6-2010

Predictive inference generation in the cerebral hemispheres: An investigation of time course and reader goals

Laura S. Motyka Joss
DePaul University, LMOTYKA2@DEPAUL.EDU

PREDICTIVE INFERENCE GENERATION IN THE CEREBRAL HEMISPHERES: AN INVESTIGATION OF TIME COURSE AND READER GOALS

A Dissertation Presented in

Partial Fulfillment Of the

Requirements for the Degree of

Doctor of Philosophy

BY

LAURA MOTYKA JOSS

June 4, 2010

DePaul University

Department of Psychology

Chicago, IL

DISSERTATION COMMITTEE

Sandra Virtue, Ph.D.

Chairperson

Department of Psychology

David Allbritton, Ph.D.

Jerry Cleland, Ph.D.

Department of Biology

Dorothy Kozlowski, Ph.D.

Department of Education

Marie Donovan, Ed.D.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to my dissertation chair, Sandra Virtue, as well as all of my committee members for their support and encouragement throughout the entire project. I would also like to thank Lauren Schliesleder, Alyssa Nudo, Laura Brady, and Melissa Saab for their help in data collection and coding.

VITA

The author graduated from James B. Conant High School in 2000. In 2004, she earned her Bachelor of Science degree in Psychology from Loyola University. In 2006, she earned her Master of Science degree from DePaul University. In 2008, she was awarded the Midwestern Psychological Association's Graduate Student Research Award. In 2009, she was awarded the Doctoral-Undergraduate Opportunities for Scholarship Award.

TABLE OF CONTENTS

List of Tables

List of Figures

Chapter I

Introduction

During reading, individuals make connections between what is explicitly written in the text and information previously mentioned in the text or information from background knowledge (i.e., generate inferences) to understand what is occurring in a text. Because readers need to make inferences to successfully comprehend a text, the activation of inferences is a key aspect of text comprehension (Graesser, Magliano, & Trabasso, 1994; Kintsch & van Dijk, 1978; Kintsch, 1988; McKoon & Ratcliff, 1992). Specifically, readers often make connections between events in a text and their background knowledge by generating expectations about what will occur next (i.e., generating a predictive inference). For example, when readers encounter the text, *The delicate porcelain vase was thrown against the wall*. they might predict that the vase *broke* next in the text (Potts, Keenan, & Golding, 1988). To generate this inference, readers must refer to their background knowledge that delicate objects are easily breakable, and that throwing something delicate against a wall would likely cause the object to break. While research findings support the routine generation of some types of inferences, the routine generation of predictive inferences has shown conflicting results (e.g., Calvo, 2000; Calvo, Castillo, & Schmalhofer, 2006; Klin, Levine, & Guzman, 1999; Klin, Murray, Levine, & Guzman, 1999; McKoon & Ratcliff, 1986, 1992; Murray, Klin, & Meyers, 1993;; Calvo & Castillo, 1996, 1998). Although predictive inferences are not generated during reading in some situations (e.g., Potts, Keenan & Golding, 1988), evidence of predictive inference generation has been found in other types of situations (e.g., Calvo, 2000). Thus, it is important to determine under what circumstances predictive inferences are routinely generated during reading. Some research shows that generating predictive inferences can aid reading comprehension. For example, readers who have been instructed to anticipate upcoming events in a text (i.e., make predictive inferences) recall text better than readers who are not instructed to make predictive inferences (Trabasso & Magliano, 1996). One explanation for these findings is that predictive inference generation allows readers to more efficiently integrate sentence information during reading, which could increase text comprehension (Trabasso & Magliano, 1996). Thus, it is important to determine what factors may influence predictive inference generation to better understand when predictive inferences are generated during text comprehension.

One factor that has been shown to influence predictive inference generation is the amount of time a reader is given to generate an inference. Although some researchers have previously examined the time course of predictive inference generation, there are currently conflicting findings. For example, some researchers propose that readers need approximately 1000 ms (approximately 1 second) to generate a predictive inference after reading a predictive inference inducing text (Calvo & Castillo, 1996; Till, Mross, & Kintsch, 1988). In contrast, other researchers suggest that predictive inferences can be drawn as early as 500 ms after the presentation of inference inducing text (Klin, Guzman, & Levine, 1999; Klin, Murray, Levine & Guzman, 1999;

Peracchi & O’Brien, 2004). It is possible the previous findings are influenced by another factor, such as how predictable an inference is, which led to these conflicting results (Calvo, 2000; Klin, Levine & Guzman, 1999). Specifically, researchers have shown that events that are highly predictable take less time to infer than events that are less predictable (Calvo, 2000). However, other studies have shown that both highly and less predictable events take readers the same amount of time to infer (Klin, Murray, Levine & Guzman, 1999). Given these conflicting findings, a thorough investigation of the time course of predictive inferences is needed to determine when predictive inferences become activated.

Another factor that influences predictive inference generation is the goal of the reader during reading. Specifically, when a participant is given instructions to read as if they were studying a text for an upcoming exam, more predictive inferences were made than when participants were given the instructions to read with the goal of being entertained (Linderholm & van den Broek, 2002; van den Broek, Lorch, Linderholm, & Gustafson, 2001). Additionally, the goal of the reader can also influence the time course of predictive inferences. For example, when a reader is instructed to anticipate an upcoming event, predictive inference generation was found earlier than if readers are instructed to read to understand the text (Calvo et al., 2006). Thus, a reading goal can influence what information is activated during reading, such that readers are more likely to anticipate upcoming events in a text as they are reading (van den Broek et al., 2001; Linderholm & van den Broek, 2002). In addition, other researchers suggest that changing a reader’s goal leads to faster activation of inference related information

(Calvo et al., 2006). Thus, the goal of the reader seems to influence predictive inference generation, as well as the time course of predictive inference generation.

To examine the specific cognitive processes underlying predictive inferences, researchers can investigate how the left and right cerebral hemispheres activate semantic information during reading. For example, cognitive neuroscience research has shown that different cognitive processes occur in the right and left hemispheres during inference generation. Specifically, a right hemisphere advantage has been found for processing predictive inferences when compared to the left hemisphere (Beeman, Bowden, & Gernsbacher, 2000). However, other research has found that the level to which the text leads to a specific, outcome (i.e., textual constraint) (Virtue et al., 2006) or the goals of the reader (Motyka Joss & Virtue, unpublished) influences the generation of predictive inferences differently in the right and left hemispheres. For example, there is a right hemisphere advantage when readers process inferential information when the text only weakly leads to a specific outcome (i.e., is weakly constrained) (Virtue et al., 2006). In contrast, if a text strongly leads to a specific, predictable outcome (i.e., is strongly constrained), inferential information is processed similarly in the right and left hemisphere. These hemispheric differences demonstrate that different cognitive processes may be carried out in the two hemispheres during reading. Interestingly, when reading goals are given to readers prior to reading, it changes the pattern displayed for weakly and strongly constrained predictive inferences. For example, if a reader is instructed to read a text with the goal of preparing for an exam, weakly constrained information is processed similarly in the right and left hemisphere (Motyka Joss & Virtue, unpublished). Thus, determining how specific factors can influence the generation of predictive inferences in the hemispheres can help researchers understand when predictive inferences may and may not be generated during reading.

Several theories have been developed to account for differences evident in the right and left hemisphere during reading. The current research will focus on the Time Course Hypothesis. The Time Course Hypothesis proposes that semantic processing occurs differently in the right and left hemisphere over time (Atchley, Burgess & Keeney, 1999; Burgess & Simpson, 1988; Koivisto, 1997). Specifically, early during semantic processing, both strongly and weakly semantically related information is activated in the left hemisphere, whereas only strongly related information is activated in the right hemisphere. In contrast, later during semantic processing, only weakly related information is activated in the left hemisphere, whereas both strongly and weakly related information is activated in the right hemisphere. For example, within 200 ms after viewing a word (e.g., *lamb*), information that is strongly semantically related to the word (e.g., *wool*) and information that is weakly semantically related to the word (e.g., *chop*) is immediately activated in the left hemisphere (Atchley et al., 1999). However in the right hemisphere, only strongly related information (e.g., *wool*) is immediately activated within 200 ms of viewing a word (e.g., *lamb*) (Atchley et al., 1999; Koivisto, 1997). By 500 ms after viewing a word, both strongly and weakly related information is activated in both the left and right hemisphere

(Atchley et al., 1999; Burgess & Simpson, 1988). Finally, 750 ms after viewing a word, only strongly related information is activated in the left hemisphere, whereas both strongly and weakly related information remains activated in the right hemisphere (Atchley et al., 1999). These results, in accordance with the Time Course Hypothesis, suggests that semantic information is activated differently over time in the right and the left hemisphere during reading.

