether this lower aptitude is related to individual differences or age differences. These justifications for an SH approach are now discussed in greater detail.

[60] It should be noted that "relative attention" in this context merely means clearer registration of specific features in the input. It does not signify that study participants achieve full and precise awareness of the underlying schema that motivates the sense of the preposition.

9.1 Family-resemblance Versus Categories With Clear Criterial Features

Declarative knowledge representations, when made the focus of attention, can be altered rapidly and fundamentally. For this reason, explicit learning is likely to exhibit a marked advantage when the to-be-acquired content is a semantic category type amenable to a training sequence involving the development of declarative knowledge, followed by proceduralization of this knowledge. Explanations of a metalinguistic nature may also be advantageous, in that they can draw connections between previously learned knowledge and to-be-learned knowledge. However, semantic categories, such as typical English prepositions, which have a family resemblance structure and require the integration of information from distinctly different dimensions (e.g., functional and typological dimensions), are difficult to describe in terms of a terse definition or explicit accounts. These categories are, therefore, likely to be difficult to learn through abstract rules. As noted by Minda and Miles (2010), rules that are too complex to be held in the phonological loop of working memory are poor candidates for rule-based categorization. It follows that L2 learners are likely to encounter difficulties in developing appropriate declarative knowledge of these structures that could form the basis for subsequent proceduralization in typical instruction involving explicit explanations followed by practice.

9.2 Integrated Approach Versus Presentation-and-Practice Approach

Research has also indicated that L1 transfer can lead to attention biases when learning an L2 (Slobin, 2004). This would present problems for implicit learning, as classes of cues (e.g., cues related to path, topology, function, etc.) that tend to be ignored in the L1 will receive less attention, as learners are engaged in "thinking for speaking," even if these cues are, in fact, highly informative in the L2. The SH treatment is more likely to overcome these biases, as attentional guidance (i.e., the semantic highlighting) occurs in close temporal proximity to the categorization task that aims to develop proceduralized knowledge. This assumption receives some support from research on instructional variables related to schemas (e.g., Andanova et al., 2010). As noted earlier, prompts immediately prior to viewing a scene can lead to the use of different schemas to process information. These prompts should therefore be capable of biasing L2 learners' form-meaning mapping, so that the elicited schema and the elaborated details of the schema match the sense associated with the target preposition. It is argued here that the biasing effect of the SH prompt is likely to occur automatically, due to patterns of association. This is an important feature that distinguishes the SH cues from typical explicit instruction.

Explicit knowledge that is provided separately in an initial phase of instruction may assist in the development of subsequent implicit learning (in this case, category induction and form-meaning mapping) by highlighting the most relevant features that effectively identify a category and distinguish it from competing categories. However, learners are likely to use this explicit knowledge sporadically during practice due to (1) inability to recall the knowledge accurately, (2) inability to work out how the more abstract knowledge applies to specific examples, and (3) a tendency to rely on their established semantic competence (i.e., previously acquired representations which are incomplete or faulty), due to the attention demands of the task.

Previous research provides some support for this assumption. The timing of SH instruction and practice is similar to that of the “rules and instances” group in N. C. Ellis (1993), except that, in that case, the group processed two exemplars after the introduction of each rule. His “rules” group, on the other hand, followed presentation-and-practice regimen similar to the D-P group. His finding of greater effectiveness for the “rule and instances” group would thus lend support to the assumption that the SH treatment will have similar advantages.

9.3 Inductive Learning to Maximize Proceduralization

The SH treatment should also be more efficient than the D-P treatment, as it does not require learners to develop an abstract representation of the semantic meaning of each sense, but instead, immediately develops procedural knowledge of how the target sense is applied to concrete examples. Within the AG learning literature, some experiments have involved conditions similar to the SH treatment. In the study by Domangue, Mathews, Sun, Roussel, and Guidry (2004), the group that used a model of the grammar during practice achieved more accuracy. In the Sallas, Mathews, Lane, and Sun (2007) study, explicit training using animation that guided attention and thus promoted immediate proceduralization resulted in enhanced performance on a cued generation test. It is important to note that explicit instruction in these studies was aimed at assisting participants as they applied the AG to actual examples. It did not attempt to promote precise, long-term, declarative representations of the AG grammar.

At the same time, it must also be noted that explicit instruction involving a presentation-then-practice sequence, while having some potential disadvantages when used for acquisition of prepositional senses, is likely to be of some benefit, due to its unique ability to draw attention to motivated extensions between senses. In the case of prepositions, many of these extensions may involve metaphorical extensions and experiential correlations.

Some empirical research shows that explicit instruction highlighting these extensions can be effective. Boers and Demecheleer (1998), for example, conducted a study examining learners' acquisition of the figurative senses of *beyond*, a word lacking a close French equivalent. Two experiments showed that French students who were instructed using a Cognitive Linguistics approach that targeted schematic meaning were better able to extend this meaning compared to students using a simple dictionary meaning of the literal sense. They also did better than students who were provided with detailed dictionary entries that included the figurative senses. The authors point to the advantages of an explicit approach that draws learners' attention to the motivated links between senses. One potential drawback of the SH approach is an inability to highlight such links.

9.4 Holistic Versus Analytic Processing

SH instruction is more likely to recruit implicit mechanisms associated with global, holistic processing of stimuli, a type of processing more appropriate for family resemblance categories; in contrast, rule-based explanations should be less ineffective when learning family resemblance categories, such as the target structures (Ashby et al., 2011).

Moreover, research has suggested that competition can occur between declarative and procedural memory systems during category learning (Ashby & Maddox, 2011). For this reason, learners who initially employ rule-based learning utilizing declarative knowledge of a set of items may continue to use this memory system during subsequent practice, even when this processing results in suboptimal performance (Ashby & Crossley, 2010). When acquiring family resemblance categories, for example, learners who initially train with rules may focus excessively on a limited set of criterial category features and, by doing so, may decrease their attentional allotment to an array of additional features useful in determining category assignment. In other words, a more analytic mode of processing, in which stimuli are compared according to specific attributes, is likely to compete with a more holistic mode of processing in which there is greater focus on global relations and overall similarity (Kemler Nelson, 1984).

To take a contrived example, a person learning the category for *bird* who was told simply to look for a beak (a criterial feature that is simple enough to be learned using rule-based learning) may subsequently reduce attention to an array of informative category features such as feathers, flying ability, or clawed toes (family resemblance features that are not criterial). This is not to say that rule-based learning precludes the learning of family resemblance structures. Induction of a more detailed category representation may occur explicitly as simple rules are revised. Moreover, a phase of rule-based instruction should not completely prevent the use of implicit categorization during a subsequent practice phase. In such circumstances, however, the influence of implicit categorization mechanisms is likely to be attenuated (see, for example, Kemler Nelson, 1984, Experiments 1-3).

It must be conceded that participants in the SH condition could also switch to rule-based hypothesis testing, but this is deemed less likely, due to the difficulty of inducing semantically complex categories using incidental rule-based categorization. Support for this assumption can be found in a study by Spiering and Ashby (2008), which showed that participants' initial encounter with difficult categorization items at the beginning of a task encouraged the use of implicit categorization (i.e., procedural connectionist learning in the COVIS model) throughout the task.

Neither the D-P nor the SH condition is likely to be process-pure in the sense of solely recruiting explicit or implicit categorization mechanisms. However, the SH condition should allow for more global and holistic processing (i.e., processing associated with procedural learning in the COVIS model), due to the fact that (1) learners are not told that the semantic highlighting reflects criterial features and (2) semantic highlighting is associated with concrete form-meaning mapping that only applies to a given sentence.

9.5 Individual Differences and Potential Interactions With Treatments

Because the SH instruction occurs within a relatively narrow cognitive window and is tied directly to a single exemplar, it should largely eliminate problems arising from failures in executive function. Executive function refers to a set of abilities associated with the effortful directing of behavior toward a specific goal (Banich, 2009). It often involves the inhibition of stereotyped behaviors while focusing on the information most relevant for the task at hand. It is, therefore, highly relevant to situations in which learners must retrieve relevant information from long-term memory (e.g., information acquired from an explicit presentation of a target linguistic structure) and apply this information within receptive or productive language tasks. Likewise, working memory is essential, as it enables learners to hold the retrieved information long enough to achieve integration with other elements that are currently being processed.

Even among normal populations, executive function shows decrements among children, adolescents, and older adults (Banich, 2009; Hale, Bronik, & Fry, 1997; Treitz, Heyder, & Daum, 2007). Similarly, children have been shown to have shorter working memory capacity (see Fry & Hale, 1996). Because the SH instruction places reduced burdens on the executive and the phonological store of WM,[61] it should be more effective than a D-P approach when used with learners who have low aptitude, and should constitute a better option for populations, such as young children or older adults, who have less executive control or WM function. The current study is not designed to test this prediction. Even so, an SH advantage in this area should translate to a slight improvement in effectiveness if certain segments of the tested population have low aptitude, especially if this is a result of lower WM capacity.

9.6 Possible Synergies Between Instructional Approaches

Another possibility, not explored so far, is that the SH instruction and the explicit presentation used in the D-P condition may have a synergistic effect when combined. Both the Clarion and the ACT models would predict advantages for a top-down approach in situations in which it is possible to develop the necessary declarative structures. Within

[61] The argument here is because SH instruction highlights one or more relevant features of the category directly prior to processing, SH learners, unlike learners following typical presentation-and-practice sequences, do not need to recall the semantic explanation from memory, retain this explanation in WM while sorting through it for information relevant to the sentence being processed, and then hold the retained information in WM along with the sentence. In fact, the SH instruction occurs in such close proximity to the processing of the sentence that it is likely to influence processing of the sentence even when the learner is not making an effort to use this information.

the SLA context, this would mean situations in which the linguistic target is not excessively difficult and therefore constitutes an appropriate target for explicit instruction (DeKeyser, 2003, 2005). It could be that the explicit explanations would be more effective if learners had already developed a base of knowledge of the family resemblance structure of the category through a more inductive approach (i.e., the SH practice). In that case, the explicit presentation could be used to further clarify existing knowledge (for a relevant discussion of bottom-up learning, see Sun, 2002, 2007). More specifically, the explicit presentation could clarify the inductively acquired knowledge by (1) pointing out subtle semantic characteristics of the target sense, (2) systematically pointing out connections with related senses within the preposition's semantic network, and (3) systematically pointing out key contrasts with competing senses of other prepositions.

Another possibility is that the D-P treatment could be enhanced if the practice phase were replaced with practice employing SH cues. These cues might focus learners' attention on the relevant features of the situation, and may thereby overcome potential problems due to WM limitations. On the other hand, hybrid approaches involving SH combined with explicit instruction may be less effective if learners find it difficult to switch between the two instructional formats. Because few studies have examined learning conditions similar to the hybrid conditions, the hypotheses regarding the mixed treatments are more speculative.

Chapter 10: Semantic Analysis of Prepositional Senses in Instructional Targets

The study adopts the Cognitive Linguistics (CL) framework, which analyzes the polysemy of prepositional senses in terms of polysemy networks. As noted by Boers and Lindstromberg (2006), prepositions have often served as the "showcase" structure of semantic analysis within the CL tradition (p. 309). The CL framework adopts what Violi (2001) describes as a Kantian perspective;[62] namely, the idea that linguistic concepts bear the mark of having been filtered through our human way of perceiving and interacting with the world. In the CL tradition, this is often described as the *embodiment* hypothesis, which, broadly speaking, is the claim that "human physical, cognitive, and social embodiment ground our conceptual and linguistic system" (Rohrer, 2007, p. 27). Because human beings relate to the world via sensorimotor routines in order to achieve typical human goals, it is assumed that meaning will reflect the embodied perception of physical forces and functional interactions.

Many of the contrasts between prepositional senses involve abstract semantic features that would be treated as thematic relations in some theoretical frameworks. The current analysis assumes a CL perspective and the compatible theoretical framework of Construction Grammar (see Goldberg, 1995). The CL perspective posits highly complex and articulated semantic structures. For this reason, an analysis in terms of thematic relations or theta roles was not pursued in this study.

As is typical for closed-class lexical items, prepositional meanings tend to be highly abstract. For example, the English preposition *for* has a sense referred to in this study as the "situational valence" sense. In a sentence such as *Junk food is bad for*

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[62] For a discussion of the ideas of schemas and embodiment in relationship to Kantian thought, see Johnson (1987).

children, the sense is based on a context in which there is some sort of plan or conception of what is good or bad for children. In terms of the target schema, typical assumptions regarding the ideal state of children's health thus function as the landmark element; an entity that positively or negatively affects this plan (in this case *junk food*) serves as the trajector. It must be noted that the notion of a plan or desire regarding the ideal state of affairs, which forms an intrinsic part of this sense, is not explicit within the noun *children* and must instead be inferred based on the prepositional sense.

Tyler and Evans (2003) proposed two methodological criteria for determining distinct senses of a polysemy network. First, the sense must include a different configuration of the trajector and landmark than that found in the proto-scene. Second, there must be instances in which the sense is context-independent, and thus cannot be inferred from the context of its occurrence. Partly following earlier work by Langacker (1987), Tyler and Evans also list various indications that a sense has central status within a polysemy network: (1) early appearance diachronically, (2) predominance within a network, (3) occurrence in composite lexical units (e.g., the use of *over* in its covering sense in *overcoat*), (4) occurrence as a key dimension distinguishing a contrasting set of items (e.g., *over*, *under*, *above*, and *below*), and (5) traceability to the central sense.

The existence of a distinct sense can also be inferred from differing constraints on the acceptability of prepositional senses. For example, some senses of *for* require that the trajector have positive semantic prosody. [63] This can be tested by using the antonym of the trajector to see if the resulting sentence results in infelicity. For example, *The nurse made the bed for him*, is acceptable, but, *The nurse messed up the bed for him*, is odd

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[63] Louw (1993) defines semantic prosody as "a consistent aura of meaning with which a form is imbued by its collocates" (p. 157).

because *for* in this context is naturally interpreted as the "benefit" sense (discussed in Chapter 10.2.5). The same constraint is not present for the situational valence sense of *for*, as can be seen from such sentence pairs as, *This is good for kids*, and, *This is bad for kids*.

The existence of irony, often of the sort observed in jokes and double-entendre, can also be used to infer the existence of multiple senses. These cases may provide additional insights if Giora's (1997) Graded Salience Hypothesis is correct. Focusing primarily on the literal and figurative meaning of idioms, Giora claimed that senses are accessed at different speeds, due to their "salience." She defines salient meanings as those that are conventional, frequent, familiar, and enhanced by prior context. Irony can appear when individuals initially process the more "salient" meaning of an expression and then subsequently process an intended meaning that is less salient. Effects of irony may provide a useful insight in analysis, as they suggest that any prepositional sense that is employed as the intended sense in a double-entendre context (in particular, one that is vague without informative cues biasing interpretation) should have less psychological salience than the initially processed sense. Along the same lines, the existence of multiple senses can also be inferred from semantic garden path effects, as seen with the following sentences:

> Dorothy went shopping for a lion. The lion had asked her to buy him a heart.
>
> Dorothy went shopping for a lion. She loved to raise exotic pets.

In addition, senses can often be clarified through inferences based on linguistic context (Gleitman, 1990; Taylor, 2003b). For example, the idea of directed motion can be posited for *at* based on the fact that *at* and other directional prepositions (e.g., *into*, *onto*, *over*, *under*, *through*) can appear after a verb such as *look* (as opposed to *see* or *watch*), as this verb signifies the directed motion of a person's gaze or focus of attention.

Finally, it should be noted that a basic assumption when positing any sense is that the sense corresponds to a psychologically plausible linguistic category. This can be determined in several ways. First, the sense should conform to the embodiment assumption, meaning that it should be relevant to typical human interaction with the environment for typical human purposes. For example, a sense defined solely in terms of topological features could be questioned on the grounds that human beings' interaction with objects in space is strongly influenced by forces such as gravity, the length of human limbs, limitations in the range of human senses, and so on. Second, the existence of a distinct sense as part of the linguistic repertoire of another language could be used to prove the sense's plausibility. This is so even if the sense is expressed via different parts of speech or via different means (e.g., as a syntactic pattern or as a morpheme).

The following section will present an analysis of the basic senses of *for*, adopting insights from the Principle Polysemy Approach presented in Tyler and Evans (2003) and from the semantic analysis discussed in Tyler, Mueller, and Ho (2011). These senses were targeted in the instructional treatments of the experiment in this study. The experiment examined adult L2 learners' acquisition of various senses associated with the prepositions *above*, *at*, *for*, *in*, *on*, *over*, *to*, and *with*, with most focus on senses associated with *for* and *to*. The target senses were chosen for several reasons: (1) previous research and piloting suggested that L2 learners (and Chinese learners of English in particular) experienced difficulty in acquiring the senses, and (2) the senses form important contrasts with each other, so that acquisition of one sense is likely to facilitate acquisition of the contrasting sense. The semantic analysis for these senses has been presented, with prepositions involving key contrasts presented sequentially to facilitate explication.

10.1 Analysis of *To*

The preposition *to* has been analyzed from a diverse range of perspectives (Cuyckens, 1999; Evans & Tyler, 2004a; Lindquist & Levin, 2009; Lindstromberg, 2010; Radden & Matthis, 2002; Tyler & Evans, 2003; Zwarts, 2005). As one of the more commonly encountered prepositions, *to* has a wide range of senses. Only six have been targeted in this research, due to their important contrasts with certain senses of *for* and *at* and their coherent relationships with one another: (1) transfer, (2) affecting attitude or behavior, (3) perception, (4) contact, (5) limit, and (6) attachment.

10.1.1 Transfer

To is widely recognized as having a sense associated with giving or sending (see, for example, Lindstromberg, 2010; Tyler et al., 2011). Most L2 learners rapidly acquire this sense, as it tends to receive overt marking in many languages. However, learners will often oversupply *to* when *at* or *for* is intended, due to their imprecise knowledge of the sense's semantic range. The sense also forms some important contrasts with *at* and *for* when used within communicative contexts (compare, for example, *The man whistled at the waitress* versus *whistled to the waitress* or *whistled for the waitress*). Learners often lack sensitivity to these contrasts. As applied to actual transfer, *to* is typically chosen when there is a willing receiver (as in the phrases *awarded it to*, *sacrificed animals to the gods*, *contributed assistance to*). Within communication, *to* tends to appear when mutual interaction is implied (compare, for example, *listen to* versus *hear*).

10.1.2 Affecting Attitude or Behavior

The association of *to* with transfer has led to an extended sense in which an attitude or behavior ends up exerting a transferred effect (for a discussion, see Lindstromberg, 2010, pp. 209, 238; Tyler et al., 2011). For example, *The waiter was rude to Tom* implies that the waiter's attitude is not something that merely exists as a subjective state. Rather, the rudeness has been manifested in such a way that Tom has been affected. The sense can appear in more general contexts (e.g., *What happened to her?)*, as well. It can also be used to refer to the effects of actions, as in the sentence, *Who did that to you?* In this latter case, *for* is available as an alternative to refer to positive effects (e.g., *He did that for me*). As a result, *to* is generally limited to negative effects.

10.1.3 Perception

When a percept impinges on the sense organs or the mind, animate beings are affected. This has led to a sense of *to* that occurs with various verbs of perception (e.g., *tastes good to me*, *feels coarse to me*, *seems odd to me*, etc.). Quite often, an evaluative judgment of the sense impression is implied (Tyler et al., 2011). This sense forms some important contrasts with the situational valence sense of *for* discussed below (compare, for example, the contributions of *to* and *for* in the following sentence: *Although being* *popular seemed so important to me at the time, I realized later that it really wasn't important for me in terms of my overall development as a person*).

10.1.4 Contact

The core sense of *to*, not targeted in the experiment, expresses the notion of a trajector that is oriented toward (and by extension, often *moving* toward) a landmark, which is often conceived of as a goal or destination (discussed in Tyler & Evans, 2003, pp. 149, 150). Due to an experiential correlation between movement to a goal and contact (or attained proximity), *to* has developed a "contact" sense (Tyler & Evans, 2003, p. 151). Many English collocations involving the repetition of body parts (e.g., *cheek to cheek*, *nose to nose*, etc.) involve this sense (for a corpus-based study of this pattern, see Lindquist & Levin, 2009). However, the sense is productive outside of this pattern (e.g., *With finger to his lips, he told the crowd to be quiet*).

10.1.5 Limit

A goal often implies the terminus of a movement or action (Tyler et al., 2011). Examples include *filled to the rim, fought a duel to the death*, or *burnt to a crisp*. It should be noted that only some of the uses of this sense involve actual movement of a physical object. Quite often, the movement is metaphorical and represents the ultimate end-state implied by a process (e.g., *crushed to powder, pounded to a pulp, etc.*). *To*, in this case, will often form a subtle contrast with *into,* which tends to be preferred when a more qualitative or radical transformation is involved.

10.1.6 Attachment

A frequent consequence of a trajector being brought into contact with another object is attachment (Tyler & Evans, 2003; Tyler et al., 2011). The notion of physical attachment can also be extended metaphorically (e.g., *wedded to*, *addicted to*, *emotionally attached to*, etc.). Many languages (e.g., Chinese) will encode attachment events with spatial particles that focus exclusively on the end state, ignoring the action by which the trajector is joined to the landmark.[64] As a consequence, many NNSs will oversupply *on* in contexts in which NSs prefer *to*. Because some of the contexts allow for a construal using *on* (compare, for example, *I stuck it to the wall* and *I stuck it on the wall*), NNSs probably receive little negative feedback on their deviations from NS norms involving this sense.

10.2 Analysis of *For*

For seems to have been analyzed in depth by relatively few researchers (e.g., Bennett, 1975; Herskovits, 1986; Tyler & Evans, 2003), so much of the analysis presented here is tentative. The experiment targeted seven senses of *for*: (1) oblique intention, (2) purpose, (3) grounds, (4) situational valence, (5) benefit, (6) proxy, and (7) exchange.

10.2.1 Oblique Intention

Especially when appearing with certain verbs of locomotion, *for* can describe an immediate purpose that is associated with a more general goal (for a related discussion, see Bennett, 1975, p. 92; Tyler & Evans, 2003, p. 153). According to Tyler and Evans,

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[64] Note, for example, Chinese NSs' overwhelming preference for *shàng* (the closest Chinese equivalent to English *on*) when describing the *nail in board* picture in the study by Zhang, Segalowitz, and Gatbonton (2011).

the intentionality associated with this sense forms an important contrast with the functional element observed with *to*. Compared to the central sense of *to*, this sense of *for* appears with less frequency and within a narrow range of contexts. Common collocations involving this sense include *bolt for*, *bound for, dash for, head for, make a beeline for, make a move for the exit, race for, run for, scramble for, set sail for, start for the door*, *fly for the window*, *drive for the border*, and so on.

As Tyler and Evans (2003) show, *for* contrasts with *to* in that *to* implies reaching the landmark (compare, for example, *He ran to the hill and back*, and *?He ran for the hill and back*). They further point out that the implication of oblique intention makes *for* infelicitous when no intention is present; thus, *The balloon floated for the ceiling* sounds odd. Furthermore, *for* seems to highlight the preliminary phase of an action (Lindstromberg, 2010; Tyler & Evans, 2003). It should also be noted that many of the examples involve haste. This may explain the preference for *toward* versus *for* in, *He methodically and carefully crawled toward the door*. When haste and incipient action are implied, some verbs that do not refer directly to locomotion, but simply involve movement, are also possible (e.g., *The gunslinger went for his gun*).

10.2.2 Purpose

The functional notion of intention gives rise to the central sense of *for*, which is associated with purpose.[65] Prototypical collocations involving this sense include *intended for*, *used for* and *tools for*. The sense's basic schema is evoked when a human being regards a trajector (often an artifact) as facilitative for some purpose (the landmark). The

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[65] As Lindstromberg (2010) points out, *for*, as opposed to *to*, is linked closely with intention instead of movement. In the sentences *Why did you eat that? That piece was for him*, the preposition *for* can only be viewed as marking intention, as the piece never made it to the intended recipient.

landmark does not need to be a goal, per se. Quite often, it simply picks out a relevant domain, within which the trajector plays a facilitative role. For example, in the sentence, *He was treated for an ulcer*, the *ulcer* is clearly not a goal or purpose, but instead represents the domain for which the treatment was intended.

10.2.3 Grounds

When applied to reasoning processes, *for* can express a justification or explanation related to the landmark (for a closely related discussion, see Lindstromberg, 2010, pp. 227, 228). For example, in the sentence, *He had no excuse for being late*, the excuse is a justification being applied to a particular domain (tardiness). Other examples would include *rationale for*, *reason for*, *strategies for*, *arguments for*, *explanations for*, *apology for*, *blame for*, and so on. It should be noted that *for* can be used in contexts that are not so closely associated with reasoning processes, but simply evoke cause and effect (e.g., *hospitalized for*, *fined for*, *sued for*, *caught hell for*, *famous for*, *punished for*, and so on).

10.2.4 Situational Valence

Through semantic bleaching, *for* has an exceedingly vague sense that can perhaps be best described as simply marking the general topic (e.g., *They're tied for second place*, or *It's common for there to be tropical cyclones in the Baja area*). Lindstromberg (2010) alludes to such a function as "ear-marking" (p. 230). Such a function would also seem to be present in sentences such as *This computer's important for her daughter*. However, *for* seems to invite a specific interpretation in this context, due to its contrast with a competing sense of *to*. If *for* is replaced with *to* in this sentence, the importance appears as a completely subjective matter. It would make no sense to say *I don't think it's important to her* unless the speaker had received a verbal report of the daughter's thoughts or had some way of making inferences regarding her subjective mental state. *For*, used in the same context, elicits a distinctly different interpretation, in which the speaker may justify the opinion on completely objective grounds.

The semantic contribution of *for*, in this case, appears to be linked to an ideal conception or plan that is associated with the landmark.[66] For example, the sentence *Junk food is bad for children* states that a trajector (junk food) hinders the plans (the landmark) that people typically have for children. Likewise, the sentence, *This job would be good for John* refers to a conception of some ideal situation regarding John. If the sentence is turned around to be *John would be perfect for this job*, it would suggest that the speaker has some ideal conception of the state of affairs regarding the landmark element (the job).

An analysis of the Chinese subcorpus of the ICLE reveals that Chinese learners have difficulty with this sense, with a tendency to replace *for* with *to*. In the following examples, the prepositional error has been put in bold. The ICLE code for each text has been listed preceding each example.

> <ICLE-CN-UK-0007.1>
>
> Firstly, more and more programmes are involving violence and sex including films and entertaining programmes which children can easily access. This is a big problem **to** children. They are exactly opium to children.

[66] Lindstromberg (2010) does not describe a distinct situational valence sense. Instead, he claims that the sense of *for* in, *Smoking is bad for you,* is based on a generalization of the "support" sense appearing in, *She was for Obama*.

<ICLE-CN-UK-0011.1>

If the genetic engineering could be accepted, it would have problems **to** public society, like security system and other organization.

<ICLE-CN-UK-0036.1>

First of all, for drawing attention to people, especially to the adults, a majority of TV programmes have being made. They are too violent, rude, or sexy. However, many young people always enjoy imitating them. Everybody knows that these kinds of programmes are very unhealthy **to** young people.

<ICLE-CN-UK-0051.1>

If you keep the murderer alive and execute the life sentence, you can make him to work in the prison for the left of his life, through such a punishment, he or she can do something good **to** the society. In their opinion, this way is both good **to** the society and the criminal as well and there's a fact that some countries or some parts of a country have abandoned the capital punishment.

<ICLE-CN-UK-0072.1>

Nowadays, higher education is regarded as the basic qualification **to** students who step into society since in recent decades, world economy have grown rapidly and the market competition have been getting serviously.

In addition to providing evidence for the difficulty of the sense for Chinese learners of English, the errors and infelicities demonstrate how lack of clarity regarding one prepositional sense may create difficulties in acquiring competing senses. The use of *to* within the quoted passages would probably be interpreted by NSs, at first glance, as referring to either the affecting attitude/action sense of *to* (the sense seen in collocations such as *rude to*, *mean to*, *nice to*, etc.) or the perceptual sense of *to* (the sense in *this tastes bad to me*). The L2 writers of the quoted passages are probably missing the precise semantic specifications of the target *for* sense, as well as the semantics of the two *to* senses.

In his discussion of several shortcomings of prototype theory, MacWhinney (1989) claims that it places insufficient emphasis on the relationship between concepts. He suggests that categories are determined, in part, by their competition with competing categories (for a similar account, see Taylor, 2004). This dynamic conception of categories forming boundaries based largely on the semantic space covered by competing categories can be overstated (for some examples proving that this is not always the case, see Violi, 2001). However, the insight is probably valid regarding certain linguistic categories, especially those involving closed word classes. For this reason, L2 learners are unlikely to achieve nativelike proficiency in their use of a particular prepositional sense prior to their development of adequate representations of a sufficient number of contrasting categories (in this case, competing prepositional senses).

The situational valence sense discussed thus far does not seem to have been treated as a discrete sense in previous research, and has, to the contrary, been subsumed under more general senses. Viewed from the perspective of semantic explication and the desire for parsimony in theoretical descriptions, this may be justified. In terms of SLA pedagogy, on the other hand, there is a need to understand the specific lack of knowledge that prevents learners from producing the appropriate preposition within a given context.

For this reason, a more fine-grained analysis may be useful for determining learners' gaps in semantic knowledge and for developing materials that specifically target such gaps.

10.2.5 Benefit

When a person acts with a specific purpose in mind and the purpose involves another person, it is often the case that the act is aimed at benefiting the other person.[67] This leads to a distinct benefit sense in which some action, or an artifact associated with an action, often serves as the trajector. The landmark is typically animate. Evidence for benefit as a distinct sense comes from the fact that the benefit sense, unlike the intention sense, is constrained to situations involving positive semantic prosody. The benefit sense occurs with great frequency, and the meaning seems to be central within the semantic network of *for*. This would suggest that this sense of *for* is highly salient. This is furthermore suggested by an apparent preference to use the benefit sense as a default interpretation of *for* when reading vague sentences placed outside of a biasing context such as, *It's for her*, *He did it for her*, *Who's it for?*, and so on.

