Foreign Language Comprehension: Understanding the Centrality Deficit

Amanda C. Miller
University of Denver

Follow this and additional works at: https://digitalcommons.du.edu/etd

Part of the Cognitive Psychology Commons

Recommended Citation
https://digitalcommons.du.edu/etd/879

This Dissertation is brought to you for free and open access by the Graduate Studies at Digital Commons @ DU. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of Digital Commons @ DU. For more information, please contact jennifer.cox@du.edu,dig-commons@du.edu.
FOREIGN LANGUAGE COMPREHENSION:
UNDERSTANDING THE CENTRALITY DEFICIT

A Dissertation
Presented to
The Faculty of Social Sciences
University of Denver

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Amanda C. Miller
June 2010
Advisor: Janice M. Keenan
ABSTRACT

The goal of this study was to determine how reading in a foreign language (L2) affects one’s mental representation of the text and the ability to recognize and recall the text’s important information. Using a within-participants design, the proportion of central and peripheral ideas recalled by participants reading in their L2 was compared to that when reading in their native language (L1). Readers recalled a greater proportion of central than peripheral ideas when reading in both their L2 and L1, but when their L2 and L1 recalls were directly compared, a very interesting, yet counterintuitive, result emerged. The greatest deficit in participants’ L2 compared to L1 recalls was on the central, rather than peripheral, information. It is counterintuitive that the ideas that participants reading in their L2 recall the best (i.e., central ideas) are also the ideas on which they show the biggest deficit relative to their L1 recall. It is proposed that this centrality deficit stems from readers having to devote more cognitive resources to L2 word identification and consequently having fewer resources remaining to form connections among the text’s ideas that allow centrality to emerge. The centrality deficit was only evident among the readers who had a lower level of L2 proficiency (i.e., those for whom L2 word identification was most difficult), which supports the theory that the centrality deficit is the result of comprehending with limited resources. Additionally, having prior knowledge of the passage topic served as a compensatory mechanism for the centrality deficit.
Specifically, readers with less L2 proficiency who did not have prior knowledge of the topic displayed a centrality deficit relative to their L1 recall, but this deficit dissipated when they did possess topic knowledge. This study provides insight into L2 discourse comprehension and suggests that evaluating the quality of L2 readers’ text recall is a worthwhile assessment that can reveal deficiencies in L2 text representations.
Acknowledgements

This project was made possible thanks to the support I received from a number of influential sources. First, I would like to thank my advisor, Dr. Jan Keenan, for helping me develop the theoretical framework, design, and implementation of this study, not to mention her valuable mentorship and training throughout my graduate career. Additionally, I would like to thank my committee members, Dr. Iris Mauss and Dr. Bruce Pennington, for their thoughtful input during my proposal meeting, as well as Dr. Gloria Miller for serving as the outside chairperson.

I would like to thank the graduate students in the Reading and Language Lab, Anh Hua, Chelsea Meenan, and Sarah Priebe, for their help constructing the study’s materials, scoring, and discussing the data. I also appreciate the contributions of Doug Herring and Diana Hidalgo who translated the materials, and undergraduate research assistants, Liz Dykhouse, Thomas McCaughey, Jenna Walton, and Hadley Weiss, who helped develop materials, score, and enter data. Additionally, I am especially grateful to Professors Gabriela Alvarez, Zulema Lopez, Gustavo Torres, Susan Walter, and Carmen Woods in the University of Denver Spanish Department who allowed me to recruit participants from their Spanish courses, as well as to all of their students who participated in the study.

This project was funded by a Grant for Doctoral Research in Second or Foreign Language Assessment from Educational Testing Service, which allowed for participant compensation, copy costs, and research assistant and translator payment.
# Table of Contents

Chapter 1: Introduction .....................................................................................................1

Chapter 2: Method ..........................................................................................................19
  Participants .............................................................................................................19
  Design ...................................................................................................................19
  Materials ..............................................................................................................21
  Procedure ............................................................................................................25

Chapter 3: Results ..........................................................................................................27

Chapter 4: Discussion .....................................................................................................38

References .....................................................................................................................45

Appendices ......................................................................................................................54
  Appendix A: Introductory Questionnaire ..........................................................54
  Appendix B: Passages ........................................................................................55
  Appendix C: Prior Knowledge Exam ...............................................................65
  Appendix D: Spanish Proficiency Exam ...........................................................66
Chapter 1: Introduction

Foreign Language Comprehension:
Understanding the Centrality Deficit

Reading comprehension is a demanding task that requires the coordination of a number of cognitive processes, such as word decoding, semantic processing, comprehension monitoring, and inferencing. When reading in our native language (L1), we use cognitive resources to coordinate these component processes in order to build a coherent representation of the text. This is generally a manageable task since word identification processes are automatic and require little cognitive effort (Tomasello, 2000); after all, we have been practicing these processes most of our lives. The processes involved in comprehending a foreign language (L2), however, are less practiced and automatic, even for highly proficient bilinguals (MacWhinney, 2001). Lack of automaticity in word identification strains L2 readers’ cognitive resources resulting in problems in sentence comprehension (Bates & MacWhinney, 1981), decreased spread of semantic activation (Segalowitz, 1986), and increased sentence processing time (Kilborn, 1989).

According to the 2000 U.S. census, 11.1% of the population is foreign born, and during the 2001-2002 school year, there were 3.8 million students learning English as a Second Language (ESL) in American public schools. This demand for ESL instruction
raises the question of how best to provide it. Effective instruction in any area requires an understanding of the component skills. The main skill that ESL instruction currently focuses on is vocabulary and trying to increase the number of words that the learner can identify. It is generally assumed that comprehension will be fine if a reader can recognize the words. But as noted above, even when word identification is successful, it can still consume cognitive resources that may result in comprehension deficits. While prior research has identified some deficits at the sentence level, little work has examined the impact on processing sets of sentences that combine to form a discourse. Discourse processing requires connecting the ideas expressed in sentences into a coherent model of what the speaker or writer intends. If difficulties in L2 reading take resources away from constructing a coherent representation, then individuals reading in their L2 may miss the main points of what they are reading.

The first goal of this dissertation is to examine readers’ memory for text when reading in L2 compared to L1. The purpose is not just to examine how L2 affects the amount recalled, but to determine if reading in L2 affects the quality of the recall – which specific ideas tend to be remembered. More specifically, we will determine whether participants display a centrality deficit when reading in their L2, compared to their L1. This term refers to readers whose greatest deficit (relative to their L1 recall) is in their ability to recall central information from L2 passages, while their ability to recall peripheral information is affected to a lesser degree. Comparing the proportion of central and peripheral information that readers recall from L2 and L1 passages, rather than only examining the quantity of ideas recalled, allows further insight into the coherence of their
text representation. Individuals might recall a great quantity of information, but if they miss out on the main points of the text, their mental representation is inadequate.

Our second goal is to determine whether the centrality deficit caused by reading in a L2 can be overcome when the reader has considerable prior knowledge (PK) of the passage topic. PK is known to improve text comprehension in general, but we aim to determine whether PK of the passage topic can influence the amount of central information recalled from a L2 text. Having PK of the topic provides the individual with ideas about what information might be central and what might be peripheral. PK also facilitates the formation of connections among the text’s ideas; in turn, the ideas with the greatest number of connections emerge as central, and the reader is able to distinguish central from peripheral information (Miller & Keenan, 2009).

Our third goal is to assess the influence of L2 proficiency on the coherence of an individual’s L2 text representation. Obviously, the lower the level of L2 proficiency, the greater the negative impact on L2 comprehension, but this study will address whether L2 proficiency impacts the proportion of central ideas recalled, in particular. Furthermore we will assess how L2 proficiency and PK interact to influence L2 readers’ text representations. Theoretically, PK should provide greater compensation for the individuals who need it most – those with low L2 proficiency.

The Competition Model

Before reviewing what we know about the coherence of L2 readers’ text representations and their memory for text, we begin by examining a theory that helps explain why L2 readers have limited cognitive resources remaining for comprehension – the Competition Model (Bates & MacWhinney, 1982; MacWhinney, 1987;
MacWhinney, 2005). Understanding why L2 readers have limited resources for text comprehension will provide the rationale for our predictions about how well L2 readers may be able to represent and retrieve the main points of a discourse.

The most widely accepted model of L2 acquisition is the Competition Model, which is an emergentist account of L2 acquisition that emphasizes two main processes: 1) the competition between the L1 and L2, and 2) entrenchment, or the degree to which a language is experienced and automatized. Consider the case of a typical 18-year-old adult beginning to learn a L2. By this point, her L1 is very well-entrenched as the result of eighteen years of experience and consolidation (Tomasello, 2000), and it is served by a network of committed neural substrates (Schneider & Chien, 2003). As she begins to learn the L2, the foreign words are initially parasitic on their L1 counterparts (Hernandez, Li, & MacWhinney, 2005); she relies heavily on the aspects of the L2 that overlap with the L1, such as sentence structure (i.e., syntax; Bates & MacWhinney, 1981; Kilborn & Cooreman, 1987; Liu, Bates, & Li, 1992) and orthography (Costa, Caramazza, & Sebastian-Galles, 2000). For example, when L1 and L2 words are orthographically similar (e.g., tourist, turista) they are easier to process than when they are dissimilar (e.g., duck, pato) illustrating that we initially process the L2 based on what we know about the L1 (Costa et al., 2000).

L2 learners also transfer their L1 semantic knowledge to the L2. For example, when adults learn “tortuga” in Spanish, they initially treat this as another way to say “turtle” (See Figure 1a; Hernandez et al., 2005); thus their L2 semantic structure is heavily dependent, or parasitic, on their L1 semantic structure. Using event-related potentials, Thierry and Wu (2007) found late bilinguals (people who were first exposed to
a L2 after the age of 12) implicitly access their L1 when reading or listening to words exclusively in their L2.

---

**Figure 1.** (a) Parasitism of the L2 on the L1, missing a direct link from the L2 to semantic meaning. (b) Later in L2 learning, a direct connection between the L2 word and its semantic meaning forms (adapted from Hernandez et al., 2005).