Although researchers have examined the time course of word meaning activation in the hemispheres, the semantic information that is activated related to inference generation in the hemispheres is less clear. The generation of inferences in the right and left hemisphere may follow the Time Course Hypothesis predictions. For example, after a relatively long delay (e.g., 750 ms) between the presentation of a text and the presentation of a word related to the inference promoted by the text, strongly and weakly constrained inferences are generated differently in the right and left hemisphere (Virtue et al., 2006). Specifically, both strongly and weakly constrained predictive inferences are generated in the right hemisphere 750 ms after being presented with an inference promoting text (Virtue et al., 2006). In contrast, strongly constrained predictive inferences were generated more often than weakly constrained predictive inferences in the left hemisphere 750ms after being presented with an inference promoting text. The pattern of inference generation observed 750 ms after being presented with an inference promoting text is similar to the pattern of word meaning activation at 750 ms in the right and left hemispheres. These results suggest that inference generation may follow a different time course in the right and left hemisphere, similar to the time course found during word meaning activation.

The current research combined findings from the time course of semantic information and reading goals of predictive inference generation in the hemispheres to investigate when predictive inferences are generated under strongly and weakly constrained text conditions. In Experiment 1, inference generation in strongly and weakly constrained texts was examined at a relatively short time delay after being presented with texts (500 ms) to determine if predictive inferences are generated as predicted by the Time Course Hypothesis (Koivisto, 1997). At this short delay, it is predicted that activation for strongly and weakly constrained predictive inferences will be found in the left hemisphere, but only strongly constrained predictive inferences will be activated in the right hemisphere. In Experiment 2, participants were given the same texts as in Experiment 1, but in addition, participants were also given a reading goal. Specifically, participants were told that they would be tested after reading to create a "study goal" condition. This reading goal manipulation allows an examination of how reading goals influence the generation of predictive inferences a short amount of time (500 ms) after being presented with texts. It is predicted that giving participants instructions to read with a study goal will lead to faster activation of predictive inferences (based on Calvo et al., 2006) for strongly and weakly constrained text in both hemispheres at a short delay.

In Experiment 3, the availability of inferential information after reading strongly and weakly constrained texts was examined at a relatively long delay

(1000 ms) to determine if inferential information remains activated as predicted by the Time Course Hypothesis. Specifically, it was predicted that activation of strongly constrained predictive inferences would be found in the left hemisphere, whereas activation of strongly and weakly constrained inference generation would be found in the right hemisphere. In Experiment 4, the same delay of 1000 ms between the presentation of the final sentence of the text and the presentation of the target word was used, but now participants were given a reading goal. In this study, the influence of reading goals on the maintenance of predictive inferences at a relatively long delay will be examined. It was predicted that activation of weakly and strongly constrained predictive inference generation will be found in both hemispheres. In sum, the current set of research studies will help clarify the time course of inferential processes in the cerebral hemispheres, as well as to help determine the influence of reading goals on the activation of predictive inferences during text comprehension.

Predictive inferences during reading

Several theories of inference generation offer different explanations for how predictive inferences are activated during reading. For example, some theories of text comprehension, such as the *Construction-Integration Model* (Kintsch & van Dijk, 1978; Kintsch, 1988), suggest that numerous inferences are generated during reading. Specifically, this model states that during reading, individuals activate the meanings of the words and phrases in a text to understand the meaning of the text. However, since some information in a text is not explicitly stated, individuals also must make connections between ideas in a text through inferences (Kintsch & van Dijk, 1978). Inferences are thought be generated by making connections between ideas in a text that are not explicitly connected, or by making connections with information in a text to a reader's background knowledge (Kintsch, 1988). Individuals then use this activated information to construct a coherent representation of the text (Kintsch, 1988). Thus, according to Construction Integration Model, numerous inferences (including predictive inferences) are initially automatically activated when readers comprehend text.

In contrast, other theories, such as the *Minimalist Hypothesis* (McKoon & Ratcliff, 1992) and the *Constructionist Theory* (Graesser, Singer & Trabasso, 1994), suggest that inferences are only activated under specific conditions. According to the Minimalist Hypothesis, only inferences that are necessary for the text to be coherent at a local level (i.e., the sentence level) are activated during reading. According to the Constructionist Theory, inferences that are necessary for the overall level of coherence in a text (i.e., the global level) are automatically activated during reading. Both the Minimalist Hypothesis and the Constructionist Theory agree that inferences that are not necessary to create a coherent representation of the text, such as predictive inferences, are not always activated during reading. These inferences are thought to be strategically generated during reading only under very specific conditions. For example, predictive inferences may be generated during reading if the inference is highly predictable (McKoon & Ratcliff, 1992), or refers to background knowledge that is very well known to the reader (Graesser et al., 1994). For example, when readers encounter the text, *Three frogs sat on a log, and a fish swam beneath them.* they might infer that the fish swam under the log. However, according to both the Minimalist Hypothesis and the Constructionist Theory, it is unlikely that this inference would be made by readers because it is not needed to maintain local coherence, and background knowledge about fish swimming under logs is not usually general knowledge (McKoon & Ratcliff, 1992). In sum, the Minimalist Hypothesis and the Constructionist Theory propose that predictive inferences are not routinely generated during reading.

Empirical evidence supports the Minimalist Hypothesis and Constructionist Theory on their shared view of predictive inferences. Specifically, predictive inferences do not appear to be routinely generated during reading (Fincher-Keifer, 1993; Magliano, Baggett, Johnson, & Graesser, 1993; Potts, Keenan, & Golding, 1988). For example, when readers are presented with a passage that promotes a predictive inference, some findings suggest that there is no difference in the amount of time it takes a reader to say a word that is associated with the inference than to say a word that is not associated with the inference (Magliano et al., 1993; Potts et al., 1988). This finding suggests that inference related information does not receive additional activation during reading. For example, Potts et al. (1988) presented some participants with the passage, *No longer able to control his anger, the husband threw the delicate porcelain vase against the wall. He had been feeling angry for weeks, but had refused to seek help.* After reading this passage, researchers measured the amount of time it took participants to say the word *break.* In contrast, other participants responded to the word *break* after reading the following passage, *"In one final attempt to win the delicate porcelain vase, the angry husband threw the ball at the bowling pins against the wall. He had never won anything and was determined not to miss this time."* If participants made the predictive inference *break*, then they should have said the word *break* faster when *break* was preceded by the first text (i.e., the inference inducing text) than the second text. However, the findings from this study showed that participants showed similar naming times to the target word (e.g., *break*) for each condition, suggesting that the preceding text did not influence the generation of a predictive inference (Potts et al., 1988). Thus, participants in this study did not seem to generate the predictive inference that the vase broke after being thrown against the wall. Findings such as these support the Minimalist Hypothesis and the Constructionist Theory, which both claim that predictive inferences are not routinely generated during reading.

Although some findings support the minimalist and constructionist viewpoints, other research shows that readers frequently do generate predictive inferences (Calvo & Castillo, 1996, 1998; Calvo, Castillo, & Estevez, 1999; Cook, Limber & O'Brien, 2001; Fincher-Kiefer, 1995, 1996; Keefe & McDaniel, 1993; Murray, Klin, & Meyers, 1993; McDaniel, Schmalhofer & Keefe, 2001). For example, Fincher-Kiefer (1995) presented participants with the following text, *The salesman was sitting in the dining car of the train. The waitress brought a bowl of soup to the table.* Then, participants either read an inference promoting text, *Suddenly, the train screeched to a halt.* or participants read a non-inference promoting text, *Suddenly, the train's lights dimmed.* In this study, participants responded faster to the word *spill* after reading the inference inducing text than after reading the non-inference inducing text. Findings such as these suggest that participants do often activate predictive inferences during reading, even if these inferences are not always necessary to comprehend the text.

Because conflicting reports exist regarding when predictive inference generation occurs, researchers have focused on identifying the specific conditions under which predictive inferences are more likely to occur during reading. Specifically, researchers have investigated such factors as text difficulty (Calvo & Castillo, 2001; Keefe & McDaniel, 1993), individual differences such as working memory capacity (Estevez & Calvo, 2000; Linderholm, 2002; Linderholm, Cong, & Zhao, 2008; Linderholm & van den Broek, 2002), vocabulary knowledge (Calvo, Estevez & Dowens, 2003), and reading skill (Binder, Chase & Manning, 2007; Long, Oppy & Seely, 1994; Murray & Burke, 2003), participant age (Valencia-Laver & Light, 2000; Zipin, Tompkins, & Kasper, 2000) and task differences (Waring & Kluttz, 1998). Thus, numerous factors have been examined in an attempt to determine when predictive inferences are generated. Additionally, three other factors have been shown to influence when predictive inferences are generated: the time course of predictive inference generation, the level of constraint in a text, and the goal of a reader. The proposed research will investigate how these three factors influence predictive inference generation in the left and right hemispheres of the brain.