10.2.6 Proxy

In order to benefit somebody, people commonly perform a task in their stead. In a sentence such as, *Mary taught the class for him*, the benefit derives from Mary's acting as a substitute. When interpreting this sentence, the focus can either be on the benefit or the substitution itself. Thus, there is a distinct sense in which the beneficial aspect of the

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[67] Tyler and Evans (2003) divide this sense into an "intended recipient sense" and a "benefactive sense" (p. 154). This division seems to be excessively fine-grained as the extension from one sense to another should be possible using inferences of a very general nature. For this reason, these two senses have been combined in the current study.

action is semantically bleached. In some cases, the proper identification of the proxy sense, as opposed to a benefit sense, is difficult, as benefit can be implied (e.g., *She has sympathy for him*, *I feel for you*, *I'm happy for you*, etc.). However, many examples clearly have no sense of benefit (*Hola is Spanish for hello*, *Finger length is a marker for prostate cancer risk*, *Do you take me for a fool?*, etc.). The contrast between proxy and benefit can be observed in the following sentences.

George taught for her. (She owned the school, and he wanted to help her out).

George taught for her. (She normally taught the class but was sick that day).

The second sentence remains somewhat ambiguous, but it is possible to further constrain the context so that a benefit reading is ruled out (e.g., *She hated to have anybody teach her class and understood that she would be fired when the school saw how much better George was at teaching, so she was enraged when she learned that he had taught for her while she was sick*).

10.2.7 Exchange

In many typical cases, people may perform an action motivated by the potential benefit of the action to others. In other cases, human beings are not so altruistic and focus instead on what they receive in return for their actions. This may explain the development of an exchange sense that is evident in phrases such as *exchanged it for another, paid $10 for*, *sold for $10, tit for tat*, and so on. The proxy sense and exchange sense are so close in meaning that it may appear that they can be combined to achieve greater theoretical parsimony. Yet sentences can be constructed that are ambiguous in terms of the two senses. For example, the sentence, *She handed the money over for him*, could receive the following two interpretations, reflecting the proxy and exchange senses respectively:

She handed the money over for him (because he couldn't hand it over himself).

She handed the money over for him (because he'd been kidnapped).

10.3 Analysis of *At*

The basic sense of *at* expresses a trajector's close proximity with a landmark (Tyler & Evans, 2003). Quite often, there is a close functional match between the trajector, which has a functional front, and the landmark, in which the area providing functional affordances is profiled. Hence, *The chair's at the desk* sounds more natural than *The ball's at the desk* (Navarro i Ferrando, 2002, p. 217). As pointed out by Navarro i Ferrando, the functional match reflects the manner in which human beings typically react with the landmark element. The experiment targeted two senses of *at*: (1) measure and (2) search for contiguity.

10.3.1 Measure

At indicates coincidence with numbers and quantities that refer to specific degrees on a scale (Herskovits, 1986; Navarro i Ferrando, 2002). It should be noted that the "specific degree" involved need not be explicitly stated. *At* is therefore felicitous in phrases such as *at high speeds*. Research (e.g., Tyler et al., 2011) and piloting has indicated that NNSs from a diverse range of L1s have difficulty acquiring this sense.

10.3.2 Search for Contiguity

As discussed by Navarro i Ferrando (2002), *at* is used extensively with motion verbs to depict directed action with a focus on the kinetic features of the motion and the asymmetrical nature of the intention (e.g., *lash out at*, *fly at*, *shoot at*, *slap at*, *throw at*, etc.). In contrast with *to*, *at* quite often implies aggression and entails the possibility that contiguity is not achieved (Navarro i Ferrando, 2002). With verbs of communication, *at*, unlike *to*, does not imply communicative interaction (compare, for example, *The construction workers whistled at the woman* versus *Her boyfriend whistled to her to get her attention*). The same analysis can be applied to the subtle differences between *at* and *to* when used with facial expressions involving innuendo (e.g., *He smiled to her as a signal for them to leave* versus *He got up every day and smiled at the world and everything in it*).

10.4 Analysis of *On* and *In*

The experiment targeted three senses of *on* which piloting has indicated are difficult for even relatively advanced learners: (1) resemblance to visual feature, (2) communicative media as support, and (3) a volitional exceptional state.

10.4.1 Resemblance to Visual Feature

The use of *on* for scenes resembling contiguity and support is discussed by Herskovits (1986) and Goddard (2002). In his discussion of this sense, Goddard gives examples such as *a shadow on the wall*, *wrinkles on forehead*, *tattoo on shoulder*, *boil on* *her knee*, and *mole on her chin* (p. 289). He claims that the same sense also motivates the use of *on* when the smaller object (i.e., the trajector) is an integral part of the reference object (i.e., the landmark) as in *muscles on his chest* or *fins on a fish's back*. Following Goddard, the target items used in the experiment feature these latter uses of *on*, treating them as extensions of the same sense of *on*.

10.4.2 Communicative Media as Support

On can be used to describe the support provided by various devices or communications media (e.g., *on the radio*, *on the Internet*, etc.). Navarro i Ferrando (1999) discusses this usage as one among many metaphors in which the landmark appears as a supporting entity. In addition to the modern technological devices he mentioned, objects such as musical instruments may be added as possible landmark elements supporting the conveyance of sound (as in *She played the song on the piano*). It must be noted that all devices that support activities do not invoke the schema associated with *on*. For example, *with* sounds more natural than *on* when describing the use of a telescope (e.g., *He looked at the stars with a telescope*). In this case, the transferred medium (e.g., light or information) is not sufficiently salient within our folk theory of *looking* to invoke the use of *on*.

Put in more general terms, the facilitative role of the telescope is not salient enough to invoke *on* (compare *on camera*). The distinction thus appears to involve a contrast between assistance from the device versus dependence on the device. Without a radio, human beings have no way to hear broadcasts; and without a piano, humans have no way to produce piano music. Likewise, cameras are necessary to record images.

However, we can see objects with the naked eye. A telescope is thus viewed as a device that boosts our normal visual capacities. Compare, for example, the contrast between *I can't quite see it, so I'll need a microscope* and *??I can't quite hear the broadcast, so I'll need a radio*.

10.4.3 Volitional Exceptional State

The state sense of *on* has been discussed in detail by Evans (2010). Deriving the state sense from specific spatial features associated with *on*, Evans argues that the states expressed by *on* (as opposed to those associated with *in*) tend to be volitional and exceptional states that generally hold for a limited period of time (as seen in the phrases *on sale*, *on duty*, or *on strike*). The states contrast with their normative counterparts (e.g., *on-duty* versus *off-duty*). Navarro i Ferrando (1999) presents a more fine-grained notion of volitional action involved with this sense, noting that many of the uses suggest people's control over the actions of others, as in phrases such as *on duty*, *on alert*, *on call*, *on hand*, and so on (p. 159). However, this seems overly restrictive, as the same state sense would seem to be at work when referring to a car as *on loan* or *on hire*, or when referring to an item as *on display*.

10.4.4 Affecting Condition

In has received a detailed treatment by a number of authors (Evans & Tyler, 2004b; Herskovits, 1986; Navarro i Ferrando, 2000; Tyler & Evans, 2003; Vandeloise, 2005). The current research targeted only the *in* sense associated with states. This target was selected since it forms a useful contrast with the state sense of *on*.

Evans (2010) argues that the state senses of *in* are derived from the notion of prevailing conditions (e.g., *in the snow*, *in the wind*, etc.) which, in turn, are associated with the notion of containment inherent in the basic spatial sense of *in*. Evans lists four lexical concepts associated with the state sense of *in*: (1) physiological state (e.g., *The woman's in labor*), psycho-somatic state (*John is in pain*), socio-interpersonal state (*John's in debt*) and professional state (*He's in banking*). Because the psycho-somatic and socio-interpersonal lexical concepts share greater semantic affinity, only these were targeted in the experiment. As Evans points out, these *in* states, unlike those associated with *on*, tend to come about inadvertently due to circumstances, and they often express a sense of enduring influence. While many examples of the state sense of *in* are negative (e.g., *in a predicament*), this need not necessarily be the case, as is evident from the use of this same sense in the collocation *in love*. As Tyler and Evans (2003) point out, the use of *in*, in this case, is motivated by the implication that the emotional state is not easily abandoned.

10.5 Analysis of *Over* and *Above*

Beginning with Brugman's (1988) seminal work, *over* has been extensively analyzed, particularly by researchers in the Cognitive Linguistics tradition (e.g., Tyler & Evans, 2003, 2004, 2005). The English prepositions of verticality (i.e., *above*, *over*, *under*, and *below*) are good candidates for instruction aimed at fairly advanced learners, as these prepositions create a more granular furcation of verticality than do similar spatial terms in many languages and are, therefore, difficult to acquire. Moreover, these prepositions, and especially *over*, possess a large number of extended senses. The experiment targeted two senses of *over*, which piloting suggested are particularly difficult for L2 learners: (1) control, and (2) covering.

10.5.1 Control

In its purely spatial sense, *over* contrasts with *above* in marking greater proximity (compare, for example, *It's just over my head* and *The eagle's flying high above us*). According to Tyler and Evans (2003), *over* has developed a control sense, due to the experiential correlation between having a higher center of gravity and the ability to exert control.[68] In addition, physical proximity implies potential contact with the ability to manipulate a person or object. Examples of this include *Camilla has authority over purchasing* and *Personality has more influence over whom we marry than does physical appearance* (Tyler & Evans, 2003, pp. 102, 103). The targeted senses in the experiment include (1) instances in which the functional element of control is prominent within a spatial scene, and (2) extended senses in which a metaphorical, nonspatial sense of control is implied.

10.5.2 Covering

As Tyler and Evans (2003) note, the trajector, while typically smaller than the landmark, can, in some cases, be larger. In such cases, the trajector's being situated just over the landmark can result in the landmark's being covered (as in *The tablecloth is over the table*). Tyler and Evans argue that the existence of covering as a separate sense is

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[68] For a critique of this analysis, see Ma (2011).

demonstrated by its felicity in situations in which the trajector is vertically lower than that which it covers (as in *They put a plastic sheet over the ceiling*).[69]

10.5.3 Preclusion of Potential for Contact or Influence

The experiment targeted only the basic sense of *above* (i.e., preclusion of potential for contact or influence), as it forms an important contrast with *over*. As Tyler and Evans (2003) point out, *above* contrasts with *over*, in that it tends to preclude the potential for contact between the trajector and landmark. They further note that an important functional implication is that *above* is thereby associated with attenuated potential for influence. The importance of the functional element is obvious within sentences in which the functional implications trump topological proximity in determining the choice of preposition. For example, in the sentence *Noisy airplanes fly over our house every day*, the preposition *over*, with its sense of influence and control, is more appropriate than *above*, in spite of the fact that the airplanes are not really in close proximity with the house in absolute terms. On the other hand, in the sentence *There were some stray marks above the line*, the marks may be only centimeters above the line, but *above* is still warranted, as the marks are unable to come into contact with the line (example taken from Tyler & Evans, 2003, pp. 112, 113). In a similar manner, NSs prefer *above* in the expression *keeping one's head above water*, due to the salience of the functional element (i.e., avoidance of drowning) over topological proximity.

[69] For a critique of this analysis, see Van der Gucht, Willems, and De Cuypere (2007).

10.6 Analysis of *With*

The experiment targeted two senses of *with*: (1) instrumentality and (2) theme-marking.

10.6.1 Instrumentality

With can be used to express an instrumental sense (e.g., *He broke the window with a bat*). According to Langacker (1992), instrumental *with* profiles an atemporal relationship in which the trajector is a schematic process or event (e.g., *He signed the treaty*) and the landmark (e.g., *[with] a ballpoint pen*) an intermediary in the causal chain between agent and patient. As discussed by Schlesinger (1995), the conceptualization of instrumentality is actually quite complex, with some important contrasts occurring between *with*, *by* (e.g., *He came by car* instead of *with a car*), and paraphrases that incorporate the word *using* (e.g., *He built it using a tape measure* instead of *with a tape measure*).

10.6.2 Theme-marking

According to Farrell (2009), prepositional phrases headed by *with* can mark the theme (i.e., the moving or transferred object) in scenarios involving transfer or change of place (e.g., *He filled the vase with flowers*). He makes the important point that although the theme often seems to be conflated with notions of instrumentality, an independent instrument-elaborating adjunct can be added to such clauses (e.g., *He filled the vase with flowers with tongs*), indicating the need for a separate category. Due to time constraints, finer points of semantic analysis (e.g., differences between spray/load verbs and swarmtype verbs) were not addressed within the instructional materials (for a discussion, see Levin, 1993). Following Goldberg (2006), the instructional strategy employed in the experiment was based on the contention that *with* constructions are not reducible to their so-called “alternations” and should, therefore, be taught as independent constructions.

Chapter 11: Hypotheses

The experiment compared a semantic highlighting (SH) treatment, a D-P treatment, and hybrid treatments involving either SH practice followed by explicit explanations (SH-D) or explicit explanations followed by SH practice (D-SH). The following hypotheses were tested:

H1: When targeting semantically complex structures, an SH approach will be more effective than a D-P approach when acquisition is measured by a fill-in-the-blanks (FB) measure.

H2: When targeting semantically complex structures, an SH approach will be more effective than an SH-D approach when acquisition is measured by a fill-in-the-blanks (FB) measure.

H3: When targeting semantically complex structures, an SH approach will be more effective than a D-SH approach when acquisition is measured by a fill-in-the-blanks (FB) measure.

H4: When targeting semantically complex structures, an SH approach will be more effective than a D-P approach when acquisition is measured by a sentence elicitation (SE) measure.

H5: When targeting semantically complex structures, an SH approach will be more effective than an SH-D approach when acquisition is measured by an SE measure.

H6: When targeting semantically complex structures, an SH approach will be more effective than a D-SH approach when acquisition is measured by an SE measure.

H7: A hybrid approach involving a D-SH sequence will be more effective than a D-P approach when acquisition is measured by the FB measure.

H8: A hybrid approach involving a D-SH sequence will be more effective than an SH-D approach when acquisition is measured by the FB measure.

The first six hypotheses thus predict that an SH instructional approach will lead to greater learning on a measure that allows for the use of both declarative and procedural knowledge (the FB test) and on a measure that primarily assesses procedural knowledge (the SE test). The final two hypotheses state that the D-SH condition will outperform all other conditions (except the SH condition) on the FB measure.

H1 and H7 are based on the assumption that a potential weakness of the D-P sequence when targeting prepositional senses is the difficulty in recalling complex rules and then holding these rules in working memory during the processing of a target sentence during the practice phase of instruction. The SH condition should be more effective, as it promotes immediate proceduralization without reference to abstract rules. The D-SH sequence should be more effective than the D-P treatment, as it facilitates the recall of the appropriate element of a complex rule during the practice phase of instruction through the use of semantic highlighting.

H2 is posited on that notion that a bottom-up sequence is unlikely to lead to extensive declarative knowledge due to the lack of opportunities for practice and honing of the knowledge acquired during the explicit presentation phase, which occurs at the end of the SH-D instruction. H1, H2, and H3 also reflect the nature of the targeted linguistic category. The semantics of prepositions involve complex family resemblance categories.

These rules should be difficult to convey via explicit explanations. An SH approach, which employs concrete cues instead of abstract explanations, is therefore more likely to be effective on both measures.

H4, H5, and H6 are based on the assumption that SH more efficiently promotes proceduralization, as it allows participants to commence developing procedural knowledge immediately without expending time developing declarative knowledge representations of the target meaning. Furthermore, the three treatments involving an explicit presentation phase, and the D-P treatment in particular, are more likely to encourage an analytical approach to the learning task. This approach is likely to affect the approach to the SE task, which involves time pressures that hinder the use of knowledge that has not been proceduralized.

H7 and H8 are both based on Minda and Miles’ (2010) assertion that rule-based learning can facilitate later implicit learning by focusing attention on relevant dimensions of a category. The D-SH sequence is likely to promote high performance on a test without time pressure, as the participants in this condition will have access to declarative representations that have been sharpened through SH practice, and will, at the same time, have access to considerable proceduralized knowledge. The following section describes an experiment designed to test these hypotheses.

Chapter 12: Current Study

The current experiment sought to determine whether prepositional senses would be learned better with an SH treatment relative to a treatment involving explicit explanations followed by practice. The latter treatment resembles the first two stages of a present-practice-produce (PPP) approach, which is commonly used in conventional language instruction.[70] In such an approach, the initial phase of instruction helps learners develop declarative knowledge of the target structure, while the second phase aims to proceduralize this knowledge. For this reason, the participants in this condition are referred to as the "declarative-procedural" (D-P) group. Another group, referred to as the "semantic highlighting" (SH) group, received instruction involving an inductive approach described in greater detail below. In addition, the experiment examined performance of two groups who received hybrid instruction involving either: (1) SH practice followed by an explicit presentation of the semantics of the target presentation (the SH-D group), or (2) a similar instructional sequence, but with an explicit presentation preceding SH practice (the D-SH group).

The experiment sought to determine whether an SH advantage would be found on (1) a fill-in-the-blanks (FB) measure that featured low time pressure and thus allowed for the use of declarative knowledge, and (2) on a sentence elicitation (SE) measure, which was speeded and therefore more likely to favor proceduralized knowledge. The speeded measure was used in light of some AG learning research (e.g., Lane et al., 2008) suggesting that there is a speed/accuracy trade-off associated with type of training.

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[70] The PPP approach, as applied to pedagogical techniques for oral English, was discussed by Byrne (1986). The presentation approach used in the D-P condition would most closely resemble what Byrne calls "structured activities" (p. 32). It should be noted that the PPP sequence is in no way novel. It was ubiquitous in language materials prior to Byrne's publication and is commonly employed in current language instruction texts.

Domangue, Mathews, Sun, Roussel, and Guidry's (2004, Experiment 1) AG learning study, for example, showed that task variables could emphasize (1) explicit learning, based on a conscious mental model, or (2) implicit learning, based on memory of instances; and furthermore, that (3) explicit learning led to greater accuracy and slower responding, whereas (4) memory-based training led to more rapid but less accurate responses. It would be useful to know if the speed-accuracy dissociation observed with different types of training extends to semantic acquisition. It was hypothesized that the SH condition would have a more marked advantage on the SE measure as the SH treatment promotes the development of more procedural knowledge, which is essential for speeded tasks.

12.1 Method

12.1.1 Participants

Because the research involved human subjects, approval for the study was obtained through the University of Maryland Institutional Review Board. The participants, adult Chinese learners of English, were recruited in a large university in China and were paid $15 for their participation. For inclusion in the study, all participants had to be 18 years old or older and had to be a native speaker of Chinese who grew up speaking Chinese. Participants filled out a short questionnaire (see Appendix G), which asked them to state their age, language used in the home while growing up, mother's and father's L1s, years of English instruction, time spent living abroad in an English-speaking country, and education (highest degree/year completed). This information was used to characterize the sampled population and to ensure that participants met all requirements for inclusion in the study.

The mean age of participants was 23.4. Of the 136 participants, 5 had spent time living in an English-speaking country. In all five cases, the participant was between 19 and 21 years of age at the time and spent an average of nine months living in the country. Because these participants did not demonstrate advanced knowledge of prepositions on the FB test, it was felt that they met the criteria for inclusion in the study, in spite of their brief experience in an English-speaking environment. All participants accepted for the study reported speaking Chinese as their L1 and stated that both parents had spoken Chinese to them while they were growing up. They had spent, on average, 11 years learning English and had, on average, completed 3 years of college. They came from a range of majors, including accounting as well as English and other foreign languages.

It should be noted that admission to colleges in China requires high English scores on the Matriculation English Test (MET, a component of the National College Entrance Exam). Although the test, like similar tests in many other non-Anglophone countries, primarily measures discrete-point knowledge of English grammar and vocabulary, it may be assumed that high-aptitude learners have an advantage. This would be particularly true for the younger participants, as the MET has been updated in the last decade, increasing both its reliability and validity as a proficiency measure (for a discussion of the status of English in China, see Gil & Adamson, 2011; Hu, 2002b).

Participants were randomly assigned to five groups: a control group and four treatment groups (i.e., SH, D-P, SH-D, and D-SH). To ensure that the control group engaged in a comparable amount of cognitive work during the instructional phase, this group received similar computerized instruction on an unrelated linguistic target (i.e., the semantics of English modals).

Treatment Type served as a between-subjects variable with five levels. The number of participants was set at 136, with 30 randomly assigned to each of the four treatment groups, and 16 randomly assigned to the control group. Results of participants who scored below 15% on the fill-in-the-blanks pretest were excluded from the study, due to concerns that their proficiency level would be so low that they might be unable to comprehend the example sentences used in the treatment.[71] This lower cut-off was also designed to eliminate participants who were not adequately engaged during the experiment. This criterion resulted in the exclusion of one participant. Participants who scored over 75% on the fill-in-the-blanks pretest were also excluded, as these participants were close to ceiling and were thus likely to show minimal gains after receiving any of the experimental treatments. This resulted in the exclusion of five participants.

In addition, two participants who reported growing up speaking a non-Chinese L1 and who later learned Chinese were excluded from the study. Moreover, one participant, who was highly distracted by incoming text messages on his phone during the instructional phase and, as a result, did not complete the instructional materials, was excluded.[72] Finally, one participant who did not follow directions on one of the experimental measures (i.e., the SE measure) was excluded, as the responses could not be scored. In total, ten participants were excluded from the main analysis. The excluded

[71] A score of 15% would be slightly more than double the average score of participants who guessed on all items.

[72] Participants had been asked to turn off their cell phones, and the proctors reminded this particular participant; however, the participant failed to comply with instructions.

participants were replaced with other participants recruited during one of the follow-up experimental sessions.

12.1.2 Materials

The experiment examined participants' acquisition of 24 senses associated with *above*, *at*, *for*, *in*, *on*, *over*, *to*, and *with*. The analysis of the target senses and polysemy networks was primarily based on the analysis given in Tyler and Evans (2003) and on the analysis of *at*, *for*, and *to* used in Tyler, Mueller, and Ho (2011). In the latter study, a 2-hour 40-minute lesson involving a presentation-practice-production (PPP) approach using similar materials produced significant overall gains (p < 001). The semantic analysis was confirmed and refined through an analysis of the prepositions' senses as they appear in the American National Corpus (Reppen et al., 2005).[73]

The instructional materials for all five groups were created using Microsoft PowerPoint™. Participants viewed the instruction on individual monitors. For the D-P group, each preposition's senses were covered separately following the sequence *to* (6 senses), *for* (7 senses), *at* (2 senses), *on* (3 senses), *in* (1 sense), *over* (2 senses), *above* (1 sense), and *with* (2 senses). Thus, a total of 24 different prepositional senses were targeted. The criteria for sequencing were (1) that the prepositions with more senses should be presented first when possible, and (2) the prepositions with important contrasts (i.e., senses that were easily confused) should be presented adjacent to one another if possible.

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[73] The ANC contains 23,122,240 running words (tokens) and 209,307 types. Approximately 17% of the texts are from spoken texts and the rest from written text. The ANC counts were calculated using Oxford Wordsmith Tools 4.0™ (M. Scott, 1999).

The D-P instructional sequences involved (1) introduction of the sense using abstract imagery and a prototypical example sentence, (2) discussion of further examples including more abstract or novel extensions of the sense, (3) sentence completion exercises involving sentences paired with pictures, and (4) similar exercises involving short video clips. All verbal instruction on the prepositions was given via computerized instruction in Chinese (the L1 of the participants), as it was felt that they would be able to process the L1 explanations more rapidly and accurately. Moreover, the use of Chinese streamlined the process of materials development, as it eliminated the need to simplify language so that learners could understand it. From a purely methodological standpoint, the use of participants' L1 also eliminated possible interactions between Treatment Type (the independent variable of interest) and learner proficiency. There was also concern that the use of English would have resulted in lower-level learners doing more poorly on the D-P condition, which involved greater use of abstract (and thus, more difficult) language.

As just mentioned, the initial sense used in the explicit instruction was a highly prototypical sense. This was because attributes common to early-learned instances of a category tend to dominate learners' representation of the category (Spalding & Ross, 1994). Three more examples of each sense were provided in the explicit instruction in order to push learners to form a more general category based on the abstract sense.[74]

If the sense had an abstract extension derived from a more concrete meaning, this abstract meaning was included as one of the last of the four examples provided during the

[74] One alternative in the experimental design would be to move one or two of these examples to the practice session. In the current study, this option was not chosen, as it would have made the D-P treatment longer, leading to different time on task for participants in the five experimental groups.

explicit presentation.[75] For example, the attachment sense of *to* was first demonstrated with a concrete example: an animated graphic showing a thumb drive being attached to a computer. Verbs such as *attach* (or *connect*) are closely associated with the attachment sense of *to*, so such a verb was selected as the initial example. The final example in the D-P instruction phase involved the phrase *married to*. In this phrase, the attachment is abstract and metaphorical. This example thus demonstrates that English conventionally extends the attachment sense of *to* to abstract contexts.

The D-P instruction used iconic imagery to convey the abstract schemas associated with each sense. One purpose of this imagery was to associate basic senses with extended senses. For example, the basic sense of *to* was depicted using a face oriented toward a goal (see Figure 22).

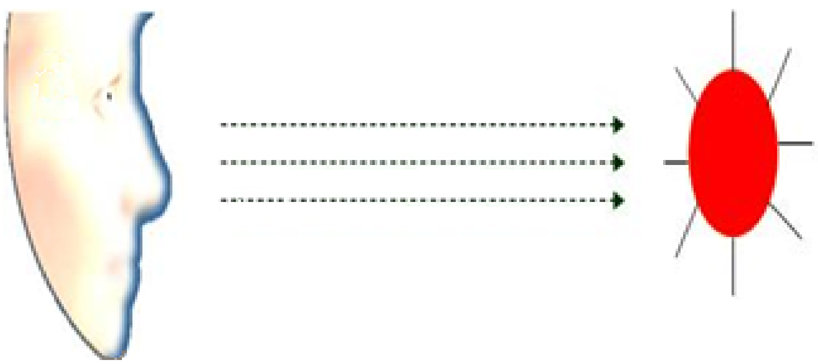

Figure 22. Iconic image used to convey basic schema for *to* in explicit presentations.

The iconic representation of other senses of *to* employed similar imagery (e.g., with trajector situated on the left). For example, the attachment sense of *to* was depicted

[75] Boers and Demecheleer (1998) have suggested that this sort of sequence, moving from a concrete central sense to a more abstract extended (often *metaphorically* extended) sense, may enhance learner acquisition.

using a thumb drive with a face underneath it moving across three dotted lines toward a goal (in this case, a laptop's USB port).

One purpose of the iconic imagery was to facilitate contrasts between easily confused senses associated with different prepositions. The basic sense of *for*, which forms an important contrast with *to*, was depicted in a nearly identical manner, but with a small object representing the intermediate goal associated with the sense (see Figure 23).

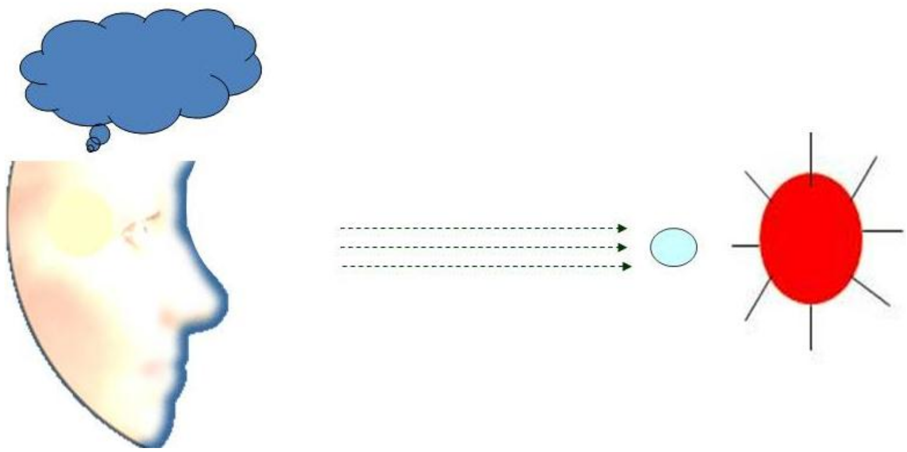

Figure 23. Iconic image used to convey basic schema for the oblique intention sense of *for* in explicit presentations.

The explicit explanations then showed how the basic schema associated with each sense related to concrete examples. For example, the abstract schema for the oblique intention sense of *for* was exemplified using a prototypical example (i.e., *The women ran for their car*) as shown in Figure 24.

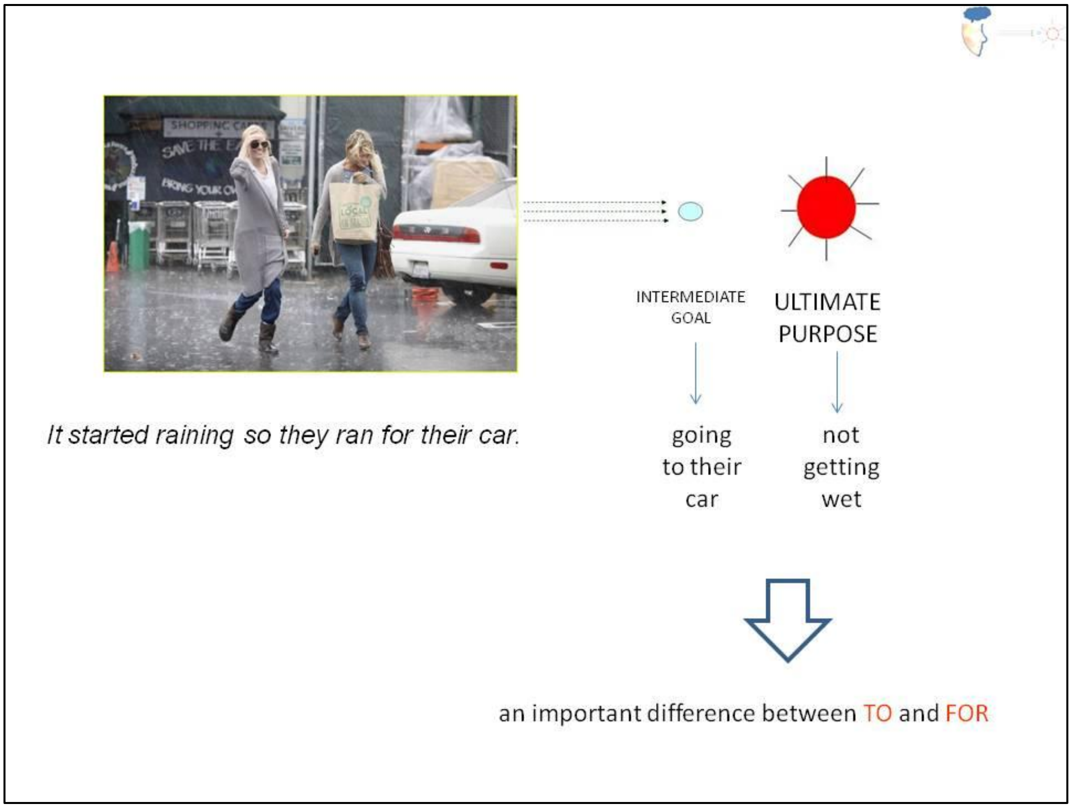

Figure 24. Instructional slide from explicit presentation showing how the abstract schema for the oblique intention sense of *for* is instantiated in an actual sentence.