(a)                 (b)

---

As the Competition Model illustrates, L2 reading is a complicated process for late L2 learners. They must constantly battle L1 transfer and interference, both explicitly and implicitly. Although after significant L2 experience they are able to decrease the dependence on the indirect L1 pathway and increase L2 automaticity (See Figure 1b; Hernandez et al., 2005), transfer and interference always occur to some degree, even for proficient L2 readers (MacWhinney, 2001). For these reasons, in addition to challenges presented by graphemic and phonetic differences of the two languages, it is no surprise that L2 comprehension results in a greater “cognitive workload” than L1 comprehension (Hasegawa, Carpenter, & Just, 2002).

**Neuroimaging Evidence of Limited Cognitive Resources in L2 Readers**

Comparing the neural activation associated with L1 and L2 processing allows insight into the amount of cognitive resources involved with the processing of each
language. Hasegawa et al. (2002) used fMRI to examine the cortical activation of native Japanese speakers who were moderately fluent in their L2 (English) as they comprehended auditory L1 and L2 sentences. They found that in most cortical regions the amount of activation was considerably greater when listening to L2 than to L1 sentences, suggesting more cognitive effort was required for L2 processing. A workload manipulation was also included such that participants heard more and less difficult sentences. Interestingly, the two difficulty levels did not affect the error rates or the amount of neural activation during L1 comprehension, but the more difficult L2 sentences created significantly more activation than the less difficult L2 sentences and resulted in higher error rates. L2 sentences were already consuming more cognitive resources than L1 sentences, and the increased workload required additional cognitive resources to be recruited.

Similarly, Chee, Hon, Lee, & Chun (2001) found that when participants performed a semantic judgment task in their less proficient L2 they showed greater brain activation in prefrontal and parietal regions than when they performed the task in their L1. In sum, brain imaging demonstrates that L2 processing involves a greater cognitive workload than L1 processing (Chee et al., 2001; Hasegawa et al., 2002; Wartenburger, Heekeren, Abutalebi, Cappa, Villringer, & Perani, 2003).

**Methods for Assessing the Impact of Limited Resources on Comprehension**

That anyone can become proficient in a L2 is a tremendous cognitive feat, but devoting cognitive resources to achieving L2 proficiency has a cost – limited cognitive resources remaining for comprehension. We know that L2 readers perform worse on comprehension assessments than L1 readers (Bates & MacWhinney, 1981; Kilborn,
1989; Segalowitz, 1986), but the majority of studies only assessed L2 comprehension by multiple-choice questions (Brantmeier, 2005; Wolf, 1993), which provide little insight into the coherence of an individual’s text representation. Rather than assessing the reader’s comprehension of the entire text, multiple-choice questions target specific ideas. Furthermore, they provide clues about the text’s ideas (Bernhardt, 1991), are susceptible to guessing strategies (Wolf), and often include items that are passage independent (Keenan & Betjemann, 2006). Even if L2 readers perform well on such questions, we do not know if they actually understood the central themes of the text or if they simply used the questions’ cues to respond correctly; good performance does not necessarily mean they have formed the appropriate connections and built a coherent representation of the text. An alternative form of comprehension assessment is memory for text, or free recall. Examining L2 readers’ memory for text assesses comprehension of the entire passage rather than specific ideas, and there are no retrieval cues to facilitate comprehension so the results are a purer evaluation of the reader’s comprehension.

Previous studies have examined L2 learners’ memory for text, but many of these studies only looked at the quantity of ideas recalled, ignoring the quality of this information (e.g., Barnett, 1986; Davis, Lange, & Samuels, 1988). The quality of a readers’ recall, however, is very informative and should not be overlooked; it allows us to gain insight into whether they comprehend the gist of the text and informs us of the coherence of their text representation. One specific aspect of L2 readers’ memory for text of interest in this study is the proportion of central and peripheral information they recall from the text compared to that of L1 readers.
The Centrality Effect

One important aspect of an individual’s memory for text is the centrality of the information recalled. Do readers recall the central, important information from the passage, or the peripheral, detailed information? It is a well-known finding in the text memory literature that the more central an idea is to the gist of the text, the more likely it is to be recalled (Britton, Meyer, Hodge, & Glynn, 1980; Cirilo & Foss, 1980; Kintsch & Keenan, 1973; Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975; Kintsch & van Dijk, 1978; Meyer, 1974). It is manifested not just in readers with normal reading skill levels, but also in very young readers (Brown & Smiley, 1978; Keenan & Brown, 1984) and poor readers (Curran, Kintsch, & Hedberg, 1996; Miller & Keenan, 2009). Retellings of text show a well established effect of centrality such that recall monotonically increases as the level of centrality of the idea increases – what has been referred to as the centrality effect.

As we read, we form connections among the semantically related text ideas and thereby develop a connected representation of the text’s ideas. Ideas having many connections emerge from the text representation as being central, while those with fewer connections emerge as peripheral. The centrality effect in text recall is thought to occur because the reader is able to best recall those central ideas with the greatest number of connections; the peripheral information, with fewer connections, is less likely to be recalled. A few studies have examined L2 readers’ memory for text and found that L2 learners of all skill levels generally show a centrality effect (Barry & Lazarte, 1995; Lund, 1991; Schmidt-Rinehart, 1994). The centrality effect is one indication that at least some of the appropriate connections among a text’s ideas are likely being made.
The Centrality Deficit

The fact that L2 readers generally show a centrality effect indicates that they can build a representation of the text that is somewhat coherent and can distinguish central from peripheral information to some extent. However, the centrality effect alone does not tell the whole story. Although L2 readers might form enough connections to recall more central than peripheral information, this does not mean that they necessarily connect all the text’s ideas as comprehensively as L1 readers do. Perhaps the L2 readers’ limited resources hinder their ability to form some connections, leaving their text representation degraded compared to L1 readers’.

Miller and Keenan (2009) illustrate just how informative comparing the centrality slopes of two groups of readers can be. They found that both good and poor readers showed the familiar centrality effect: recall increased as the centrality of the information increased. Most interestingly, while good readers recalled more central and peripheral information than poor readers, the difference between the groups was actually larger for the central information than for the peripheral information (see Figure 2). There was a significant interaction between reading ability and centrality. The pattern that they identified as the centrality deficit was actually apparent, but not identified, in other studies as well (Curran et al., 1996; Hansen, 1978; Purvis & Tannock, 1997; Smiley, Oakley, Worthen, Campione, & Brown, 1977). Just as comparing the amount of central and peripheral information recalled by good and poor readers has provided insight into the coherence of poor readers’ text representations, comparing the ideas recalled from L2 and L1 passages will inform us of the coherence of L2 readers’ text representations by determining whether there is a specific L2 deficit in recalling central ideas.
Miller & Keenan (2009) attributed the centrality deficit to the limited resources of the poor readers; poor readers must devote more cognitive resources to decoding, leaving fewer resources available to make connections among the text’s ideas. Because individuals reading L2 passages also have limited resources, it is plausible that, like poor readers, individuals reading L2 passages might also display a centrality deficit compared to their L1 recall (see Figure 3). To the extent that L2 readers laboriously struggle to access the words’ meanings, the paucity of their remaining cognitive resources may result in a centrality deficit. One might question whether there is a “floor effect” influencing poor readers’ recall of peripheral ideas. However, it is important to remember that on a free recall task, the floor would be zero. Free recall does not allow readers to guess the right answers; they must remember and recall the information.
Figure 3. Hypothetical data for individuals reading foreign language (L2) passages, relative to native language (L1) passages.

Alternatively, readers might not show a specific deficit recalling central information from L2 passages, but rather a comparable deficit on the recall of central and peripheral information (see Figure 4).

Figure 4. Alternative pattern of L2 reader memory for text.

If they do not show a greater deficit on the central than peripheral information it is unlikely that the primary cause of their deficit is a struggle to form connections that allow
centrality to properly emerge; rather, this deficit might be caused by a general lack of linguistic understanding for many of the text’s ideas. Perhaps they miss out on ideas due to deficient L2 vocabulary and syntactic knowledge. It could be the case that readers form all the appropriate connections among the limited number of ideas that they can identify in L2 passages, but since they cannot access meaning for all the text’s ideas, they recall significantly fewer ideas overall – not just central, but peripheral as well.

**Knowledge Compensation**

Reading comprehension is a constructive process that involves integrating the words in the text with one’s knowledge of the world. Many studies have shown that prior knowledge (PK) of the passage topic facilitates comprehension (e.g., Haenggi & Perfetti, 1992; Rawson & Kintsch, 2004; Samuelstuen & Braten, 2005). Miller & Keenan (2009) found that PK allowed poor readers to compensate for their centrality deficit. Poor readers showed the centrality deficit compared to good readers when both groups did not have PK, but when both groups had PK of the passage topic poor readers no longer showed the deficit (see Figure 5). PK did not affect the performance of the good readers, however, suggesting that they were able to form connections among the text’s ideas based on text cues alone.
Figure 5. Proportion of central and peripheral ideas recalled by children with high prior knowledge of the passage topic as a function of reading ability. Means are adjusted for IQ (Miller & Keenan, 2009).

No study has examined the effect of PK on the quality of recall in L2, but a number of studies clearly demonstrate that PK increases the quantity of L2 recall, facilitates L2 question answering, and allows readers to ignore irrelevant information (Barry and Lazarte, 1995; Carrell, 1983; Schmidt-Rinehart, 1994; Taglieber, Johnson, & Yarbrough, 1988; Tudor, 1988; Tyler, 2001). One study even found that PK is more related to L2 question answering than L2 proficiency is. Levine and Haus (1985) identified second and third year high school Spanish students as having low or high PK of baseball, based on a baseball quiz. They found that those who were knowledgeable about baseball showed superior performance to those who had limited knowledge of baseball on comprehension questions about a baseball passage. Most importantly, they failed to find a main effect of language level (year 2 versus year 3), suggesting that PK influenced comprehension performance more than L2 proficiency level did.
The proposed study will assess readers’ memory for text to determine whether they show a centrality deficit when reading L2 passages relative to L1 passages, and if they do, whether PK of the passage topic can help readers compensate for such a deficit. Just as Miller and Keenan (2009) found that PK aided the quality of poor readers’ memory for text but did not aid that of good readers, it is possible that PK improves recall of L2 passages but that readers already form the appropriate connections in L1 passages and do not receive further benefit from PK. Because PK and IQ are likely correlated, and either could influence memory for text, we will assess PK as a within-participants variable in order to avoid this confound.