First, the amount of time readers need to generate a predictive inference has been shown to influence inference generation. One way to examine how long it takes a reader to generate a predictive inference is to manipulate the amount of time between the presentation of an inference inducting text and the presentation of a target word related to the inference, otherwise known as the stimulus onset asynchrony (SOA), in a lexical decision task (i.e., when participants decide if a presented string of letters spells a real or fake word) or a naming task (i.e., when participants say a presented string of letters) (Till, Mross, & Kintsch, 1988). In some studies, faster response times to inferential target words compared to non-inferential control words occurred only after an SOA of approximately 1000 ms and not at shorter SOAs of 500 ms and less (Till et al., 1988; Calvo & Castillo, 1996, 1998). For example, Calvo & Castillo (1998) presented participants with sentences that either promoted a predictive inference or did not promote a predictive inference, followed by a target word related to the inference. For example, for the target word *read*, participants were presented with either a predictive inference promoting text, *Lola was eager to know the end of the novel, so she lay down comfortably and opened it to the page she had reached last time. Lola…*or a control text, *Lola knew the author of the novel whose photo appeared on the first page of the newspaper, so she phoned to congratulate her on her success. Lola….* When the target word "*read"* was presented after an SOA of 500 ms, no difference in naming times between these two conditions was found (Calvo & Castillo, 1998). This finding suggests that readers were not generating predictive inferences at a short SOA. However, when the SOA was increased to 1000 ms, participants named predictive inference target words faster when they were preceded by a predictive inference promoting text than when the target words were preceded by a non-predictive inference promoting text. This finding suggests that readers were generating predictive inferences at a longer SOA. In addition, findings such as these suggest that it may take a relatively long amount of time for readers to show evidence of predictive inference generation, which is consistent with the predictions of both the minimalist and constructionist viewpoints. Specifically, because predictive inferences are considered elaborative and strategic, it makes sense that predictive inferences will take longer to activate than other types of inferences that are more necessary for text comprehension (McKoon & Ratcliff, 1986, 1992).

Although some researchers suggest that a long SOA is needed to show evidence of predictive inference generation, predictive inferences have shown to be activated at a shorter SOA of 500 ms (Keefe & McDaniel, 1993; Peracchi & O'Brien, 2004). For example, participants are slower to judge that the word *dead* was not included in the sentence, *The director and the cameraman were ready to shoot close-ups when suddenly the actress fell from the 14th story.* than after reading the sentence, *Suddenly, the director fell upon the cameraman, demanding close-ups of the actress on the 14th story*. Although these findings demonstrate that predictive inferences are consistently activated at 1000 ms, it is unclear if predictive inferences are activated at earlier time points during reading. Thus, the proposed research study will more closely examine the specific time course of predictive inference generation.

Second, the context of a sentence can influence the generation of predictive inferences during reading. The Minimalist Hypothesis and

Constructionist Theory propose that predictive inferences are only generated when the predicted inference is highly predictable (e.g., *strongly constrained*) and not when there are multiple possible outcomes (e.g., *weakly constrained*) (Graesser et al., 1994; McKoon & Ratcliff, 1992). For example, Klin, Guzman, & Levine (1999), presented one set of participants with passages that were strongly constrained toward the inference break, such as, *Today, Stephen was angry at his wife because she had left a mess in the kitchen. He tried to cool down, but he felt his resentment building. No longer able to control his anger, he threw a delicate porcelain vase against the wall.* Another set of participants were presented with passages that were unrelated to the predictive inference (i.e., control passages), such as, *Today, Stephen was angry at his wife because she had left a mess in the kitchen. He reacted by acting cool towards her. He apologized for getting angry, and then offered to clean her delicate porcelain vase to make up for it.* Each set of participants then named a target word (e.g., *break*) as fast as possible after a 500 ms SOA. After reading the strongly constrained texts, participants showed faster naming times to targets than after reading control texts, indicating that predictive inferences were generated (Klin, Guzman, & Levine, 1999). Other research findings confirm that predictive inferences are generated after reading strongly constrained text but not control text (Murray, Klin & Meyers, 1993), which support the Minimalist Hypothesis and Constructionist Theory claims that predictive inferences need to be strongly constrained to be generated during reading.

Although the Minimalist Hypothesis and Constructionist Theory propose that text must be strongly constrained to generate a predictive inference, evidence of predictive inference generation from weakly constrained text has been shown. For example, Klin, Murray, Levine, & Guzman (1999) presented participants with a text that was either strongly or weakly constrained, or a text that was not related to a specific predictive inference. After reading either the strongly or weakly constrained passage (or a control passage), participants were then presented with a word that was related to the predictive inference. For example, in one passage from Klin, Murray, Levine, & Guzman (1999), participants either read the strongly constrained passage:

> *Brad was wandering through a department store, looking for a present for his wife's birthday. He wanted to find something special for her but he had been laid off from his job three months ago and he couldn't afford to buy anything nice. In the jewelry department, he saw a beautiful ruby ring sitting in a display on the counter. He looked around to make sure no salespeople were watching. His wife would be thrilled by the ring, but there was no way he could pay for it. He had to have it. Seeing no salespeople or customers around, he quietly made his way to the counter.*

or participants read the weakly constrained passage:

> *Brad was wandering through a department store, looking for a present for his wife's birthday. He wanted to find something special for her. He had just started a new job but had not received his first paycheck. He wasn't sure if he could buy anything nice. In the jewelry department, he saw a beautiful ruby ring sitting in a display on the counter. He looked around for any salespeople nearby. His wife would be thrilled by the ring, but he wasn't sure he would be able to pay for it. He thought she would love it. He quietly made his way closer to the counter.*

After reading either the strongly or weakly constrained passage, participants would then name the related target word (e.g.,*"steal*"). In this study, targets were named faster for targets when they were preceded by both strongly and weakly constrained targets than when they were preceded by control texts (Klin, Murray, Levine, & Guzman, 1999). Thus, it seems that predictive inferences can also be generated when a text is weakly constrained toward a particular predictive inference during text comprehension.

While evidence of predictive inferences has been found under both strongly and weakly constrained conditions, the time course of predictive inference activation may differ based on the level of textual constraint. Specifically, it is has been suggested that strongly constrained predictive inferences may be generated faster than weakly constrained predictive inferences (Calvo, 2000). For example, Calvo (2000) presented strongly and weakly constrained texts, followed by a predictive inference related target word at an SOA of either 500 ms or 1000 ms. In this study, participants responded faster to strongly constrained targets than control targets at both 500 ms and 1000 ms. However, participants only responded faster to weakly constrained targets than control targets at an SOA of 1000 ms, and not an SOA of 500 ms (Calvo, 2000). Studies that have examined how long it takes participants to read texts that are either strongly or weakly constrained towards a predictive inference have also demonstrated that weakly constrained predictive inferences may require additional time to be generated compared to strongly constrained predictive inferences (Calvo, Meseguer, & Carreiras, 2001; Weingartner, Guzman, Levine, & Klin, 2003). Thus, the influence that textual constraint plays over the time course of predictive inference generation may help explain why some research findings find evidence of predictive inferences at short SOAs and other research findings only show evidence of predictive inferences at longer SOAs. It is possible that when participants read strongly constrained text, evidence of predictive inference generation may be evident after 500 ms SOAs. However, if a text is not strongly constrained, then it makes sense that no evidence of predictive inference generation may be found until the SOA has been increased to 1000ms. In sum, a text may not need to be strongly constrained for readers to generate a predictive inference, but strongly constrained text may be needed for readers to generate a predictive inference at shorter SOAs.

Third, the goal of the reader has been shown to influence inference generation. The Constructionist Theory proposes that during reading, individuals attempt to construct meaning from the text, and their motivation to do so is influenced by their reading goal (i.e., the reader goal assumption) (Graesser et al., 1994). Therefore, the information that is activated during reading can differ based on the individual's purpose for reading. Research findings support the idea that individuals activate different semantic information during reading based on their reading goal (Calvo, Castillo & Schmalhofer, 2006; Rapp & Kendeou, 2007; Schmalhofer & Glavanav, 1986; Zwaan, 1994). For example, if a participant is instructed to read a text as if it were from a newspaper, participants remember more factual statements in a text then after reading the same text as if it were from a literary novel (Zwaan, 1994). These findings demonstrate that the goal of the reader can change how readers process information in a text.