The images and pictures thus facilitated the development of abstract representations of meaning and highlighted key contrasts. It is surmised that they also enhanced subsequent recall (for a theoretical discussion of benefits of using imagery to enhance recall, see Dirven, 2001; Morimoto & Loewen, 2007; Paivio, 2007; Stevick, 1986, 1996).

During the D-P instructional phase, four example sentences were shown for each target prepositional sense. Every sentence appeared with pictures or, in a few cases, with a short video clip. The pictures and video clips were used to facilitate participants' accurate interpretation of the sentences and to make the materials more stimulating.

Decontextualized language materials have an inherent drawback, as the sentences may invite slightly different interpretations and implied contexts. The use of accompanying pictures was thus felt to be important to avoid this potential problem.

During the D-P instructional phase, the computerized lesson discussed (using Chinese, the participants' L1) one prototypical example extensively. Three other sentences were also presented and discussed briefly. When the sense involved an important contrast with an easily confused sense of another preposition, one example sentence was used to discuss this contrast. This was always done after the two relevant senses (i.e., the senses being contrasted) had already been introduced and discussed.

The determination of which contrasts to target is not a straightforward matter. The instruction would ideally contrast senses that are easily confused, due to their perceived similarity, but the tendency to confuse certain senses is likely to be affected by crosslinguistic influences affecting each L1 group of learners. To ensure that the highlighted contrasts would be useful for the Chinese L1 learners of English who participated in the study, the contrasts were selected based on several criteria.

First, a semantic analysis of the sense had to reveal that there were certain elements in common. For example, the "transfer" sense of *to* and the "search for contiguity" sense of *at* both involve the movement of a trajector toward an intended landmark element. However, in the former case, *to* implies a willing recipient. In the latter case, this implication is not present. The use of contrasting examples was therefore designed to highlight this distinction.

Second, contrasting senses were highlighted if it had been found, in the error analysis of the ICLE Chinese subcorpus, that learners typically confused the two senses.

For example, the corpus analysis revealed that Chinese speakers often used the preposition *to* when the "situational valence" sense of *for* was intended. Chinese speakers appeared to lack a fine-grained understanding of the "perception" sense of *to*. The instructional materials therefore contrasted these two senses.

Third, contrasting senses were targeted if previous patterns of Chinese NNSs error had been identified in previous research. Some of these errors were identified in analysis of the results of the experimental measures during the piloting phase of the research. Others were identified through examination of preposition errors in previous research involving Chinese learners (e.g., Mueller, 2011).

The example in Figure 25 shows a slide that pointed out an important contrast between *for* and *to*. As participants viewed the slide, they heard in Chinese, "Notice how it doesn't make sense to say that '[read in English] the balloon floated *for* the ceiling.' Balloons can't have intentions, so the sentence sounds odd if we use *for*." As the latter sentence was voiced, an animated line crossed out the incorrect sentence.

As shown in Figure 25, on slides presenting the same sense, the same small icon, representing the sense under discussion, appeared in the upper right corner to provide greater organizational coherence to the lesson.

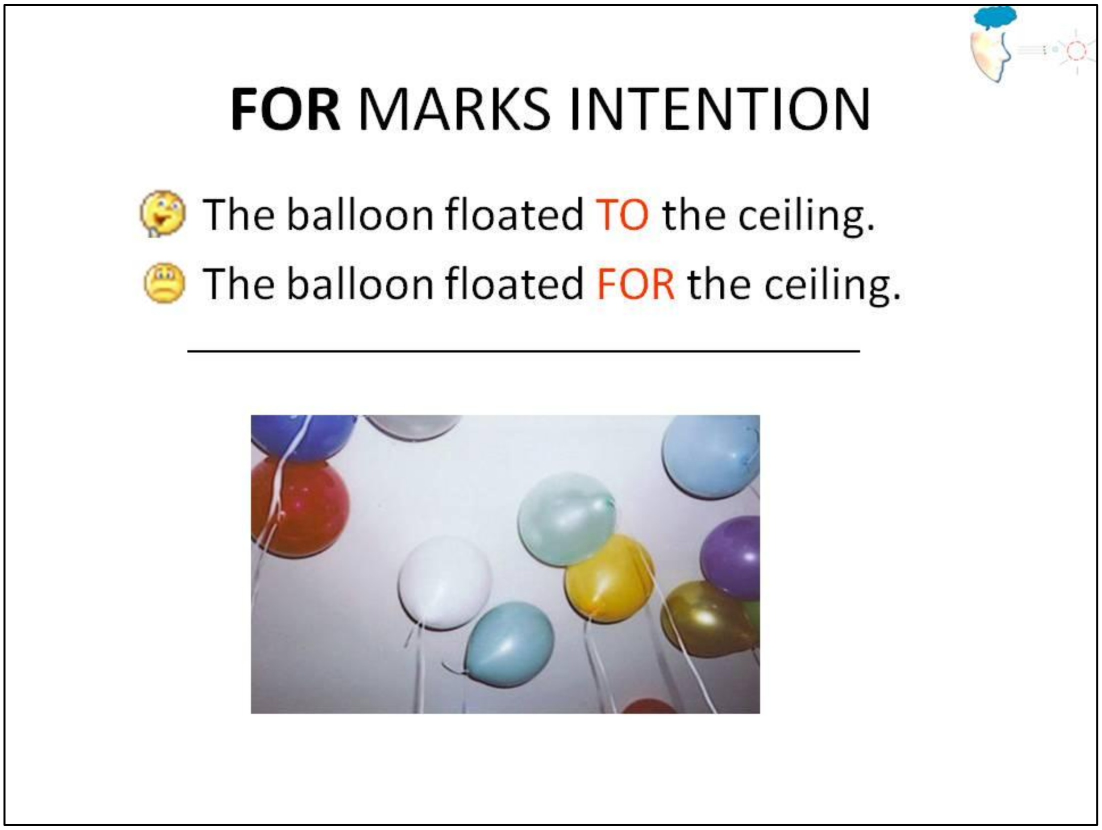

Figure 25. Example slide from explicit presentation showing important contrast between easily confused senses: the basic sense of *to* and the oblique intention sense of *for*.

During the practice phase of the D-P instruction, an additional four example sentences for each sense were presented. Each sentence appeared at the top of a slide that featured a related picture (see Figure 26, Slide A). Three buttons then appeared, and participants mouse-clicked on one of the three prepositions at the bottom of the slide, selecting the option that best completed the target sentence (see Figure 26, Slide B). The decision to place a slide with no buttons (i.e., Slide A) prior to Slide B was based on concern that some participants might race through the practice without fully considering the meaning of the practice sentence. If participants chose correctly, they heard a chime, after which, the correct response was displayed for two seconds in bright red letters (see

Figure 26, Slide C). If they chose incorrectly, they heard a buzz. The slide did not progress until they had selected the correct response.

The choice of feedback timing was based on research indicating that (1) rule-based categorization requires feedback to be available for a couple of seconds so that it can be processed (Maddox, Ashby, Ing, & Pickering, 2004) and (2) information-integration category learning is hampered in cases in which feedback occurs outside of a 2.5 second cognitive window (Maddox et al., 2003).[76] Immediate feedback that is not of overly short duration would thus seem to be ideal, as it allows for both forms of categorization and does not bias the instructional parameters in a manner favoring one experimental treatment.

Figure 26. Sample slide sequence for practice phase of D-P condition.

When the example sentences associated with each sense were first presented, they were presented consecutively or in close proximity. In this way, a participant who just

[76] Minda and Miles (2010) claim that the nonverbal category learning system can function without feedback and without direct connections between stimulus and response. Even if this is true, it is likely that learning is enhanced by the presence of timely feedback.

received feedback on a target sense was more likely to recall the recently encountered negative or positive feedback when processing another sentence involving the same target sense on the following slide. The subsequent example of the same sense appeared adjacent to an easily confused contrasting prepositional sense, if one had been identified. In the final portion of the practice segment, the prepositional senses were presented randomly to provide realistic practice at employing knowledge.

The senses presented to both the D-P group and other groups during the practice session thus followed a general sequence from easier items in more obvious contexts (e.g., prototypical usages occurring adjacent to similar items) to items appearing in more difficult contexts. As touched on previously, predictions regarding which items will be easiest can be made by examining which usages tend to be frequent and typical. From a psycholinguistic perspective, prototypical usages (often items with typical collocating verbs and nouns) will share a greater number of potential retrieval cues with other items involving the same prepositional senses. As a consequence, these items will be more likely to evoke the schema during the initial practice (for a related discussion, see Gick & Holyoak, 1983).

During the final phase of practice, learners viewed additional slide sequences that featured 22 short video clips. The movie clips lasted from 5 to 40 seconds. They were embedded into the PowerPoint™ presentation and started automatically when participants pressed a button prompting for the next slide. They were added to the lesson to provide more highly contextualized examples of the target semantics and to ensure that the materials remained engaging. The clips were taken from cartoons, television series, and popular movies.

While viewing the video clips (the final segment of the practice phase in each group's instructional PowerPoint™) on their individual monitors, participants were instructed to guess which preposition went in the blank and then watch the movie clip to verify that their answer was correct. As in the earlier practice phase, a final slide with the correct answer was provided as feedback. The D-P treatment consisted of 345 slides, which were associated with 146 sound files, and 28 video clips. The slide count is not very informative, as the timing of slides varied greatly (to include the feedback slides, which were only displayed for two seconds), but it provides a general sense of the fluid and interactive nature of this and the other treatments, which also included numerous slides, audio files, and video clips.

The practice phase of the D-P treatment could therefore be described as a "meaningful" drill (for a discussion of the differences between mechanical and meaningful drills, see DeKeyser, 2007a) in that the participants had to remain focused on meaning to complete the task (i.e., clicking on the correct preposition). In some language materials (e.g., drills focused on subject-verb agreement), drills can often allow learners to process sentences without taking the overall meaning into account. The practice tasks in the D-P condition (and the other conditions as well) preclude such mechanical processing, as meaning was essential to the selection of the correct response.

The SH condition consisted solely of practice resembling the practice provided during the second half of the D-P treatment, except that semantic highlighting (verbal cues to features of the situation relevant to correct choice of preposition) were provided as the initial slide for each sequence was shown. In earlier piloting of the materials, the SH audio clip had been played as the target sentence was displayed. In the experiment, an extra slide lacking the sentence was inserted into the beginning of the sequence, and the SH audio was played as this slide was viewed. This change was implemented out of concern that participants would begin reading the sentence and fail to fully process the SH audio.

Moreover, it was felt that L1-based preferences for form-meaning mapping (i.e., the preferences discussed by Slobin, 1996, in terms of "thinking for speaking") might exert a more pernicious influence on sentence processing if the SH audio and sentence appeared simultaneously. In other words, it was assumed that the participants’ extraction of key elements of a schema for linguistic expression would begin in earnest after a sentence frame appeared and they were asked to fill in the sentence. It is argued here that prior to this point, at which time only the picture was displayed, participants’ attention was more malleable; hence, the SH cues were more likely to shift attention to those specific aspects of a scene or situation that were most informative in determining the target prepositional sense.

An example SH practice sequence is shown in Figure 27. As can be seen, the SH sentences, which appeared solely in audio format in the actual materials, highlighted the key elements of the underlying schema of the situational valence sense of *for*. Specifically, the semantic highlighting drew attention to the trajector (the unwholesomeness of junk food), the landmark (children), and the assumptions regarding the landmark that appears in this sense (i.e., a commonly held plan or notion regarding an ideal state of affairs). By drawing attention to these aspects of the situation, it was hoped that participants would attend to the key dimension (i.e., the landmark’s association with a plan) that distinguishes this sense from the perceptual sense of *to* (e.g., *Junk food tastes good to children*).

Initial analysis of the Chinese subcorpus of the International Corpus of Learner English (ICLE, Granger et al., 2009) indicates that Chinese speakers often conflate these senses, using *to* for *for* in sentences such as the one in the example. Semantic highlighting aimed to block participants' predisposition to attend to irrelevant aspects of the situation while increasing their attentional weightings of relevant dimensions. It should be noted that the semantic highlighting did not, at any point, provide an abstract meaning or schema for the situational valence sense, although it did promote the induction of such a schema.

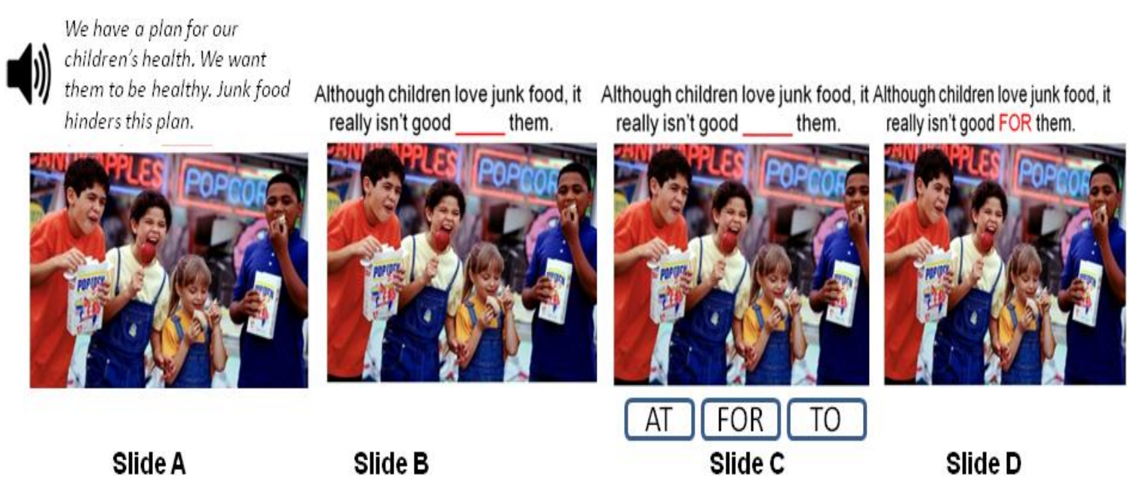

Figure 27. Four-slide sequence used in the instruction for the SH condition.

The SH participants therefore received instruction that attempted to shift their attention to the aspects of the situation that were relevant for determining each preposition's sense (and by extension, the appropriate preposition matched with the sense). In the SH treatment, the declarative knowledge could be described as an integral element of the practice. Moreover, the instruction was designed to show the relevant form-meaning mapping as it applied specifically to individual sentences. Participants had to induce the more general abstract meaning (the schematic meaning targeted in the D-P instruction) from specific examples. The induction of the abstract schema for the target sense (i.e., the induction of the semantic category) is hypothesized to involve both explicit and implicit categorization. The latter would be connectionist procedural learning in the COVIS model, bottom-level connectionist learning in the Clarion model, and exemplar-based processing in the Anderson and Betz (2001) model.[77]

Participants in the SH condition could also switch to rule-based hypothesis testing, but this is deemed less likely, due to the difficulty of inducing the target categories using incidental rule-based categorization. Support for this assumption can be found in a study by Spiering and Ashby (2008) which showed that participants' initial encounter with difficult categorization items at the beginning of a task encourages the use of implicit categorization (i.e., procedural connectionist learning in the COVIS model) throughout the task.

The sequencing of the materials for the SH group was similar to that used for the D-P group. Prototypical examples of a sense were presented first and were followed by an addition example of the same sense. If the sense had an extension that went from the concrete to the abstract, the abstract (or metaphorical) extension appeared at some point after the more concrete example. Subsequent examples were intermingled with easily confused senses involving another preposition if the sense involving the other preposition occurred among the senses targeted in the experiment. Toward the end of the lesson, the various senses were presented randomly. The total number of example sentences

[77] The Anderson and Betz categorization model was implemented within the ACT-R cognitive architecture.

targeting each sense (i.e., eight exemplars), their context (e.g., accompanying pictures or video clips), and their order of presentation were kept constant in the materials for all four instructional groups.

The two hybrid groups received the same explicit presentation of prepositional senses as given to the D-P group. They also completed a practice session on the same sentences used during the practice session of the D-P condition. However, their practice included the use of SH cues. To ensure that time on task was the same for all groups, the hybrid groups' explicit presentation was reduced by a third. In effect, the reduction in this portion of the lesson was offset by the addition of SH instruction, which the D-P group had not received. Because the hybrid groups (like the D-P group) viewed half of the target exemplars during the explicit presentation of instruction, their SH instruction was limited to the four remaining exemplars they encountered during the practice session. The only difference between the two hybrid groups involved presentation order. The SH-D group began with SH practice followed by an explicit presentation of target senses. For the D-SH group, this order was reversed.

The abstract imagery and explanations used in the presentation phase of the D-P treatment, and in the SH-D and D-SH treatments, as well, could be described as metalinguistic. That is to say, the explanations were of a sufficient degree of abstraction and elaboration that they could be applied to the full range of instantiations of a target sense. The SH cues, on the other hand, were not metalinguistic, but were, instead, concrete and tied directly to the sentence being processed. As general characterizations of the target sense, they were inadequate. However, they were presumably easier to understand and were shorter, as the examples did not need to use abstract terms to refer to the various elements of the target sense schema (e.g., the landmark or trajector) and did not need to consider the full range of extensions of the targeted sense. For this reason, the SH treatment, relative to the D-P presentation, can be viewed as involving a trade-off. The explanation of the sense is reduced, so that it has low generalizability and can only appear within the context of the particular exemplar of the target sense. At the same time, it is reduced to such an extent that it can be inserted directly into the practice sequence so as to more readily affect the processing of the target sentences in working memory.

In earlier piloting of the materials, participants had been informed briefly about the purpose of the semantic highlighting. In the current experiment, the three groups receiving SH treatment (i.e., the SH, SH-D, and D-SH groups) were simply told at the beginning of their presentation that the SH highlighting "described the situation" depicted in the picture. The decision to eliminate reference to the psycholinguistic motivation for the SH cues was based on concern that the participants would spend time analyzing each SH cue, in order to develop an abstract and generalizable rule explicitly. Because the psycholinguistic motivation for the SH treatment was based on the assumption that the generalization process would occur automatically through inductive learning and because such analytical rule-based processes are likely to lead to less detailed and holistic processing of each exemplar, task variables that would encourage participants to switch to a more analytical mode of processing were deemed undesirable.

Mandarin Chinese, the L1 of the participants, was used for the explicit instruction of the D-P group and for the SH cues used with the SH group. All the Chinese materials were developed with the assistance of a native Chinese-speaking graduate student studying in the U.S. who was originally from Beijing. The original materials were created in English and then translated into written Chinese by the graduate student. The translation was then verified by the author, who is able to read Chinese. The written Chinese versions were then read by the Chinese graduate student. The author then edited the recording, so as to create individual sound files, which were embedded into the four PowerPoint™ files. The final versions were then checked again by the author for accuracy.

The four treatment groups were affected by a certain amount of mental fatigue as the result of the long treatment, and this was likely to affect their posttest results on the two measures. To ensure that the control group engaged in a similar amount of cognitive work, it received similar computerized training on English modals, a target structure unrelated to prepositions. The materials for this condition used an explicit discussion of the senses of the modals *could*, *must*, *should*, and *would*. This was followed by a practice involving SH. In other words, the modals instruction essentially constituted a D-SH condition targeting a different linguistic structure. The CL semantic analysis for the control group's modal lesson was based on that used in Tyler, Mueller, and Ho (2010).

A key methodological concern when developing the computerized instruction was maintaining control over time on task (a control variable in the experiment) within the context of a lesson containing interactive elements. To control the timing as much as possible, most of the slides would only advance based on predetermined time intervals that had been set for each slide. Some slides, such as those presenting participants with choices of prepositions, would advance when participants mouse-clicked on a response or graphic. In PowerPoint™ presentations, the default option is to allow users to click on all slides to advance them. This default feature was blocked to dissuade participants from advancing at different speeds through the presentation.

12.1.3 Measures

Two measures were used: a fill-in-the-blanks (FB) test (see Appendices H and I) and a sentence elicitation (SE) test (see Appendices J and K). The FB test was designed to measure both declarative and proceduralized knowledge. The SE test, which involved greater time pressure, was designed to measure primarily proceduralized knowledge. A general conclusion in research on the development of cognitive skills is that declarative knowledge that has not been proceduralized is difficult to employ in real-world situations involving time pressure (Anderson, Douglass, & Qin, 2005). This general finding has been confirmed in studies focusing on L2 acquisition, as well (Hu, 2002a).

On the FB test, each item consisted of a sentence missing a preposition, which had to be supplied using options in a box above the sentences. During piloting, participants would occasionally fail to follow the directions requiring them to circle one option. Instead, they would write their response in the blank, often ignoring the options. This rendered their scores unusable, as the options were provided to prevent participants from selecting plausible alternative responses.

In the experiment’s FB measure, participants were successfully dissuaded from doing this through verbal reminders at the beginning of the test, by the insertion of a dark mesh pattern in the blank, and by the reduction of the size of the blank. Each item included 15 response options, which (excluding the “none of the above” option) were placed in alphabetical order. Participants were told to select the preposition that was most natural and appropriate.

Figure 28 shows one example item from Form B of the FB test.

ABOUT, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH

none of the above

19. Water boils ___ 100 degrees Celsius.

Figure 28. Example item from the FB test, Form B.

Unlike the fill-in-the-blank measure used in Tyler, Mueller, and Ho (2011), the target sentences were not joined together in paragraphs. While such paragraphs can be useful in providing context, the requirement to develop related sentences is overly constraining when creating test items. Moreover, there was concern that performance might be compromised in instances in which the participant failed to provide the correct preposition in an earlier sentence and thereby misconstrued the intended sense of the paragraph, resulting in decreased performance on later items within the same paragraph.

Another difference between the measure and that used in the Tyler, Mueller, and Ho (2011) study was the inclusion of a “none of the above” response. It was felt that this was useful, as it prevented participants unfamiliar with the target sense of the correct preposition from using inference to deduce the correct answer. More specifically, if participants preferred a plausible response that was not provided, they would not be able to use deduction to determine that one of the provided responses had to be correct.

Each sentence was accompanied by one or more pictures that served to clarify the intended meaning. This was done to prevent unrelated factors, such as participants' vocabulary knowledge, from exerting a strong effect on the results. The pictures were designed to constrain the task, so that the intended meaning could be readily inferred. As far as possible, an attempt was made to develop items that did not rely excessively on nonlinguistic knowledge (e.g., cultural knowledge) that some of the participants may have lacked.

On tests targeting learners' knowledge of semantics of prepositions, it is difficult to construct informative items, as many sentences can be interpreted in a way that makes an alternative preposition plausible. One alternative is to provide, as options, only prepositions that are clearly inappropriate, but this solution results in tests that are excessively easy and are not sensitive to subtle mismatches between learners' semantic representations and those of NSs.

To overcome this problem, "correctness" on the test was operationalized in a more probabilistic manner, as referring to a response selected by NSs more than 90% of the time during piloting. In other words, the preferred response is based on NSs' default construal of the situation implied by the sentence. It is felt that NNSs' deviance from NSs' typical choices is more likely to reflect nonnativelike semantic representations rather than other factors.

Post hoc analysis of the pilots supported this assumption. When NNS participants used somewhat plausible prepositions that were not preferred by NSs, the same participants' responses on other test items targeting the same sense were incorrect in nearly all cases. In other words, their choice of a somewhat infelicitous alternative appeared to reflect a lack of precise semantic knowledge of the preposition selected by NSs.

Both FB test forms (Form A and Form B) contained 55 items (48 target items and 7 distractors). Each of the 24 target prepositional senses appeared twice on each test. The items were placed in pseudo-random order so that items targeting the same sense always appeared on different halves of the test.

The SE measure was created using a PowerPoint™ presentation with timed slides. Participants were asked to write a sentence corresponding to each PowerPoint™ slide. To constrain the task so as to ensure that the target preposition was elicited, participants were given words that had to be used within their responses. They were told to create a single sentence, as short and simple as possible, that used these words in the same order and form in which they were provided.

To obtain a better measure of procedural knowledge, each item appeared for only 15 seconds. Initial piloting had used a 12-second interval, but this proved to be too short, resulting in many blank responses. As participants viewed the PowerPoint™, a black line slowly turned red at one-second intervals, indicating the time remaining to respond to the prompt. An example is shown in Figure 29. The item elicited sentences such as *The girl is kind to her dog* or *She's always kind to her dog*.

Participants were given a sheet of paper with blanks for the missing words (see Figure 30). To discourage participants from going back and changing responses after the 15 seconds had passed, the words appearing on the PowerPoint™ were replaced with dark mesh patterns on the participants' answer sheets. The mesh pattern was the same length as the missing words.

Figure 29. Sample slide used for sentence elicitation measure (SE Form B, Item 44).

In piloting of the materials, answer sheets with only two blanks and no mesh patterns had been used. Unfortunately, this resulted in participants occasionally losing track of their current place in the exam. The mesh patterns made the items more distinctive and thus successfully eliminated this problem. To further ensure that participants wrote their response on the correct line, the PowerPoint™ slides were numbered.

44. __________________ [redacted] __________________ [redacted].

Figure 30. SE Form B response sheet, Item 44.

Participants had to turn their answer sheets over after Item 20 and Item 40. To prevent the loss of time from affecting performance, a five-second slide that said, "Now get ready for item 21" (or "41") was inserted after these two items in the PowerPoint™. The test included three distractor items, which were used as the first and last item and at a point in the middle of the test. The initial item was to account for variance in performance as people adjusted to the timing and found their correct place on the answer sheet. The final item was necessary, as people had a little more time to change this response prior to the collecting of answer sheets.

The use of numerous distractors was deemed unnecessary, due to the use of two blanks in each item. Only one of these blanks elicited the target preposition. The other blank elicited either a different preposition (in a relatively small number of items) or words or phrases associated with different parts of speech. The inclusion of two blanks was aimed at increasing time pressure and preventing participants from adopting an overly mechanical strategy of supplying only prepositions. Both SE measures (Form A and Form B) took 13 minutes for participants to complete. Scoring of the test was based on an operationalization of "correct response" as simply the response that NSs provided in over 75% of instances during piloting of the measures.

When exposed to instruction on prepositions, learners will, in some cases, acquire the semantics of the target sense. In other cases, they might simply memorize the entire phrase in which the preposition is embedded and then use this syntagmatic knowledge to improve their accuracy in production (cf. Mueller, 2011).[78] Because the current study was interested in assessing participants' acquisition of the underlying semantics of the target prepositional senses versus collocational knowledge, it was important to design measures that assessed learners' ability to extend their learning to contexts that had not been encountered during the treatment. For this reason, all the test items were unique and did not resemble items presented during the treatment or other items presented on either test. In other words, the verbs and nouns that occurred with a particular prepositional sense in the treatment did not appear in items targeting the same sense in the FB or SE measures.

The total occurrence of each prepositional sense in the treatments and the two measures is shown in Table 3. The D-P group and the two hybrid groups were exposed to four exemplars during the explicit presentation of the prepositions and to four exemplars during the practice phase of the treatment. Because the SH condition did not include an explicit presentation of each prepositional sense, all eight exemplars shown to this group were presented during the same single phase of instruction. Total exposure to exemplars was identical for each condition and thus served as a control variable.

[78] Ellis (1993) found a dissociation between chunk learning and acquisition of more abstract knowledge that could be employed when encountering new combinations of acquired linguistic patterns.

Table 3

Occurrence of Prepositional Senses in Treatments and Two Experimental Measures

Preposition	Sense	Number of Exemplars		
		Treatments[1]	FB	SE
ABOVE	Preclusion of Potential for Contact	8	4	4
AT	Measure	8	4	4
AT	Search for Contiguity	8	4	4
FOR	Oblique Intention	8	4	4
FOR	Purpose	8	4	4
FOR	Grounds	8	4	4
FOR	Situational Valence	8	4	4
FOR	Benefit	8	4	4
FOR	Proxy	8	4	4
FOR	Exchange	8	4	4
IN	Affecting Condition	8	4	4
ON	Resemblance to Visual Feature	8	4	4
ON	Communicative Media as Support	8	4	4
ON	Volitional Exceptional State	8	4	4
OVER	Control	8	4	4
OVER	Covering	8	4	4
TO	Transfer	8	4	4
TO	Affecting Attitude	8	4	4
TO	Perception	8	4	4
TO	Contact	8	4	4
TO	Limit	8	4	4
TO	Attachment	8	4	4
WITH	Instrumentality	8	4	4
WITH	Theme-marking	8	4	4

[1] Because the control group did not receive any instruction on prepositional senses, the numbers shown in the table under "Treatments" only apply to the SH, D-P, SH-D, and D-SH group.

12.1.4 Procedure

The FB measure was preceded by the SE measure. The decision to sequence the measures in this way was based on concerns about reactivity. It was felt that the greater use of declarative knowledge and reasoning during the FB test was likely to have subtle effects on performance in the more speeded SE measure. This could result in positive effects as participants developed hypotheses about prepositions' meanings and then used these hypotheses as the basis for their performance on the SE measure. It could also have negative effects if participants adopted an overly analytical strategy to a speeded task. The sequencing of the experimental tasks is shown in Table 4.

Table 4

Sequencing of Experimental Tasks in Study

Task	Minutes
Sentence Elicitation Pretest	15
Fill-in-the-Blanks Pretest	25
Computerized Instruction (Treatment)	60
Questionnaire	5
Break	5
Sentence Elicitation Posttest	15
Fill-in-the-Blanks Posttest	25
Total	2 hours 30 minutes

Participants were randomly assigned to the four experimental conditions. Upon entering the computer room, they were told to sit in particular seats in which a consent form and questionnaire bearing the participant's identification code and SE answer sheet (Form A) had been placed. At the beginning of the lesson, participants were informed of the sequence of experimental tasks. The SE task was described, and the example on the front of the SE answer sheet (see Appendices L and M) was discussed. Participants were then advised to complete an additional example item on the bottom of the front of the SE answer sheet. The computer room used for the experiment allowed central control of all computers so that the material shown on the controller's screen would be broadcasted to each individual screen. This was done for both of the SE tests. After completing the second practice item, participants turned the page of their answer sheets and began the test.