**Language Proficiency**

L2 proficiency is a clear predictor of L2 comprehension when comprehension is measured by open-ended questions (e.g., Asfaha, Beckman, Kurvers, & Kroon, 2009), cloze procedure (e.g., Gottardo & Mueller, 2009), and quantity of ideas recalled (Fecteau, 1999). Our theory predicts that low proficiency L2 readers will also show a more striking centrality deficit when reading L2 passages than will high proficiency L2 readers. Low proficiency L2 readers have even fewer cognitive resources remaining for comprehension than high proficiency L2 readers do. If the centrality deficit is caused by L2 readers’ limited cognitive resources inhibiting the development of a coherent text representation, then it follows that low proficiency L2 readers will demonstrate an even greater centrality deficit than high proficiency L2 readers.

On the other hand, some studies assessing the degree to which L1 interferes during L2 processing have suggested that L2 proficiency does not necessarily predict the amount of L1 interference (Chambers & Cooke, 2009; Schwartz & Kroll, 2006). These
studies found that even highly proficient L2 readers still experienced a great deal of L1 interference during L2 processing. Because L1 interference is one of many factors that we suggest might deplete a L2 readers’ cognitive resources, it is possible that both high and low proficiency L2 readers will demonstrate a similar centrality deficit when recalling L2 passages compared to their recalls of L1 passages.

The extent to which low L2 proficiency can be compensated by PK remains to be established. A few studies have attempted to address this question but have yielded mixed results. While some find PK to serve as a compensatory mechanism for readers with poor L2 proficiency (Hudson, 1982; Levine & Haus, 1985; Uso-Juan, 2006), others find the relationship to be ambiguous (Carrell, 1983; Hammadou, 1991). Such inconsistencies in the literature can most likely be attributed to inconsistent or invalid methods of assessing both PK and/or proficiency. The present study will help clarify these mixed results by assessing how PK and L2 proficiency interact to affect the quality of memory for text of L2 passages. Additionally, this study will advance previous work by assessing L1 verbal ability along with L2 proficiency. This will help ensure that proficiency effects are a function of L2 proficiency specifically, rather than the result of general verbal ability, as these two variables could be correlated.

**Effect of Knowledge on Reading Rate**

In addition to helping us know how ideas should be connected, PK has been shown to facilitate word identification (Priebe, Keenan, & Miller, submitted). Theoretically, PK makes the word identification process more automatic, and in turn leaves the reader with more cognitive resources to build a coherent representation of the text. When L2 readers are familiar with a passage topic they are likely familiar with its
associated vocabulary and may be better able to identify words than they could in an unfamiliar context. For example, L2 readers may be very likely to identify montaña rusa (L2) as roller coaster (L1) in a passage about a well-known topic (e.g., amusement parks), while they are less likely to identify this word if the topic is unfamiliar (e.g., the physics of roller coasters).

If PK facilitates word identification in L2, then we would expect it to speed the rate at which the text is processed, allowing readers to read the L2 text faster when they have high PK than when they have low PK. Chen and Donin (1997) provide evidence to support this idea. They assessed the effects of PK and L2 proficiency on reading rate. L2 participants were divided into high and low PK groups, which were subdivided into two levels of proficiency. Within the low PK group those with more proficiency read significantly faster than those with less proficiency, but within the high knowledge group there was no significant difference in the reading rate of more and less proficient readers. The authors concluded that PK facilitated reading rate, but these data should be interpreted with caution due to small cell sizes (only four participants had high knowledge and were more proficient).

Therefore, this dissertation will also examine whether PK facilitates L2 word identification and speeds L2 reading rate. We suspect that such facilitation could be the basis for eliminating the centrality deficit. If readers with PK show centrality effects with steeper slopes than those without PK, such effects may be the result of PK facilitating word identification, leaving more cognitive resources to devote to building a coherent representation of the text.
Overview

L2 readers are known to show comprehension deficits compared to L1 readers (Bates & MacWhinney, 1981; Kilborn, 1989; Segalowitz, 1986). Only a few studies, however, have assessed the quality of L2 readers’ text representations by examining their recall of central and peripheral information (Barry & Lazarte, 1995; Lund, 1991; Schmidt-Rinehart, 1994). The studies that have assessed this construct have shown that readers generally display a centrality effect when reading L2 passages, recalling more central than peripheral information. This suggests that readers connect the L2 text’s ideas to some degree; however, the centrality effect is not a sensitive assessment. Even if readers show a centrality effect in their L2 recalls, this does not necessarily mean that they are connecting the text’s ideas to the same degree that L1 passages are connected. Lacking connections could result in readers showing a specific deficit in the recall of central ideas from L2 compared to L1 passages (i.e., a centrality deficit). This study establishes whether participants reading in their L2 show a centrality deficit compared to their L1. We then ask: 1) whether having greater Spanish proficiency reduces the centrality deficit, and 2) whether PK of the passage topic can help compensate for this deficit. Additionally, we examine whether PK speeds the rate at which L2 passages are read.

Participants were native English-speaking undergraduates learning Spanish as a L2. Participants read passages both in their native English (L1 condition) and in Spanish (L2 condition), thus language was a within-participants variable. The importance of each passage’s idea units were rated by an independent group of undergraduates, and these ratings were used to determine which ideas were central and which were peripheral. The
proportion of central and peripheral information recalled by the participants reading in their L1 and L2 was compared.

Spanish proficiency was a between-participants variable (high or low), based on participants’ performance on a Spanish exam. PK was a within-participants variable; a variety of passage topics were included so that each participant would likely have high PK of some topics and low PK of others. The mean proportions of central and peripheral ideas that each individual recalled from the passages of which they had low PK were compared to those for which they had high PK.
Chapter 2: Method

Participants

Forty-three undergraduates previously or currently enrolled in the Spanish curriculum at the University of Denver participated in the study and received monetary compensation, or if they preferred, extra credit for a psychology course. All participants were native English speakers who were recruited from the following Spanish courses: SPA 1002, 1003, 2001, and 2002. Two additional participants were tested but were excluded because they were not native English speakers. Data were lost from one participant’s recall on one passage (Pele) because the audio recorder failed to record the passage, but data from this participant’s remaining nine passages were included in the analyses. Also, one participant does not have a score for the Woodcock Johnson Letter-Word Identification due to administration error, but the rest of this participant’s data were included in the analyses.

Design

Every participant read a total of ten passages: eight L2 Spanish passages and two L1 English passages (see Figure 6).
Figure 6. Layout of the study design. Represents data collected from each participant.

Passage order was randomized across participants, such that each participant had a different passage order. Passage language and language order were counterbalanced across participants. Each participant read every passage one time, either the English or Spanish version. The reason that fewer passages were given in English than Spanish has to do with the PK variable. We anticipated that PK would play a compensatory role, as in Miller & Keenan (2009), and thus only influence memory for text of L2 passages. Participants read a greater number of L2 Spanish passages in order to increase the likelihood of scoring within the high PK category on some of the L2 passages and within the low PK category on others. See Table 1 for a breakdown of participants’ knowledge of each passage topic. Because we did not evaluate the effect of PK on the L1 passages, we only administered two L1 passages. Averaging across these two passages (as opposed to using only one passage) decreased the influence of passage variability, but did not substantially increase the length of the testing session. Each English passage was read by
either 8 or 9 participants (each of the 43 participants read 2 English passages. 86 / 10 different passages = 8.6).

Table 1.
*Number of participants reading each passage in Spanish with Low Prior Knowledge, Spanish with High Prior Knowledge, and English.*

<table>
<thead>
<tr>
<th>Passage</th>
<th>Spanish Low PK</th>
<th>Spanish High PK</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battle of the Alamo</td>
<td>14</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Ferdinand Magellan</td>
<td>13</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>Hannah Montana</td>
<td>6</td>
<td>29</td>
<td>8</td>
</tr>
<tr>
<td>Galapagos Islands</td>
<td>13</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>Manatees</td>
<td>8</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>Margaret Mead</td>
<td>34</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Panama Canal</td>
<td>8</td>
<td>26</td>
<td>9</td>
</tr>
<tr>
<td>Pele</td>
<td>14</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Stegosaurus</td>
<td>19</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Tower of London</td>
<td>24</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>

**Materials**

**Introductory questionnaire.** A questionnaire assessed variables related to participants’ reading ability, the duration and intensity of their Spanish study, and academic variables (see appendix A for questionnaire and summary data). This questionnaire was designed to determine whether factors such as Spanish immersion programs (e.g., study abroad) and general academic performance were related to L2 comprehension.
Passages. All passages were expository, 257 - 395 words in length, and considered 5th – 7th grade reading level (determined by the Flesch-Kincaid grade level rating system), and covered a range of topics (see Appendix B).

Selection of passage topics and passage construction was guided by two pilot studies. The first pilot study assessed 14 participants’ knowledge of 17 different topics. Participants were asked 5 – 7 questions about each topic. The topics that showed greatest variability in knowledge were included in the study, in an effort to use topics about which some participants had significant knowledge and others had no knowledge. Once the passages were written about these ten topics, a second pilot study was conducted. Nine participants were asked to read and recall each passage. The passages from which participants did not recall at least 10% more central than peripheral ideas were rewritten in an attempt to increase the recall of central ideas relative to peripheral ideas.

All ten passages were translated to Spanish by two Spanish-English bilingual individuals, one whose native language is English and the other whose native language is Spanish. They translated the passages back and forth between the two languages until they agreed that the English and Spanish passages were equivalent, paying careful attention that the translations did not change the passages’ meaning, length, or overall reading difficulty. The English and Spanish versions were entered into language-specific readability formulas (English: Flesch Reading Ease; Spanish: Huerta Reading Ease) that provide readability estimates using the same scale (0-100, with lower scores indicating more difficult reading). The English (M = 73.07) and Spanish (76.02) readability estimates did not significantly differ using a 2-tailed test ($t(9) = 1.64, p > .05$). Using a 1-
tailed test, the English passages were marginally more difficult than the Spanish ($t(9) = 1.64, p = .07$).

**Idea checklists.** Each passage was broken down into idea units based on clause structure. Every word of each passage was included in its idea checklist. Parsing the sentences was done by two individuals independently; disagreements were settled by a third individual.

**Classifying ideas as central vs. peripheral.** A variety of techniques have been employed to determine which ideas in a passage are central and which are peripheral. Some, such as propositional hierarchies (Kintsch & Keenan, 1973; Kintsch, 1974) and causal networks (van den Broek & Trabasso, 1986), can be extremely laborious to apply to long passages such as those used in the present study. A measure that correlates highly with more theoretical assessments of centrality is ratings of centrality (Albrecht & O’Brien, 1991; O’Brien & Myers, 1987). Because ratings are easier to obtain for long passages, we defined the centrality of the idea units in our passages using ratings obtained from undergraduates.