Research findings also demonstrate that changing the reading goal changes the inferences that are generated during reading (Allbritton, 2004; Magliano, Trabasso, & Graesser, 1999). For example, readers who were instructed to anticipate upcoming events in a text made more predictive inferences than readers who were instructed to associate events in a text with other events in a text (Magliano et al., 1999). Additionally, when participants are instructed to read a text as if they were preparing for an upcoming exam, participants make more predictive inferences than if they were instructed to read for entertainment (Linderholm & van den Broek, 2002; Narvaez et al., 1999; van den Broek et al., 2001). Research has also shown that participants with both high and low working memory capacities make more predictive inferences during study conditions than entertainment conditions (Linderholm & van den Broek, 2002). Further, study goal participants generated more inferences that are considered necessary and automatic to successful text comprehension during reading than entertainment goal participants (Narvaez et al., 1999; van den Broek et al., 2001; van den Broek & Lorch, 2002). Specifically, when instructed to read for study purposes, participants made more inferences that connected events in a text (i.e., bridging inferences) than when participants were instructed to read for entertainment purposes (Narvaez et al., 1999; van den Broek et al., 2001). These findings nicely demonstrate how the goal of the reader can influence what inferences are generated during reading. One explanation for why reading goals lead to changes in inference generation comes from college students' assessments of their reading strategies. Specifically, college students have self reported that when reading for study, they make more attempts to integrate information into a coherent representation of the text than when reading for other reasons, such as entertainment (Lorch, Lorch & Klusewitcz, 1993). Thus, participants who have been instructed to read with a study purpose may attempt to integrate the text with background knowledge or previous information mentioned in the text and anticipate future events in the text, leading to an increase in predictive inference generation (van den Broek et al., 2001).

Further, research findings show that the goal of the reader can influence the time course of predictive inference generation. For example, when a participant is instructed to anticipate upcoming events in a text, participants activate predictive inference information earlier (e.g., at 500 ms) than when participants are explicitly instructed to understand the text (Calvo et al., 2006). Participants who are not instructed to anticipate upcoming events do not show evidence of predictive inference generation until the SOA is increased to 1000 ms (Calvo et al., 2006). Thus, the goal of the reader changes not only what information is activated during reading, but also the amount of time it takes individuals to activate predictive inferences during reading.

In sum, it is not yet clear when predictive inferences are activated during reading. Under the Minimalist Hypothesis (McKoon & Ratcliff, 1992) and the Constructionist Theory (Graesser et al., 1994), predictive inferences are not routinely drawn because they are not always necessary for text comprehension. While some empirical findings support these viewpoints (e.g., Potts et al., 1988; Murray et al., 1993), other research findings suggest that predictive inferences are routinely drawn during reading (e.g., Klin et al., 1999). Numerous factors have been investigated to determine how readers generate predictive inferences. For example, research findings suggest that the amount of time needed to generate the inference (e.g., Calvo & Castillo, 1998) and the goal of the reader (e.g., Narvaez et al., 1999) may be of particular importance to predictive inference generation. Thus, the proposed research aims to investigate how the time given to the reader and the type of reading goal influences the generation of predictive inferences during text comprehension.

Inference Generation in the Hemispheres

Cognitive neuroscience research methodologies have been useful to learn more information about how language is processed in the brain. Researchers have examined the cognitive processes involved during text comprehension by investigating the specific roles of the right and left cerebral hemispheres during complex processes such as inference generation (Beeman, Bowden, & Gernsbacher, 2000; Blake & Lesniewicz, 2005; Lehman Blake & Thompkins, 2001; Mason & Just, 2004; Virtue, Parrish, & Jung-Beeman, 2008; Virtue, van den Broek, & Linderholm, 2006; Virtue & van den Broek, 2005). Previous researchers have concluded that the left hemisphere is dominant for the majority of language processing (references). Despite this well established left hemisphere dominance for language processing, recent behavioral studies (Beeman et al., 2000: Virtue et al., 2005; Sundermeier, Virtue, Marsolek, & van den Broek, 2006; Virtue et al., 2006), electrophysiological studies (Federmeier, 2007; Federmeier & Kutas, 2002; Federmeier & Kutas, 1999), and neuroimaging studies (Mason & Just, 2004; Virtue et al., 2008; Virtue, Haberman, Clancy, Parrish & Beeman, 2006) have demonstrated unique right hemisphere involvement during inferential processes. For example, right hemisphere priming has been observed when individuals read less familiar events in a text than when they read more familiar events in a text (Sundermeier et al., 2006). In addition, right hemisphere brain damaged individuals do not appear to generate inferences as often as non-brain damaged individuals (Beeman, 1998; Blake & Lesniewicz, 2005; Lehman Blake & Tompkins, 2001). Thus, converging evidence suggests that different cognitive processes are involved in the left and right hemisphere when readers generate inferences during text comprehension.

One way to examine the semantic activation of information during reading is to use a priming paradigm. In a priming paradigm, researchers present participants with a word (e.g., Burgess & Simpson, 1988; Beeman et al., 1994) or a sentence(s) (e.g., Faust, Bar-lev, & Chiarello, 2003; McKoon & Ratcliff, 1992; Keefe & McDaniel, 1993;) that contains information that is either related in meaning (i.e., semantically related) or unrelated to another word (i.e., the target word). For example, the word *cat* is related to the target word *dog*, while the word *cap* is not related to the target word *dog* (Beeman & Chiarello, 1998). Then, researchers measure how long it takes participants to either pronounce the target word (e.g., a naming task), or how long it takes participants to recognize that the letters spell a word or a nonword (e.g., a lexical decision task). Research findings have revealed that when a prime is semantically related to the target, naming and lexical decision times are faster than when a prime in not semantically related to the target (e.g., Beeman & Chiarello, 1998). This finding suggests that when a word is encountered in a text, related words are also activated.

To examine the hemispheric processes involved during reading, researchers often use a divided visual field paradigm. In the divided visual field paradigm, participants perform a lexical decision or a naming task to a target word or nonword that is presented to either the right visual field or left visual field on a computer screen (Bourne, 2006). To ensure the target word is presented to just the right visual field or the left visual field, a visual angle is calculated. Each eye has a right visual field and a left visual field (see figure 1). Information that is presented to one visual field is initially processed in the contralateral hemisphere. Specifically, target words presented to the right visual field are initially processed in the left hemisphere, whereas target words presented to the left visual field are initially processed in the right hemisphere. The amount of time the target is presented on the screen is very brief, usually under 200 ms, to ensure that participants cannot focus their eyes on the center of the target word and thus process the target word in both hemispheres (Bourne, 2006). Thus, the divided visual field paradigm is particularly useful in examining how the hemispheres process text during a reading task.

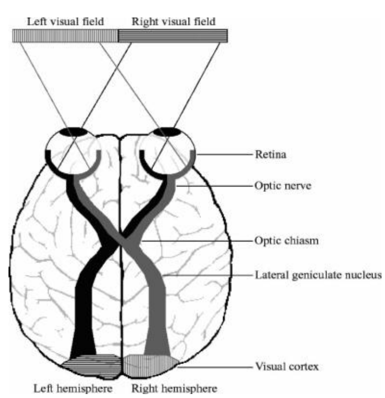


Figure 1. The divided visual field paradigm

Researchers have used the divided visual field paradigm to examine how texts that promote a predictive inference may prime target words related to the inference. For example, in Beeman et al. (2000), participants read *Bob took his daughter Karen out of school for the day so she could enjoy the very historic event that would take place that morning. The shuttle sat on the ground in the distance.* After reading this text, participants then saw either a predictive inference related target word (e.g.,*launch*) or a non-inference related target word (e.g.,*sand*) (i.e., the control condition) and named the target word as quickly as possible. The findings from this study revealed that target words related to a predictive inference were named faster than control words. This finding suggests that when participants read texts that included a predictive inference, they activated information related to the inference (e.g., *launch*) compared to information not related to the predictive inference (*e.g., sand*). More importantly, the findings from this study revealed that target words related to a predictive inference were named faster when presented to the right hemisphere than the left hemisphere (Beeman et al., 2000). This finding suggests that there may be a right hemisphere advantage for predictive inference generation. Further evidence for the role of the right hemisphere during predictive inference generation comes from studies with right hemisphere brain damaged participants. Specifically, right hemisphere brain damaged individuals were slower to make lexical decisions to inference related words than to unrelated words after reading an inference promoting passage (Beeman, 1993). In contrast, nonbrain damaged individuals responded faster to inference related target words than unrelated target words.

Taken together, these findings suggest a specific role for the right hemisphere during predictive inference generation.