The SE test forms were found to be roughly equivalent during piloting. Test form sequences are often alternated as a blocked condition, but prior to the experiment, it was decided to forgo counterbalancing of the SE tests for two reasons: (1) the experimenter was not sufficiently familiar with the equipment to know how to send different versions of the test to different computer stations (if, indeed, the facilities allowed for this), and (2) there was concern that participants who inadvertently viewed test items on other screens showing the alternative form of the SE pretest might be more attentive to relevant materials during the lesson and could thereby gain an advantage on the posttest that would affect the validity of the measures.

Immediately after the SE measure was completed, participants were given the FB measure. The FB Form A and Form B were counterbalanced so that half of the participants in each group received Form A for the pretest and Form B for the posttest and the other half received the tests in the opposite order. The directions were read out loud in Chinese by a Chinese proctor. It was emphasized that they should circle their answer and should select only what they felt was the best response, even if more than one response was possible.

After completion of the FB test, test forms were collected and participants were asked to open a PowerPoint™ file that had been downloaded onto their desktop in a separate directory, along with the accompanying sound and video files. They were told to open the presentation in slide show format, so that the lesson appeared on the full screen. The experimenter along with two proctors went around the room and assisted participants who reported difficulties. Four computers had been kept in reserve for participants who had technical problems. In three cases, participants switched to these computers at the beginning of their treatment, due to problems in hearing the audio files. As participants opened their PowerPoint™ files, they were told that they should follow the lesson sequence as presented.

During all four experimental sessions, the experimenter and one or two Chinese-speaking proctors were present in the room as participants completed the lesson. During the entire treatment, the experimenter stood at the back of the room at a point from which all screens were visible to ensure that participants went through the lesson as instructed. At the end of the treatment, participants completed their questionnaires and were then given a short break. Following the break, they took the SE Form B posttest followed by the FB posttest (Form A or Form B depending on their block). The procedures were the same as those used for the pretest, but the preliminary instructions were more cursory as participants were now familiar with the testing format. The entire procedure took 2 hours and 30 minutes.

12.1.5 Analysis

To determine the reliability of the measures, Cronbach's α, a measure of internal consistency, was computed for the target items on the two FB test forms and the two SE forms. FB Form A had high reliability, Cronbach's $\alpha = .82$. The deletions of a few of the items would improve the reliability of the measure, but the improvements would have all been marginal. FB Form B also had high reliability, Cronbach's $\alpha = .92$, and there were no items for which deletion improved the reliability of the test. The Form B value was excessively high, suggesting that many of the items were redundant.

For Form A (48 target items only) of the SE measure, Cronbach's α was .75, indicating adequate reliability for a measure of ability. The reliability could be increased with the deletion of several of the items, but the increase, in each case, would have been marginal. For Form B (48 target items only), Cronbach's α was .84, indicating good reliability. The deletion of two of the items would increase reliability, but in both cases, the increase would have been marginal. Piloting established that the two SE test forms were roughly equivalent in terms of difficulty.

Treatment Type was treated as a between-subjects variable with five levels. In one ANCOVA, the FB posttest scores were treated as the dependent variable, and the FB pretest scores were treated as a covariate. In another ANCOVA, the SE TLU posttest scores were treated as the dependent variables, and the SE TLU pretest scores were treated as a covariate. Another ANCOVA using SE raw scores was also reported as part of the post hoc analysis, but this analysis was not used to confirm or disconfirm the hypotheses.

12.2 Results

12.2.1 FB Descriptive Results

As shown in Figure 31, the four treatment groups all showed improvement on the FB posttest. The two hybrid groups had slightly lower scores on the pretest.

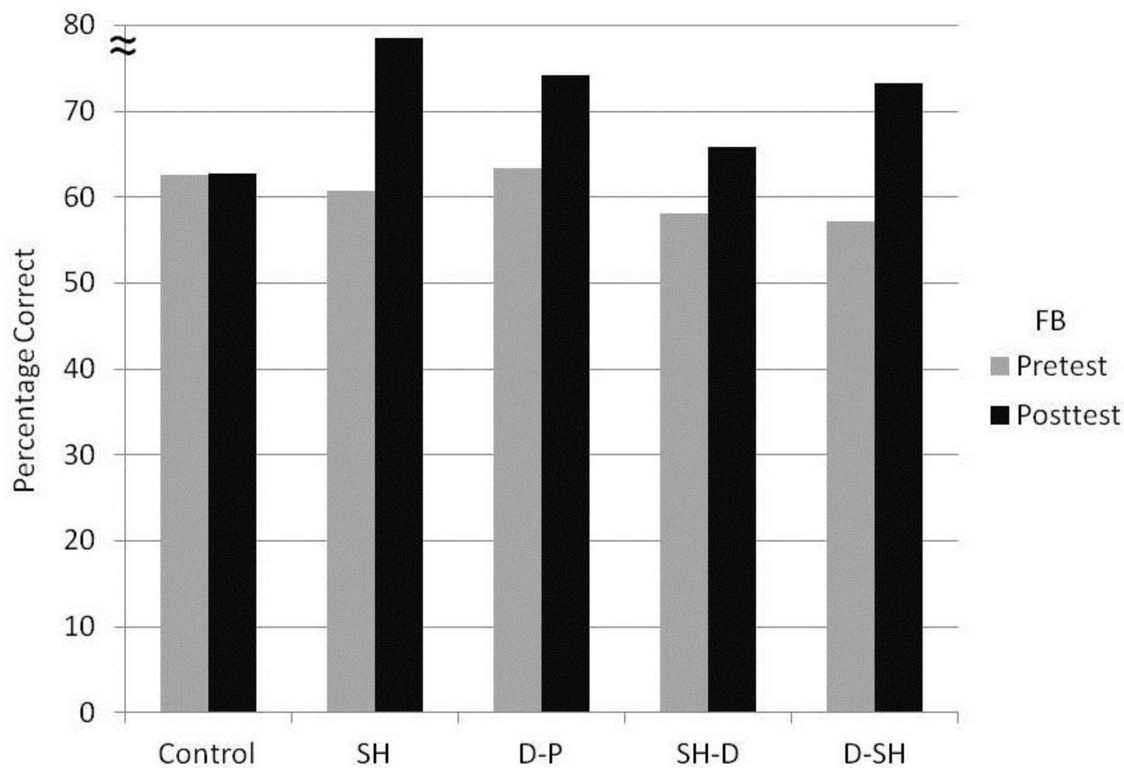

Figure 31. Five experimental groups' percentage correct on FB pretest and posttest.

The descriptive statistics for the FB pretest and posttest have been provided in Table 5 and Table 6.

Table 5

Descriptive Statistics for Fill-in-the-Blanks Pretest

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	30.1 (5.7)	29.2 (4.5)	30.4 (4.4)	27.9 (3.8)	27.4 (6.0)
M% (*SD*)	62.6% (11.8%)	60.8% (9.3%)	63.3% (9.1%)	58.1% (7.8%)	57.2% (12.4%)
95% CI	27.1 to 33.1	27.5 to 30.9	28.8 to 32.0	26.5 to 29.3	25.2 to 29.7
Min./Max.	15 to 36	20 to 36	20 to 36	20 to 33	14 to 36

Table 6

Descriptive Statistics for Fill-in-the-Blanks Posttest

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	30.1 (6.9)	37.7* (4.4)	35.6* (5.7)	31.6* (6.0)	35.2* (5.6)
M% (*SD*)	62.8% (14.3%)	78.5%* (9.1%)	74.2%* (11.9%)	65.8%* (12.5%)	73.3%* (11.6%)
95% CI	26.5 to 33.8	36.1 to 39.3	33.5 to 37.7	29.4 to 33.8	33.1 to 37.3
Min./Max.	14 to 40	28 to 47	23 to 46	13 to 43	22 to 47

* $p < .001$.

In the D-P condition, learning during the practice phase requires participants to retrieve declarative knowledge formed while watching the explicit presentation.

Participants must then apply this knowledge to a particular exemplar appearing in a practice slide. Because the ability to hold declarative knowledge in working memory while processing an example sentence is constrained by each participant's individual working memory (WM) capacity, performance in the D-P condition would be expected to be influenced more by individual differences associated with WM. Greater SDs on the posttest, relative to the SH condition, would therefore be expected. The slightly higher observed SD for this group is therefore consistent with theoretical assumptions.

It should be noted that the SDs for the SH-D group moved from the lowest among the five groups on the pretest to the highest among the four treatment groups. As this condition involved a bottom-up learning sequence that is typically not used in language instruction, the higher SDs may reflect differences in the participants' ability to adapt to this unfamiliar instructional sequence.

12.2.2 SE Descriptive Results

Because the SE measure involved elicited production, a TLU analysis[79] was used. Compared to measures involving raw scores, the TLU calculation depresses scores, as it takes into account both failure to produce a form in an obligatory context and the overproduction of forms in nonobligatory contexts (Pica, 1984).

The scores for the five experimental groups are depicted in Figure 32. As can be seen, the performance across groups roughly parallels that seen in the FB scores. The treatment groups' gains are impressive. Although this may be interpreted as a practice

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[79] TLU scores are computed by tallying the correct suppliance of the form in obligatory contexts and then dividing this number by the number of obligatory contexts plus the number of times the form was used in nonobligatory contexts (Lightbown, Spada, & Wallace, 1980; Pica, 1983). TLU is typically used to analyze learners' production of a grammatical form within relatively unconstrained production tasks.

effect on the SE measure, the control group's lack of gains make this interpretation less plausible. In experimental measures designed to detect variance between groups receiving a treatment, the scores would ideally move, on average, from the second quartile on the pretest to the third quartile on the posttest, thereby avoiding both floor and ceiling effects. For the most part, the scores were within this ideal range. The SE test scores viewed using a TLU analysis were therefore close to the appropriate levels of difficulty for the sampled population, resulting in variation within a range that is maximally sensitive to group differences.

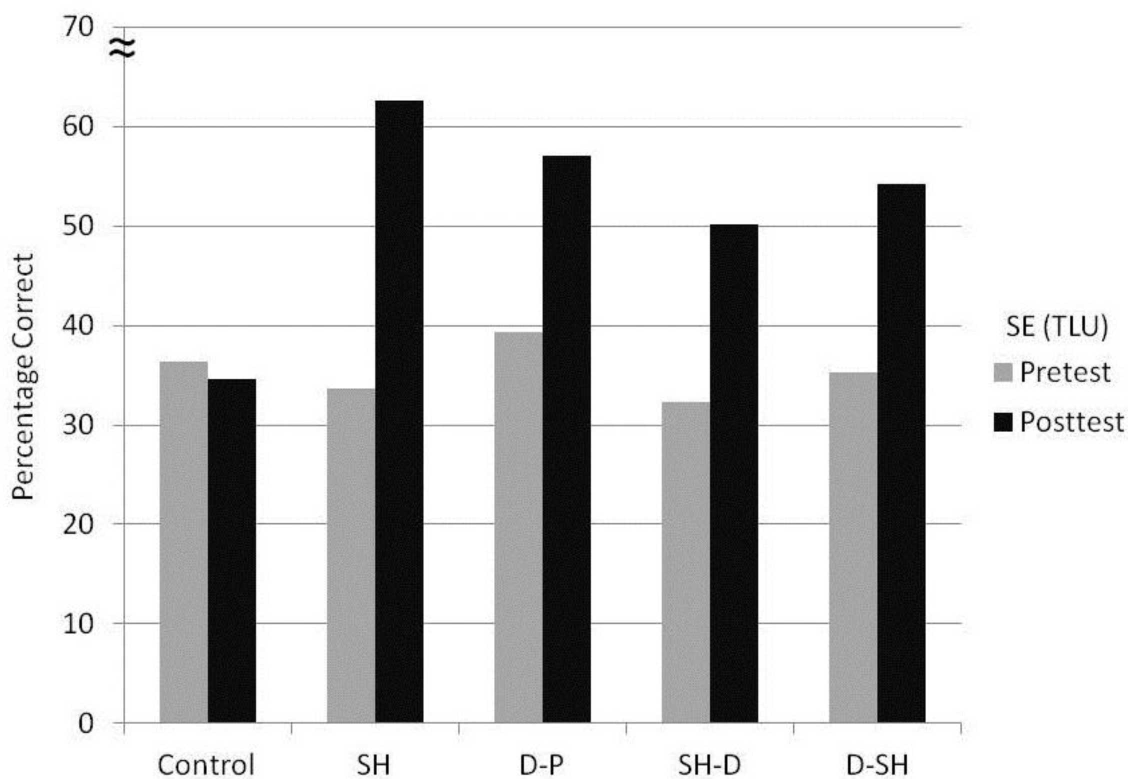

Figure 32. Five experimental groups' percentage correct on SE pretest and posttest using TLU analysis.

The descriptive statistics are shown in Table 7 and Table 8.

Table 7

Descriptive Statistics for Sentence Elicitation Pretest's TLU Analysis

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	17.4 (5.7)	16.2 (5.5)	18.9 (6.6)	15.5 (4.9)	16.9 (5.4)
M% (*SD*)	36.3% (11.8%)	33.7% (10.9%)	39.3% (14.4%)	32.3% (10.3%)	35.3% (11.3%)
95% CI	14.4 to 20.4	14.1 to 18.2	16.4 to 21.3	13.7 to 17.4	14.9 to 19.0
Min./Max.	6.2 to 25.1	5.3 to 25.5	8.5 to 34.6	5.6 to 26.0	1.8 to 26.5

Table 8

Descriptive Statistics for Sentence Elicitation Posttest's TLU Analysis

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	16.6 (6.6)	30.0* (6.6)	27.4* (7.0)	24.1* (6.8)	26.0* (8.0)
M% (*SD*)	34.6% (13.8%)	62.6%* (13.8%)	57.1%* (14.5%)	50.1%* (14.2%)	54.2%* (16.6%)
95% CI	13.1 to 20.2	27.6 to 32.5	24.8 to 30.0	21.5 to 26.6	23.0 to 29.0
Min./Max.	5.7 to 28.9	13.1 to 41.5	12.2 to 44.0	5.5 to 36.1	5.1 to 38.6

* $p < .001$.

The control group's roughly equivalent performance on the SE pretest and posttest suggests that the two SE forms were of similar levels of difficulty. Compared to the FB scores, the score range for each group is quite large and the SDs higher. This may reflect, in part, the fact that the TLU measure is likely to be influenced by differences in test-taking strategies. Learners who tend to reflect on the list of target items covered during the lesson while taking the test will probably tend to overproduce target forms and will therefore produce different patterns of results. Because the experiment was fairly long and the SE measure relatively taxing, the larger SDs on the posttest may also reflect the differential effects of fatigue on the participants.

To determine whether the pattern of results changes dramatically if a TLU analysis is not used, the SE measure was analyzed using raw scores. The scores for the five experimental groups are shown in Figure 33. As can be seen, the pattern of results using raw scores closely parallels the pattern derived from the TLU calculation.

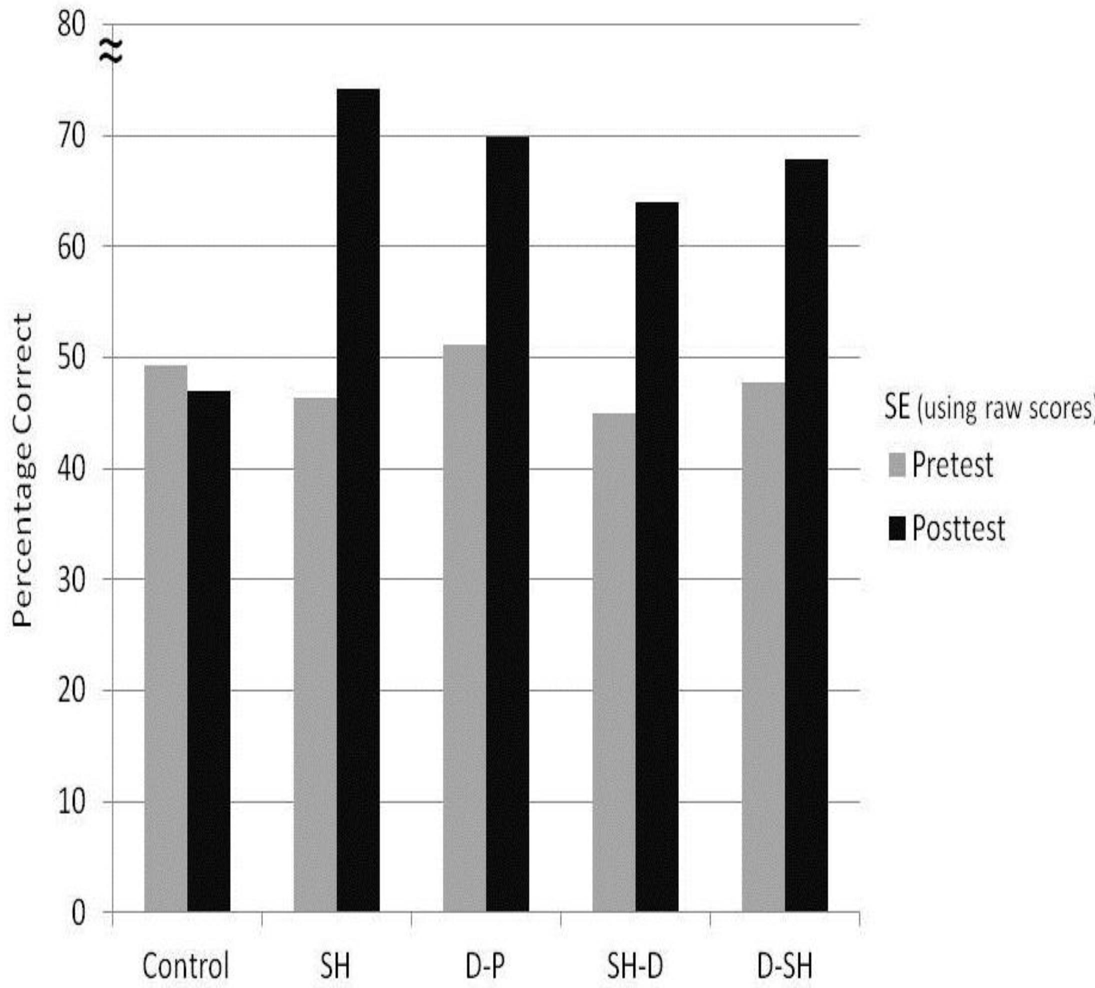

Figure 33. Five experimental groups' percentage correct on SE pretest and posttest using raw scores.

The descriptive results using the raw scores are shown in Table 9 and Table 10. As can be seen, the SDs are slightly lower than those observed in the TLU analysis and are in the same range as those for the FB scores.

Table 9

Descriptive Statistics for Sentence Elicitation Pretest

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	23.7 (6.0)	22.3 (5.4)	24.5 (5.9)	21.6 (4.9)	23.0 (5.8)
M% (*SD*)	49.3% (12.5%)	46.4% (10.6%)	51.1% (13.2%)	44.9% (10.3%)	47.8% (12.1%)
95% CI	20.5 to 26.9	20.2 to 24.3	22.3 to 26.7	19.7 to 23.4	20.8 to 25.1
Min./Max.	11 to 31	12 to 31	14 to 37	9 to 31	3 to 32

Table 10

Descriptive Statistics for Sentence Elicitation Posttest

	Control	SH	D-P	SH-D	D-SH
M (*SD*)	22.6 (6.7)	35.6* (5.0)	33.5* (5.4)	30.7* (6.0)	32.6* (6.6)
M% (*SD*)	47.0% (12.5%)	74.2%* (10.4%)	69.8%* (11.3%)	64.0%* (12.5%)	67.8%* (13.7%)
95% CI	19.0 to 26.2	33.7 to 37.5	31.5 to 35.5	28.5 to 33.0	30.1 to 35.0
Min./Max.	11 to 34	21 to 44	20 to 45	13 to 39	12 to 41

* $p < .001$.

12.2.3 FB Inferential Statistics

The results of the two measures were analyzed using two ANCOVAs. To account for the increased likelihood of a Type 1 error when using multiple statistical tests, the alpha value for the main effects of each ANCOVA was subjected to a Bonferroni correction and was thereby reduced from the conventionally accepted .05 value to .025. All analyses were run using SPSS Statistics GradPack 17.0 for Windows™.

The first ANCOVA examined the effect of Treatment Type on the five experimental groups' performance on the FB test. In the analysis, Treatment Type was a between-subjects variable, with five levels: (1) control, (2) SH, (3) D-P, (4) SH-D, and (5) D-SH. The FB posttest scores were the dependent variable. The effect of prior knowledge of the target forms, as represented by the pretest scores, was factored out by using those scores as a covariate.

To confirm the assumptions of an ANCOVA, several tests were conducted. First, the assumption of normality was assessed using Shapiro-Wilk tests. Only the pretest for the control group (p = .039) and the D-SH group (p = .038) were significant at an alpha value of .05. The normality of the distribution of all groups was then double-checked using a Kolmogorov-Smirnov test with a Lilliefors significance correction. Significant results (i.e., results suggesting non-normality) were not found for any of the groups. These results and a visual examination of the data on Q-Q plots suggested that the distributions were, for the most part, normal.

To ensure that the assumption of homogeneity of variances was valid, a Levene's test was conducted. The result was not significant (p = .539), suggesting that the assumption of homogeneity of variance was valid.

To test the assumption of homogeneity of regression slopes, a customized ANCOVA model was run, including both the main effects and the interaction between the covariate (pretest scores) and the independent variable (Treatment Type). The interaction between treatment and pretest (p = .014) was significant at an alpha level of .05, indicating that the assumption of homogeneity of regression slopes had not been met.

To better understand this interaction, the main results of the ANCOVA are herein reported prior to a discussion of the interaction and the alternative analysis conducted due to the violation. In the ANCOVA, all alpha values were set at .025. There was a significant effect of Treatment Type after controlling for the effect of prior knowledge of the target items using the pretest as a covariate, $F(4,130) = 10.35$, $p < .001$. Treatment Type accounted for about a quarter of the variance between groups, as indicated by a partial eta squared value of .242.

To determine the precise nature of the Treatment Type's effect, pairwise comparisons were conducted. As in the main analysis, alpha was set at .025 and a Bonferroni adjustment was made to account for the increased likelihood of Type 1 error when making multiple comparisons. The control group had significantly lower marginal gains compared to the SH group ($p < .001$, 95% CIs[-12.6, -3.62]), D-P group ($p = .005$, 95% CIs[-9.8, -0.8), and D-SH group ($p < .001$, 95% CIs[-11.3, -2.2]). The control group and SH-D group were not significantly different in terms of marginal gains ($p = .521$, 95% CIs[-7.4, 1.7]). The SH group's marginalized gains were significantly higher than those of the SH-D group (p < .001, 95% CIs[1.5, 9.0]). Moreover, the D-SH group's marginalized gains were significantly higher than those of the SH-D group ($p = .018$, 95% CIs[0.1, 7.6]).

The findings may be summarized as follows:

SH > SH-D, Control

D-SH > SH-D

SH, D-P, D-SH > Control

A scatter plot with loess lines showing the relationship between the covariate (pretest scores) and the dependent variable (posttest scores) by group is shown in Figure 34.

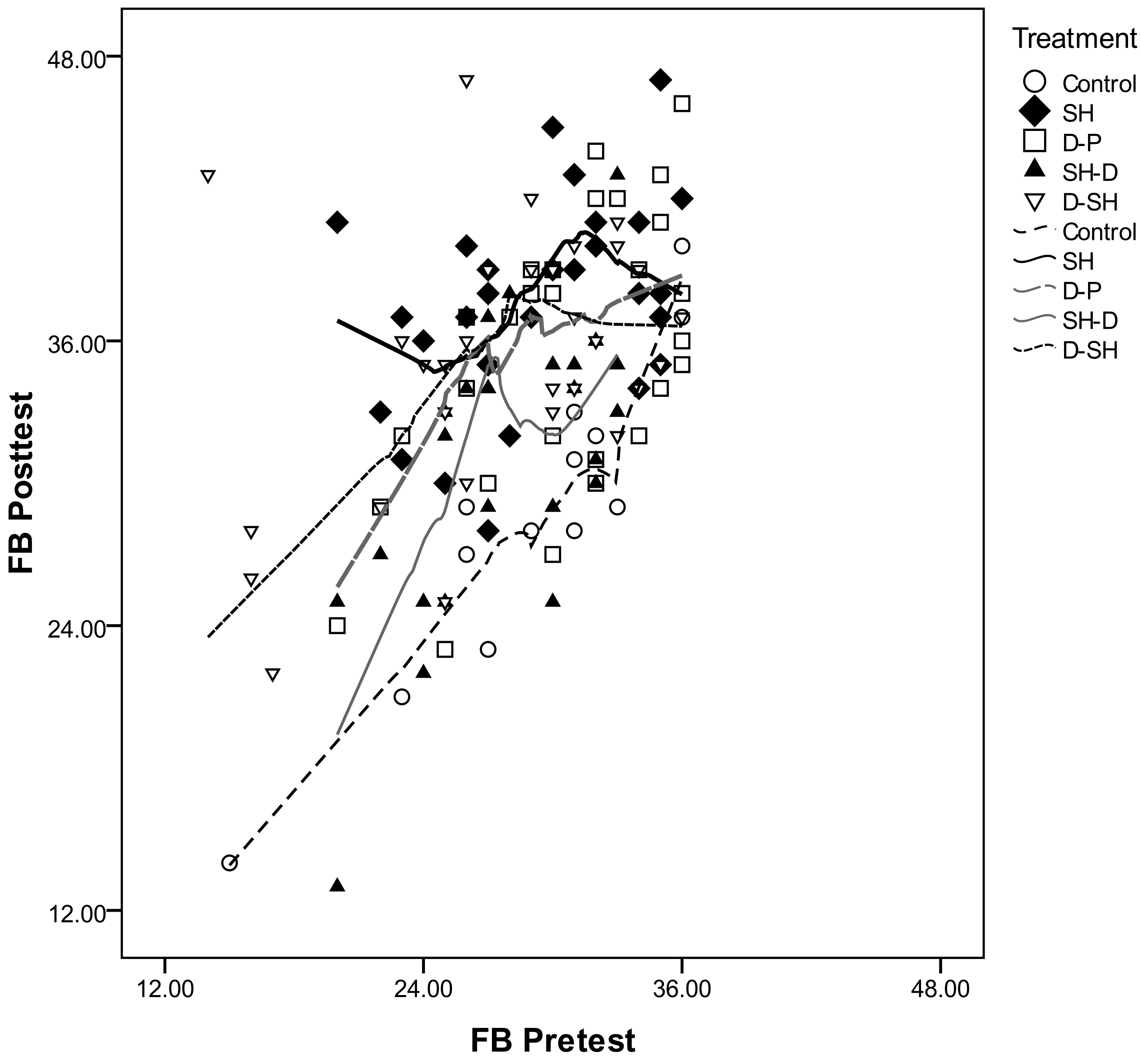

Figure 34. Scatter plot of FB pretest and posttest scores for the five experimental groups.

As can be seen, the regression slopes for the SH and D-SH groups are flatter than those of the other groups. This indicates that the slightly higher scores for these groups can be attributed to the fact that the participants who scored low on the pretest in these groups performed better on the posttest, relative to the participants from other groups who scored low on the pretest.

To explore this interaction further, the Johnson-Neyman procedure was utilized to identify the regions in the range of the moderator variable (i.e., pretest scores) where the effect of the focal predictor (i.e., Treatment Group) on the outcome (i.e., posttest scores) was statistically significant and not significant. The procedure was performed using SPSS Statistics GradPack 17.0 for Windows™ with the SPSS MODPROBE script developed by Hayes and Matthes (2009).[80] The procedure was only utilized on the comparisons that had been significant in the pairwise analyses which had been conducted as follow-up tests in the ANCOVA.

The Johnson-Neyman procedure revealed that there was a significant difference between the posttest scores of the SH and SH-D group at an alpha level of .05 at values of the moderator variable (i.e., the pretest scores) 32.2 and lower. When pretest scores were 31.2 and lower, the difference between groups was significant at an alpha of .011. One interpretation of the findings would be that ceiling effects begin to exert an influence when participants are correct on approximately two-thirds of the pretest items (32 correct out of the 48 items). In other words, learners who began the experiment with a fairly

[80] The script was retrieved from http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html on April 27, 2012.

good grasp of English prepositions did not achieve much new learning and consequently failed to show performance gains differentiated by Treatment Type.

The regression slopes for the SH and SH-D groups with the boundary condition marked are shown in Figure 35.

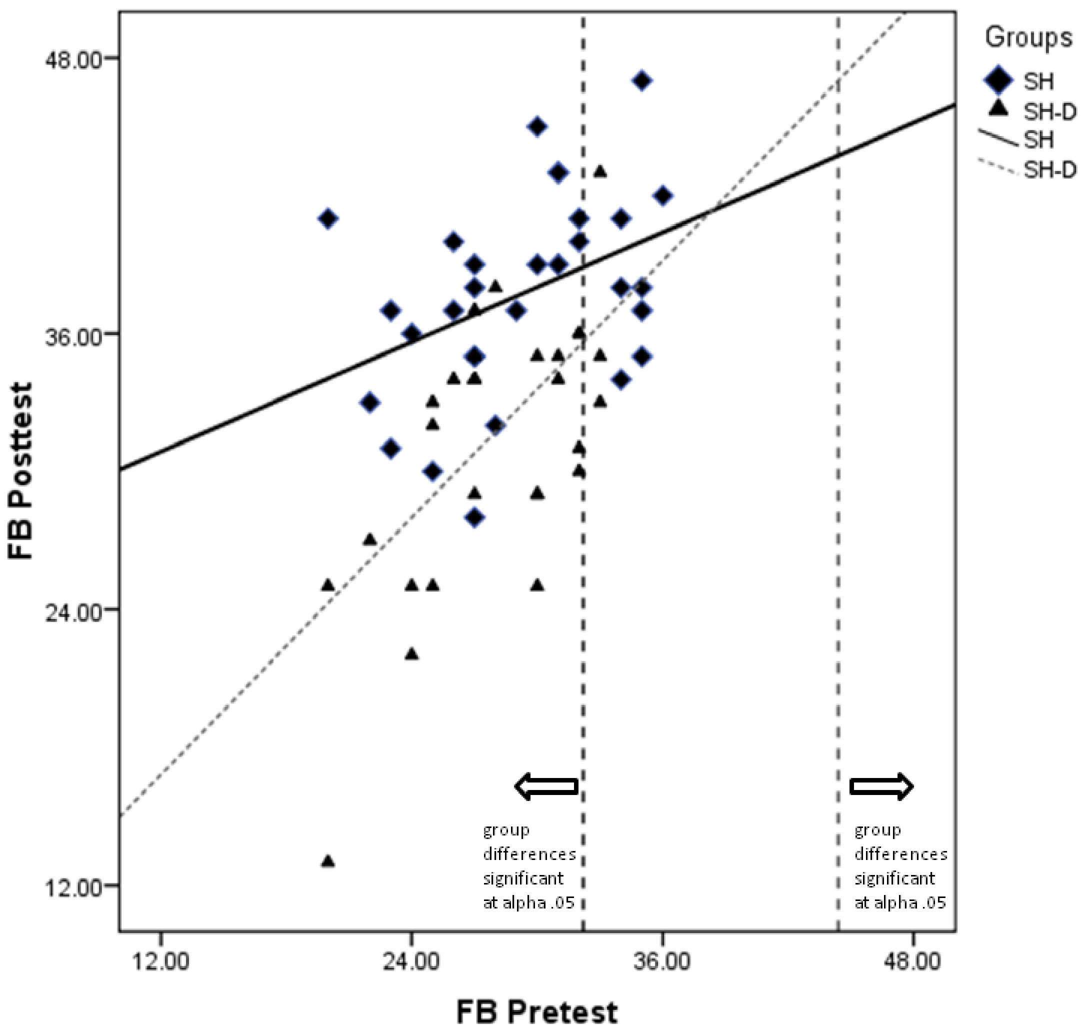

Figure 35. Scatter plot showing FB regression slopes for SH and SH-D groups with boundary conditions for effect of Treatment Type.