A norming study was performed to determine whether each idea unit in the 10 passages was central or peripheral to the passage’s overall meaning. Native English speaking undergraduates rated the importance of each item on the idea checklist using a Likert scale ranging from 0 (the idea unit is unimportant to the overall meaning of the story) to 7 (the idea unit is very important to the overall meaning of the story). Each participant provided ratings for six passages in a one hour testing session. Each passage was rated by a total of 20 undergraduates. Mean ratings were calculated, and the idea
units whose ratings fell above the median were considered central, while those below the median were considered peripheral.

**Prior knowledge assessment.** Participants’ PK of the passage topics was assessed by a test prior to reading the passages (Appendix C). The examiner asked the participant one open-ended question about each of the ten topics, such as “Who was Ferdinand Magellan?” If the participant gave a correct response, they were asked a follow-up question about that topic to assess the extent of their knowledge, such as “What was the significance of Magellan’s voyage?” Participants were encouraged to state everything they knew about the topic. Participants’ responses were scored by two independent raters (Cronbach’s $\alpha = .98$) and categorized as Low PK or High PK for each passage. If participants did not have any knowledge of the topic they were included in the low PK group. Although we considered asking more questions about each topic, we decided it would be best to keep the PK assessment brief, because an extensive PK inventory could activate the passages’ central themes and artificially influence memory for text. By limiting the number of questions about each topic and administering them at the very beginning of the testing session, rather than directly before their corresponding passages, we hoped to reduce the potential effects such artificial knowledge activation might have on memory for text.

Because the effects of PK were assessed within-participants, participants who only had one level of PK on all the passage topics (who either knew something about every passage topic or who knew nothing about any of them) were excluded from the PK analyses. One participant’s data were excluded from the PK analyses for this reason. Likewise, if a participant scored in a given PK group on only one passage, this
participant’s data were also excluded, because calculating a mean recall score based on only one passage is risky, as there is inevitably some degree of passage variability and averaging across at least two passages creates a more stable construct. Seven participants’ data were excluded from the PK analyses for this reason.

Assessment of English word identification skills. The Letter-Word Identification subtest of the Woodcock Johnson Tests of Achievement-III (Woodcock, McGrew, & Mather, 2001) was used to measure English word reading ability. Raw scores ranged from 60 to 76 (maximum score possible = 76) with a mean of 70.02 (SD = 3.27).

Spanish proficiency assessment. An exam consisting of 38 multiple-choice questions assessed participants’ knowledge of Spanish grammar and vocabulary (see Appendix D). Questions were selected from an online source (Fun Spanish Quizzes) and included questions that targeted beginning, intermediate, and advanced proficiency levels. Raw scores ranged from 12 – 35 correct (mean = 23.19, SD = 5.79). Because we were interested in understanding how proficiency interacts with memory for text and prior knowledge, we divided our sample into a high and low Spanish proficiency group. Those below the 33rd percentile composed the Low Proficiency group (n = 16) and those above the 66th percentile composed the High Proficiency group (N = 18). It is important to note that this difference in proficiency was not also evident in the participants’ L1. Those with high and low L2 proficiency did not differ on English verbal skills, as measured by the Letter-Word identification or self-reported ACT scores (see Table 2).
Table 2. *Descriptive statistics of participants with Low and High Spanish Proficiency. Means and standard deviations are presented.*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Spanish Exam</th>
<th>WJ</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Proficiency</td>
<td>16</td>
<td>17.00 (2.61)</td>
<td>70.33 (3.13)</td>
<td>26.33 (3.04)</td>
</tr>
<tr>
<td>High Proficiency</td>
<td>18</td>
<td>28.67 (2.87)</td>
<td>69.94 (3.72)</td>
<td>27.53 (3.91)</td>
</tr>
</tbody>
</table>

**Procedure**

First, all participants completed the introductory questionnaire, which required 2 – 3 minutes. Next, they answered the PK exam in order to assess their knowledge of the passage topics (5 – 10 minutes). The PK exam was asked and answered orally in English. No time limit was enforced. Responses were recorded and subsequently independently scored by two raters. After the PK assessment, the Woodcock-Johnson Letter-Word Identification was administered (5 minutes), followed by the Spanish proficiency exam (10 – 15 minutes). Participants read the questions silently and marked their answers on the paper provided.

After these three preliminary exams, participants read the first passage and immediately recalled everything they could remember from the passage. All participants read silently in English or Spanish and then freely recalled each passage in English, regardless of the language in which it was read. Lee (1986) showed that participants recalled significantly more ideas when they recalled L2 passages in their L1 rather than their L2; therefore, as suggested by Lee and others (Donin & Silva, 1993; Wolff, 1987), participants in this study recalled the passages in English so that their memory for text was not masked by limited Spanish production skills. The reason they were asked to read
silently is that L2 readers exhibit better comprehension when reading silently than when reading aloud (Bernhardt, 1983). Bernhardt suggests reading silently allows L2 readers to focus cognitive resources on comprehension rather than pronunciation.

This procedure was repeated for the remaining nine passages. Participants measured their reading rate using a stop watch, and times were noted at the end of each passage. Reading and recalling the 10 passages required approximately 60 minutes. Recalls were digitally recorded, subsequently transcribed, and scored using the idea checklists. A subset of the passages (n = 80) was scored by two raters, and inter-rater reliability was very high (Cronbach’s α = .98).
Chapter 3: Results

Passage Validity

As previously stated in the introduction, a well-established finding in the text memory literature is that individuals recall a greater number of central than peripheral ideas from the passage (Britton, Meyer, Hodge, & Glynn, 1980; Cirilo & Foss, 1980; Kintsch & Keenan, 1973; Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975; Kintsch & van Dijk, 1978; Meyer, 1974). We first wanted to ensure that all of our passages met this expectation. If central ideas do not emerge from a given passage as being central, it is misleading to compare the proportion of central and peripheral ideas recalled from this passage to that of other passages. Depending on the comparison, it could over- or underestimate the existence of a centrality deficit, and it would be difficult to draw conclusions about the coherence of the L2 text representation.

To test whether the passages showed a centrality effect, a repeated-measures ANOVA was performed on each passage, comparing the proportion of central and peripheral information recalled. Participants (L1 and L2 combined) recalled significantly more central than peripheral ideas from eight of the ten passages (see Table 3). The two passages from which participants did not recall more central than peripheral information were Hannah Montana and Battle of the Alamo. These passages were not included in subsequent analyses because their atypical centrality patterns would not allow us to assess our main question of how L2 processing impacts the centrality of readers’ recall.
Table 3.

Mean proportion of peripheral and central ideas recalled from each passage, averaged over L1 and L2 (and standard deviation).

<table>
<thead>
<tr>
<th>Passage</th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battle of the Alamo</td>
<td>.25 (.12)</td>
<td>.25 (.13)</td>
</tr>
<tr>
<td>Ferdinand Magellan</td>
<td>.24 (.13)</td>
<td>.30 (.15)*</td>
</tr>
<tr>
<td>Hannah Montana</td>
<td>.41 (.15)</td>
<td>.42 (.14)</td>
</tr>
<tr>
<td>Galapagos Islands</td>
<td>.22 (.14)</td>
<td>.33 (.11)*</td>
</tr>
<tr>
<td>Manatees</td>
<td>.11 (.11)</td>
<td>.25 (.13)*</td>
</tr>
<tr>
<td>Margaret Mead</td>
<td>.22 (.13)</td>
<td>.34 (.15)*</td>
</tr>
<tr>
<td>Panama Canal</td>
<td>.17 (.11)</td>
<td>.37 (.15)*</td>
</tr>
<tr>
<td>Pele</td>
<td>.27 (.12)</td>
<td>.34 (.11)*</td>
</tr>
<tr>
<td>Stegosaurus</td>
<td>.13 (.09)</td>
<td>.27 (.18)*</td>
</tr>
<tr>
<td>Tower of London</td>
<td>.16 (.12)</td>
<td>.31 (.11)*</td>
</tr>
</tbody>
</table>

* Significantly more central than peripheral ideas recalled, $p < .001$

Unless otherwise stated, all subsequent analyses include data from the remaining eight passages averaged together. Two participants read both Hannah Montana and Battle of the Alamo in English, so their data had to be eliminated due to lack of English recall data. Additionally, four participants had to be excluded from the PK analyses after Hannah Montana and Battle of the Alamo were removed because they were left with less than two passages on either the high PK dimension (1 participant) or low PK dimension (3 participants). However, if a participant was left with only one L1 passage, they were
still included in the analyses. The reason for this is that an additional 13 participants would have been eliminated, and the sample size did not allow for this.

**Centrality Deficit**

The mean proportion of central and peripheral ideas recalled by participants reading in their L1 and L2 was examined using a 2 x 2 repeated measures ANOVA, with language (L1, L2) and centrality of recalled idea units (central, peripheral) as within-participant variables, and proportion of idea units recalled as the dependent variable. As expected based on previous research, there was a main effect of language ($F(1, 40) = 96.84, p < .001; \text{partial } \eta^2 = .71$), such that participants recalled a greater proportion of ideas when reading in their L1 compared to their L2. There was also a main effect of centrality ($F(1, 40) = 192.75, p < .001; \text{partial } \eta^2 = .83$), with participants recalling significantly more central than peripheral information. Tests of simple effects showed that the centrality effect was highly significant for participants reading L1 ($F(1, 40) = 84.85, p < .001; \text{partial } \eta^2 = .68$) and L2 passages ($F(1, 40) = 176.15, p < .001; \text{partial } \eta^2 = .82$).

Our main question of how reading in a foreign language impacts the construction of a mental representation of the text is addressed by examining the interaction of language and centrality. Participants showed a significantly greater deficit in the recall of central than peripheral information when reading L2 passages compared to when reading L1 passages ($F(1,40) = 4.79, p < .05; \text{partial } \eta^2 = .11$). As can be seen in Figure 7, when reading in L2, readers show a centrality deficit relative to their L1 recall.
Figure 7. Proportion of central and peripheral ideas recalled by participants reading in their native language (L1) and foreign language (L2).