Although some researchers proposed a right hemisphere advantage for predictive inferences, additional findings suggest involvement of both hemispheres during predictive inferences. Specifically, inference generation processing in the right and left hemisphere differs depending on the type of text participants read (Lehman-Blake & Thompkins, 2001; Blake & Lesniewicz, 2005; Virtue et al., 2006). For example, Virtue et al. (2006) presented participants with texts that either strongly led participants to predict a specific, upcoming event (i.e., were strongly constrained) or they were presented with texts that only weakly led participants to predict a specific upcoming event (i.e., were weakly constrained). For example, in this study, all participants read the following three sentences: *Tom and Krista were standing together holding hands. Both of them were a little nervous, but they were mostly excited about today. Tom imagined the future as he looked at Krista.* Then, participants in the strongly constrained condition read, *They were just pronounced as man and wife.* whereas participants in the weakly constrained version read, *"They were just announced as college graduates."* In addition, some participants read a neutral text that did not imply the inference related target word (e.g., *kiss*), such as, *Janet's coffee table had become wobbly. She planned to pick up some glue to fix the loose leg. Somehow, she could never find the time to stop after work. She always wanted to get home and watch television after work.* After reading the strongly or weakly constrained text, participants made a lexical decision to an inference related target word (e.g.,*kiss*). In this study, weakly constrained inferences received greater facilitation in the right hemisphere than the left hemisphere (Virtue et al., 2006). However, strongly constrained targets showed similar facilitation in both the right and left hemisphere. This finding suggests that a right hemisphere advantage may exist for specific types of predictive inferences, but that *both* hemispheres are involved in predictive inference generation. Thus, this finding contradicts previous claims of a right hemisphere advantage for predictive inferences in general.

Further evidence that textual constraint influences predictive inference generation in the hemispheres comes from studies using brain damaged individuals. Specifically, studies examining the ability of right hemisphere brain damaged individuals to generate predictive inferences found that textual constraint influenced predictive inference generation (Blake & Lesniewicz, 2005; Lehman-Blake & Thompkins, 2001). For example, participants in Blake & Lesniewicz (2005) read stories out loud that were either strongly constrained or weakly constrained towards a particular outcome. While reading each story, participants were instructed to talk about any predictions they had about what would happen next in the story. Findings from Blake & Lesniewicz (2005) demonstrated that right hemisphere brain damaged individuals were able to generate predictive inferences when the context strongly suggested one specific outcome, but that right hemisphere brain damaged individuals were less likely to generate predictive inferences when multiple outcomes were possible in a story. In contrast, non-brain damaged individuals were able to generate predictive inferences from both strongly and weakly constrained texts. Taken together, these findings suggest that both hemispheres contribute during the processing of predictive inferences, but that different cognitive processes may occur in the hemispheres during predictive inference generation.

There are several theoretical explanations for the observed differences found during predictive inference generation in the hemispheres. One theory is the Fine Coarse Coding Theory (Beeman et al., 1994; Beeman, 1998; Beeman et al., 2000). This theory suggests that after a reader is presented with a word, sentence, or passage, distantly or weakly related semantic information is activated in the right hemisphere. In contrast, after a reader is presented with a word, sentence, or passage, strongly related information is activated in the left hemisphere (Beeman et al., 1994) (see figure 2). The top portion of figure 2 depicts the predicted semantic fields of activation by the Fine Coarse Coding Theory in each hemisphere when readers see the word *foot*. When the word *foot* is presented to the left hemisphere, only strongly related words, such as *toes*, *sock*, and *heel* are activated. When the word *foot* is presented to the right hemisphere, both strongly related words and weakly related words, such as *pay*, are activated. Thus, according to the Fine Coarse Coding Theory, the amount of semantic information activated differs in each hemisphere during reading.

The large amount of semantic information that is activated in the right hemisphere during reading allows some semantic fields of activation from separate words to actually overlap with each other. This semantic activation that overlaps across different words allows words that are located within the overlapping regions to become more strongly activated (e.g., summation activation) (see figure 2) (Beeman et al., 1994; Faust & Lavidor, 2003; Faust, Barak, & Chiarello, 2005). In Beeman et al. (1994), participants were presented with three priming words that were either weakly, strongly, or unrelated to the meaning of a target word. In the weakly related condition, the three words were weakly related to the target word (e.g., the words *foot*, *cry* and *glass* primed the target *cut*). In the strongly related condition, however, one word was strongly related to the target word (e.g., the word *scissors* primed the target *cut*), along with two unrelated target words (e.g., *nothing*, *whether*). In the right hemisphere, participants were as fast to name weakly related targets as strongly related targets, whereas in the left hemisphere, participants named strongly related targets faster than weakly related targets (Beeman et al., 1994). This finding supports the predictions of the Fine Coarse Coding Theory that the right hemisphere has an advantage for overlapping semantic information which leads to summation activation. Figure 2 depicts summation activation. For example, the wide area of semantic activation for the words *foot*, *cry* and *glass* is thought to allow converging fields of semantic activation for the word *"cut"* in the right hemisphere. However, because the fields of semantic activation are considerably smaller in the left hemisphere, the word *cut* is thought to not receive additional activation when weakly related primes were presented to the left hemisphere. This difference in activation of semantic information in the right and left hemispheres is useful during inferential processes. Specifically, the small field of semantic activation in the left hemisphere may allow readers the ability to rapidly select the most appropriate inference during reading, whereas the wide area of semantic activation in the right hemisphere may allow readers the ability to generate multiple inferences during reading (Beeman et al, 2000). Thus, the Fine-Coarse Coding Theory can help explain findings showing differences in inference generation in the right and left hemispheres.

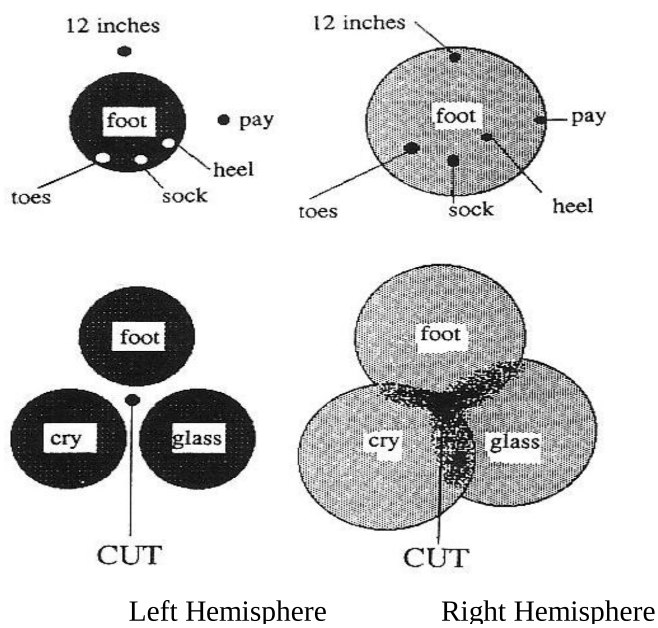


Figure 2. The Fine Coarse Coding Theory (Beeman et al., 1994)

Other theoretical frameworks also help explain how information is activated in the hemispheres during reading. For example, the Production Affects Reception in the Left Only (PARLO) Framework suggests that the context provided by a text, not the relation between concepts in the text, influences semantic activation in the hemispheres (Federmeier, 2007). Specifically, in the left hemisphere, the context of a sentence provides cues that allow readers to generate predictions about what will occur next in a text (Federmeier, 2007). The PARLO Framework suggests that if a word encountered during reading is easy to integrate with the previously presented information in a text, it will be easier to process when it is presented to the left hemisphere than if the word is more difficult to integrate with the previously presented context in the text (Federmeier, 2007). In contrast, the right hemisphere is less sensitive to contextual information, and the previously encountered textual context does not influence word processing during reading in the right hemisphere. The PARLO Framework suggests that differences in hemispheric activation during reading may reflect hemispheric differences to contextual cues provided by the text rather than differing levels of semantic activation for strong and weak semantic associates as suggested by the Fine Coarse Coding Theory.