The interaction would predict that the SH-D treatment would actually have an advantage (on the FB test) for learners with advanced knowledge of prepositions (i.e., learners with scores greater than 38.3 on the pretest), and that this advantage would reach significance at an alpha level of .05 for learners who scored 44.4 or higher on the pretest. The interaction would also predict that group differences for participants scoring between 32.2 and 44.4 on the pretest would not be significantly different at an alpha level of .05.

The Johnson-Neyman procedure was also utilized to examine the differences between the D-SH and SH-D group. As was found in the examination of the scores for the SH and SH-D groups, the D-SH and SH-D group differences ceased to be significant when pretest scores were high. More specifically, the differences were significant at an alpha value of .05 when pretest scores were in the range below 29.5. It should be noted that only 55% of the pretest scores were below 29.5. Within the pretest score range of 28.3 and lower, the group differences were significant at an alpha level of .01.

The regression slopes for the D-SH and SH-D groups with the boundary condition marked are shown in Figure 36. The interaction would again predict that the SH-D treatment would actually have an advantage for learners with advanced knowledge of prepositions (i.e., learners with scores greater than 34.6 on the pretest) and that this advantage would reach significance at an alpha level of .05 for learners who scored 39.7 or higher on the pretest.

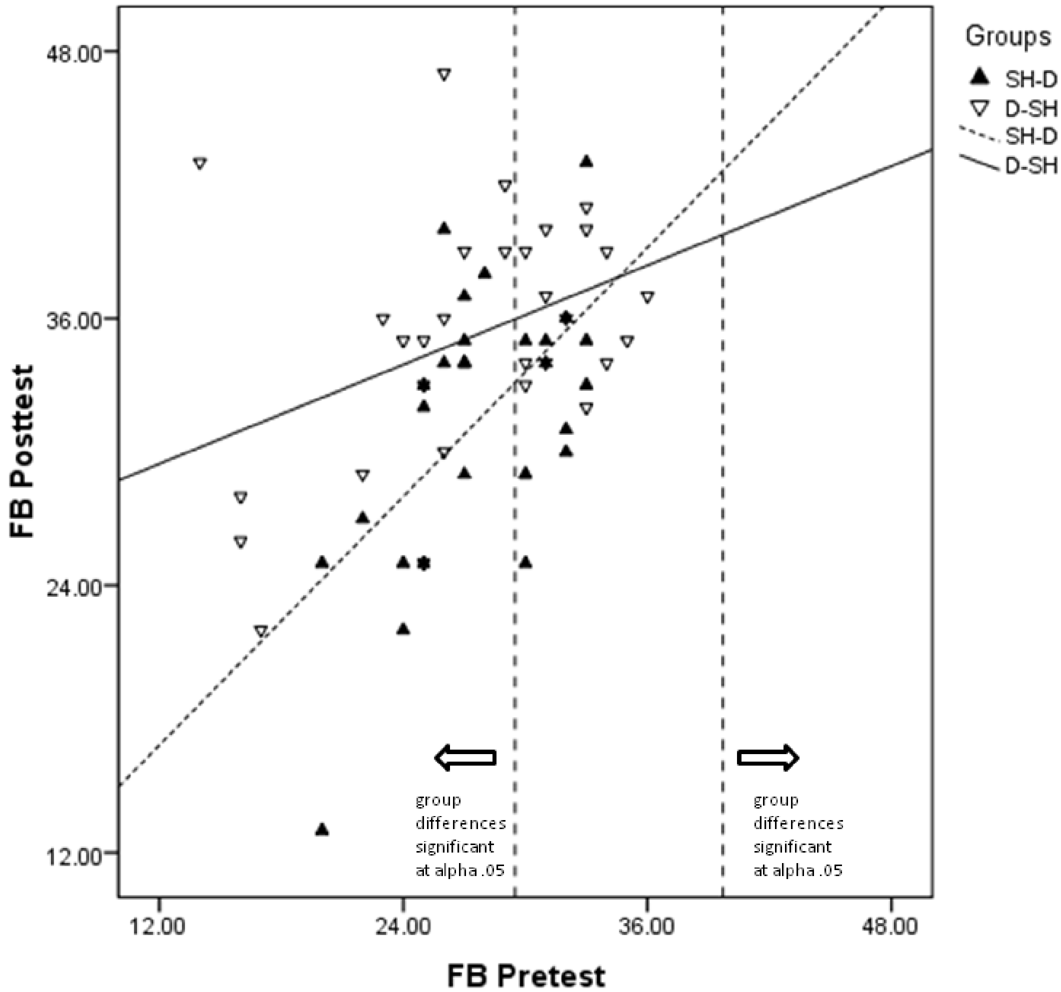

Figure 36. Scatter plot showing FB regression slopes for D-SH and SH-D groups with boundary conditions for effect of Treatment Type.

The SH and D-P groups were not different in terms of FB marginalized gain scores in the ANCOVA. Even so, the trend in the regression slopes is informative in light of the previous analysis. As shown in Figure 37, the relationship between the covariate (pretest scores) and the dependent variable (posttest scores) would suggest that the numeric advantage for the SH group is primarily due to the greater benefits of the SH treatment for learners who begin with less knowledge of English prepositions.

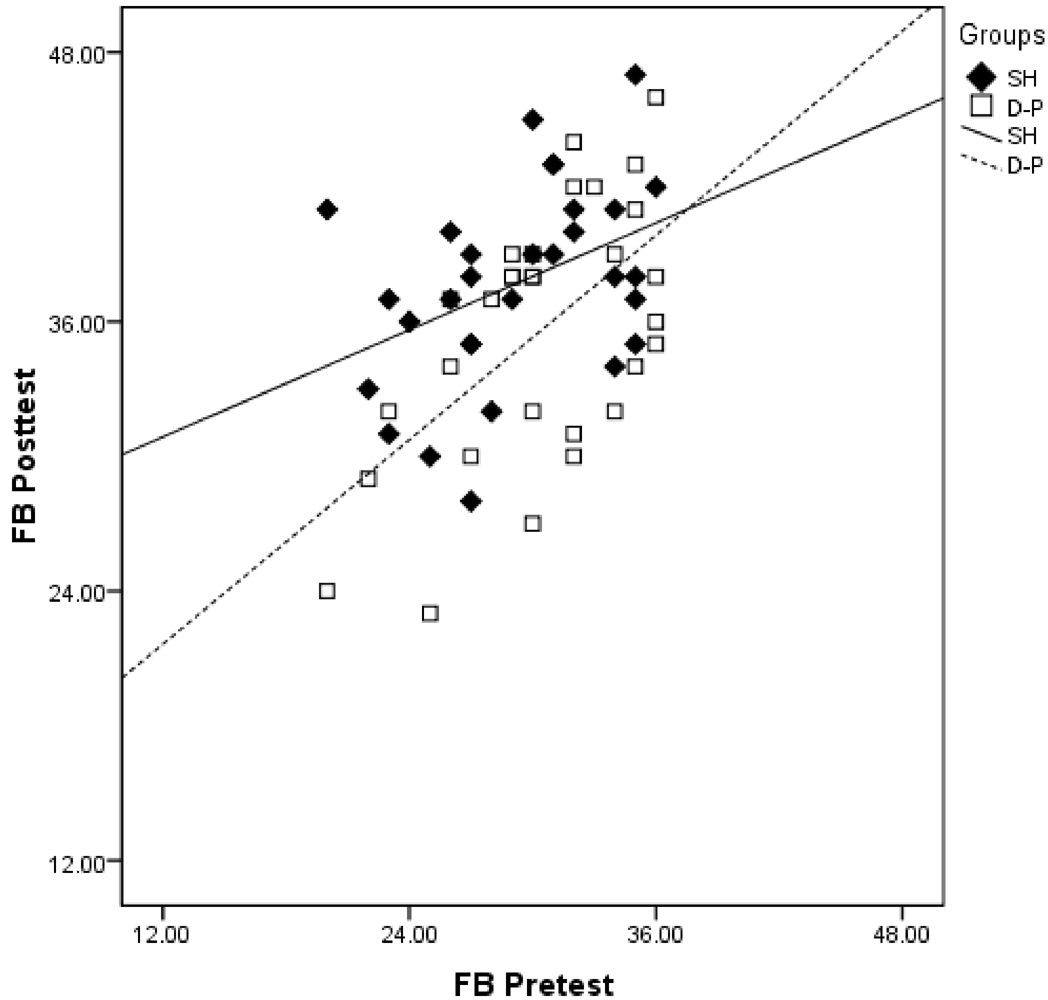

Figure 37. Scatter plot showing FB regression slopes for SH and D-P groups.

Using the Johnson-Neyman procedure, the boundary conditions for a significant effect at an alpha of .05 are given in Table 11 for all the significant pairwise comparisons of FB posttest scores. As can be seen in every comparison, it is the high pretest scores that fall outside of the boundary. The results can, therefore, be broadly interpreted as a ceiling effect. The comparison between the SH and control group is virtually unaffected by the boundary condition. The comparisons involving other treatment groups and the control group show that around a quarter to a fifth of the observations lie outside the critical threshold for significance at an alpha value of .05.

Table 11

Boundary Conditions (Lower Bound) for Significant Effects of Treatment Type on FB Posttest Scores

Group Contrast	Boundary Condition (Lower Bound)	Observations Beyond Range
SH, SH-D	≤ 32.2	18.4%
D-SH, SH-D	≤ 29.5	45.0%
SH, Control	≤ 35.8	6.5%
D-P, Control	≤ 34.7	26.1%
D-SH, Control	≤ 33.4	19.6%

In summary, numeric advantages for the SH and D-SH groups on the FB measure would appear to be due to the advantage of this treatment for learners who have less knowledge of English prepositions. The trends in the regression slopes would suggest that the SH-D and D-P treatments may turn out to be as effective, or even more effective, for learners who already understand English prepositions quite well.

It is possible that the observed interaction between prior knowledge and the effectiveness of the various treatments was caused by a treatment-aptitude interaction. In other words, it could be that the students with lower pretest scores had lower language aptitude. The SH and D-SH treatments may have been more beneficial for these learners, due to the provision of cues immediately prior to the processing of the practice sentences in working memory. It could also be that advanced learners require the detailed explicit explanations, such as those given in the D-P condition, to make further progress. Because the experiment did not include aptitude or working memory measures, these explanations are only speculative; moreover, they fail to account for the patterns of results observed for the D-SH and SH-D groups, who received identical instruction but in a different sequence.

The violation of the assumption of homogeneity of regression slopes is problematic for the ANCOVA based on raw scores. In his work on pretest-posttest designs, Bonate (2000) notes that the assumption of homogeneity of regression slopes is often violated in ANCOVAs. One alternative he suggests, which provides a more robust test without considerable loss of power, is to use an ANCOVA on rank-transformed scores. Rank transformation in ANCOVA has been analyzed in Monte Carlo simulations and has been treated in depth in several studies (Conover & Iman, 1982; Seaman, Algina, & Olejnik, 1985). Moreover, both parametric ANCOVA and rank-transformed ANCOVA have been found to be robust to minor deviations from assumptions regarding normality (Olejnik & Algina, 1984), so the deviation from normal distributions detected in the Shapiro-Wilk tests for two groups on the pretest should not pose a problem for the statistical analyses if a rank transformation is applied.

Following the procedures outlined by Conover and Iman (1982), ranks were separately assigned for the dependent variable (i.e., posttest scores) for the entire data set without regard to the independent variable Treatment Type. High ranks thus corresponded to high scores. The same was then done for the covariate (pretest scores).

An ANCOVA was then conducted using the transformed scores. Following Conover and Iman's procedures, mean scores were used for ties.

In the rank-transformed ANCOVA, there was a significant effect of Treatment Type after controlling for the effect of prior knowledge of the target items using the pretest as a covariate, $F(4,130) = 9.17$, $p < .001$. Treatment Type accounted for about a fifth of the variance between groups, as indicated by a partial eta squared value of .22. Follow-up tests were conducted to evaluate pairwise differences among the adjusted means using a Bonferroni adjustment for multiple comparisons. Using an alpha value of .025, the SH group ($p < .001$), D-P group ($p = .011$) and D-SH group ($p < .001$) all had scores that were significantly higher than those of the control group; however, the SH-D group did not differ significantly from the control group ($p > .999$). In addition, the SH group ($p < .001$) significantly outperformed the SH-D group, whereas the D-SH group's greater gains relative to the SH-D group approached conventional levels of significance ($p = .066$). No other comparisons were significant.

An additional post hoc analysis was conducted to determine whether each group demonstrated learning on the FB measure following the experimental treatment. For this comparison, the original scores were used in place of the rank-transformed scores. Separate paired-samples *t*-tests (Table 12) showed that all four treatment groups made significant gains at an alpha level of .05, and the R-squared values showed that much of the variance was captured by the effect of instruction. As would be expected, the control group demonstrated no learning and no positive practice effect from taking the pretest.

Table 12

FB Pretest to Posttest Gains for the Five Experimental Groups

	Control	SH	D-P	SH-D	D-SH
Gain Score	.06	8.5	5.2	3.7	7.8
SD	2.5	4.8	4.8	4.9	6.3
CI	-1.2 to 1.4	6.7 to 10.3	3.4 to 7.0	1.9 to 5.6	5.4 to 10.1
t	0.10	9.65	5.96	4.19	6.72
df	15	29	29	29	29
Sig.	$p = .920$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
R-squared	N/A	.76	.55	.38	.61

12.2.4 SE Inferential Statistics

The second ANCOVA examined the effect of Treatment Type on participants' performance on the SE test using scores based on a TLU analysis. Treatment Type was the between-subjects variable with five levels: (1) control, (2) SH, (3) D-P, (4) SH-D, and (5) D-SH. The SE TLU posttest scores served as the dependent variable. To account for the effect of pre-existing knowledge of the targeted prepositional senses, the SE TLU pretest scores served as a covariate.

To confirm the assumptions for an ANCOVA, several tests were conducted. First, the assumption of normality was assessed using a Shapiro-Wilk test and a Kolmogorov-Smirnov test with a Lilliefors significance correction. Both tests produced no significant results for any of the groups on either the pretest or posttest. These results and a visual examination of the data suggested that the distributions could be regarded as normal and posed no problems for the statistical analysis. A Levene's test was also conducted. The test was not significant (p = .074), suggesting that the assumption of homogeneity of variance was valid.

To test the assumption of homogeneity of regression slopes, a customized ANCOVA model was run, including both the main effects and the interaction between the covariate (TLU SE pretest scores) and the independent variable (Treatment Type). The interaction between Treatment Type and TLU SE pretest scores (p = .287) was not significant at an alpha level of .05, indicating that the assumption of homogeneity of regression slopes was valid.

The regression slopes of the five conditions are shown in Figure 38. As can be seen, the slopes of the conditions are roughly parallel. However, the slope of the D-P condition is slightly flatter at the upper end, indicating that those D-P participants who scored highest on the pretest achieved somewhat attenuated gains relative to their high-scoring counterparts in the other groups. In addition, the SH-D participants with the highest scores are seen to have benefitted less from the SH-D treatment.

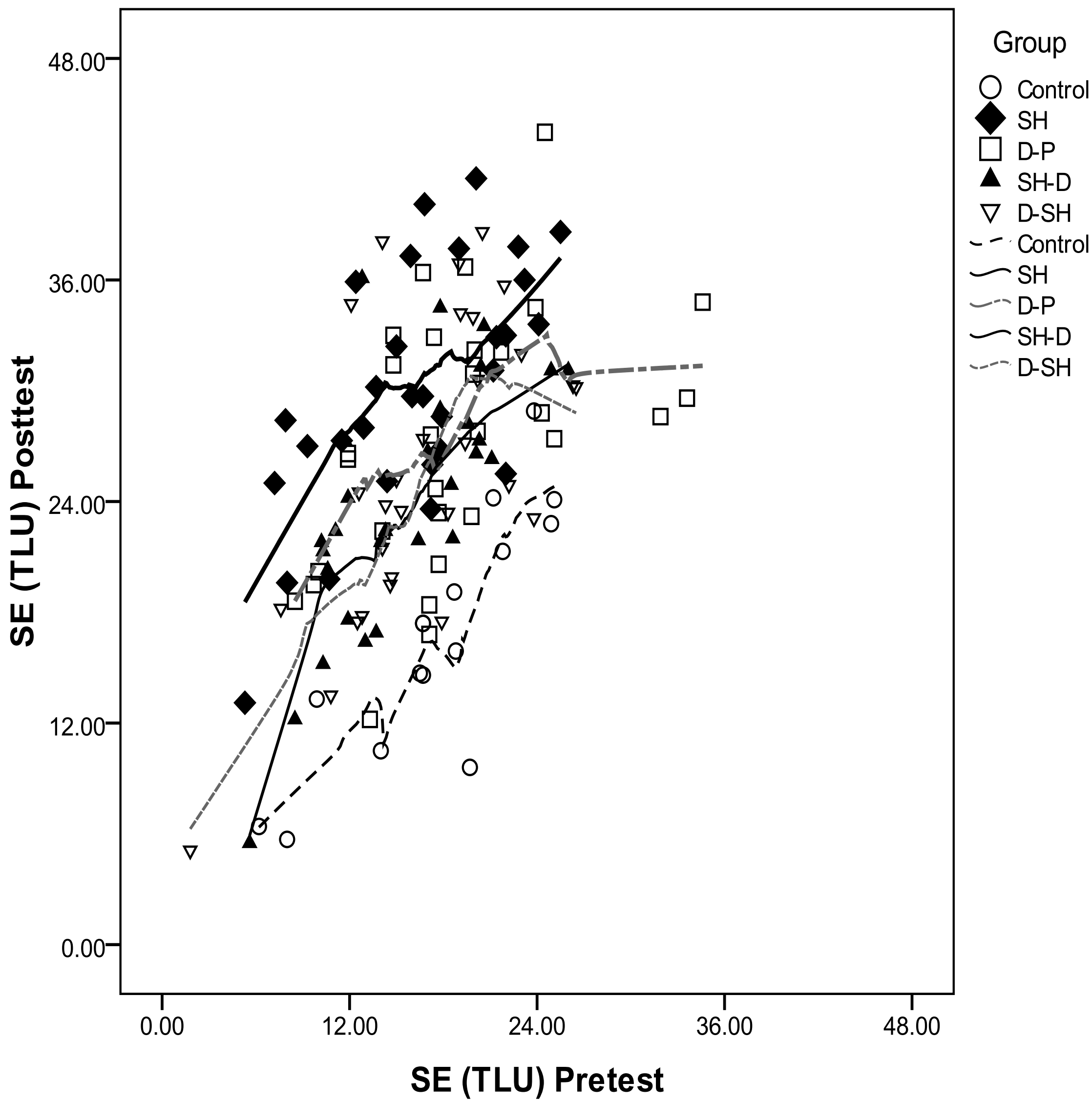

Figure 38. A scatter plot of the SE (TLU) pretest and posttest scores for the five experimental groups.

In the ANCOVA, there was a significant effect of Treatment Type at an alpha level of .025 after controlling for the effect of prior knowledge of the target items using the pretest as a covariate, $F(4,130) = 18.74$, $p < .001$. Treatment Type accounted for approximately a third of the variance between groups, as indicated by a partial eta squared value of .359.

Follow-up tests were conducted to evaluate pairwise differences among the adjusted means using a Bonferroni adjustment for multiple comparisons. Compared to the control group, the estimated marginal mean differences in scores were significantly higher at an alpha level of .025 for the SH group ($p < .001$, 95% CIs[9.2, 19.6]), D-P group ($p < .001$, 95% CIs[4.4, 14.8]), SH-D group ($p < .001$, 95% CIs[3.7, 14.2]) and D-SH group ($p < .001$, 95% CIs[4.5, 15.0]). Moreover, the SH group's marginal mean differences in scores were significantly higher at an alpha level of .025 relative to the D-P group ($p = .010$, 95% CIs[0.4, 9.2]), D-SH group ($p = .002$, 95% CIs[1.1, 9.8]) and SH-D group ($p = .013$, 95% CIs[0.3, 9.0]). No other comparisons were significant.

An additional post hoc analysis was conducted to determine whether each group demonstrated learning on the SE TLU measure following the experimental treatment. As shown in Table 13, separate paired-samples *t*-tests showed that all four treatment groups made significant gains at an alpha value of .05. The variance attributable to the effect of the treatment was large, based on the R-squared values. As might be expected, the control group demonstrated no learning and no positive practice effect from taking the pretest.

To determine whether the results differed greatly if a TLU analysis was not employed, a post hoc analysis was conducted using the raw SE scores. For this analysis, another ANCOVA was conducted using Treatment Type as the between-subjects variable. Raw SE scores were the dependent variable, and raw pretest scores served as a covariate.

A Kolmogorov-Smirnov test with a Lilliefors significance correction was conducted. The test produced no significant results for any of the groups on either the pretest or posttest. These results and a visual examination of the data on Q-Q plots showed that the distributions could be regarded as normal and posed no problems for the statistical analysis.

Table 13

SE TLU Pretest to Posttest Gains for the Five Experimental Groups

	Control Group	SH	D-P	SH-D	D-SH
Gain Score	-0.8	13.9	8.5	8.5	9.1
SD	3.5	5.1	6.8	4.8	6.2
CI	-2.6 to 1.0	11.9 to 15.8	6.0 to 11.1	6.7 to 10.3	6.7 to 11.4
t	- 0.93	14.76	6.83	9.81	8.03
df	15	29	29	29	29
Sig.	$p = .369$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
R-squared	N/A	.88	.62	.77	.69

Levene's test was conducted and was not significant ($p = .618$), suggesting that the assumption of homogeneity of variance was valid. To test the assumption of homogeneity of regression slopes, a customized ANCOVA model was run, including the interaction between the covariate (SE pretest scores) and the independent variable (Treatment Type). The interaction between Treatment Type and pretest scores ($p = .071$) was not significant at an alpha level of .05, indicating that the assumption of homogeneity of regression slopes was valid. All other assumptions for ANCOVA were met.

The ANCOVA indicated a significant effect of Treatment Type after controlling for the effect of prior knowledge of the target items using the pretest as a covariate,

$F(4,130) = 27.71$, $p < .001$. Treatment type accounted for nearly half of the variance between groups, as indicated by a partial eta squared value of .460.

Follow-up tests were conducted to evaluate pairwise differences among the adjusted means using a Bonferroni adjustment for multiple comparisons. Compared to the control group, the estimated marginal mean differences in scores were significantly higher at an alpha level of .025 for the SH group ($p < .001$, 95% CIs[9.9, 18.1]), D-P group ($p < .001$, 95% CIs[6.1, 14.4]), SH-D group ($p < .001$, 95% CIs[5.5, 13.8]) and D-SH group ($p < .001$, 95% CIs[6.3, 14.6]). The SH group's marginal mean differences in scores were significantly higher at an alpha level of .025 relative to the D-P group ($p = .012$, 95% CIs[0.3, 7.2]), D-SH group ($p = .002$, 95% CIs[0.9, 7.8]) and SH-D group ($p = .020$, 95% CIs[0.1, 7.0]). No other comparisons were significant. In sum, the pattern of significant results on the SE measure was the same whether TLU calculations or raw scores were used.

12.3 Discussion

In an experiment examining four pedagogical interventions' effect on the acquisition of specific senses of various English prepositions, an integrative and inductive instructional approach (i.e., the SH treatment) was found to be more effective than a hybrid approach involving bottom-up learning (i.e., the SH-D treatment) on a measure that allowed for the use of both declarative and procedural knowledge (i.e., the FB measure). On a sentence-elicitation measure designed to test proceduralized knowledge, the SH treatment was found to be more effective than a typical presentation and practice approach (D-P) and two hybrid approaches in which an explicit presentation was combined with SH practice (i.e., the SH-D and D-SH treatments). In terms of the statistical significance (at an alpha level of .025) of the differences between marginalized gain scores, the performance of the five experimental groups on the FB measure and the SE measure (using either TLU-based scores or raw scores) can be summarized as follows:

FB

SH > SH-D, Control

D-P, D-SH > Control

SE (TLU, raw scores)

SH > D-P, SH-D, D-SH > Control

The experiment failed to confirm H1, which had predicted that the SH treatment would be more effective than the D-P treatment in terms of the FB measure. An earlier pilot of the materials produced significantly higher results for the SH condition relative to a D-P condition in an FB test. This different result may be attributable to several distinctive design features of the final experiment. In particular, the outcome probably reflects the fact that the treatment in the pilot had lasted about 50% longer. In other words, the shorter treatment in the current study may have led to differences between groups that were too small to be detected using the FB measure. It should also be pointed out that the pretest scores on the FB measure were closer to ceiling than those on the SE measure, resulting in a reduced likelihood that significant group differences would appear on the FB posttest.

H2, which had predicted that the SH group would outperform the SH-D group on the FB test, was confirmed. It should be noted that the SH-D group did poorly on both measures, failing to show statistical gains beyond the control group on the FB measure. In some respects, the group's mediocre performance is surprising. After all, the explicit presentation phase of the SH-D group's instruction actually occurred in closer temporal proximity to the posttest, relative to the explicit presentation phase of the D-P and D-SH groups. The group should have experienced some advantage in recalling explicit instruction that had been more recently provided, and this knowledge should have been useful on the FB measure in particular. In view of the fact that the SH-D group was the only group, among the three receiving explicit explanation, for which the explicit phase was not followed by practice, this group's disadvantage seems to reflect these participants' inability to recall information from a relatively long explicit presentation, due to the fact that this information had not been honed and internalized through practice.

The poor performance of the SH-D group may also reflect a conflict between proceduralized and declarative knowledge in some bottom-up learning. Sun, Slusarz, and Terry (2005) have suggested that knowledge representation at the top (i.e., explicit knowledge) and bottom levels (i.e., implicit knowledge) can sometimes be mismatched. Although the SH-D group's initial phase of SH instruction is likely to have engaged both implicit and explicit processes, the occasional use of rule-based categorization in the SH phase is probably less constrained, especially when this phase is not preceded by an explicit presentation of target senses. Following the initial SH practice, the SH-D participants may have experienced difficulty in matching their acquired representations to the abstract explanations presented during the declarative phase of instruction.

H3, which had predicted that the SH condition would be more effective than the D-SH condition when acquisition was measured using the FB measure, did not receive support. The D-SH group's good overall gains, which approached significance relative to the SH-D group, tentatively suggest that this group's gains may not be solely explained by the cumulative effects of the two segments of the instruction, which were identical for both hybrid groups, but must lie instead with the inherent synergy between the declarative phase and SH practice when the two instructional components follow a top-down sequence.

H4, which had predicted greater SH gains on the SE measure relative to the D-P group, was confirmed. The SH group also outperformed the two hybrid groups on this measure, confirming H5 and H6. These results can be attributed to a number of factors. On the one hand, the explicit presentation phase in the D-P, SH-D, and D-SH groups may have encouraged participants to adopt an overly analytical orientation toward the SE measure, in which time pressures, to some extent, prevented the full deployment of declarative knowledge. The SH treatment also appears to have been more efficient at developing proceduralized knowledge, as it completely skipped the presentation phase and immediately commenced with practice. The results could also reflect greater compatibility between practice and test conditions in the SH condition. The four example sentences in the training segment of the explicit presentations given to the D-P, SH-D, and D-SH groups were simply displayed and discussed. Such training, while facilitating the development of clear declarative knowledge representations, is not likely to promote proceduralized knowledge.

H7, which had predicted greater gains for the D-SH group relative to the D-P group on the FB measure, did not receive confirmation. However, the D-SH group did achieve slightly greater gains, suggesting possible synergies between the explicit presentations of target senses and SH practice when the presentation occurs first. Even when explicit instructional materials are well-designed, learners' acquisition is likely to be partial and, to some extent, imperfect when the instructional targets are complex and involve "ecological" considerations (e.g., when accurate representation of one target sense entails setting an appropriate boundary with another target sense associated with a different preposition). The practice phase following explicit instruction may be helpful in honing the acquired knowledge and eliminating faulty representations of the instructional targets. The SH cues in the D-SH condition may have further enhanced the practice phase's effectiveness. However, this is speculative, as the D-P and D-SH groups' FB scores were not statistically distinguishable.

H8 had predicted that a hybrid approach, in which the explicit presentation appeared first (D-SH), would be more effective than a treatment involving a bottom-up sequencing of practice followed by explicit explanations (SH-D) when acquisition was measured on the FB measure. Although H8 was not confirmed, it should be noted that the D-SH group's greater gains approached levels of conventional significance. A summary of the status of the eight hypotheses is provided in Table 14.