If the deficit in Figure 7 occurs because reading in L2 diminishes the cognitive resources available to connect ideas together, we should find that participants with lower L2 proficiency show more of a centrality deficit than those with higher proficiency. This prediction was tested with a mixed design ANOVA with Centrality (peripheral, central) and Language (L1, L2) as within-participant variables and Proficiency (Low, High) as a between-participant variable. As Figure 8 shows, the findings support our prediction that the centrality deficit should be greater when language proficiency is lower. The top panel of Figure 8 shows the participants with Low Spanish Proficiency. Planned comparisons revealed that they show a significant centrality deficit when reading L2 passages compared to L1 passages (Centrality x Language interaction: $F(1, 15) = 7.29, p < .05$; partial $\eta^2 = .33$). The bottom panel of Figure 8 shows the High Spanish Proficiency
group; here the centrality deficit is no longer evident (Centrality x Language interaction: $F(1, 15) < 1$; partial $\eta^2 = .002$). Although the pattern of findings supports the notion that recall of central info is differentially affected by language proficiency, it should be noted that the 3-way interaction between Centrality (Peripheral, Central), Language (L1, L2), and Proficiency (Low, High) was not significant ($F(1, 30) = 2.38, p > .05$; partial $\eta^2 = .07$).

---

*Figure 8.* Proportion of central and peripheral ideas recalled by participants with either Low L2 Proficiency or High L2 Proficiency, reading in their L1 and L2.
Knowledge Compensation

After finding that participants showed a centrality deficit when reading L2 compared to L1 passages, particularly when they are less proficient in their L2, we next assessed whether having PK could help compensate for this deficit. In order to analyze the PK effects, we standardized recall within each passage and then calculated the average z-score for each participant’s high PK passages and the average z-score for their low PK passages. This standardization was necessary because the distribution of PK on several passages was unbalanced (see Table 1), and some passages were more memorable than others (associated with relatively high or low recall proportions; see Table 3). If recall data were not standardized, the combination of these two issues could disproportionately impact the results. For example, the majority of participants had high
PK of manatees and, compared to other passages, recalled a relatively low proportion of ideas from the *Manatees* passage. The combination of these two issues would unduly lower the mean proportion of ideas recalled by the high PK group if the recall data were not standardized.

Comparing the recalls of participants reading L2 passages about which they had High PK versus Low PK in a 2 (High PK, Low PK) x 2 (High Proficiency, Low Proficiency) x 2 (Central, Peripheral) mixed design ANOVA resulted in a significant 3-way interaction ($F(1, 21) = 8.64, p < .01$; partial $\eta^2 = .29$; see Figure 9). Among Low Proficiency L2 readers, when they had Low PK, they showed a significant centrality deficit compared to when they had High PK (PK x Centrality interaction: $F(1, 12) = 5.83$, $p < .05$; partial $\eta^2 = .33$). Tests of simple effects revealed that the difference between the proportion of central ideas recalled by Low Proficiency readers when they had High PK versus Low PK was marginally significant ($t(12) = 2.08$, $p = .06$), while the difference in peripheral ideas was not significant ($t(12) < 1$). Among High Proficiency L2 readers, however, readers did not show a centrality deficit when reading with Low PK compared to when they had High PK (see Figure 9). Readers with High Proficiency actually showed a greater deficit in the recall of peripheral ideas when they had Low PK compared to when they had High PK, but this interaction failed to reach significance (PK x Centrality interaction: $F(1, 9) = 3.54$, $p = .09$; partial $\eta^2 = .28$). Planned comparisons indicate that among High Proficiency participants, there was no difference between the amount of central ideas recalled by readers when they had Low PK versus High PK ($t(9) < 1$) or the amount of peripheral ideas recalled by readers with Low PK versus High PK ($t(9) = 1.41$, $p > .05$).
Figure 9. Proportion of central and peripheral ideas recalled by participants with either Low L2 Proficiency or High L2 Proficiency, reading in their L2 with High or Low PK of the passage topic. Proportions were standardized within each passage.

A final analysis compared how the size of the centrality deficit in L2 relative to L1 depends on L2 proficiency and PK of the passage topic. The previous analysis
revealed that PK allowed L2 readers to compensate relative to when they do not have PK, but this analysis allows us to examine the degree of compensation relative to fluent L1 reading. A Passage (L2 passages High PK, L2 passages Low PK, L1 passages) x Proficiency (High L2 Proficiency, Low L2 Proficiency) x Centrality (Central, Peripheral) mixed design ANOVA was performed. This analysis showed that PK again operated as a compensatory tool for the low proficiency L2 readers: when low proficiency L2 readers had PK, the centrality deficit was attenuated, but when they did not have PK, they continued to demonstrate the deficit. This finding is evidenced by a significant Passage x Proficiency x Centrality interaction ($F(2, 19) = 5.04, p < .05$; partial $\eta^2 = .35$; see Figure 10).

Figure 10. Proportion of central and peripheral ideas recalled by participants with either Low L2 Proficiency or High L2 Proficiency, reading in their L1 and in their L2 with High and Low PK of the passage topic. Proportions were standardized within each passage.

Low L2 Proficiency
Planned comparisons revealed that Low Proficiency L2 readers showed a significant centrality deficit when reading L2 compared to L1 passages when they have Low PK (Centrality x Passage interaction: $F(1,12) = 7.56, p < .05$; partial $\eta^2 = .39$), while High PK allows Low Proficiency L2 readers to compensate for this deficit (Centrality x Passage interaction: $F(1,12) = 1.14, p > .05$; partial $\eta^2 = .09$). However, this pattern changes for High Proficiency L2 readers: High Proficiency L2 readers did not show a centrality deficit compared to L1 readers, regardless of whether they had Low PK or High PK (Centrality x Passage interaction: $F(1,8) = 1.21, p > .05$, partial $\eta^2 = .13$ and $F(1,8) < 1$, respectively). In sum, both High PK and High L2 proficiency can help L2 readers build the appropriate connections among the text's ideas and thereby compensate for the centrality deficit.

It should be noted that participants still recalled fewer ideas overall in their L2 relative to their L1, regardless of whether they possessed PK and/or High L2 Proficiency. This is evidenced by a significant main effect of Passage among High L2 Proficiency
readers with Low PK \( F(1, 8) = 13.82, p < .01; \) partial \( \eta^2 = .63 \), High L2 Proficiency readers with High PK \( F(1, 8) = 22.52, p < .01; \) partial \( \eta^2 = .74 \), Low Proficiency readers with Low PK \( F(1, 12) = 37.02, p < .001; \) partial \( \eta^2 = .76 \), and Low L2 Proficiency readers with High PK \( F(1, 12) = 26.63, p < .001; \) partial \( \eta^2 = .69 \).

**Reading Rate and Prior Knowledge**

The effect of PK on L2 reading rate was examined across all ten passages. A 2-way ANOVA with PK (Low, High) and Proficiency (Low, High) assessed differences in reading rate, measured as the number of words read per second. Participants read significantly faster when they had High PK compared to when they had Low PK \( F(1, 30) = 6.34, p < .05; \) partial \( \eta^2 = .17 \). The interaction between PK and Proficiency was not significant \( F(1, 30) < 1 \). One-tailed t-tests indicated that having PK significantly increased the reading rate of high L2 proficiency readers \( t(16) = -1.94, p < .05 \), and the boost that low L2 proficiency readers received from PK was marginally significant \( t(14) = -1.66, p = .059 \); see Table 4 for means and standard deviations).

<table>
<thead>
<tr>
<th>Low PK</th>
<th>High PK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Proficiency</td>
<td>2.01 (.63)</td>
</tr>
<tr>
<td>High Proficiency</td>
<td>2.18 (.53)</td>
</tr>
<tr>
<td>Overall</td>
<td>2.04 (.58)</td>
</tr>
</tbody>
</table>

* \( p < .05 \)

\( \dagger \) \( p < .10 \)
Study Abroad and Achievement Variables

See Appendix A for demographic data from the Introductory Questionnaire. The effect of studying abroad on L2 discourse processing could not be assessed because only five participants reported a study abroad experience. Neither self-reported GPA nor ACT scores correlated significantly with scores on the Spanish proficiency exam (GPA, Spanish proficiency: \( r(30) = .10 \); ACT, Spanish proficiency: \( r(28) = .16 \)).
Chapter 4: Discussion

The goal of the present study was to determine how reading in a L2 affects one’s mental representation of the text and the ability to glean the important information. The quality of participants’ memory for L2 texts was examined using a within-participants design and comparing the proportion of central and peripheral ideas recalled. The main finding was that when reading in their L2, participants demonstrate a centrality deficit. This means that compared to their L1 recall, the greatest deficit when reading L2 passages was in the recall of central, rather than peripheral, information. This study is the first to recognize the impact of reading in L2 on the ability to derive the central information.

Although previous studies have recognized that L2 readers display a centrality effect (Barry & Lazarte, 1995; Lund, 1991; Schmidt-Rinehart, 1994), none have compared the slope of this centrality effect to that of L1 readers. Like previous studies, we too found that participants reading in their L2 recalled more central than peripheral ideas overall, so it was counterintuitive that the ideas best recalled by participants reading in their L2 (i.e., central information) were also the source of their greatest deficit compared to their L1 recall. It seemed more intuitive that participants struggling to read in their L2 would show a deficit relative to L1 either across the board on central and peripheral ideas, or that they would get the main ideas and show a deficit only in recalling the less critical information. The centrality deficit can be explained, however,
by realizing that it is an indication of a failure to build a coherent representation of the text. Central ideas emerge as central because they have a greater number of connections. Because ideas with more connections are most easily recalled, this leads to greater recall of central than peripheral information. The fact that L2 readers display a centrality effect suggests that they connect the text’s ideas to some extent; however, their centrality deficit implies that they fail to connect the text’s ideas to the same degree that L1 readers do.

We theorized that the centrality deficit stems from the fact that word identification is more effortful for people reading in a L2 and requires more cognitive resources (Hasegawa et al., 2002). Because participants reading in their L2 must allocate more resources to word identification, fewer resources remain to connect the text’s ideas, and consequently, less differentiation between central and peripheral ideas occurs.

This theory is supported by the finding that the centrality deficit is closely tied to L2 proficiency. When participants were divided according to their level of L2 proficiency (i.e., Low Proficiency versus High Proficiency), the centrality deficit was apparent in the memory for text of the readers with low L2 proficiency, but not in those with higher L2 proficiency. Readers with low L2 proficiency must devote even more cognitive resources to word identification than those with higher L2 proficiency, and consequently are left with even fewer resources to form connections among the text’s ideas. Readers with low L2 proficiency did not differ from those with high L2 proficiency on L1 verbal ability, which strongly suggests that it was lower L2 proficiency that caused the centrality deficit, rather than differences between the two proficiency groups in general verbal ability.