Evidence for the PARLO framework is based on several electrophysiological event related potential (ERP) response findings (Federmeier, Mei, & Kutas, 2005; Federmeier & Kutas, 2002; Federmeier & Kutas, 1999). For example, one ERP component wave, the N400, has been linked to processing the meaning of a word, sentence, or passage. When a text is difficult to understand, N400s are larger than when a text is less difficult to understand (Federmeier & Kutas, 1999). In one study, Federmeier & Kutas (1999) presented participants with texts that led towards a specific word. For example, participants read, *They wanted to make the hotel look more like a resort. So along the driveway, they planted rows of* ___. Participants were then either presented with an expected ending (e.g., *palms*), an unexpected ending that was from the same category (e.g., trees) as the expected ending (e.g., *pines*), or an unexpected ending that was not from the same category (e.g., *tulips*). When target words that reflected these different endings were presented to the left hemisphere, smaller N400s were elicited for unexpected endings that were not from the same category (e.g., *tulip*) than for unexpected endings that were from the same semantic category (e.g., *pines* and *palm* are both trees) (Federmeier & Kutas, 1999). Federmeier (2007) explains these results by stating that the activation of the prediction *palms* leads to the activation of other category members, such as *pines*, specifically in the left hemisphere, before the target word was presented. Thus, it is likely that contextual information influences processing in the left hemisphere. However, in the right hemisphere, N400s were similar for both unexpected and expected endings. This suggests that contextual information does not influence processing in the right hemisphere, and that predictions may not be activated during reading in the right hemisphere. According to the PARLO framework, since predicted information is not being activated in the right hemisphere, less contextually appropriate or more weakly related information may have a processing advantage in the right hemisphere (Federmeier, 2007). Thus, the PARLO framework, similar to the Fine Coarse Coding Theory, also suggests different semantic information is activated in the hemispheres during reading.

While there has been some empirical support for the idea that different amounts of semantic information are activated in the hemispheres during reading, other research does not support this idea (Richards & Chiarello, 1995; Coney, 2000; Livesay & Burgess, 2003; Motyka Joss & Virtue, unpublished). For example, Chiarello & Richards (1995) presented participants with word pairs that were either directly related (e.g., *water* and *drink*) or indirectly related (e.g., *soap* and *drink*). In the indirectly related condition, words were related via a third, unseen word (e.g., *soap* is related to *water* and *water* is related to *drink*). Because the indirect word pairs were weakly related to each other, the Fine Coarse Coding Theory (Beeman et al., 1994) would predict a right hemisphere advantage for indirectly related targets. However, this study found the same amount of priming in the right and left hemisphere for indirectly related targets (Richards & Chiarello, 1995). In addition, when participants were presented with multiple primes that either converged onto the same meaning of a word (e.g., *lion* and *stripes* for the word *tiger*) or diverged onto different meanings of an ambiguous word (e.g., *kidney* and *piano* for the target *organ*), greater priming was found for converging than diverging targets in both the right and left hemisphere (Kandahai & Federmeier, 2007). Thus, these results suggest that the same semantic information is activated in the right and left hemispheres during reading.

One explanation for the conflicting findings demonstrated for the activation of semantic information in the hemispheres is that the time course of semantic information may differ in the right and left hemisphere. For example, The Time Course Hypothesis (Koivisto, 1997) proposes that the same semantic information is activated in the right and left hemisphere, but the amount of time it takes to activate this semantic information is different. Previous research findings lend support for the Time Course Hypothesis (Abeare, Gufstason & Whitman, 2005; Abernethy & Coney, 1993; Bouaffre & Faita-Ainseba, 2007; Chiarello, Liu, Shears, Quan, & Kacinik, 2003; Yochim, Kender,; Korsnes & Magnussen, 2007). Specifically, when a prime and target are strongly related (e.g., *arm* and *leg*), activation of the target word occurs in both the left and right hemisphere at short

SOAs (150ms or less) (Chiarello et al., 2003). In addition, weakly related word meanings (e.g., *coffee* and *wine*) are also activated in the left hemisphere at short SOAs (165 ms), whereas weakly related word meanings may take a short delay to become activated in the right hemisphere (Koivisto, 1997). By 500 ms, findings show that weakly related word meanings are activated in the both hemispheres and this semantic activation continues at long SOAs (e.g., 800 ms) (Koivisto, 1997). However, in the left hemisphere, weakly related word meanings become inhibited at long SOAs (e.g., 800ms), while weakly related word meanings are still activated in the right hemisphere (Koivisto, 1997; Yochim et al., 2005). Thus, according to the Time Course Hypothesis, semantically associated words are activated relatively quickly in the left hemisphere, whereas semantic associated words are activated more slowly in the right hemisphere. In addition, weakly related semantic associates seem to remain activated in the right hemisphere at longer SOAs. However, at long SOAs, there seems to be no evidence of weakly related semantic associate activation in the left hemisphere.

In addition to the large number of studies have examined the Time Course Hypothesis using strong and weak semantic associates, the time course of activation for words with multiple meanings has also been examined. For example, words with multiple meanings (e.g., *bank* more frequently refers to a financial institution but can also refer to part of a river) (Burgess & Simpson, 1985; Burgess & Simpson, 1988). Research findings demonstrate similar results as studies that used semantically associated prime and target pairs. Specifically, the more frequent meaning (e.g., *money*) and less frequent meaning (e.g., *river*) of *bank* both receive activation at short SOAs (e.g., 35 ms) in the left hemisphere, and no priming is evident in the right hemisphere. At longer SOAs (e.g., 750 ms), priming effects are only found for the more frequent word meaning in the left hemisphere, while priming for both word meanings is found in the right hemisphere. It is possible that less frequent word meanings would also be more distantly related to the target (Beeman et al., 1994; Beeman & Chiarello, 1998). Thus, based on previous research examining the time course of semantic activation in the hemispheres, relations that are considered “weaker” are activated initially in the left hemisphere and are then inhibited, while these same relations lead to activation that is maintained at longer SOAs in the right hemisphere. In contrast, strongly related information is activated and maintained in both hemispheres, although there is a slight delay for activation in the right hemisphere.

Although research has examined the time course of semantic activation in the hemispheres, little research has examined the time course of activation for inferences in the hemispheres. Interestingly, research studies examining the time course of inference related words and semantically associated words has suggested that inference generation takes a longer amount of time than activating semantic associates (Till, Mross, & Kintsch, 1988). For example, Till et al. (1988) presented participants with short paragraphs that included an ambiguous word and promoted an inference, such as *The millionaire jumped from the window after he heard of the new rate of interest. His entire fortune was at stake.* In this example, the word *interest* has two possible meanings (i.e., a hobby, or a financial measurement). After reading some paragraphs, participants performed a lexical decision task to target words that was either related to the context appropriate meaning of the ambiguous word (e.g., *money*) or was not related to the context appropriate meaning of the ambiguous word (e.g., *hobby*). In addition, after reading some paragraphs, participants completed lexical decision tasks to target words that were related to the inference promoted by the text (e.g., *suicide*) or not related to the inference promoted by the text (e.g., *affair*). Till et al. (1988) found that participants did not show differences in response times to inference related and inference unrelated target words until approximately 1000 ms after the presentation of the paragraph. This finding suggests that predictive inference activation does not occur until a later time point in predictive inference processing. In contrast, participants only took 400 ms for target words to be responded to faster if they were related to the context appropriate meaning of the ambiguous word than the context inappropriate meaning of the ambiguous word (Till et al., 1988). Based on this finding, research studies investigating hemispheric differences in inference activation have often used examined inference processing at a later time point to ensure that inferential information is activated in the hemispheres. In fact, many divided visual field studies use an SOA of approximately 750 ms to properly investigate hemisphere differences in the activation of inferential information (Beeman et al., 2000; Virtue et al., 2005; Virtue et al., 2006; Kandhadai & Federmeier, 2007; Motyka Joss & Virtue, unpublished). However, other research studies examining inference activation have shown that inferences can be generated at a shorter SOA of 500 ms (e.g., Klin et al., 1999; Calvo, 2000; Calvo et al., 2006). Thus, it is unclear how much time is needed to generate an inference in the right and left hemispheres.

In sum, cognitive neuroscience studies examining predictive inference generation (e.g., Beeman et al., 2000; Virtue et al., 2006) provide support for claims that predictive inferences are routinely generated during reading. Specifically, findings suggest that the right hemisphere activates information related to predictive inferences under a wide variety of conditions. However, the Time Course Hypothesis suggests that it takes a longer amount of time for semantic information to become activated in the right hemisphere (Koivisto, 1997). Thus, one reason that previous research shows little evidence of predictive inference generation may be that participants are not given enough time to generate the predictive inference.