Table 14

Status of Eight Hypotheses Based on Experimental Findings

Hypothesis	Assumed Outcome	Measure	Confirmed?
H1	SH > D-P	FB	No
H2	SH > SH-D	FB	Yes
H3	SH > D-SH	FB	No
H4	SH > D-P	SE	Yes
H5	SH > SH-D	SE	Yes
H6	SH > D-SH	SE	Yes
H7	D-SH > D-P	FB	No
H8	D-SH > SH-D	FB	No

It should be noted that the D-P group's gain scores on the FB test (10.8%) were actually closer to those of the SH-D condition (7.8%) than they were to those of the D-SH condition (16.2%) or SH condition (17.7%). This suggests that even when opportunities for practice and feedback are provided, learners may fail to proceduralize instruction, due to an inability to recall the knowledge effectively during the practice phase. In other words, the numerically higher performance of the D-SH group may reflect the usefulness of the semantic highlighting to cue memories of the instructional materials.

The greater FB gains among participants in the SH and D-SH group who had scored low on the pretest (as observed using the Johnson-Neyman procedure) are highly suggestive. These instructional treatments appear to more effectively promote declarative knowledge in learners with less initial understanding of English prepositions. Because the

FB differences between the D-P group and the SH and D-SH group were too small to detect using the FB measure, these interpretations are merely speculative.

It should also be recalled that the scatter plot of SE results showed the opposite trend for the D-P group, which demonstrated greater gains in procedural knowledge (i.e., the SE test scores) among participants with less initial knowledge of English prepositions. The pattern tentatively suggests that individual differences related to prior knowledge of the target form influence learners' ability to benefit from top-down versus bottom-up instructional sequences.

The mediocre performance of the D-P group could also reflect a treatment-aptitude interaction. It could be that expert language learners with good executive control, longer working memory span, and effective learning strategies are able to recall the instruction from the declarative phase and proceduralize it effectively within the time constraints of the practice session. Learners with lower aptitude may require the provision of cues in much closer temporal proximity to their processing of the practice sentences and may, therefore, benefit more from the D-SH and SH treatments. If this speculative interpretation is correct, the slightly higher FB scores for the D-SH group (relative to the D-P group) may reflect the enhanced performance of a subset (i.e., learners with lower aptitude) of the D-SH group relative to low-aptitude learners in the D-P condition. The higher SDs on the FB posttest for the three treatment groups who received the explicit presentation (the "declarative" phase) may reflect such an interaction. Again, this is only speculative, as the D-P scores were statistically indistinguishable from those of the two hybrid groups and the SD differences small.

Finally, it must be acknowledged that the greater gains for the SH group relative to the other groups, depending on the measure examined, are either non-existent or small. Moreover, the long-term effects of instruction were not examined in this study. It could very well be that the D-P and D-SH conditions foster greater declarative knowledge that continues to be proceduralized in the days and weeks following the treatment, leading to more overall learning on longer time-scales. On the other hand, the D-SH and D-P groups' scores on the FB measure, which were on par with those of the SH group, could reflect acquisition of declarative knowledge that would ultimately prove to be highly unstable and short-lasting if not soon reinforced. In this case, the SH treatment, which involved concrete cues tied directly to examples, may ultimately lead to greater long-term gains. Future research needs to be conducted to address this important issue.

Chapter 13: General Discussion and Conclusion

The following section will provide an overview of major findings, discussing them in light of previous research on categorization, explicit instruction, and practice. Limitations of the study will then be discussed. Finally, avenues of future research to verify and clarify the current findings will be outlined.

13.1 Summary of Findings

Because many linguistic features can be readily acquired through exposure to natural language within meaningful contexts, SLA theorists have rightly taken an avid interest in interventions designed for structures and patterns that resist acquisition. Much of the research has focused on syntax. Fewer studies have examined the problem of forming appropriate semantic categories or the specific complications that arise when different categories (i.e., different senses of words and constructions) are expressed by the same linguistic form, as is the case with polysemous and homonymous forms.

This study has expanded the repertoire of possible pedagogical approaches by demonstrating that a novel approach that uses integrative, inductive practice is at least as effective as a typical presentation and practice approach when acquired knowledge is tested using measures with low time pressure, and even more effective when measures involve time pressure (i.e., when they tap into proceduralized knowledge). Because the SH approach represents an innovation, further studies will be necessary to replicate the results with other populations and target forms, to refine the approach, and to determine the scope of its effectiveness.

The study found firm empirical support for the notion that prepositions generally pose serious problems for L2 learners, even at fairly advanced stages of acquisition. Difficulties have been cited in a number of learner error studies and were confirmed in this dissertation in a partial analysis of errors in the ICLE Chinese subcorpus. In the current experiment, the 136 participants achieved only 60.2% accuracy on the FB pretest and 47.8% accuracy on the SE pretest (35.3% accuracy in terms of TLU scores). This provides additional evidence that many prepositional senses have not been acquired by some groups of fairly advanced NNSs.

The results of research using other L1 groups of English learners have been similar. The advanced learners in Mueller (2011), whose median length of residence in the U.S. was nearly two years and who were virtually all students who had satisfied TOEFL requirements for admission to either four-year or graduate-level university programs, achieved only 66.7% overall accuracy in a preposition test in which over a quarter of the items involved frequently encountered collocations. In Tyler, Mueller, and Ho's (2011) experiment examining the acquisition of *at*, *for*, and *to*, fairly advanced Italian learners achieved 48.8% accuracy on a pretest.

It could be countered that the cited research and the current experiment primarily targeted noncentral prepositions and that the errors are thus unrepresentative; however, the errors and patterns of undersuppliance and oversuppliance in learner corpora suggest that many advanced NNSs' knowledge in this area deviates markedly from NS norms. Moreover, many of the individual senses that were targeted in Tyler, Mueller, and Ho (2011), Mueller (2011), and the current experiment occur with high token frequency and within a wide range of contexts (i.e., with high *type* frequency) in NS corpora.

To take just one example, only a third of the 90 Chinese, Korean, and Spanish L1 learners in Mueller (2011) were correct on the item (in a low frequency collocation) targeting the attachment sense of *to*. NNSs' difficulty with the sense would seem, at first sight, surprising, as this sense is ubiquitous in input, occurring in a wide range of concrete contexts (e.g., *attach to, connect to, link to, stick to*) and abstract contexts (e.g., *addicted to*, *emotionally attached to*, *married to*, and so on).

As for the cause of these observed difficulties, a number of factors were discussed, including saliency and complexity. NNSs are likely to overcome the cumulative effect of these factors to some extent through reliance on knowledge and assumptions from their L1 and by mapping specific L2 forms onto L1 counterparts. However, research suggests that this is an imperfect solution. Languages differ in their weighting of dimensions and features of spatial categories, and there is also evidence that languages tend to extend basic proto-scenes differently. The exploratory examination of preposition use in various NS corpora and a learner corpus (the ICLE) showed great NNS variation. This variation provides tentative support for the view that L1-related factors exert a strong influence on L2 acquisition of prepositions.

Based on this assumption, it was concluded that the key learning problem related to prepositions is in establishing new categories of semantic meaning. At one level, this may entail the development of novel categories or the restructuring of current divisions of semantic space. At a more subtle level, this may require the resetting of the weights assigned to various cues (e.g., the weighting of topological and functional features for a given sense). The process of semantic restructuring is further complicated by the fact that English prepositions constitute family resemblance categories. The literature on categorization has demonstrated that these categories may be difficult to learn through detailed explicit explanations, even when these explanations are followed by practice with feedback.

The literature on the interface between explicit instruction and proceduralization suggests a number of potentially effective regimes for the provision of explicit instruction and practice in cases in which the to-be-learned item is highly complex. A bottom-up approach (Sun, 2002) has been suggested as potentially effective, as it allows for the development of initial representations at the bottom (i.e., implicit) level, which can then be sharpened and honed through interaction with knowledge at the top (explicit) level. In the current experiment, this approach was operationalized as the SH-D condition, in which participants received SH training in the initial phase of instruction prior to viewing explicit explanations in the second phase of instruction.

It may be argued that the SH-D condition was not an ideal operationalization of a bottom-up approach, due to the instruction provided (i.e., the SH cues). However, the SH cues were given to participants as they viewed a picture and were not presented as rules applicable to multiple instances. From the participants' standpoint, the SH cues would appear to be saying something fairly obvious regarding the picture presented on the PowerPoint™ slide. This is especially the case for the SH and SH-D conditions, in which explicit presentations of the target semantics did not appear prior to the SH treatment.

For this reason, it is felt that the SH cues were associated with processing that was more "holistic" in nature (cf. Brooks, 1978; Kemler Nelson, 1984) than the processing of example sentences during the explicit presentation (e.g., the first part of the D-P treatment). The SH-D condition would therefore seem to be best described as a bottom-up approach. Ideally, the experiment would have also included a “P-D” group that received the D-P instructional sequence in inverse order, but this was not possible within the current study, due to the large number of participants this would have required.

The group receiving the SH-D instruction performed poorly relative to the pure SH group. Given the overall good performance of the SH group, these results seem somewhat paradoxical. The group might be expected to learn just as much as the SH group during the initial phase and be differentiated from the SH group, solely due to the relative advantages or disadvantages of SH versus explicit presentation of the target senses during the second phase of instruction. The SH-D group’s poor performance may reflect the low utility of declarative knowledge that has not been proceduralized.

The Power Law of Practice (Newell & Rosenbloom, 1981) would predict that proceduralization occurs in a nonlinear function that is initially rapid but then levels off. However, learners may need to view several SH cues (in the instructional materials, several slides targeting the same sense) to develop an adequate starting point for proceduralization. In other words, the SH-D group may be at the point at which proceduralization has finally begun in earnest, just as they switch to the instructional phase, at which point further proceduralization is largely blocked due to the lack of practice and feedback. The poor results for the SH-D group should, therefore, be interpreted with caution. It is possible that a bottom-up approach may work if the instruction occurs at longer intervals and the explicit presentation is followed by further practice (e.g., an “SH-D-SH” or “SH-D-SH-D-SH” sequence).

The finding that the SH approach represents a viable alternative to conventional presentation and practice approaches, when targeting the semantics of complex family resemblance categories, is encouraging; it suggests that the development of procedural knowledge does not require the prior development of abstract declarative knowledge that is stored in long-term memory. In terms of the categorization literature, the finding that SH is at least as effective as the D-P condition provides tentative support for the role of timely interventions in guiding attention allocations to informative dimensions of linguistic meaning, so as to facilitate the induction of a linguistic category.

In a certain sense, the positive findings for SH can be viewed as a confirmation of the general consensus regarding the explicit-implicit interface. While there remains disagreement on the nature of the interface, there is a broad consensus among SLA researchers that explicit knowledge does not directly transform into implicit knowledge. This would imply that the role of explicit knowledge in L2 acquisition is primarily[81] to provide a basis for proceduralization by guiding learners toward nativelike form-meaning mappings while target structures are processed during incidental encounters with the form in input or (as in the current study) during focused practice.

This view of explicit rules as mere facilitators or triggers for learning processes that involve more global processing finds some support in the general categorization literature. For example, Brooks and Hannah (2006) claim that rules, as they are typically employed in conversation and learning contexts, do not, in fact, provide sufficient criteria for categorization. They claim that individuals, when learning items from a feature list, "use the terms of the rule to provide foci of attention for perceptual learning" (p. 134).

[81] It must be acknowledged that declarative knowledge, even when it has not been proceduralized, is likely to be of some minimal use as learners perform language tasks with low time pressures. However, even language activities such as reading and writing require proceduralization and automatization in order to be performed efficiently and fluently.

This view of rules accords well with what is known about working memory. Because WM constraints create a bottleneck permitting the temporary use of only a limited amount of information, only simple rules are likely to be effective within this type of learning. When rules or semantic explanations are complex, learners, who are constrained by working memory limitations, are likely to process only part of the rule (or in the case of semantic categories, only specific features or dimensions of the semantic category) as they encounter each exemplar during practice.

There is some empirical support for such effects of cognitive constraints on the ability to use explicitly acquired rules. Hu (2002a), for example, found that greater time pressure in a writing task affected participants' ability to employ rules and led to reduced accuracy. Hu also found that the participants showed a tendency to use the rules within highly prototypical contexts. This would suggest that one possible benefit of the SH condition is its ability to draw participants' attention to key semantic features in instances in which the exemplar (i.e., the targeted preposition in the practice sentence on the PowerPoint™ slide) represents a more peripheral instantiation of the target sense.

In light of the good performance of the SH group, a tentative argument could be made that L2 instructors, in many cases, need not be so vigilant regarding the explanatory adequacy of linguistic accounts used in explicit instructions. Instead of providing long explanations of fully adequate rules, which are then only imperfectly used by the learner during practice (due to working memory limitations and other factors), instruction should perhaps focus more on incomplete rules (or cues) that are shorter and thus more feasibly interspersed within input (cf. the "rule and instance" group in N. C. Ellis, 1993). It seems that these shorter rules or cues would be more likely to ensure correct form-meaning mapping of linguistic constructions being processed in working memory.

13.2 Implications

Langacker (2001) has argued that the effectiveness of pedagogical applications has important implications for linguistic theory. His statement can be broadened to include many theoretical claims within the general cognitive literature on language representation and processing. In this regard, the study's finding that the SH approach is a viable alternative to the conventional "presentation and practice" approach is valuable in extending the findings supporting the inductive and integrative approach found in Sallas, Mathews, Lane, and Sun (2007). In their study of AG learning, these authors found that if participants were provided with an animated diagram of an artificial grammar, they achieved both fast and accurate performance. The authors claimed that a key factor underlying the success of the participants was that model-based information was provided just as it was needed during training. The success of the SH group in the current study suggests that their results have validity for semantic acquisition, a learning problem that differs markedly from AG learning.

Few pedagogical options exist for difficult semantic structures that remain unlearned despite their prevalence in the input. The approach employed in the SH and D-SH conditions provide novel alternatives. Although these approaches are probably applicable to only a narrow range of linguistic phenomena, it should be noted that many potential target structures share the features of semantic complexity and high frequency in typical input. In addition to prepositions, English modals would be an appropriate linguistic target for this approach, as they are polysemous (Sweetser, 1990) and occur with high frequency (and are thus important for learners). Moreover, they generally allow for little positive L1-transfer, as they map poorly onto corresponding linguistic categories in many languages.

Among most instructors, there is a justified preference for pedagogical practices that maximize the communicative use of language within highly contextualized contexts. However, there may be advantages, particularly when targeting polysemous forms that are resistant to acquisition, for explicit instruction that targets multiple items and multiple target senses of these items, as this sort of practice is more likely to destabilize the learners' interlanguage. This is particularly the case for contrasting senses, in which case, the correct delineation of one sense may require restructuring of a contrasting sense.[82] The ability to clarify such contrasts may be one advantage of proactive instruction used to target certain difficult structures.

Computerized instruction may also facilitate acquisition when using SH instruction due to its ability to provide immediate feedback. If the requirement for immediate feedback within a 2.5 second window for the learning of information-integration categories (Maddox et al., 2003) is correct, computerized instruction may be one of the few practical options available. A great deal of caution is warranted regarding this point in light of disagreement over whether immediate feedback is crucial. The degree to which the COVIS research is generalizable to the acquisition of prepositions is also open to question. That said, researchers and instructors designing computerized

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[82] Pinto and Rex (2006), in their discussion of Spanish *por* and *para*, make the case that little is to be gained from contrasting prepositions unless the contrast is complete, so that if "it's not one, it's the other" (p. 619, 620). Their position appears somewhat extreme, as it does not take into account the idiosyncratic nature of individuals' interlanguage grammars, in which the prepositions may be closely associated. If L2 learners confuse two forms, it seems that there would be advantages in drawing contrasts.

interventions for either experimental or pedagogical purposes should probably err on the side of caution and ensure that feedback is prompt and of sufficient duration to allow for both similarity-based and rule-based categorization (unless, of course, length of feedback is being used as an experimental variable of interest).

13.3 Additional Considerations

In his discussion of theory-building in SLA, Long (1993) states that any SLA theory should, at the very least, contain (1) a model of starting L1/L2 communicative ability, (2) a model of target communicative potential, (3) generalizations about systematic interlanguage development, and (4) explanations regarding the mechanisms underlying this development. As Long mentions, SLA research has often failed to provide adequate accounts of cognitive mechanisms. The current study, in an attempt to avoid this common shortcoming, has buttressed its examination of a pedagogical approach with links to possible explanatory mechanisms associated with explicit instruction, proceduralization, and categorization.

It should be noted that in spite of the prevalence of explicit instruction (and in many cases, *metalinguistic* instruction) within typical pedagogical materials, the field of SLA has developed only sparse and inadequate accounts to explain how explicit instruction works and under which conditions[83] it is likely to be effective. Judging from the *de rigueur* mention of *noticing* in discussion sections of typical SLA articles, there appears to be a wide consensus that attention-guiding interventions are often necessary to ensure that L2 adult learners accurately process L2 form-meaning mappings that would

[83] There have been some notable attempts to fill this lacuna in research (e.g., DeKeyser, 1997, 2005; de Graaff & Housen, 2009; Hulstijn & de Graaff, 1994).

otherwise be overlooked (N. C. Ellis, 2011; Long, 2000; Robinson, 1995; Schmidt, 2001). Unfortunately, the discussion of noticing is often coarse-grained and fails to take into account relevant psycholinguistic constraints related to memory systems and other factors (for some notable counter-examples, see Doughty, 2001, and the research from the last decade discussed in Leow, Johnson, & Zárate-Sández, 2011).

Researchers have also examined how explicit instruction can lead to proceduralization and automatization of target structures that are encountered within incidental input, or within input (e.g., practice) that is specifically designed to promote proceduralization (DeKeyser, 2003, 2007b, 2010; Segalowitz & Hulstijn, 2005). Yet relatively few studies have examined the benefits of different combinations of explicit instruction and practice. Studies that have examined the synergy between explicit instruction and practice have generally focused on abstract grammar rules.

Because relatively few studies have investigated the acquisition of complex semantics in relation to the instructional variables examined in this study, the current results must be regarded as tentative. Instruction such as that used in the experiment inevitably involves a large number of variables (e.g., use of visual material, time on task, etc.). These can be experimentally controlled by reducing them to a single level for all groups (as was done for time on task); however, these variables and their potential synergies with other features in an instructional treatment cannot be fully explored within any single experiment.

To give just one important example, the explicit presentation of senses provided to the D-P, SH-D, and D-SH groups involved the use of abstract images. Due to individual differences, participants may have benefitted differentially from such imagery, which was not provided to the SH group, as the SH condition only provided concrete cues related to specific target sentences. Individual participants may have also become more or less attentive, due to their preferences and expectations regarding instruction.

In addition, adjustments to time on task could turn out to have nonlinear effects on outcomes. It could be that longer or shorter instructional sessions favor a particular approach. It is also possible that certain approaches produce U-shaped development (cf. McLaughlin, 1990), and that the outcome measures are only providing a picture of learner development after the interlanguage system has been destabilized. In longer studies, the same measures may show steep learning curves for what were low-performing groups in the current study. It is, therefore, difficult to reach definitive conclusions without a large body of closely comparable research.

Another related problem is that the time allotment for various components of the instruction was different for some of the conditions. The explicit presentation of prepositional senses, for example, was longer for the D-P group than for the two hybrid groups. These time adjustments to instructional components were made to ensure that time on task remained the same for each experimental group, but they make the interpretation of the results more problematic. It may be speculated that the shorter explicit presentations given to the hybrid groups were not quite long enough to clarify the target senses. It could also be that the explicit presentation given to the D-P group was excessively long, in which case, this group may have benefitted more from extra time allotted to practice.

To eliminate these alternative interpretations of the findings, further research using similar designs and materials will be required. Research that provides longitudinal data to track learning during the pedagogical treatment would be particularly helpful in this regard, as it could show individual learning curves, determine whether learning tends to be gradual, and identify points at which the curve is steep or tapers off.

One strength of the current study was the use of a single L1 group that was fairly homogeneous. This reduced the likelihood that lurking variables associated with intragroup heterogeneity could influence the results. This increase in internal validity, however, was purchased at the cost of decreased generalizability. For this reason, future research will be needed to determine whether the results hold for other groups. Generalizability of the sampled population is probably not so problematic in terms of the L1 itself. English prepositions appear to be difficult for NNSs from most L1 backgrounds, and the general cognitive mechanisms associated with the experimental conditions should remain relevant.

Of greater concern is the fact that the sampled population consisted of young college students who probably had very high aptitude for language learning, far above that of the general population. Because the cognitive mechanisms and abilities implicated in the various instructional treatments (e.g., working memory, top-down inhibitory control, associative learning ability, etc.) are likely to be attenuated in many populations (e.g., early learners, older learners, and learners with low aptitude), further research will be necessary to confirm the findings in other populations.

The semantic analysis of the target prepositions presented in this paper is largely based on previous research; however, some of the ideas and refinements, particularly those dealing with the preposition *for*, are original. When designing explicit instructional materials, whether they be used for abstract explanations, such as those used in the D-P condition, or for concrete cues, such as those used in the SH condition, the semantic analysis is extremely important. Much work remains to be done to determine how best to characterize the semantic networks associated with prepositions.

Psycholinguistic research will also be needed to clarify the psychological status of polysemy networks within the minds of NSs and NNSs (to include balanced bilinguals). It will be important to determine whether semantic networks are a synchronic phenomenon that is psychologically real for NSs or primarily a diachronic pattern that has only tenuous links to representation in individual speakers. If future research continues to suggest that semantic networks are relevant to L1 representation and processing, studies will be needed to determine whether highly proficient NNSs are capable of developing the same network of representations and the extent to which their representations are affected by crosslinguistic influences.

13.4 Future Directions

Based on the results of the current experiment, both SH and D-SH instruction should be further explored as possible alternatives to teaching semantically complex forms that resist acquisition. Whereas the current study suggests that the inductive and integrative approach used in SH instruction may be better for typical college students, especially in terms of promoting greater proceduralization, a number of theoretical considerations would suggest that the sequence holds even greater promise for other populations of L2 learners.

Compared to alternative approaches, SH may be particularly effective for low-aptitude learners. Research has indicated that aptitude correlates with the ultimate attainment (UA) of adult L2 learners, even when learning occurs within naturalistic contexts (DeKeyser, 2000). Aptitude may even affect the UA of childhood L2 learners (Abrahamsson & Hyltenstam, 2008). The Chinese participants in the current experiment, as noted previously, are likely to have had high language aptitude.[84] This is especially the case for the considerable number of participants who were from language-related majors. These participants would be likely to have greater working memory (WM) capacity, an important component of foreign language aptitude (Kormos & Sáfár, 2008; Linck & Weiss, 2011; Miyake & Friedman, 1998). Consequently, these learners, compared to other adult learners, would be cognitively suited to learning under the D-P condition. The fact that the D-P group did not outperform the SH group on either experimental measure suggests that the task of effectively using complex semantic knowledge presented during an initial phase of instruction is probably challenging even for this population of learners.

Low-aptitude learners (particularly, those with limited WM capacity) can be expected to find the D-P task even more challenging when instructional targets are characterized by complex semantics or complicated rules. These learners are likely to do poorly in lessons in which the presentation phase is not closely integrated with practice, due to difficulties in retrieving the relevant information from long-term memory and then holding the information within WM long enough to influence processing. In the SH instruction, on the other hand, the concrete explicit cues appear directly prior to the L2 learner's processing of a target sentence. These cues are thus more likely to augment these learners' processing, in spite of their limited WM spans. Future research should

[84] The mere fact that the sample consisted solely of students who had achieved a relatively high measure of academic success relative to students in the general population suggests that they had relatively high native language literacy, high verbal intelligence, and high IQ, factors known to correlate with foreign language aptitude (see Gardner & Lambert, 1972; Sparks, Patton, Ganschow, Humbach, & Javorsky, 2006).

therefore examine low-aptitude (especially limited WM span)[85] groups or account for interactions with aptitude-related factors in the experimental design.

SH may also prove effective for very young (especially, kindergarten or early primary school) learners. Because young learners (e.g., learners still in primary school) have not yet developed sophisticated analytical and reasoning skills (Sternberg & Nigro, 1980), it has been suggested that instruction for this age group should focus on activities that involve a more holistic approach to language (Muñoz, 2007). Research also indicates that executive control is underdeveloped in younger children (i.e., prior to around age ten) and that these children thus perform much better on cognitive tasks that do not require executive control (Reuter-Lorenz & Jonides, 2007).

Some research suggests that very young children exhibit poor performance on categories best learned by rules but are good at learning family-resemblance categories (e.g., Kemler Nelson, 1984, Experiment 4; Minda, Descroches, & Church, 2008; Minda & Miles, 2010).[86] An important question concerns whether this group also benefits from explicit SH cues that focus attention on the most informative features and dimensions of a category. Because the SH instruction does not require the development of stable declarative knowledge representations of the linguistic form in long-term memory, it would seem to be well-suited for young children.

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[85] There is even some research suggesting that information-integration categories are learned better by people with less working memory (DeCaro, Thomas, & Beilock, 2008). Future SLA research may be able to constrain categorization accounts by verifying or disconfirming the importance of WM for complex semantic categories.

[86] There is some counter-evidence suggesting that even very young children, including preschoolers, readily adopt analytical modes of processing in typical categorization tasks (Ward, Vela, & Hass, 1990). However, this analytical processing tends to focus on single predictive dimensions or features. If this is the case, SH may be effective by guiding young learners to focus on the dimensions that are most informative in the L2.

It may be argued that young children simply need input, but for children in non-immersion contexts, such input may not be available. Moreover, young children, like their adult counterparts, may be affected by similar (albeit, more attenuated) entrenchment of L1 semantic categories and L1 weightings of category dimensions (e.g., path, vectors, and so on).

SH may also have advantages for aging learners. Older adults have been shown to generally process all information at slower speeds, and they show a related decline in working memory capacity, especially in terms of the visuospatial domain (Hale, Myerson, Emery, Lawrence, & Dufault, 2007). Research has also suggested that implicit learning abilities are affected by age (Janacsek, Fiser, & Nemeth, 2012).

In one study (Howard et al., 2004), for example, it was shown that young adults (*M* age = 20) outperformed elderly adults (*M* age = 71) when learning nonsalient patterns in an implicit learning task. Participants in the study performed an alternating serial response time task in which four flashes appeared on a screen in a predictable pattern followed by another four flashes that appeared at random (lag-2) or by another eight flashes that appeared at random (lag-3). Younger learners were better at learning patterns within both lag-2 and lag-3 structures, while older learners appeared to be unable to learn the lag-3 structure. The findings on cognitive aging, as generalized to language acquisition, would suggest that older learners may have greater difficulty in using implicit learning mechanisms to gradually develop abstract knowledge of complex patterns in the input through repeated exposure. The SH instructional sequence, or perhaps D-SH sequence, may provide a better option by guiding attention to relevant cues.

In spite of its failure to produce as much proceduralized knowledge as the SH instruction, the D-SH instructional sequence should be explored further. It may turn out to be as effective, or perhaps even more effective, than SH instruction if the SH component is extended. Certain theoretical considerations would predict advantages for D-SH instruction.

Medin, Wattenmaker, and Hampson (1987), for example, found that participants persisted in using unidimensional rules in a sorting task, even when the categories had a family resemblance structure (Experiments 1-4); however, participants were able to abandon unidimensional sorting after interproperty relationships between dimensions had been made salient. Such findings suggest that there may be benefits to explicit explanations that clarify category relations (e.g., the motivations for the extension of the core sense to peripheral senses).

Some empirical research on teaching polysemous words through explicit instruction that highlights the motivation for the target items' semantic network (Csábi, 2004; Tyler et al., 2010) suggests that this finding may be relevant to SLA pedagogy.[87] Explicit instruction of the sort used in the D-P and D-SH conditions would appear to be ideally suited for highlighting such relations between the semantic dimensions and features associated with prepositional senses. While the benefits of such links might be offset by difficulty in recalling complex declarative representations in the D-P condition, the D-SH condition should not have this problem. Future studies should therefore examine whether D-SH is, in fact, superior to the other instructional sequences when longer practice is provided.

[87] Csábi's study had a number of methodological weaknesses, such as the omission of a pretest; hence, the results should be interpreted as tentative.

In the current experiment, both the SH cues and explicit explanations were provided in participants' L1. This was done largely out of methodological considerations. Use of English would have led to differences among participants in their ability to understand the English explanations. This would have resulted in a potential confound, due to the fact that the explanations used in the D-P treatment and the two hybrid conditions were more abstract and were therefore more likely to be misunderstood than the more concrete SH cues.

When considering practical implementations of the SH instruction, a number of arguments can be made for using the target language for the SH cues (or if a D-SH sequence is used, for both the explicit explanations and the SH cues). Of course, many classrooms, especially in an ESL context, have mixed-L1 learners, or they may involve situations in which the instructor is unable to develop materials in learners' L1, so the decision to use only the L2 is often based on imperatives inherent in the learning situation. However, even when the L1 is an option, an argument may be made that classrooms should maximize learners' exposure to L2 input. According to this argument, the resulting inefficiency related to incomplete comprehension of instructional targets is sure to be offset by implicit and incidental learning of untargeted linguistic structures in the input.

In addition, there may be some sound psycholinguistic motivations for using only the L2. When learners access, produce, or translate an L2, they must inhibit the L1 (Abutalebi & Green, 2007; Kroll, Bobb, Misra, & Guo, 2008; Pivneva, Palmer, & Titone, 2012). Inhibitory control is essential in order to ignore irrelevant information and to select less dominant responses while suppressing habitual responses (Linck & Weiss, 2011). The finding that lower proficiency leads to even greater inhibition of the L1 when using the L2 suggests that this inhibition may be especially important during the earlier stages of learning a second language (Levy, McVeigh, Marful, & Anderson, 2007).

This leads to the question of how learners' inhibitory control may be enhanced during instruction. One important finding in this regard is that inhibitory control appears to be stronger when learners are not required to switch back and forth between languages, as is the case in immersion contexts (Kroll, Linck, & Sunderman, 2009). While it would be rash to conclude, based on such findings, that the L1 has no place in instruction (cf. De la Colina & Garcia Mayo, 2009; V. M. Scott & de la Fuente, 2008), an argument may be made that certain instructional treatments may suffer greater interference from L1 use. When learning through SH instruction, for example, inhibitory control might be especially important, as the instruction is designed precisely to overcome deeply entrenched L1-based predispositions to attend to uninformative dimensions of a semantic category. These predispositions may be easier to inhibit when learners' L1 is not used.