Granted, even the high L2 proficiency readers still recall quantitatively fewer ideas in their L2 than L1, but the fact that the slope of their L2 centrality function is
parallel to that of their L1 centrality function indicates that the primary cause of their deficit is not in connecting ideas. Perhaps they miss out on some of the text’s ideas due to deficient L2 vocabulary and syntactic knowledge, which reduces the recall of both central and peripheral information to the same degree. In other words, perhaps L2 readers with high L2 proficiency are capable of forming the appropriate connections among the limited number of ideas that they can identify and access, but since they cannot access meaning for all the text’s words and ideas, they recall significantly fewer ideas overall.

In addition to being the first study to recognize that L2 impacts the derivation of what is most central and to offer a theory to explain this centrality deficit, another major contribution of this study was to identify a compensatory mechanism that can help alleviate the centrality deficit: prior knowledge of the passage topic. Using a within-participants design, we compared the memory for text of L2 passages of which participants did not have PK with those about which they did possess PK. Participants showed a centrality deficit in their recall of low PK passages compared to their recall of high PK passages. This interaction indicates that when a reader with low L2 proficiency is aided by PK, this knowledge not only facilitates recall, but improves recall of the central ideas in particular. Because PK was a within-participants variable, this strongly suggests that it was PK of the specific passage topic, rather than a variable related to general cognitive ability (e.g., verbal IQ) that aided L2 readers in connecting the text’s ideas. When we turn to the high L2 proficiency readers, we see a different pattern. Here their recalls about passages of which they have low PK do not show a centrality deficit compared to their high PK passages; if anything there is a “detail deficit”, or a greater deficit on the recall of peripheral ideas. Although this interaction was not significant, this
is nevertheless an interesting pattern. It might suggest that regardless of whether they have PK, the high proficiency L2 readers possess sufficient resources to adequately connect all the ideas that they can recognize, and they hit a relative “ceiling” for central recall; this “ceiling” is not a function of the task, but rather a function of their lack of L2 fluency. Rather than boosting the recall of central ideas, PK boosts recall of peripheral ideas instead. This conclusion is highly speculative based on the present findings, and future research should address this question.

We have established that, among low L2 proficiency readers, PK attenuates the centrality deficit when recalling L2 passages. To further explore the influence of PK, we compared participants’ recalls of L2 passages with and without PK to their recall of L1 passages. Employing L1 recall as the comparison helps determine the degree of compensation that PK allows. In other words, is the effect of PK influential enough to compensate for the degree of centrality deficit shown by low proficiency L2 readers compared to L1 readers? As expected, among the low L2 proficiency readers, those who were not aided by PK displayed a centrality deficit compared to L1 readers. Remarkably, however, when the same participants were equipped with PK, the centrality deficit disappeared. PK allowed centrality to emerge to the same degree for low L2 proficiency readers reading L2 and L1 texts.

This finding parallels that of Miller and Keenan (2009) who found that possessing PK of the passage topic helped poor readers resolve the centrality deficit. They theorized that readers who have difficulties using text information to establish connections could offset those difficulties by using their PK in a number of ways to form connections. They proposed that PK might provide the reader with a preexisting idea of what is central
(Goetz, Schallert, Reynolds, & Radin, 1983). They also proposed that PK could decrease the amount of resources required to form connections among text ideas because those connections are already available. Finally, PK may also enable word identification to proceed more automatically (Priebe et al., submitted). In fact, the present study strongly supports this idea, because having PK of the passage topic improved L2 readers’ reading rate.

In short, these findings suggest that as long as L2 readers are equipped with either PK of the passage topic or a higher level of L2 proficiency, they will no longer demonstrate the centrality deficit compared to L1 readers. Only individuals with lower L2 proficiency who do not possess PK of the passage topic are impacted. Both of these compensation tools are theorized to operate in a similar manner – by facilitating the formation of connections among the text’s ideas, which in turn allows central ideas to be recalled more easily.

Future research should explore the role that working memory (WM) plays in recalling ideas from L2 passages. Because WM is involved in connecting the text’s ideas (Cain, Oakhill, & Bryant, 2004; Swanson, Howard, & Saez, 2007), it should play a greater role in the recall of central than peripheral information; if the appropriate connections are not formed, centrality is unable to emerge (Miller, Keenan, & Willcutt, 2009). WM capacity influences L2 proficiency (Kormos & Sáfár, 2008; Tokowicz, Michael, & Kroll, 2004; van den Noort, Bosch, & Hugdahl, 2006), thus future work should explore the extent to which the L2 centrality deficit is related to individual differences in WM capacity.
A limitation of this study was variability across the ten passages. Many factors, such as length and readability, were successfully held constant, but several passage differences did emerge. For example, the passages’ overall memorability differed (i.e., some passages were more easily recalled than others), there was an unequal distribution of PK about the passage topics, and the relative recall of central and peripheral ideas was not consistent across all passages. We addressed this limitation by combining data from at least two passages to create composite variables, which allowed for more stable constructs and minimized the influence of passage differences. However, after excluding the two passages that failed to show a centrality effect, some participants were left with data from only one English passage. We could not afford to exclude these participants due to a limited sample size, so their L1 recall proportion is only based on one passage and could potentially be influenced to some degree by characteristics of that passage.

The results of this study suggest several avenues for future research regarding L2 instruction. Future studies should explore whether training L2 readers to use metacognitive techniques aimed at helping them form connections among the text’s ideas would be an effective instruction strategy. Furthermore, future work should investigate whether such metacognitive training would be more or less effective than improving L2 comprehension through traditional methods, such as vocabulary and syntax instruction. Also, the present findings indicate that PK can serve as a powerful compensatory mechanism, which suggests that future work should explore whether devoting time toward improving the reader’s world knowledge could also be beneficial.

This study has several practical implications regarding the assessment of L2 comprehension. First, this study substantiates the value of examining the quality of L2
readers’ memory for text. Existing assessments such as multiple-choice or cloze formats are incapable of such a fine-grained analysis of the coherence of L2 text representations. Determining whether L2 readers exhibit a centrality deficit is the only way of knowing whether they form the appropriate connections among the text’s ideas that allow centrality to fully emerge. Additionally, our finding that PK compensates for the centrality deficit suggests that L2 comprehension assessment need not only assess readers’ comprehension, but should also take into account the knowledge that the reader brings to the table. In other words, L2 comprehension assessment should not occur in a vacuum; it is pertinent to be aware of the influence that PK (or lack of PK) may have on L2 readers’ comprehension.
References


Appendix A
Introductory Questionnaire and Summary Responses

1. Do you have a history of reading problems in your NATIVE language?  
   
   YES 37 NO

2. Is English your native language?  
   
   YES 0 NO

3. How many years have you been studying Spanish?  
   
   mean = 4 years (SD = 2.08)

4. Have you studied abroad in a Spanish speaking country?  
   
   YES 38 NO

5. Approximately how much time have you spent in a Spanish speaking country (e.g., study abroad, vacation, mission trip, etc.)?  
   
   Years
   Months
   Weeks
   Days: Median = 7 days (SD = 120.16)

6. In the United States, how often do you use Spanish outside of the classroom? When?  
   (e.g., speaking with native Spanish-speaking friends, working with native Spanish-speakers, etc.)  
   
   The majority of participants (n = 29) reported that they rarely or never use Spanish outside the classroom.

7. SAT: mean = 1683.64 (n = 11)  
   ACT: mean = 27.27 (n =30)

8. GPA: mean = 3.46 (n =33, includes both DU and high school GPA)

9. Please list the Spanish courses you’ve taken and the grades you received in each:
Appendix B. Passages

The Galapagos Islands

Want to go to the “world’s end?” The Galapagos Islands have been called this. These islands are located off the coast of Ecuador in the Pacific Ocean. They are made of volcano craters. Their lava cliffs rise up from the sea to form the islands.

The islands were first discovered in the 1500s by Spanish explorers. These explorers named the islands after the giant turtles they found there. These giant turtles can weigh as much as five hundred pounds. They can live for more than one hundred years. They can grow to be four feet long, and they are large enough for a man to ride.

The giant turtles are not what made these islands famous, however. The islands were made famous after a great scientist named Charles Darwin visited there. Darwin sailed his ship, The Beagle, to the Galapagos Islands in the early 1800’s. Darwin scientifically studied the geology and biology of the islands. Darwin noticed that the same species of bird, the finch, differed from island to island. He also found that other animals of the same species, such as tortoises, varied from island to island. These facts helped him develop his theory of natural selection. This theory was presented in the book The Origin of Species. Darwin used the theory of natural selection to explain how species evolve. His influential ideas formed the basis of modern evolution theory.

The islands are home to many birds and plants not found in other parts of the world. They are the only place where you can find giant turtles in the wild. On the larger islands, you will find wild dogs, cats, and goats. Most of these animals were abandoned by passing ships. You can also find giant iguanas that may grow to be three feet long! Today very few people live on the islands. Life is hard there. The ground is covered with lava rocks. But the soil is rich for growing things. The people raise coffee, fruit, and sugar cane.

Today laws protect these islands. In fact, you need special permission to visit the islands. The islands provide a safe place for wildlife – the same wildlife that allowed Darwin to form his famous theory of natural selection many years ago. There are no other islands like the Galapagos Islands.

Source: Hyde, 1999
Manatees

Imagine yourself swimming in a Florida river. It is a warm, sunny day. Suddenly, you see a ten-foot long, three-foot wide creature gliding directly toward you! At first you are terrified! But you soon see the creature’s whiskery face and fat, lovable lips. You realize it is only a manatee. Lucky for you, manatees are known for their peaceful nature. They are the gentle giants of the sea.

Manatees are very unique creatures for many reasons. One reason is that they can survive in both saltwater and fresh water. They like places where fresh water rivers or bays meet saltwater oceans. They live in warm, shallow water, usually above sixty-eight degrees. They are most commonly found off the gulf coast of Florida.

Another unique fact about manatees is that they are the only marine mammals that are herbivores. Their main diet is sea grass. The typical manatee eats more than one hundred pounds of water plants everyday! That is equal to more than two hundred heads of lettuce! By eating so much sea grass, they help keep rivers and seaways clear. Without manatees, the sea grass would clog the waterways and cause problems.