In addition to the amount of time it takes to generate an inference, the goal of the reader may influence how the hemispheres activate information related to a predictive inference. Research findings suggest that the goal of the reader can influence the pattern of hemispheric activation of strongly and weakly constrained predictive inferences (Motyka Joss & Virtue, published). One study (Motyka Joss & Virtue, unpublished) closely followed the procedure established by Virtue et al., 2006, but altered the instructions given to the participants. One group of participants adopted a study goal prior to the experiment. For example, before beginning the experiment, participants were told, *Most importantly, remember that your task is to study the texts. Be sure to carefully read the material. You will be tested both during and after the texts.* In this study, participants who adopted a study goal showed similar facilitation for weakly and strongly constrained inference related targets in the right and left hemisphere (see figure 3). Importantly, no right hemisphere advantage was observed for weakly constrained targets in the study condition. In contrast, another group of participants was not given these specific study instructions. Instead, this group of participants were given procedural instructions (i.e., similar to those used in Virtue et al., 2006). Participants who were not given a study goal showed different patterns of facilitation in the right and left hemisphere for strongly and weakly constrained text. Importantly, a right hemisphere advantage was found for weakly constrained text compared to the left hemisphere when participants were not given a specific study goal (Motyka Joss & Virtue, unpublished). This finding replicates the findings from Virtue et al. (2006), which also showed a right hemisphere advantage for weakly constrained predictive inferences. Thus, it appears that manipulating the goal of the reader influences the facilitation of weakly constrained predictive inferences in the left hemisphere. However, the extent to which specific reading instructions can alter predictive inference generation in the hemispheres is currently unclear. One explanation for these results is that the experimental instructions may have influenced *when* the inference was generated in the right and left hemisphere (Calvo et al., 2006). Previous studies have suggested that encouraging participants to read with a study goal, and thus orienting readers to a study strategy, changes the information that is activated by the participant (van den Broek et al., 2001). Specifically, participants may activate multiple possible outcomes of an event mentioned in the text to fully comprehend the text (Rapp & Kendeou, 2007). It is possible that in this previous study, the goals of the reader may have influenced the time course of activation of predictive inferences.

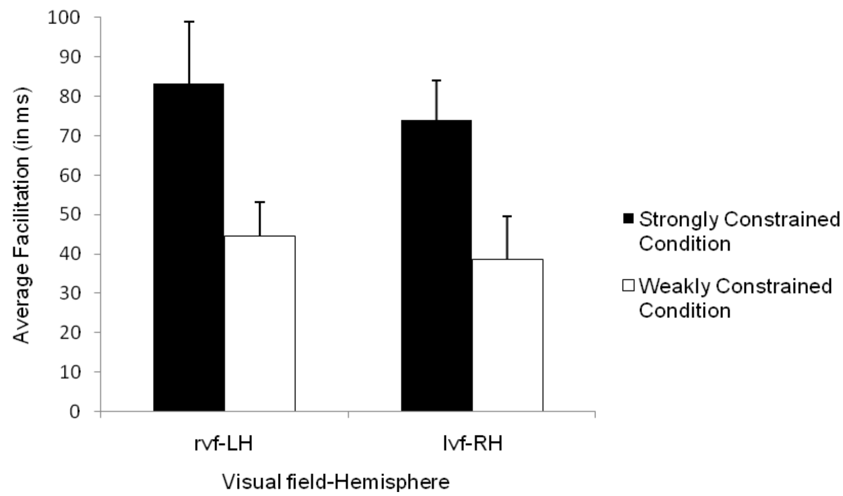


Figure 3. Results from Motyka Joss & Virtue (unpublished)

Thus, converging evidence from behavioral (Klin, Murray, Levine & Guzman, 1999) and cognitive neuroscience studies (Beeman et al., 2000; Virtue et al., 2006) indicate that predictive inferences are activated frequently during reading. Cognitive neuroscience research provides evidence that different cognitive processes may be occurring in the hemispheres during reading. For example, strongly and weakly constrained inferences are generated differently in the hemispheres (Virtue et al., 2006). By examining hemispheric differences during reading, we can determine how textual constraint, the time course of activation, and the goal of the reader influence predictive inference generation. It is possible that the amount of time it takes a reader to activate an inference may differ in the right and left hemispheres (e.g., Koivisto, 1997). In addition, the goals of a reader may influence the activation of predictive inferences during reading (e.g., van den Broek et al., 2001) and how quickly it is activated (Calvo et al., 2006). Research findings also suggest that the goals of the reader can influence predictive inference generation in the hemispheres during reading (Motyka Joss & Virtue, unpublished). Therefore, the current study will examine hemispheric differences in predictive inference generation to determine how textual constraint, time course and reader goals influence predictive inference activation during reading.

RATIONALE

There are two main reasons for examining the time course of predictive inferences. First, conflicting findings exist regarding when predictive inferences are drawn. Specifically, some findings show that reader do not routinely generate predictive inferences during reading (Potts et al., 1988), while others findings show that readers do routinely generate predictive inferences during reading (Calvo & Castillo, 1998). One explanation for these conflicting findings is that under specific circumstances, such as if the text is weakly constrained, predictive inferences may become more activated in the right hemisphere than the left hemisphere (Virtue et al., 2006). However, weakly constrained inferences may take longer to become activated in the right hemisphere, as suggested by the Time Course Hypothesis (Koivisto, 1997). Thus, previous studies that show little evidence of predictive inference generation may have presented weakly constrained texts to participants, or did not allow enough time for participants to generate the predictive inference. In addition, some predictive inferences may be maintained in the right hemisphere during reading, while predictive inferences may eventually become de-activated in the left hemisphere. Thus, examining when predictive inferences are activated in the hemispheres will help clarify the circumstances under which predictive inferences are activated

Second, although there is a large body of evidence from studies that examine the activation of semantic information to support the Time Course Hypothesis, less research has directly tested this theory using texts that specifically contain predictive inferences. However, research examining the activation of strongly and weakly constrained predictive inferences at a later time point in predictive inference processing (i.e., a SOA of 750 ms) has found a right hemisphere advantage for weakly constrained predictive inferences (Virtue et al., 2006). This finding is similar to the finding of a right hemisphere advantage for weakly semantically related information at relatively long SOAs (e.g., Burgess & Simpson, 1988). It is possible that the activation of strongly and weakly constrained predictive inferences may follow a similar pattern as strongly and weakly semantically related information. By manipulating the SOA in the current study, the exact time course of predictive inferences in the hemispheres can be examined. Thus, examining the time course of predictive inferences in the hemispheres will contribute to theoretical knowledge regarding how semantic information is activated in the right and left hemisphere during reading.

In addition, there are several reasons to examine the influence of reader goals on the time course of predictive inference generation in the hemispheres. First, specific experimental instructions, such as reading for study or reading for understanding (Motyka Joss & Virtue, unpublished), can influence predictive inference generation in the hemispheres. Additionally, when given instructions to study, participants generate more predictive inferences (e.g., van den Broek et al., 2001) and generate predictive inferences more quickly (e.g., Calvo et al., 2006). Thus, examining how instructions influence the time course of predictive inference generation at a short SOA and a long SOA will help examine how the time course of predictive inference generation is influenced by different reader goals.

Second, the Time Course Hypothesis suggests that information is activated at different times in the hemispheres. In addition, the Time Course Hypothesis proposes that information remains activated for different amounts of time in the hemispheres. Importantly, research examining the influence of instructions on predictive inferences suggests that instructions can lead to faster activation of predictive inferences, which suggests that reading goals may influence the time course of predictive inference activation. Although specific reading goals can lead to predictive inference generation at short SOAs (e.g., Calvo et al., 2006), it is unclear how reading goals may influence the time course of predictive inference generation in the hemispheres. At short SOAs, reading goals may influence activation in the right hemisphere, given previous findings that semantic information becomes activated more slowly in the right hemisphere, but automatically in the left hemisphere. In addition, it is possible that predictive inferences generation is found at longer SOAs when readers are given a specific reading goal because the inferential information remains in attentional focus longer (van den Broek et al., 2002; Rapp & Kendeou, 2007). It is possible that predictive inference related information will remain activated for a longer amount of time when readers are given a specific reading goal particularly in the left hemisphere, since information tends to be already maintained in the right hemisphere. Thus, examining how instructions influence the time course of predictive inferences will contribute to our theoretical knowledge regarding the specific factors that can influence activation in the right and left hemispheres.

To examine the time course of predictive inference generation, this research will examine an early time point (using an SOA of 500 ms), and examine a later time point (using an SOA of 1000 ms) during predictive inference processing. The SOA of 500 ms was selected for three specific reasons. First, studies examining the time course of predictive inferences consistently use 500 ms to measure processing occurring at a short SOA (Calvo & Castillo, 1996; 1998; Klin et al., 1999; Calvo, 2000; Linderholm, 2002; Calvo et al., 2006). Second, while some findings demonstrate that inferences are activated at an SOA of 500 ms (Klin et al., 1999), there are also findings that suggest inferences are not activated at this early time point in predictive inference processing (Calvo & Castillo, 1998) or that predictive inferences are only activated under specific conditions at this time point during inference generation (Calvo, 2000; Calvo et al., 2006). Third, studies examining the activation of inferential information and semantic information have demonstrated that participants take longer to activate information related to an inference compared to semantic information (Till et al., 1988). The SOA of 1000 ms was selected for two specific reasons. First, multiple studies have identified this amount of time as the optimal time for inference activation (Calvo & Castillo, 1996, 1998; Fincher-Keifer 1995, 1996; Till et al., 1988). Second, research regarding the roles of the right and left hemisphere during word processing demonstrates that the left hemisphere does not maintain activation of weakly related information at SOAs after 800 ms (Burgess & Simpson, 1988). Thus, an SOA of 1000 ms should be long enough to determine if inference activation follows the predictions set forth by the Time Course Hypothesis.