An additional consideration, when determining the language to be used in the SH prompt, is the potential effects of activation of L1 or L2 words. Both L1 and L2 lexical items that are associated with the target preposition may activate associated L1 or L2 lexical items or syntactic frames. Because the purpose of the SH cues is to increase the learner's attentional allocations to informative dimensions of the target semantic category, activations based solely on word to word lexical links may be regarded as extraneous to the proposed model of learning that underlies the SH treatment.

The SH cues are designed to strengthen the conceptual links between the L2 word (i.e., the target preposition) and the targeted concept (i.e., the L2 semantic category).

There is some evidence that a speaker's L1 can more readily activate conceptual information (Kroll & De Groot, 1997). More work needs to be done in this area to determine whether theories of bilingual lexical and conceptual representation, such as the Revised Hierarchical Model (Kroll & Stewart, 1994), can be used to make precise and testable predictions regarding the effects of using learners' L1 or L2 for the SH prompts.

Another outstanding issue concerns the degree to which the experiment's instructional sequence led participants to adopt either an analytical or holistic orientation to learning. There is evidence that, while manipulation of instructional task variables appears to have a noticeable effect on analytic versus holistic orientation, verbal instructions to learners to alter their orientation to the task appear to fail (Kemler Nelson, 1984, Experiment 2). Moreover, there is research suggesting that even when task variables are shifted to favor or disfavor rule-based categorization, learners do not always make a complete shift to either a holistic or analytical orientation to the categorization of stimuli. Allen and Brooks (1991), for example, found that similarity of items to previous exemplars continues to impact patterns of learning even when learners perform rule-based classification.

Because the categorization literature in this area is likely to be only partially generalizable to SLA, further L2-related research needs to be conducted to determine the extent to which instructional variables influence learners' orientation and patterns of acquisition when learning either rule-based or family resemblance categories. This may require the use of highly controlled lab experiments. One option is to examine *ab initio* learning of constructed languages in which the category structure of the linguistic targets is completely controlled (for a discussion of methodological considerations when using such artificial languages for research, see Hulstijn, 1997).

Finally, it should be noted that all four experimental treatment groups made significant gains on both measures following an hour of instruction. This suggests that, regardless of the instruction and practice sequence employed, the semantic analysis, based on the Principled Polysemy Approach presented in Tyler and Evans (2003), provided learners with useful insights into the meanings of the targeted prepositions. It may also be that the interactive practice and immediate feedback provided to all four groups during at least part of their instruction was especially effective.

Small function words such as prepositions are often overlooked in instruction, as it is assumed that learners master this word class at early stages in their acquisition. There is ample evidence that prepositions, which appear in virtually every sentence in English, are, in fact, extremely difficult due to their polysemy. Semantic complexity and polysemy are characteristic of many word classes (e.g., prepositions and modals) and frequently occurring lexical items. For this reason, researchers in SLA need to strive toward a more detailed and coherent account of the mechanisms and processes associated with adult acquisition of complex semantic targets. At the same time, they need to identify instructional variables that promote rapid and enduring acquisition. It is hoped that this important work may then influence language pedagogy, providing instructors and learners with better options for tackling complex polysemous structures.

Appendix A

English Preposition Use in NS Corpora (first half)

All counts represent tokens per million words.

	Brown	BNCw	COCAa	COCAm	TIME
all	122,149	116,059	128,010	109,087	119,409
OF	30,971	32,624	38,329	25,795	32,532
IN	18,093	18,921	21,838	17,506	20,353
TO	9,413	10,578	10,988	9,641	10,395
FOR	8,071	9,086	8,992	8,729	9,239
WITH	6,200	6,957	6,771	7,335	6,613
ON	5,606	6,144	5,656	6,313	6,157
AT	4,568	5,393	3,253	4,454	4,673
BY	4,512	5,547	5,512	4,320	5,773
FROM	3,717	4,560	4,400	4,263	4,576
INTO	1,522	1,667	1,274	1,820	1,828
ABOUT	1,093	1,276	1,382	1,806	1,265
THROUGH	789	649	915	837	783
OVER	807	474	623	782	805
BETWEEN	620	983	1,426	570	558
AFTER	908	777	580	826	1,015
UNDER	601	568	470	372	609
AGAINST	533	597	434	423	745
DURING	498	476	793	542	534
WITHOUT	496	476	460	471	464
WITHIN	305	474	637	262	229
ABOVE	183	144	97	135	112

Appendix B

English Preposition Use in NS Corpora (second half)

All counts represent tokens per million words.

	COCAn	COCf	COCAs	BNCs	BASE
all	106,861	95,260	90,313	71,373	N/A[88]
OF	23,654	19,193	20,621	16,594	29,089
IN	18,465	13,153	15,388	11,379	17,622
TO	9,269	9,314	8,536	7,633	8,680
FOR	9,221	6,297	7,449	6,397	5,247
WITH	6,673	6,779	5,712	4,516	4,578
ON	6,385	6,421	6,099	4,608	4,704
AT	5,255	5,316	3,727	4,571	4,739
BY	3,971	2,314	2,273	1,625	2,965
FROM	4,163	4,044	3,450	2,315	3,397
INTO	1,410	2,610	1,173	1,057	1,657
ABOUT	1,888	2,101	3,650	2,504	3,999
THROUGH	756	1,158	600	497	864
OVER	765	928	640	483	506
BETWEEN	478	428	360	361	942
AFTER	1,034	733	698	455	350
UNDER	407	471	309	224	327
AGAINST	601	567	489	258	284
DURING	548	197	271	151	188
WITHOUT	393	506	286	225	247
WITHIN	188	135	163	249	473
ABOVE	79	191	44	49	84

[88] The POS search functions provided in the BASE corpus made it difficult to calculate a total count for all prepositions, so no total is available for this corpus.

Appendix C

English Preposition Use in ICLE (Germanic Languages)

All counts represent tokens per million words.

	Dutch	German	Norwegian	Swedish
all	105,144	103,326	100,316	102,810
OF	28,737	25,844	23,408	26,091
IN	19,122	16,713	19,076	19,487
TO	8,136	8,420	7,811	9,027
FOR	8,577	8,765	9,557	7,929
WITH	5,759	6,526	6,207	6,452
ON	5,239	5,495	4,919	4,473
AT	2,602	3,880	2,858	2,618
BY	4,526	3,956	3,116	3,196
FROM	2,787	3,017	3,025	3,434
INTO	1,083	1,732	1,069	1,276
ABOUT	2,567	2,473	2,548	2,926
THROUGH	445	741	678	590
OVER	392	533	420	406
BETWEEN	955	599	644	1,049
AFTER	1,052	1,234	945	665
UNDER	295	229	138	195
AGAINST	898	614	544	492
DURING	436	579	635	530
WITHOUT	762	1,082	969	979
WITHIN	207	229	339	357
ABOVE	53	147	57	65

Appendix D

English Preposition Use in ICLE (Romance Languages)

All counts represent tokens per million words.

	French	Italian	Spanish
all	108,657	109,014	108,241
OF	33,887	33,338	34,495
IN	17,859	19,997	20,140
TO	8,576	7,914	8,789
FOR	7,078	7,713	6,104
WITH	5,315	5,709	6,079
ON	4,946	4,203	3,298
AT	3,162	2,185	2,426
BY	4,353	4,810	4,613
FROM	3,256	3,582	2,720
INTO	941	880	781
ABOUT	1,903	2,195	2,228
THROUGH	921	932	710
OVER	244	320	284
BETWEEN	1,716	1,114	1,269
AFTER	629	531	513
UNDER	265	234	279
AGAINST	499	1,081	655
DURING	603	636	614
WITHOUT	983	1,368	1,045
WITHIN	281	91	183
ABOVE	114	225	157

Appendix E

English Preposition Use in ICLE (Slavic Languages)

All counts represent tokens per million words.

	Russian	Czech	Polish	Bulgarian
all	103,757	99,711	108,379	104,497
OF	33,331	28,857	34,307	30,550
IN	16,817	16,577	16,741	18,735
TO	8,077	7,508	9,106	8,813
FOR	8,464	8,806	7,686	9,195
WITH	5,368	5,736	5,967	6,600
ON	4,488	4,664	5,259	4,191
AT	2,562	2,822	2,488	2,625
BY	3,525	3,447	4,421	3,167
FROM	3,198	3,178	3,491	2,966
INTO	1,438	1,045	1,311	1,606
ABOUT	2,921	3,318	2,263	1,686
THROUGH	290	393	469	642
OVER	544	296	452	381
BETWEEN	613	749	769	773
AFTER	617	840	738	547
UNDER	299	269	195	166
AGAINST	553	544	525	301
DURING	447	587	421	216
WITHOUT	1,415	1,066	864	1,059
WITHIN	138	151	187	35
ABOVE	32	92	91	80

Appendix F

English Preposition Use in ICLE (Non-Indo-European Languages)

All counts represent tokens per million words.

	Chinese	Finnish	Turkish	Japanese	Tswana
all	106,753	102,774	103,262	91,515	102,603
OF	29,227	29,601	24,459	21,393	24,200
IN	21,060	19,700	21,119	18,155	17,651
TO	8,823	8,191	8,393	8,091	9,569
FOR	8,854	8,037	9,755	7,718	9,771
WITH	2,920	4,852	4,991	5,090	6,347
ON	5,733	4,527	4,142	3,682	2,879
AT	1,961	1,992	2,868	2,759	3,993
BY	4,272	3,212	3,873	4,464	5,077
FROM	4,491	2,972	3,645	3,264	3,590
INTO	1,430	1,060	606	802	711
ABOUT	1,709	2,413	2,775	2,966	2,465
THROUGH	686	463	295	449	424
OVER	303	383	326	641	277
BETWEEN	791	841	953	636	242
AFTER	1,045	831	1,056	883	832
UNDER	291	186	337	141	277
AGAINST	445	703	409	368	373
DURING	570	469	404	303	408
WITHOUT	447	1,023	994	1,170	1,064
WITHIN	113	192	62	96	166
ABOVE	57	96	36	55	35

Appendix G: Questionnaire

1. How old are you? ________

2. Have you ever lived in an English-speaking country? (Circle one.) Yes No
If the answer's "yes," how old were you when you lived there? ___________
Also, how long did you live there (how many years and months)?
______ years _______ months

3. What language did you use at home while you were growing up? _________________

4. What's your father's native language? __________________

5. What's your mother's native language? __________________

6. How many years did you study English in school? __________________

7. What's the highest degree/year of education that you have completed (circle one)?

B.A. Degree (years completed):	1	2	3	4	completed
Master's Degree: (years completed):	1	2			completed
PhD:	current student				graduate

Appendix H

Fill-in-the-Blank Test: Form A

Directions: ***Circle*** *the best choice from the possible answers that are listed above each set of items. Choose only* ***one*** *answer. If more than one answer is possible, choose the* ***best*** *possible response based on the meaning of the sentence and the picture. If no answer fits with the sentence, choose the "none of the above" response.*

Example:

ABOVE, AFTER, AT, BY, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO none of the above	
David got __ a bad accident while riding his bike.	[Picture: A young man riding down a sleep slope begins to fall from his mountainbike.][89]

You should have given the following response:

Example:

ABOVE, AFTER, AT, BY, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO none of the above	
David got __ a bad accident while riding his bike.	[Picture: A young man riding down a sleep slope begins to fall from his mountain bike.]

Although IN is also possible, INTO is probably most natural here, so INTO should have been your response. Let's try another practice item.

Example:

ABOVE, AFTER, AT, FOR, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, UPON, VIA none of the above	
If you can't swim very well, you should probably walk __ the lake.	[Picture: A man approaches a wide lake.]

You should have chosen the following response:

Example:

ABOVE, AFTER, AT, FOR, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, UPON, VIA none of the above	
If you can't swim very well, you should probably walk __ the lake.	[Picture: A man approaches a wide lake.]

AROUND would be the best answer here, but the word AROUND didn't appear in the options, so "none of the above" is the best response. None of the other options sound natural or make sense within the context of the sentence.

The test will now begin.

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[89] In the actual materials, pictures were shown with each item.

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ONTO, OVER, PER, TO, WITH **none of the above**	
1. Our old table was ugly, so we put a tablecloth ▓ it. **OVER-covering**	[Picture: A table has a tablecloth over it.]

ABOVE, AT, BELOW, BEYOND, DOWN, FOR, IN, OF, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
2. The stone sank ▓ the bottom of the lake. **TO-limit**	[Picture: A pebble begins to sink.]

ABOUT, AMONG, AT, BY, FOR, FROM, IN, ON, ONTO, OVER, TO, VIA, WITH, WITHOUT **none of the above**	
3. The stock is currently trading ▓ its lowest level this year. **AT-measure**	[Picture: A chart shows initial gains followed by a sharp drop.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, TOWARD **none of the above**	
4. The artist was ▓ need of inspiration, so he went to the beach. **IN-state**	[Picture: A man stands on a beach, painting on an easel.]

ABOVE, AMONG, AT, BETWEEN, FOR, FROM, IN, INTO, OF, ON, OVER, TO, VIA, WITH **none of the above**	
5. Type 2 diabetes is common ▓ people who eat too much sugar. **distractor-among**	[Picture: Sugar cubes are stacked on a spoon.]

ABOVE, AT, BENEATH, DOWN, FOR, FROM, IN, INTO, OF, ON, OVER, TO, VIA, WITH **none of the above**	
6. When John plays with his sister, he kicks the ball ▓ her and she kicks it back. **TO-giving**	[Picture: A boy kicks a soccer ball to a younger girl.]

ABOVE, AFTER, AT, BY, FOR, FROM, IN, INTO, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
7. When the jailer wasn't looking, the prisoners made a dash ▓ the open door. **FOR-oblique-intention**	[Picture: A prisoner in a cell whispers to a prisoner passing on the other side of the bars. The passing prisoner glances furtively out of the corner of his eye.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, WITH **none of the above**	
8. The table's piled ▓ magazines. **WITH-theme**	[Picture: Magazines are stacked up on a table next to a coffee cup.]

ABOUT, AFTER, AMONG, AT, BY, FOR, FROM, IN, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
9. When the woman lost all her data, she cursed ▓ the computer. **AT-intended-collocation**	[Picture: Glaring at her computer, a woman grits her teeth in an expression of deep consternation. At the same time, she turns her arms upward in a gesture of profound frustration.]

ABOUT, AMONG, AT, BY, FOR, FROM, IN, INTO, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
10. The man went to the pharmacy ▓ some aspirin. **FOR-purpose**	[Picture: In a pharmacy, a middle-aged man consults with a white-robed pharmacist.]

ABOVE, AT, BEYOND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO, WITH **none of the above**	
11. South-Korean troops are ▓ patrol at the border. **ON-state**	[Picture: Two soldiers with rifles stand guard in front of concertina wire.]

ABOVE, AROUND, AT, BETWEEN, FOR, FROM, IN, INTO, OF, ON, OVER, TO, VIA, WITH **none of the above**	
12. Regardless of their position, wealth or status, nobody in a democracy is ▓ the law. **ABOVE-beyond-influence**	[Picture: Three federal agents escort Bernard Madoff in front of a large financial firm.]

ABOUT, AROUND, AT, BY, FOR, FROM, IN, INTO, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
13. This apartment is not big enough ▓ me. **FOR-situational-valence**	[Picture: A young man stands in the narrow hallway of a very small studio apartment.]

ABOVE, AT, BELOW, BEYOND, DOWN, FOR, FROM, IN, OF, ON, OVER, TO, VIA, WITH **none of the above**	
14. He put his ear ▓ the wall. **TO-contact**	[Picture: Leaning against the wall of a room, a man puts his ear against the wall.]

ABOUT, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
15. She has a reputation ▓ being late. **FOR-grounds**	[Picture: A woman in professional attire glances at her watch as she ascends the steps of a building.]

ABOUT, AMONG, AT, FOR, FROM, IN, INTO, OF, ON, ONTO, PER, TO, TOWARD, WITH **none of the above**	
16. Black widow spiders can be identified by the red hour-glass shape ▓ the underside of their abdomen. **ON-visual-feature**	[Pictures: Two pictures show a black widow. One shows the hourglass shape on the abdomen. The other shows the spider from the side with the red patch barely visible.]

ABOUT, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, UPON, VIA **none of the above**	
17. Bruce Springsteen campaigned ▓ Obama in the 2008 election. **FOR-benefit**	[Pictures: Bruce Springsteen holds a guitar as he stands on a stage with Obama.]

ABOVE, AT, BELOW, DOWN, FOR, FROM, IN, INTO, OF, ON, OVER, TO, VIA, WITH **none of the above**	
18. The horse was chained ▓ the ground. **TO-attachment**	[Picture: A horse, which has been chained to the ground, rears up.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA **none of the above**	
19. NASA retired the Space Shuttle in 2011. It's now seeking a possible replacement ▓ it. **FOR-proxy**	[Picture: The space shuttle sits next to a large hangar. A crowd stands in front of it.]

ABOVE, AT, BELOW, BEYOND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, TO, WITH **none of the above**	
20. She saw the singer for the first time ▓ YouTube. **ON-support-for-activity**	[Picture: A girl watches a YouTube video of a singer.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO **none of the above**	
21. My neighbor swapped his horse ▓ a car. **FOR-exchange**	[Picture: A man stands with his horse in a parking lot with many cars.]

ABOVE, ABOUT, AT, DOWN, FROM, IN, INTO, OF, ON, OVER, TO, UPON, VIA, WITH **none of the above**	
22. The Antarctic landscape is inhospitable ▓ nearly all animals. **TO-affecting-attitude/action**	[Picture: The sun is faintly visible over a frozen Antarctic landscape.]

ABOVE, ABOUT, AT, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH **none of the above**	
23. His son needed some help ▓ his homework. **distractor-with**	[Picture: A man sits at a table with a young boy. The man points to an open textbook.]

ABOVE, ABOUT, ALONG, AT, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH **none of the above**	
24. My brother doesn't believe in global warming. I can't understand him! ▓ me, it's a really serious problem that requires global action. **TO-perception**	[Picture: Two men sit at a table. One appears to be talking. The other listens as he rubs his chin.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, OVER, PER, TO, VIA, WITH **none of the above**	
25. Personality has the most influence ▓ who we'll marry. **OVER-control**	[Picture: A couple sits at a bar. The man smiles at the woman.]

ABOVE, ABOUT, AT, FOR, FROM, IN, INTO, OF, OFF, ONTO, OVER, PER, TO, WITH **none of the above**	
26. ▓ her cute looks and attractive smile, my cousin always gets her way. **WITH-instrumental**	[Picture: A young coquette smiles in a flirtatious manner.]

ABOVE, AT, BY, BEFORE, DOWN, FOR, FROM, IN, INTO, OF, OVER, PER, TO, WITH **none of the above**	
27. The man gestured ▓ his fans, asking them to quiet down so that he could talk. **TO-giving**	[Picture: An athlete standing before a crowd gestures with his hands half raised and his palms turned down. He is calling for the crowd to be quiet.]

ABOUT, ABOVE, AROUND, AT, FOR, IN, INTO, OF, ON, ONTO, OVER, PER, UNTIL, WITH **none of the above**	
28. When my friend was 20 years old, he took off ▓ India to study yoga, but on his way there, he met a Japanese lady and ended up living with her in Japan. **FOR-oblique-intention**	[Picture: A blond man stands in front of a lake with his arm around an Asian woman.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, WITH **none of the above**	
29. Music played ▓ high volumes can damage your hearing. **AT-measure**	[Picture: An abstract image shows a young man wearing headsets. Numerous musical notes are flying out of his ears.]

ABOUT, ABOVE, AT, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, UNTIL, WITH **none of the above**	
30. She's training ▓ the Olympics. **FOR- purpose**	[Picture: A woman in a gym is lifting weights.]

ABOVE, AT, BY, BEFORE, DOWN, FOR, FROM, IN, INTO, OF, OVER, PER, TO, WITH **none of the above**	
31. The workers say that the company has been very good ▓ them during the last ten years. **TO-affecting-attitude/action**	[Picture: An older man in a suit poses in the middle of six younger men and women in business suits. They are all smiling.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, TOWARD, WITH **none of the above**	
32. Marilyn Monroe did a special performance ▓ U.S. troops in Korea. **FOR-benefit**	[Picture: Marilyn Monroe stands on a stage holding a microphone in front of U.S. troops.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH none of the above	
33. I heard you recently had an operation. If you're still ▓ pain, you should talk to a doctor. **IN-state**	[Picture: A woman hunches over as if in pain.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH none of the above	
34. George received a bonus ▓ his excellent work last year. **FOR-exchange**	[Picture: An abstract picture shows a man giving a lecture in front of a chart. The chart's lines all indicate positive growth.]

ABOVE, AT, BEFORE, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH none of the above	
35. As he gets older, Tracy Morgan is starting to get a few lines ▓ his forehead. **ON-visual-feature**	[Picture: Tracy Morgan smiles. Lines on his brow are visible.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, INTO, OF, OFF, THROUGH, TO, VIA, WITH none of the above	
36. He held the purple wire ▓ the black wire. **TO-contact**	[Picture: A purple wire is held so that it is in contact with a black wire.]

ABOVE, AFTER, AROUND, AT, BY, FOR, IN, OF, OFF, ON, OVER, TO, UPON, WITH none of the above	
37. The bear moved quickly with the cub trailing ▓ her. **distractor-after**	[Picture: A cub follows a larger bear along a forest path.]

ABOVE, ACROSS, AT, BY, FROM, IN, OF, ON, OVER, PER, THROUGH, TO, UP, UPON none of the above	
38. In the 1900s, Americans always wrote letters ▓ cursive. **distractor-in**	[Picture: An old letter is shown. The letter is written in cursive.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, OF, OFF, ON, OVER, THROUGH, TO, WITH none of the above	
39. During processing, the coal is crushed ▓ a fine dust. **TO-limit**	[Picture: Near a large coal plant, large piles of black coal are visible.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, WITH none of the above	
40. The 2012 Prius is ▓ show at the local Prius dealership. **ON-state**	[Picture: A shiny Prius is shown on a showroom floor.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, VIA, WITH none of the above	
41. There's no excuse ▓ her bad behavior. **FOR-grounds**	[Picture: While pulling her pigtails, a girl sticks her tongue out. She is throwing a tantrum.]

ABOVE, AT, BY, BEFORE, DOWN, FOR, FROM, IN, INTO, OF, PER, TO, VIA, WITH **none of the above**	
42. Many war medals were pinned ▓ the man's chest. **TO-attachment**	[Picture: An officer poses with many medals pinned to his uniform.]

ABOVE, ACROSS, AT, BY, DOWN, FOR, FROM, IN, OF, ON, OVER, PER, TO, WITH **none of the above**	
43. The streets are lined ▓ vendors selling fruits and vegetables. **WITH-theme**	[Picture: A street of a Southeast Asian food market is lined with fruit and vegetable vendors.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO, WITH **none of the above**	
40. College is becoming a basic qualification ▓ young people seeking jobs. **FOR-situational-valence**	[Picture: A graduation cap lies next to a rolled up diploma with a ribbon around it.]

ABOVE, AT, BESIDE, BY, IN, OF, OFF, ON, OVER, PER, TO, UP, UPON, VIA **none of the above**	
45. ▓ our arrival, my sister came out to greet us. **distractor-upon**	[Picture: A smiling woman with arms opened wide greets another woman.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, TO, TOWARD, WITH **none of the above**	
46. Stephen Hawking is paralyzed and can't speak, so a computer speaks ▓ him when he gives presentations. **FOR-proxy**	[Picture: Stephen Hawkins smiles as he sits in his wheelchair with a computer monitor behind him.]

ABOVE, ACROSS, AT, BESIDE, BY, FOR, FROM, IN, OF, OFF, ON, OVER, TO, UPON **none of the above**	
47. She really didn't like someone looking ▓ her shoulder as she worked. It made her nervous. **OVER-influence**	[Picture: A man leans over a woman sitting in front of a computer. She appears to be surprised and uncomfortable.]

ABOVE, AT, BY, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, UPON, WITH, WITHOUT **none of the above**	
48. We stood ▓ the entire concert. **distractor-through**	[Picture: A stadium is full of people. Those in front are standing.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, OFF, ON, OVER, PER, TO, UPON, WITH **none of the above**	
49. The hippo tested the water ▓ its toe before jumping in. **WITH-instrument**	[Picture: A cartoon hippo with children's flotation devices on its arms sticks its toe in a small pond to test the temperature of the water.]

ABOVE, AT, BESIDE, BY, FOR, FROM, OF, OFF, ON, OVER, PER, TO, UPON, WITH **none of the above**	
50. I don’t like the way women look when they have hair hanging down ▓ their eyes. **OVER-covering**	[Picture: An Asian girl poses. Her hair hangs down, completely obscuring her eyes.]

ABOVE, ALONG, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, THROUGH, TO, WITH **none of the above**	
51. She came across a great deal ▓ eBay. **ON-support-for-activity**	[Pictures: The picture on the left shows a young lady sitting on her couch staring at her computer screen with avid attention. The picture on the right shows an eBay advertisement for a purse.]

ABOVE, ALONG, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, THROUGH, TO, WITH **none of the above**	
52. She unexpectedly came ▓ some money, and now her boyfriend suddenly wants to marry her. **distractor-into**	[Picture: An elated woman holds out her hands, showing her cash winnings.]

ABOUT, ABOVE, AMONG, AT, BY, FROM, IN, INTO, OF, OFF, OVER, PER, TO, WITH **none of the above**	
53. The parking regulations in the city are confusing ▓ many people, especially tourists. **TO-perception**	[Picture: A cartoon shows a man using a parking meter. He appears to be upset and confused.]

ABOVE, ACROSS, AT, BESIDE, BY, FOR, IN, OF, OFF, ON, OVER, TO, UP, UPON **none of the above**	
54. The math scores of students in Singapore are far ▓ the scores of U.S. students. **ABOVE-beyond-influence**	[Picture: An older Asian lady helps a young Asian girl with her math worksheet.]

ABOUT, ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OFF, ON, ONTO, OVER, TO, WITH **none of the above**	
55. The dog growled ▓ the boy. **AT-intended-collocation**	[Picture: A small dog bears its teeth at a man. The man leans back in fear.]

Appendix I

Fill-in-the-Blank Test: Form B

Directions: ***Circle*** *the best choice from the possible answers that are listed above each set of items. Choose only* ***one*** *answer. If more than one answer is possible, choose the* ***best*** *possible response based on the meaning of the sentence and the picture. If no answer fits with the sentence, choose the "none of the above" response.*

Example:

ABOVE, AFTER, AT, BY, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO none of the above	
David got __ a bad accident while riding his bike.	[Picture: A young man riding down a sleep slope begins to fall from his mountainbike.][90]

You should have given the following response:

Example:

ABOVE, AFTER, AT, BY, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO none of the above	
David got __ a bad accident while riding his bike.	[Picture: A young man riding down a sleep slope begins to fall from his mountain bike.]

Although IN is also possible, INTO is probably most natural here, so INTO should have been your response. Let's try another practice item.

Example:

ABOVE, AFTER, AT, FOR, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, UPON, VIA none of the above	
If you can't swim very well, you should probably walk __ the lake.	[Picture: A man approaches a wide lake.]

You should have chosen the following response:

Example:

ABOVE, AFTER, AT, FOR, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, UPON, VIA none of the above	
If you can't swim very well, you should probably walk __ the lake.	[Picture: A man approaches a wide lake.]

AROUND would be the best answer here, but the word AROUND didn't appear in the options, so "none of the above" is the best response. None of the other options sound natural or make sense within the context of the sentence.

The test will now begin.

---

[90] In the actual materials, pictures were shown with each item.

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ONTO, OVER, PER, TO, VIA **none of the above**	
1. If you keep behaving badly ▓ your brother, you won't be able to go to the movie with your friends this weekend. **TO-affecting-attitude/action**	[Picture: A woman berates her daughter, waving her finger at her. The daughter buries her head in her hands.]

ABOVE, AT, BELOW, BEYOND, DOWN, FOR, IN, OF, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
2. We drove down the mountain but eventually had to stop because of the giant boulder and fallen trees that were ▓ our way. **distractor-in**	[Picture: A boulder and scattered limbs lie in the road.]

ABOUT, ABOVE, AMONG, AT, BY, FOR, FROM, IN, ON, ONTO, OVER, TO, VIA, WITHOUT **none of the above**	
3. Wittgenstein built a house ▓ his sister. **FOR-benefit**	[Pictures: On the left is a picture of Wittgenstein. On the right is a picture of the house he built for his sister.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, TOWARD **none of the above**	
4. They kept having bad luck. It was as if a dark cloud lay ▓ their family. **OVER-control**	[Picture: Dark storm clouds form.]

ABOVE, AMONG, AT, BETWEEN, FOR, FROM, IN, OF, OFF, ON, OVER, TO, VIA, WITH **none of the above**	
5. The European Union is ▓ danger of breaking up. **IN-state**	[Picture: The EU flag is shown, with a rip forming in the center.]

ABOVE, AT, BENEATH, DOWN, FOR, FROM, IN, INTO, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
6. This gene is a marker ▓ lung cancer. **FOR-proxy**	[Pictures: The picture on the left shows a double helix with brackets indicating a particular segment. The picture on the right shows a white lump in an X-ray scan of the lungs.]

ABOVE, AFTER, AGAINST, BY, FOR, IN, ON, ONTO, OVER, PER, TO, VERSUS, VIA, WITH **none of the above**	
7. Early ships couldn't sail ▓ the wind. **distractor-against**	[Picture: An ancient sailing vessel sets out to sea.]

ABOVE, AT, DOWN, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, TOWARD, WITH **none of the above**	
8. The man waved ▓ the flies buzzing around his food. **AT-intended-collocation**	[Picture: A man with a frustrated expression swats flies. On the ground next to him is a picnic basket.]

ABOUT, AFTER, AMONG, AT, BY, FOR, FROM, IN, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
9. She gently put the flower ▓ her nose. **TO-contact**	[Picture: A child smells a flower. The flower is positioned just centimeters away from her nose.]

ABOUT, AMONG, AT, BY, FOR, FROM, IN, ON, ONTO, OVER, TO, UP, VIA, WITH **none of the above**	
10. He nailed the board ▓ the ceiling. **TO-attachment**	[Picture: A woman nails a long board to the ceiling where the ceiling meets the top of a wall.]

ABOVE, AT, BEYOND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO, WITH **none of the above**	
11. Her dog does tricks ▓ tasty treats. **FOR-exchange**	[Picture: A woman holds up a treat as her dog stands on its heels with its paws raised.]