A third fact about the manatees is a tragic one. Manatees are endangered. There are fewer than three thousand manatees in U.S. waters. Though they have few predators in the wild, their worst enemy is man. Boats are the biggest threat. Manatees swim close to the water’s surface, so they are often hit and killed by boats. Sometimes they survive the accidents, but suffer deep wounds. Humans also threaten manatees in other ways. Habitat destruction, litter, and illegal poaching are all dangers that manatees face.

Many groups are trying to save the manatee. They work to pass laws to protect them. For example, manatees are now protected by the Endangered Species Act. Several groups take care of sick and wounded manatees. They try to help them get better so they can be released into the wild again. Once they are released, they are carefully observed.

The manatee is a very special creature. No other animal on land or sea compares to them. We must protect this majestic creature before it is gone forever!

Source: www.wikipedia.com
Stegosaurus

Scientists have been studying dinosaur bones for hundreds of years. They are intrigued by the creatures that once roamed our planet. One of the best known dinosaurs is the stegosaurus. The most complete stegosaurus skeleton was found in 1992. By studying these and other stegosaurus remains, we now know a lot about this animal. The bones tell us about its anatomy, intelligence, and lifestyle.

The stegosaurus had unique plates along its back. These plates made it a very strange dinosaur. There is much debate about their use and arrangement. The plates were up to two-feet tall and two-feet wide. Most scientists believe that they were used for temperature regulation. They might have helped cool and heat the animal. Another theory, however, suggests that they could have been used as a display during courtship. They may have been brightly colored. A third idea is that the plates could move up and down. This motion might have scared away predators.

The stegosaurus had spikes on its tail. For years every stegosaurus model showed the spikes pointing up. In the 1990's, however, this idea changed. Now scientists think that the spikes stuck out horizontal to the ground. This would have made the tail a weapon that could be swung at predators.

The stegosaurus is often called the dumbest dinosaur. It had an incredibly small brain. In fact, most scientists believe that its brain was too small to control such a large creature. Scientists think the stegosaurus might have used an “auxiliary brain”. The auxiliary brain might have been located above its rear legs to help control its movements. This was not a true brain. It was really a bundle of nerves. These nerves helped relay information from its real brain to the rest of its body.

Stegosaurus probably lived in family groups or herds. They were plant-eaters. They probably moved slowly through forests and ate the low-growing plants.

The stegosaurus is a fascinating animal. Its plates and spiked tail make it one of the most easily identified dinosaurs. Although not the smartest, the stegosaurus is one of the world’s most popular dinosaurs.

Source: www.wikipedia.com
Hannah Montana

_Hannah Montana_ is an American television series. The show aired for the first time on March 24, 2006. It is on the Disney Channel. The show is about a teenage girl named Miley, who is played by Miley Cyrus. Miley moved from Tennessee to Malibu. She stays busy adapting to her new lifestyle.

Miley has a huge secret. She leads a double life. Most people know her as an average teenage school girl named Miley Stewart. Very few people know that she is also a very famous pop singer named Hannah Montana. Only a few people know about Miley’s secret double life. These are her closest friends and family members. Miley hides her fame because she wants to live a normal life.

The theme song for _Hannah Montana_ is _The Best of Both Worlds_. The song is performed by Miley Cyrus (as Hannah Montana). The song's lyrics describe Miley’s double life.

In the show, Miley lives with her dad, who is named Robbie Ray. Robbie Ray is played by her real-life father, Billy Ray Cyrus. Billy Ray Cyrus is a country music star. She also has a brother on the show. His name is Jackson. Miley has lots of fun with her two best friends, Lilly and Oliver. The TV series shows how the friends learn to deal with typical teenage dilemmas.

The television show _Hannah Montana_ receives very high ratings. Hannah Montana also performs live concerts. These concerts are extremely popular. Tickets for every concert have sold out. Some tickets have sold for thousands of dollars.

Source: www.wikipedia.com and Internet Movie Database
Battle of the Alamo

If you go to San Antonio, Texas, you will find a story of long ago. This story began at an old church, called a mission. The mission closed in 1793, but came to play a key role in the Texas Revolution fifty years later. This is where the Battle of the Alamo occurred.

You need to go back in time to understand this battle. Texas used to be part of Mexico. The people of Texas wanted to be free. They wanted their own land. Mexico claimed the land as its own.

Santa Anna was a Mexican general. In 1836 he led 5,000 Mexican soldiers into San Antonio. He ordered the people of Texas to surrender. They refused.

The Texans used the mission as a fort. They only had one-hundred and fifty men to fight. They knew they were outnumbered. There were far more men in the Mexican army. Still, they fought for freedom. They fought for their land. American hero Davy Crockett was one soldier who fought in this battle.

The battle went on for 13 days. It lasted from February 23 to March 6, 1836. It ended when the Mexican soldiers stormed the Alamo. The Texans lost the Battle of the Alamo. They lost many brave men that day. But they succeeded in stalling the Mexican army. This extra time allowed Sam Houston, the leader of the Texan Revolution who was not fighting at the Alamo, to gather troops and supplies. This enabled the Texans to win the next battle against the Mexicans. This battle was called the Battle of San Jacinto.

The Texans went on to win their independence. The Battle of the Alamo inspired the rest of Texas to unite and fight for their freedom. You have probably heard the phrase “Remember the Alamo”. This phrase signifies patriotism and independence.

The Alamo is in the middle of San Antonio. It is a reminder of what freedom means. There is a statue in front of the fort to honor the heroes who gave their lives to freedom.

Sources: www.wikipedia.com and Hyde, 1999
Tower of London

London is the capital of England. It is very old and rich in history. Many buildings in London tell of life long ago. One such place is the Tower of London. It was built by William the Conqueror in 1078 as a fortress. It was built on the banks of the Thames River to protect the king’s family.

The Tower was once surrounded by a moat, but there is no water in the moat today. A high wall goes around the Tower. The Tower is not just one building. There are thirteen buildings in all, such as the White Tower and the Bloody Tower. The royal family once lived in one of the buildings. Workers, soldiers, and knights lived in the other buildings. It took many people to run a castle.

Another building was the prison. The Tower held many famous prisoners, such as Thomas More, Sir Walter Raleigh, and members of the Royal Family. The Tower was also the place of many executions. Anne Boleyn, Henry VIII’s second wife, was one person executed there. There is a legend that Anne Boleyn walks around the White Tower to this day, carrying her head under her arm.

The royal family no longer lives in the Tower. Today it is home to many of England’s jewels and treasures. Visitors can see rings, bracelets, and crowns that belonged to kings and queens. They can see swords with jewels. They can also see the famous Crown Jewels. These include objects worn by kings and queens during their coronation. These treasures are part of history. They are priceless. Suits of armor worn by knights are also in the Tower.

The treasures in the Tower are well guarded. Special guards are trained to protect the treasures. They are called Beefeaters. It is an honor to be a guard of the Tower. If you see a Beefeater, you will see a man dressed as guards dressed long ago.

For nearly a thousand years, the Tower of London has guarded many important things. It is more than buildings. It represents England’s past and present. The Tower helps us realize England’s rich history.

Source: Hyde, 1999
Pele

Pele was born in the South American country of Brazil. He lived in a small village and his family was very poor. But Pele had a dream. He wanted to become a professional soccer player. He could not afford a soccer ball so he fashioned one. He took an old sock, stuffed it with newspapers, and sewed it together with string. It was a poor substitute, but it was better than nothing. Pele and his friends formed their own team. They did not have enough money to purchase shoes, but that did not stop them. They played barefoot and became known as the "barefoot team."

Pele and his friends saved their money, and eventually the team was able to get a regular ball and shoes. Pele discovered that the ball could be better controlled when he wore shoes. Pele and his team practiced continuously. They soon began playing older and more established teams from the big cities. The team began to win most of its games. Pele was the star of the team. People thought this was amazing because he was only eleven years old!

Pele's skill at soccer came to the attention of influential people, and when he was fifteen, he was signed by the Santos team. Pele led the Santos team to many championships. He also led the Brazilian national team to three world championships. Pele also holds many records and has scored over twelve hundred goals in his career as a professional player.

Pele decided to retire in 1974. Then he changed his mind and came to the United States, where he joined the New York Cosmos. Soccer had not been very popular in the United States up to this point, but Pele's presence had a dramatic effect. Crowds at games doubled and tripled as people came to see the famous and exciting Pele. Games began to be shown on television. Soccer gained in popularity and many children in the United States began to play soccer. Soccer is now one of the most popular sports in the United States, due in part to the dream of a young boy in Brazil.

Source: Leslie & Caldwell, 2001
Margaret Mead

Margaret Mead had always been interested in the ways of life of people from other lands. When Mead went to college, she took a class in anthropology. This is the study of how different people live. Mead decided to make this her career. She wanted to study primitive people before modern ways of living destroyed their culture.

Mead realized that living with a people is the only effective way to learn about them. She chose a village in Samoa to investigate. Several islands make up Samoa, which is in the Pacific Ocean. Mead worked hard to prepare for Samoa by studying the Samoan language. She read everything she could about the Samoan people. She read about their food and how they built their homes. She read about their ceremonies, their past history, and their taboos. But she wanted to learn much more.

Finally Mead arrived in Samoa. At first life was difficult for her. She felt alone. She was not fluent in the Samoan language. She lived in a house with no walls and no electricity or gas. It had no running water and no bathroom. One day she said to herself, “I can't go on” in Samoan. Then she thought that maybe she could continue after all. Mead became fluent in the Samoan language, and the people soon regarded her as one of the village. She listened to them talk. They told her their problems. Mead felt that being a woman assisted her in learning more about the lives of these people. Instead of having to go on hunts with the men, Mead stayed with the women. She observed the children play and learned how food was prepared. She made efforts to get the older people to recount tales of the past.

Mead learned many things from the Samoan people. She always took notes and kept careful records. These notes were used to write her first book, which was called *Coming of Age in Samoa*. It made her famous. Mead spent the rest of her life studying and writing about primitive ways of life that no longer exist today.

Source: Leslie & Caldwell, 2001
Panama Canal

What are five city blocks long and six stories high? They are the doors leading into the Panama Canal. These doors are huge! They are made of steel. They weigh thousands of tons.