ABOVE, AT, BETWEEN, FOR, FROM, INTO, OF, ON, OVER, PER, TO, UPON, VIA, WITH **none of the above**	
12. She checked to see if she had received any calls ▓ her cellphone**.** **ON-support-for-activity**	[Picture: A person's thumb presses one of the digits on a cellphone. The cellphone screen is visible.]

ABOUT, AROUND, AT, BY, FOR, FROM, IN, INTO, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
13. His parents always urged him to work ▓ his highest potential. **TO-limit**	[Picture: A beaming college graduate donning a cap and gown is flanked by his smiling parents.]

ABOVE, AT, BELOW, BEYOND, DOWN, FOR, FROM, IN, OF, ON, OVER, TO, VIA, WITH **none of the above**	
14. The lion made a sudden leap ▓ the blue bird, which was clearly beyond the lion's reach. **FOR-oblique-intention**	[Picture: A lion leaps up, trying to catch a bluebird perched on a bridge above. The bluebird is clearly out of reach.

ABOUT, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, VIA, WITH **none of the above**	
15. Michael flashed a victory sign ▓ the crowd**.** **TO-giving**	[Picture: Michael Jackson flashes a peace sign.]

ABOUT, ABOVE, AMONG, AT, FOR, FROM, IN, OF, ON, ONTO, PER, TO, UPON, WITH **none of the above**	
16. The thief tiptoed ▓ the house, being careful not to wake anyone. **distractor-about**	[Picture: A thief wearing a mask furtively tiptoes while toting a bag.]

ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, UPON, VIA **none of the above**	
17. We live on the 2nd floor. She lives ▓ us on the 10th floor. **ABOVE-beyond-influence**	[Picture: High-rise apartments rise into the sky.]

ABOVE, AT, BELOW, DOWN, FOR, FROM, IN, INTO, OF, ON, OVER, TO, VIA, WITH **none of the above**	
18. When he gave me a special price on the stock, I grew suspicious. Something about the deal didn't smell right ▓ me. **TO-perception**	[Picture: A businessman with slicked back hair gestures toward a younger man as if to explain something.]

ABOUT, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH **none of the above**	
19. Water boils ▓ 100 degrees Celsius. **AT-measure**	[Picture: Water boils in a glass pot. Next to the pot, a thermometer reads 100 degrees Celsius.]

ABOVE, AT, BELOW, BEYOND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, TO, WITH **none of the above**	
20. Air pollution's a serious problem ▓ people living in large cities. **FOR-situational-valence**	[Picture: A Beijing street is shown in a heavy haze.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO **none of the above**	
21. Penny and her friends had Chinese food ▓ lunch. **FOR- purpose**	[Picture: Five friends sit around an apartment eating take-out food.

ABOVE, ABOUT, AT, DOWN, FROM, IN, INTO, OF, ON, OVER, TO, UPON, VIA, WITH **none of the above**	
22. He opened the letter ▓ a knife. **WITH-instrumental**	[Picture: A graphic shows a knife opening a letter.]

ABOVE, ABOUT, AT, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH **none of the above**	
23. Marilyn Monroe had a small mole ▓ her cheek. **ON-visual-feature**	[Picture: Marilyn Monroe's face is shown with her distinctive mole.

ABOVE, ABOUT, ALONG, AT, FROM, IN, INTO, OF, ON, OVER, PER, TO, VIA, WITH **none of the above**	
24. The mother and daughter walked ▓ the beach. **distractor-along**	[Picture: A woman and her daughter walk along a beach.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, OVER, PER, TO, VIA, WITH
none of the above

25. The ship's captain has been criticized ▓ abandoning the ship before his passengers were all safe. **FOR-grounds**	[Picture: On the left, a picture shows the Costa Concordia sinking. On the right, Captain Schettino is wearing handcuffs. He is surrounded by police officers.]

ABOVE, ABOUT, AT, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO, WITH
none of the above

26. The workers are ▓ strike. **ON-state**	[Picture: Striking workers stand outside a building holding protest signs.]

ABOVE, AT, BEFORE, DOWN, FOR, FROM, IN, INTO, OF, ON, OVER, PER, TO, WITH
none of the above

27. In his new home, the cat was surrounded ▓ dogs. **WITH-theme**	[Picture: A cartoon shows a startled cat surrounded by dogs.]

ABOUT, ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, ON, OVER, PER, UNTIL, WITH
none of the above

28. More and more school-age children suffer ▓ poor social interactions and emotional problems. **distractor-from**	[Picture: A young teen girl sits at her desk out in the hall. She looks depressed and bored.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, WITH
none of the above

29. There are no guarantees ▓ 14,000 feet. Anything can happen. **AT-measure**	[Picture: A man stands on a peak of a snowy mountain.]

ABOUT, ABOVE, AT, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, UNTIL, WITH
none of the above

30. ▓ newlyweds, communication is crucially important. **FOR-situational-valence**	[Picture: Two newlyweds pose. The woman wears a wedding gown.]

ABOVE, AROUND, AT, BY, BEFORE, DOWN, FOR, INTO, OF, ON, OVER, PER, TO, WITH
none of the above

31. When hiking, I often drink water ▓ my hands. **WITH-instrumental**	[Picture: A person's cupped hands are shown immersed in the water of a stream.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, ONTO, OVER, TO, WITH
none of the above

32. The Louisiana government is favorable ▓ new businesses that want to move to the state. **TO-affecting-attitude/action**	[Picture: The Lousiana governer sits in a chair during an interview. As he talks, his hand is extended in a benevolent gesture.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH **none of the above**	
33. I feel very grateful ▓ all the help my father gave me when I was growing up. **FOR-grounds**	[Picture: A girl is shown studying with her father.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH **none of the above**	
34. Bill's department has authority ▓ purchases. **OVER-control**	[Picture: A man in an office sits in front of a computer, talking on the phone.]

ABOVE, AT, BEFORE, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH **none of the above**	
35. She brought her finger ▓ her lips and told us to be quiet. **TO-contact**	[Picture: A woman holds her finger to her lips as if telling her interlocutor to be quiet.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, INTO, OF, OFF, THROUGH, TO, VIA, WITH **none of the above**	
36. He had an iPod clipped ▓ his pocket. **TO-attachment**	[Picture: An iPod is shown clipped to someone's back jean pocket.]

ABOVE, AFTER, AROUND, AT, BY, FOR, IN, INTO, OFF, ON, OVER, TO, UPON, WITH **none of the above**	
37. A large truck crashed ▓ the house. **distractor-into**	[Picture: A large truck has crashed into a house. Two workers with orange vests examine the wreck.]

ABOVE, ACROSS, AT, BY, FROM, IN, OF, ON, OVER, PER, THROUGH, TO, UP, UPON **none of the above**	
38. He heard about the incident ▓ the evening news. **ON-support-for-activity**	[Picture: A man watches the news on a TV in a bar.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, OF, OFF, ON, OVER, THROUGH, TO, WITH **none of the above**	
39. After spending a lovely summer in France, Mary slowly got her things together and departed ▓ home. **FOR-oblique-intention**	[Picture: A cartoon shows a woman folding clothes. A suitcase sits on the bed in front of her.]

ABOVE, AROUND, AT, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, WITH **none of the above**	
40. Our professor's office is always stacked ▓ books. **WITH-theme**	[Picture: Books are stacked haphazardly on a table in front of a bookshelf.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, TO, VIA, WITH
none of the above

41. The protester taped a dollar bill ▓ his mouth to show that corrupt banks and politicians had silenced the average citizen
OVER-covering

[Picture: An Occupy Wall Street protester stands in a protest with a dollar bill taped across his mouth.]

ABOVE, AT, BY, BEFORE, DOWN, FROM, IN, INTO, OF, OVER, PER, TO, VIA, WITH
none of the above

42. The man sang a song ▓ his girlfriend.
TO-giving

[Picture: A cartoon shows a man serenading a woman on a balcony above him. The moon is visible in the distance.

ABOVE, AT, BY, DOWN, FOR, FROM, IN, OF, ON, ONTO, OVER, PER, TO, WITH
none of the above

43. The fish has some red coloration ▓ its tail.
ON-visual-feature

[Picture: A distinctive tropical fish is shown with dark red on its tail.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, ON, ONTO, OVER, PER, TO, WITH
none of the above

44. The court system ensures justice ▓ all.
FOR-benefit

[Picture: A statue, representing justice, sits in front of the U.S. Supreme Court.]

ABOVE, BEHIND, BY, FOR, IN, OF, OFF, OVER, PER, TO, UP, UPON, VIA, WITHIN
none of the above

45. If you have too much to drink, you should have somebody else drive ▓ you.
FOR-proxy

[Picture: A woman holding a wine glass hands a man her car keys.]

ABOVE, AT, BEHIND, FOR, FROM, IN, INTO, OF, OFF, ON, OVER, TO, TOWARD, VIA
none of the above

46. Even ▓ death, Lenin has continued to be influential.
IN-state

[Picture: Lenin lies in state.]

ABOVE, ACROSS, AT, BESIDE, BY, FOR, FROM, IN, OF, OFF, ON, OVER, TO, UPON
none of the above

47. The Williams sisters have worked hard to get ▓ the top of their field.
TO-limit

[Picture: The Williams sisters high-five after a tennis match.]

ABOVE, AT, BY, IN, INTO, OF, OFF, ON, OVER, THROUGH, TO, UPON, WITH, WITHOUT
none of the above

48. Looking closely, we could see some small birds hiding in the cliff ▓ us.
ABOVE-no-influence

[Picture: Birds nest in crevices in a high cliff. The picture is taken from far below.]

ABOVE, AT, BY, DOWN, FOR, FROM, IN, OFF, ON, OVER, PER, TO, UPON, WITH **none of the above**	
49. Greg's future father-in-law insisted that he take a lie-detector test before marrying his daughter. The situation felt extremely uncomfortable ▓ Greg. **TO-perception**	[Picture: A younger man is hooked to a lie-detector test. An older man in informal attire looks at the results.]

ABOVE, AT, BESIDE, BY, FOR, FROM, OF, OFF, ON, OVER, PER, TO, UPON, WITH **none of the above**	
50. If a ship's captain falls asleep ▓ his watch, he must take full responsibility if a disaster subsequently happens. **ON-state**	[Picture: A ship carrying oil is on fire at sea.]

ABOVE, ALONG, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, THROUGH, TO, WITH **none of the above**	
51. My mother puts a mesh tent ▓ our food to keep flies from landing on it. **OVER-covering**	[Picture: A small mesh cover sits over picnic food on a table.]

ABOVE, ALONG, AT, BY, FOR, FROM, IN, INTO, OF, ON, OVER, THROUGH, TO, WITH **none of the above**	
52. Our company will give you an especially low price ▓ being such a loyal customer during the last 20 years. **FOR-exchange/grounds**	[Picture: Two men shake hands in an office.]

ABOUT, ABOVE, AT, BY, FOR, FROM, IN, INTO, OF, OFF, OVER, PER, TO, WITH **none of the above**	
53. ▓ a change in scenery, he traveled to Italy. **FOR- purpose**	[Picture: A man leans over a fence on a winter day. In his thought bubble, there is a sunny coastal scene.]

ABOVE, ACROSS, AT, BESIDE, BY, FOR, IN, INTO, OFF, ON, OVER, TO, UP, UPON **none of the above**	
54. Last week she saw a cat chasing a small black bird. She saved the bird by tossing sticks ▓ the cat. **AT-intended-collocation**	[Picture: A cat is about to catch a bird. The bird is flapping its wings to get away.]

ABOVE, AT, FOR, FROM, IN, INTO, OFF, ON, ONTO, OVER, TO, TOWARD, UPON, WITH **none of the above**	
55. Cats can crawl ▓ very small spaces. **distractor-into**	[Picture: A kitten peaks out from the narrow opening of a long rectangular box.]

Appendix J

SE Questions Appearing on Timed PowerPoint™ Slides: Form A

Items #1, #16, and #51 were distractors.

	Words Displayed Below Picture	Target Preposition	Picture on PowerPoint™
Ex.	… crawled … the obstacle.	UNDER	Two men in military fatigues crawl under a flat obstacle.
1.	… was coming … the clouds.	THROUGH	Sunbeams filter through clouds.
2.	… whistled … woman.	AT	Construction workers whistle at a woman.
3.	… search … drugs.	FOR	Police search a house for drugs.
4.	Sheldon put … shirt … face.	OVER	A man is shown with his shirt up, covering his nose and mouth.
5.	… sounds really good … Minnie.	TO	A cheerful Minnie listens to Mickey play music.
6.	The shoes … too small … the woman.	FOR	A woman's feet are in shoes that are clearly too small for her.
7.	The star player got …, so another player played … her.	FOR	A woman sits on a soccer field with an injured leg.
8.	… blew a kiss … boyfriend.	TO	A young woman, in front of a webcam, blows a kiss to someone.
9.	… bartered fish … grain.	FOR	Two pairs of hands exchange fish for grain.
10.	… robber was caught …. camera.	ON	A female bank robber holds up a bank. A camera is above her.
11.	The young man … arrested … shoplifting.	FOR	A young man is arrested by a security guard in a grocery store.
12.	… provided students … pencils.	WITH	One picture shows students about to take a test. Another picture shows pencils.
13.	… white marks … its wing.	ON	A yellow and black bird is shown with two white blotches on its wings.
14.	… tried to touch her head … ground.	TO	A woman bent down in a yoga pose is trying to touch her head to the ground.
15.	In the morning, … set out … the distant peak.	FOR	A picture shows mountains with peaks in the distance.
16.	… crawled … the ledge.	ALONG	A man crawls along a ledge outside his window.
17.	… purchasing a gift … Penny.	FOR	A man and two friends are in a gift shop. One friend holds a gift set.
18.	A cheetah running … full speed is as fast …	AT	A cheetah runs fast, kicking up dust.
19.	… has command … all U.S.	OVER	Obama wears a military officer's

	military forces.		uniform with many badges.
20.	The … is … critical condition.	IN	A patient is in a hospital, hooked up to a breathing machine. Two doctors stand beside her bed.
21.	… nailed a board … the hole in the ceiling.	OVER	Two men work on a ceiling. One has a hammer. A small board has been nailed to the ceiling.
22.	… tied the man … the tree.	TO	A man is shown tied to a tree with thick ropes.
23.	… put a mark … the window.	ABOVE	Using a straight-edge, two hands are shown putting a mark above a window.
24.	In China, … eat … chopsticks.	WITH	A hand is shown holding two chopsticks.
25.	… is very hostile … me.	TO	A tall man in a business suit yells at a shorter man who looks alarmed.
26.	A soldier's always … guard … Buckingham Palace.	ON	A soldier stands guard in front of Buckingham Palace.
27.	… swam … surface.	TO	In the picture on the left, a fish swims toward the surface of a fishbowl. In picture on the right, it has reached the surface.
28.	… tattoo … shoulder	ON	Two women sit in a bar. One has a tattoo on her bare shoulder.
29.	… dress would be perfect … you.	FOR	A smiling store clerk holds up a dress to a customer.
30.	… 300 pounds, this is the world's largest …	AT	The picture on the left shows the world's largest dog's head with a person's head below it. The picture on the right shows a woman lying under the standing dog.
31.	… gave Sheldon $20 … the cat.	FOR	A man behind a table hands a cat to a young girl. The table says, "Cat's $20."
32.	When he saw the shark, … started rowing … the shore.	FOR	A man sits in a kayak. A large shark swims directly in front of him.
33.	This is a … of two people standing toe … toe.	TO	A picture shows two people's feet standing toe to toe.
34.	… dressed up as devils … costume party.	FOR	A young woman and a man, dressed up as devils, smile.
35.	… must not drink while they're … duty.	ON	Two policemen stand in front of a marble building.
36.	She applied polish … her toenails … a small brush.	WITH	A foot is shown with red polish being applied.
37.	… loaded the wagon … hay.	WITH	Farmers load a horse-pulled wagon with hay.
38.	The … is … debt.	IN	A woman looks worriedly at her credit cards with what looks like a bill on the table in front of her.

39.	… feels sharp enough … me.	TO	A hand gently touches the blade of a knife with whetstone below it.
40.	… promote higher wages … workers.	FOR	Protesters are shown, one with a sign saying, “Living Wages.” At the bottom of the picture, it says “Poor Workers’ Unions.”
41.	In ancient times, … sacrificed animals … their gods.	TO	Two men from classical period are shown over a large urn. One holds a knife while the other holds a goat.
42.	This … very friendly … dogs.	TO	A cat affectionately pushes its head against a happy-looking dog.
43.	… aimed … duck.	AT	On lower left, a man aims a gun. On upper right, a duck flies through air.
44.	… hospitalized … a heart attack.	FOR	An unhealthy-looking middle-aged man is lying on a hospital bed.
45.	She skipped … the book’s final …	TO	A woman is lying on the floor, reading a book.
46.	The Spanish word … *hello* … *hola*.	FOR	A graphic containing the word *hello* is shown on left. A graphic on the right shows the word *hola*. Between them is an equal sign.
47.	We hung the pot … the fire to heat …	OVER	A large cooking pot hangs down from a wire over a wood fire. Flames shoot halfway up the pot.
48.	… washed … soap.	WITH	On the left, a woman is shown lathering her hair in the shower. On the right is a bar of soap bearing the word “soap.”
49.	… played games … laptops.	ON	Four young men are shown sitting in front of their laptops. Their exaggerated expressions, avid attention, and use of headsets suggest that they are playing computer games.
50.	… were hiking …. the clouds.	ABOVE	Three people hike through snow. Clouds can be seen in the valley below them.
51.	… a lime … teeth.	BETWEEN	A young woman and man sit in front of an empty tequila bottle. The woman is holding a lime between her teeth.

Appendix K

SE Questions Appearing on Timed PowerPoint™ Slides: Form A

Items #1, #27, and #51 were distractors.

	Words Displayed Below Picture	Target Preposition	Picture on PowerPoint™
Ex.	… crawled … the obstacle.	UNDER	Two men in military fatigues crawl under a flat obstacle.
1.	… horses … the river.	ALONG	Three people ride horses along a river bank.
2.	… seems to be … a bad mood.	IN	A two-framed comic strip shows someone struggling to staple papers and then storming off.
3.	… unhealthy … teens.	FOR	A teen lights her friend's cigarette with her cigarette.
4.	… stuck her tongue out … Sheldon.	AT	A young woman sticks her tongue out at a young man, who appears to be somewhat offended.
5.	… held the shirt … his chest.	TO	A young man holds a shirt to his chest, pointing at the shirt's logo.
6.	… told them his plan … the attack.	FOR	Four young men sit in a barn in military uniforms. One holds a notebook. As he talks, he points with his finger.
7.	… saw his shadow … wall.	ON	A black and white cartoon shows a man staring at his shadow on the wall.
8.	… awarded the Nobel Prize … Obama.	TO	Obama is shown having just received the Nobel Prize at a ceremony.
9.	… can hear sounds … high frequencies.	AT	A dog tilts its head and raises its ears. Next to one ear, there is a graphic of a speaker emitting sound and a graphic of a sound wave. Above the wave, it says "high frequency wave."
10.	… wore a scarf … her face.	OVER	A woman wears a gauze scarf over her face.
11.	The Titanic … bound … New York.	FOR	On a clear, starry night, the Titanic is about to hit an iceberg.
12.	… special facilities … the elderly.	FOR	A nurse is shown assisting an elderly man as he stands to use a walker.
13.	Using ropes, … fastened the man … ground.	TO	A picture shows the Lilliputians tying Gulliver to the ground.
14.	… won an award … best actress.	FOR	Kate Winslet holds up her award for best actress.
15.	… can lift the boat … one hand.	WITH	Showing no sign of strain, a man holds up a very light kayak.
16.	… is a symbol … peace.	FOR	A dove is shown holding an olive branch.
17.	… flying high … the mountains.	OVER	An eagle flies high above snowy mountains.

18.	These kids … unfriendly … other kids.	TO	Young kids on a baseball diamond stand around looking tough as if challenging an opposing group of kids.
19.	… museum, a Greek vase … display.	ON	A Greek vase sits in a museum display case.
20.	… was burnt … ashes.	TO	On the left is a picture of a burning house. On the right are the charred remains.
21.	… smelled fresh … Penny.	TO	On the left, a young woman picks up an orange at the supermarket. On the right, she holds it to her nose.
22.	… played a song … piano.	ON	A girl plays music on a piano.
23.	… supplied the army … guns.	WITH	Heavily armed, rowdy troops walk in a disorganized column. One holds up a machine gun.
24.	… has a strange power … men.	OVER	An attractive woman confidently walks down the street. Men she passed have turned their heads to look back at her.
25.	… fixed my computer … free.	FOR	A young man is lying on the floor with a screwdriver fixing a partially disassembled computer.
26.	The two … bowed … each other.	TO	Two men bow to each other.
27.	… collapsed … exhaustion.	FROM	A man running a marathon begins to collapse.
28.	… no good shows … TV tonight.	ON	A man sleeps in an armchair in front of a TV.
29.	… sang her baby … sleep.	TO	A woman rocks her baby. A call-out icon shows that she is singing. Her baby is asleep in her arms.
30.	… threw rocks … police.	AT	A band of youth throws rocks toward a distant line of policemen. Smoke from fire and tear gas grenades rises up in front of them.
31.	After the …, the country was … alert.	ON	On the left is a bombed out building. On the right, two guards stand with guns. One is pointing at something.
32.	… make great sacrifices … their children.	FOR	Two parents kiss the cheeks of their young daughter who stands between them.
33.	… has a rash … his back.	ON	A toddler's back is visible. On his back, there is a small red patch of skin.
34.	When the sheriff saw …, he went … his gun.	FOR	On the left, a sheriff in a white hat goes for his gun. On the right, a typical bad guy wearing a black hat has his hand next to his gun.

35.	He was irritated … the planes flying … his house every day.	OVER	A plane flies low over some old houses.
36.	… signed … package.	FOR	On the left, a delivery man hands a young man something to sign. A large box is visible behind the young man. On the right, the delivery man is now gone and the young man and his friend carry the box up the stairs.
37.	The man … handcuffed … fence.	TO	A well-dressed man is handcuffed to a fence.
38.	… blame Obama … the bad economy.	FOR	On the left, Tea Party protesters hold signs protesting Obama's presidency. On the right, a red arrow on a chart stretches downward across a map of the U.S.
39.	… cut open the package … scissors.	WITH	A boy cuts open a plastic bag with scissors.
40.	… traffic lights, green is … "go."	FOR	A traffic light has turned green.
41.	… jogs … a slower pace.	AT	An elderly man jogs.
42.	… an emergency, pull the handle …	IN	A red fire alarm is shown. On the front are the words, "Lift then pull handle" and the word "fire."
43.	Sheldon … hand … head.	TO	In the picture on the left, a young man sits listening to a friend. In the picture on the right, he has touched his fingers gently to his temple.
44.	… is kind … her dog.	TO	A girl pets her dog.
45.	… greeted me … kind words.	WITH	Two friends warmly greet each other, shaking hands.
46.	Would you mind changing this dollar … four …?	FOR	A man stands at the counter of a small store in front of a clerk. In the thought call-out are four quarters. On the counter, there is a one-dollar bill.
47.	He says the … tastes bitter … him.	TO	A man holding a coffee cup has a disgusted look on his face.
48.	… had a blindfold … her eyes.	OVER	A woman in a blindfold walks in a room with arms outstretched.
49.	… dreamed that he was floating high … the Earth.	ABOVE	A man floats high above the clouds. His upward turned legs and hands suggest that he is moving upward as if in a dream.
50.	… bad … young kids.	FOR	Four kids eat junk food.
51.	… can fly … the air.	THROUGH	Superman is flying through the air.

Appendix L

SE Answer Sheet: Form A

Directions: *Fill in the blanks with an appropriate word or words that best describes the picture on each PowerPoint™ slide. Each item contains two blanks. One or more word goes in each blank.*

Example:

______________ JUMPED ______________THE OCEAN.

On your answer sheet, you will see only the blanks.

Example 1: _______________ [redacted] _______________ [redacted] [redacted].

You should use one or more words for each blank. Your sentence should match the picture. Try to make your sentence as simple and as short as possible. For the example, you could have answered:

Example 1: The children______ [redacted] into__________ [redacted] [redacted].

You'll have only 15 seconds to write down your answer for each question. After 15 seconds, you should go on to the next item even if you aren't done. Don't worry about spelling and punctuation! It's only important that you make the best sentence you can in the short time you're given. Let's try one more.

Example 2: _______________ [redacted] _______________ [redacted].

The test will now begin.

1. __________ [redacted] __________ [redacted].
2. __________ [redacted] __________ [redacted].
3. __________ [redacted] __________ [redacted].
4. [redacted] __________ [redacted] __________ [redacted].
5. __________ [redacted] __________ [redacted].
6. [redacted] __________ [redacted] __________ [redacted].
7. [redacted] __________, [redacted] __________ [redacted].
8. __________ [redacted] __________ [redacted].
9. __________ [redacted] __________ [redacted].
10. __________ [redacted] __________ [redacted].
11. [redacted] __________ [redacted] __________[redacted].
12. __________ [redacted] __________ [redacted].
13. __________ [redacted] __________ [redacted].
14. __________ [redacted] __________ [redacted].
15. [redacted], __________ [redacted] __________ [redacted].
16. __________ [redacted] __________[redacted].
17. __________ [redacted]. __________ [redacted].
18. [redacted] __________[redacted].[redacted]__________ .
19. __________ [redacted] __________ [redacted].
20. [redacted] __________ [redacted] __________ [redacted].

21. __________ [redacted] __________ [redacted].

22. __________ [redacted] __________ [redacted].

23. __________ [redacted] __________ [redacted].

24. [redacted], __________ [redacted] __________ [redacted].

25. __________ [redacted] __________ [redacted].

26. [redacted] __________ [redacted] __________ [redacted].

27. __________ [redacted] __________ [redacted].

28. __________ [redacted] __________ [redacted].

29. __________ [redacted] __________ [redacted].

30. __________ [redacted] __________

31. __________ [redacted] __________ [redacted].

32. [redacted], __________ [redacted] __________ [redacted].

33. [redacted] __________ [redacted] __________ [redacted].

34. __________ [redacted] __________ [redacted].

35. __________ [redacted] __________ [redacted].

36. [redacted] __________ [redacted] __________ [redacted].

37. __________ [redacted] __________ [redacted].

38. [redacted] __________ [redacted] __________ [redacted].

39. __________ [redacted] __________ [redacted].

40. __________ [redacted] __________ [redacted].

41. [redacted], ______________ [redacted] ___________ [redacted].

42. [redacted] _________________ [redacted] _________________ [redacted].

43. _________________ [redacted] _________________ [redacted].

44. _________________ [redacted] _________________ [redacted].

45. [redacted] _________________ [redacted] _________________ .

46. [redacted] _________________ [redacted] _________________ [redacted].

47. [redacted] _______________ [redacted] _________________.

48. _________________ [redacted] _________________ [redacted].

49. _________________ [redacted] _________________ [redacted].

50. _________________ [redacted] _________________ [redacted].

51. _________________ [redacted] _________________ [redacted].

<The end>

Appendix M

SE Answer Sheet: Form B

SPEEDED TEST

Directions: *Fill in the blanks with an appropriate word or words that best describes the picture on each PowerPoint™ slide. Each item contains two blanks. One or more word goes in each blank.*

Example:

______________ JUMPED ______________THE OCEAN.

On your answer sheet, you will see only the blanks.

Example 1: _______________ [redacted] ______________ [redacted].

You should use one or more words for each blank. Your sentence should match the picture. Try to make your sentence as simple and as short as possible. For the example, you could have answered:

Example 1: The children_____ [redacted] into_________ [redacted].

You'll have only 15 seconds to write down your answer for each question. After 15 seconds, you should go on to the next item even if you aren't done. Don't worry about spelling and punctuation! It's only important that you make the best sentence you can in the short time you're given. Let's try one more.

Example 2: _______________ [redacted] ______________ [redacted].

The test will now begin.

1. __________ [redacted] __________ [redacted].

2. __________ [redacted] __________ [redacted].

3. __________ [redacted] __________ [redacted].

4. __________ [redacted] __________ [redacted].

5. __________ [redacted] __________ [redacted].

6. __________ [redacted] __________ [redacted].

7. __________ [redacted] __________ [redacted].

8. __________ [redacted]__________ [redacted].

9. __________ [redacted] __________ [redacted].

10. __________ [redacted] __________ [redacted].

11. [redacted] __________ [redacted] __________ [redacted].

12. __________ [redacted] __________ [redacted].

13. [redacted], __________ [redacted] __________ [redacted].

14. __________ [redacted] __________ [redacted].

15. __________ [redacted] __________ [redacted].

16. __________ [redacted] __________ [redacted].

17. __________ [redacted] __________ [redacted].

18. [redacted] __________ [redacted] __________ [redacted].

19. __________ [redacted], [redacted] __________ [redacted].

20. __________ [redacted] __________ [redacted].

21. ________ [redacted] ________ [redacted].

22. ________ [redacted] ________ [redacted].

23. ________ [redacted] ________ [redacted].

24. ________ [redacted] ________ [redacted].

25. ________ [redacted] ________ [redacted].

26. [redacted] ________ [redacted] ________ [redacted].

27. ________ [redacted] ________ [redacted].

28. ________ [redacted] ________ [redacted].

29. ________ [redacted] ________ [redacted].

30. ________ [redacted] ________ [redacted].

31. [redacted] ________, [redacted] ________ [redacted].

32. ________ [redacted] ________ [redacted].

33. ________ [redacted] ________ [redacted].

34. [redacted] ________, [redacted] ________ [redacted].

35. [redacted] ________ [redacted] ________ [redacted].

36. ________ [redacted] ________ [redacted].

37. [redacted] ________ [redacted] ________ [redacted].

38. ________ [redacted] ________ [redacted].

39. ________ [redacted] ________ [redacted].

40. ________ [redacted], [redacted] ________ “[redacted]”.

41. ________________ [redacted] ________________ [redacted].

42. ________________ [redacted], [redacted] ________________.

43. [redacted] ________________ [redacted] ________________ [redacted].

44. ________________ [redacted] ________________ [redacted].

45. ________________ [redacted] ________________ [redacted].

46. [redacted] ___________ [redacted] ____________.

47. [redacted] ________________ [redacted] ________________ [redacted].

48. ________________ [redacted] ________________ [redacted].

49. _______________ [redacted] ______________ [redacted].

50. ________________ [redacted] ________________ [redacted].

51. ________________ [redacted] ________________ [redacted].

<The end>

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