The Panama Canal is in the country of Panama. Panama is in Central America. The canal took over ten years to build. It cost more than 375 million dollars. The canal is over forty-seven miles long. It can take a ship over eight hours to pass through it.

In the late 1800s, France tried to build a passage through Panama. Having a passage was very important because it would connect the Pacific and Atlantic Oceans. Instead of having to go all around the southern tip of South America, which was a long and very dangerous voyage, a passage would allow ships to cut through Central America. The men worked hard. They faced many problems. The ground was soft. They had many mud slides that ruined their work. Over 21,000 workers died. After seven years, they ran out of money, and the work stopped.

Then Theodore Roosevelt became president of the United States. He was a man full of ideas. He was a man of action. He knew that a passage was needed through Panama. It would be good for trade. He decided that the United States would finish the canal.

At first, the builders had a lot of trouble. Then a man named John Stevens was sent as the engineer. He thought of building a lock canal. A lock canal has giant doors on each end. The lock is filled with water. The front door opens to allow a ship to enter. Then it closes. More water is pumped into the lock. The water lifts up the ship so it can travel through the canal. Then the ship goes out the back door of the lock. It took four years just to build the lock canal.

The first ship passed through the Panama Canal in 1914. Each year, more than 14,000 ships pass through the canal. It is one of the most important trade routes for North and South America.

Source: Hyde, 1999
Ferdinand Magellan

Ferdinand Magellan was a Portuguese noble, soldier, and sailor. He performed a great achievement on the sea. Magellan had spent years in Asia. He often gazed across the Pacific Ocean and asked a question. “How far away from here are the lands discovered by Columbus? If I sailed to the New World, could I find a passage to the Pacific Ocean and the rich Spice Islands?”

Magellan hoped to find answers to his questions as well as obtain a large cargo of rare and costly spices. The Portuguese king refused to help him, so he turned to Spain for help.

In 1519, Magellan sailed from Spain with 5 ships. He had a crew of almost three hundred sailors. He sailed across the Atlantic. When he reached the New World, he followed the coast of South America until he found the straits that connected the two oceans. It took Magellan thirty-eight days to sail through the stormy straits to the Pacific. In the straits one ship was wrecked. Another headed back to Spain. Once in the Pacific, Magellan turned north. He traveled for months without seeing land.

The voyage was filled with hardship. Several angry Spanish captains rebelled against Magellan. Magellan defeated the rebels. He left two of them on shore to die.

Several times the ships ran low on supplies. With little food and water, the sailors begged to turn back. But Magellan would not allow this. He declared that they would keep sailing even if they had to eat the leather rigging of the ships. Disease and starvation claimed many of the crew. But they remembered what happened to the earlier rebels and no one opposed Magellan.

Magellan finally reached the islands of the Pacific. Unfortunately he was killed in a fight with some natives. After that one of the ships became unseaworthy and the other was wrecked.

The remaining ship with only seventeen of the original crew members sailed west through the Indian Ocean and around the southern tip of Africa. When they finally returned to Spain they had been gone three years!

Although Magellan did not live to see the end of the voyage, he and his crew accomplished what no one had ever done before. They sailed around the world. Magellan never knew that he proved what Columbus had predicted. The lands of the East could be reached by sailing west.

Source: Leslie & Caldwell, 2001
Appendix C. Prior Knowledge Exam

1. Ferdinand Magellan
   a. Who was Ferdinand Magellan?
   b. What was the significance of Magellan’s voyage?

2. Hannah Montana
   a. Who is Hannah Montana?
   b. What is the basic premise of the TV show Hannah Montana?

3. Battle of the Alamo
   a. Where was the Battle of the Alamo (City/State)?
   b. Why was this battle significant?

4. Stegosaurus
   a. Describe what a stegosaurus looked like.
   b. Tell me everything you know about stegosaurus.

5. Tower of London
   a. What is the Tower of London?
   b. What is the Tower of London used for today?

6. Galapagos Islands
   a. Where are the Galapagos Islands?
   b. Why are they famous?

7. Manatees
   a. What is a manatee?
   b. Describe everything you know about manatees.

8. Pele
   a. Who was Pele?
   b. Tell me everything you know about Pele.

9. Margaret Mead
   a. Who was Margaret Mead?
   b. Tell me everything you know about Margaret Mead.

10. Panama Canal
    a. What is the Panama Canal?
    b. Tell me everything you know about the Panama Canal.
### Appendix D. Spanish Proficiency Exam

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jorge ______ contó un chiste a sus amigos.</td>
<td>se, lo, los, les</td>
<td>se</td>
</tr>
<tr>
<td>2. En la clase de español, ¿quién____ alto?</td>
<td>son, es, soy, somos</td>
<td>es</td>
</tr>
<tr>
<td>3. El libro es _______ la chica.</td>
<td>por, con, para, sin</td>
<td>por</td>
</tr>
<tr>
<td>4. Yo ______ la tarea de matemática todas las noches.</td>
<td>hace, hago, haga, hacemos</td>
<td>hago</td>
</tr>
<tr>
<td>5. La cocina ______ sucia ahora.</td>
<td>está, están, esta, estar</td>
<td>están</td>
</tr>
<tr>
<td>6. Ellos ______ Chicago muy bien.</td>
<td>saben, conocen, conocemos, conocer</td>
<td>conocen</td>
</tr>
<tr>
<td>7. Mañana vamos a tener una fiesta. Será un____ día.</td>
<td>grande, grand, gran, fantástica</td>
<td>gran</td>
</tr>
<tr>
<td>8. En la escuela, ¿Quiénes____ inteligentes?</td>
<td>son, seré, es, soy</td>
<td>son</td>
</tr>
<tr>
<td>9. ¿Qué ves? Yo____ un gato.</td>
<td>Ves, Ve, Ver, Veo</td>
<td>Ves</td>
</tr>
<tr>
<td>10. La niña cantó tan bien que el público____ otra canción.</td>
<td>cambió, compró, pidió, ganó</td>
<td>compró</td>
</tr>
<tr>
<td>11. Desde que Verónica vive en España____ nunca la vemos.</td>
<td>casi, antes, sí, no</td>
<td>antes</td>
</tr>
<tr>
<td>12. Elsa es más grande____ yo.</td>
<td>como que, que, de, de que</td>
<td>como que</td>
</tr>
</tbody>
</table>
13. José ______ dá regalos a Marta.
   - le
   - la
   - lo
   - les

14. ¿Qué te ______ comer, pizza o helado?
   - gustó
   - guste
   - gustan
   - gusta

15. Por favor, no ______ esas flores
   - compras
   - comprar
   - comprado
   - comprando

16. La ______ maestra de la escuela es Juana.
   - más buena
   - más mal
   - más mejor
   - mejor

17. A los ancianos ______ viajar en avión.
   - le gusta
   - les aburre
   - les gustan
   - se aburre

18. El lunes pasado yo vi a Raul en la escuela. Él ______ drogas ilícitas.
   - ha vendiendo
   - vendiste
   - estaba vendiendo
   - vendaba

19. When we went to the beach we would always swim. Cuando íbamos a la playa siempre ______
   - nadaremos
   - nadaríamos
   - nadábanos
   - nadamos

20. Don't say anything. She's thinking.
No diga nada. Ella ______
   - está pensando
   - tiene que pensar.
   - es pensando
   - ha pensando

21. Cuando seas profesor, vas a ______ muchos privilegios.
   - tienen de
   - encantar de
   - divertirse con
   - disfrutar de

22. Por fin Susana aprendió el ...
   - cuerda
   - leer
   - lección
   - poema

23. Cuando la policía vio al niño perdido, se lo entregó a su ______
   - casa
   - estación de policía
   - doctor
   - madre

24. No ______ la pena ser violento.
   - es
   - vale
   - va
   - tiene
25. Carlos nunca se preocupa por su tarea, pero esa tarea lo tiene ______
   - preocupada
   - de mal humor
   - tristeza
   - feliz

26. Tenía miedo de salir en la noche porque la calle ______
   - estará fea
   - esta limpia
   - estaba sucia
   - estaba oscura

27. The conference is at nine.
   - La conferencia es a las diecinueve.
   - La conferencia es a las nueve.
   - La conferencia hay a las nueve.
   - La conferencia está a las nueve.

28. Juan and I became good friends.
   - Juan y yo nos hicimos buenos amigos.
   - Juan y yo nos hacíamos buenos amigos.
   - Juan y yo nos hacían buenos amigos.
   - Juan y yo nos hicieron buenos amigos.

29. I advise you to do it.
   - Te aconsejo que lo haga.
   - Te aconsejo que lo hagamos.

30. México is a magnificent city.
   - México está una ciudad magnífica.
   - México es un ciudad magnífica.
   - México es una ciudad magnifica.
   - México sería una ciudad magnífica.

31. You did well on the test!
   - ¡Qué mal examen hizo Ud.!
   - ¡Qué bien examen hizo Ud.!
   - ¡Qué bueno examen hizo Ud.!

32. Estaba escuchando música, de repente, ______ el timbre.
   - sonó
   - sonaban
   - soñó
   - sonará

33. Cuando Maribel se fue nos dijo que volvería antes, él nos dijo que ______ antes de las ocho.
   - regresar
   - regresamos
   - regresas
   - regresaría

34. Ella se fue triste cuando salió de casa porque nunca había ______
   - viajó
   - viajado
   - ha viajado
   - viajar

35. Nos entristece mucho que no puedas ______ aquí con nosotros.
   - estaremos
   - estarás
   - estar
   - es
36. What a shame that you didn’t have money to buy the house.
   - ¡Qué lástima que te faltó el dinero para comprar la casa!
   - ¡Qué lástima que faltaras el dinero para comprar la casa!
   - ¡Qué lástima que falta el dinero para comprar la casa!
   - ¡Qué lástima que te faltara el dinero para comprar la casa!

37. Which books do you like?
   - ¿Qué libros te gustan?
   - ¿Qué libros te gustaron?
   - ¿Cuáles libros te gustas?
   - ¿Cuáles libros te gustan?

38. I told Mr. Perez: Bring it to me, but he didn’t.
   - Le dije al Sr. Pérez: Me lo traiga, pero no me lo traje.
   - Le dije al Sr. Pérez: Tráigamelos, pero no me lo traje.
   - Le dije al Sr. Pérez: Tráemelo, pero no me lo traje.
   - Le dije al Sr. Pérez: Traiganos, pero no me lo traigan.