In sum, by examining the time course of predictive inferences and the influence of reading goals on predictive inference generation in the hemispheres, I aim to produce a more thorough understanding of how predictive inferences are generated during reading and provide more specific information about the role of the right and left hemispheres.

STATEMENT OF HYPOTHESES

In Experiment 1, I will examine the time course of predictive inference generation in strongly and weakly constrained texts at an early time point (i.e., a short SOA of 500 ms). The Time Course Hypothesis predicts that strongly and weakly related information is activated differently in the hemispheres. Thus,

Hypothesis 1a: If inferential information is activated similarly to semantic information in the left hemisphere, then at a short SOA, both strongly and weakly constrained inferential targets will show facilitation in the right visual field-left hemisphere (rvf-LH) compared to a baseline measurement.

Hypothesis 1b: If inferential information is activated similarly to semantic information in the right hemisphere, only strongly constrained inferential targets will who facilitation in the left visual field- right hemisphere (lvf-RH) compared to a baseline measurement.

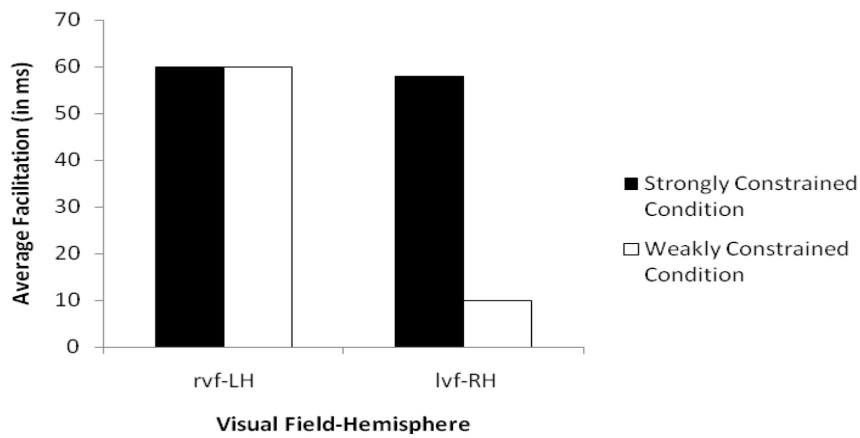


Figure 4. Experiment 1 Expected Findings

In Experiment 2, I will examine the influence of reading goals on predictive inference generation at a short SOA.

Hypothesis 2: If having a specific reading goal (i.e., a study goal) leads to faster activation of predictive inferences (Calvo et al., 2006), and delays in activation of weakly constrained information are specific to the right hemisphere (Koivisto, 1997), then instructions to study will lead to equal facilitation of strongly and weakly constrained predictive inferences in the rvf-LH and the lvf-RH.

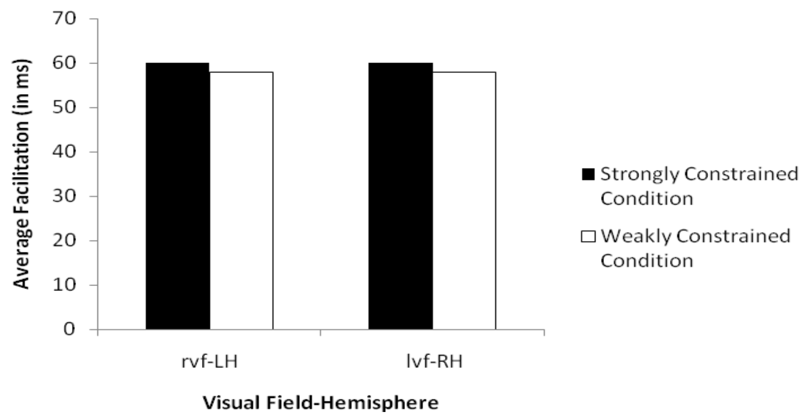


Figure 5. Experiment 2 Expected Findings

In Experiment 3, I will investigate the generation of predictive inferences at a later time point (e.g., a long SOA of 1000 ms). The Time Course Hypothesis predicts that activation is different in the right and left hemispheres at later time point, such that there is a right hemisphere advantage for maintaining activation of weakly related information. Thus,

Hypothesis 3a: If inferential information is activated similarly to semantic information in the left hemisphere at a long SOA, then strongly constrained predictive inferences will show facilitation but not weakly constrained predictive inferences at an SOA of 1000 ms in the rvf-LH.

Hypothesis 3b: If inferential information is activated similarly to semantic information in the right hemisphere at a long SOA, then both strongly and weakly constrained inferential information will show facilitation in the lvf-RH at an SOA of 1000 ms.

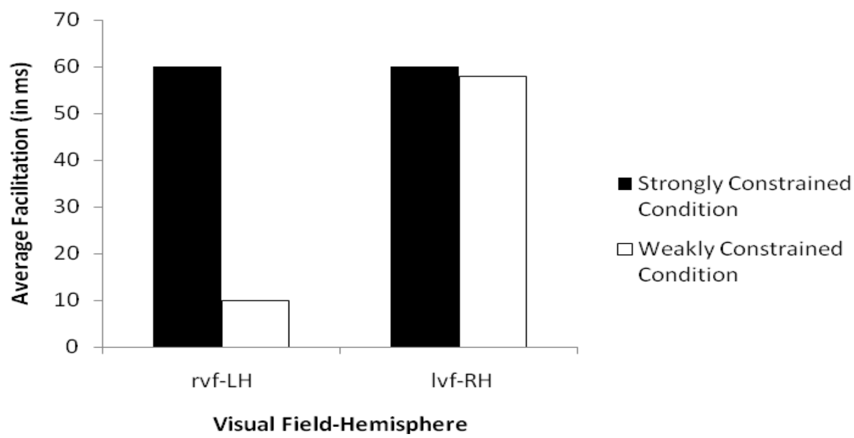
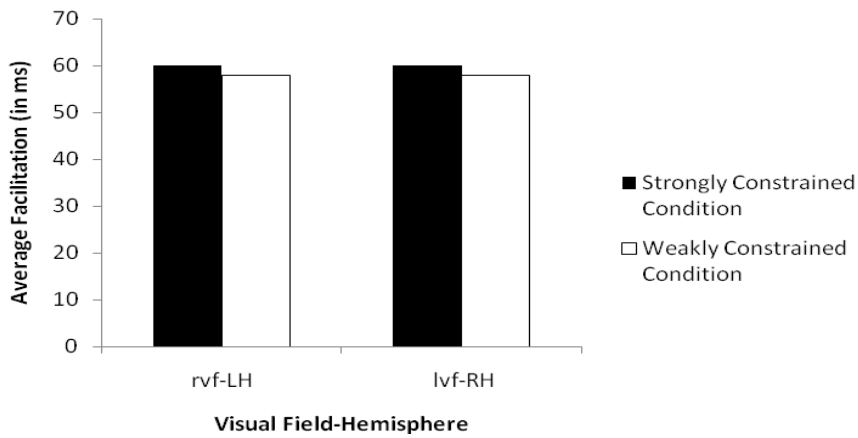


Figure 6. Experiment 3 Expected Findings

In Experiment 4, I will examine the influence of reading goals on the activation of predictive inferences at a later time point (i.e. a long SOA of 1000 ms). Previous findings (Motyka Joss & Virtue, unpublished) suggest that study instructions influence the activation of weakly constrained information in the left hemisphere in particular, even at longer SOAs (750 ms). Thus,

Hypothesis 4: If having a specific reading goal (i.e., a study goal) influences the amount of time predictive inferences are activated, then activation of weakly constrained predictive inferences will be found in both the rvf-LH and the lvf-RH at a long SOA of 1000 ms.



.

Figure 7. Experiment 4 Expected Findings

Chapter II

METHODS

Experiment 1

Participants

One hundred participants were recruited for participation in Experiment 1 (73 female, 27 male). All participants were recruited for participation in this experiment through the Introductory Psychology Subject Pool at DePaul University. Nine participants were removed prior to data analyses. Specifically, four females were removed for not following instructions, two females were removed because data was missing for the neutral condition, and three female participants were removed for not completing the experiment. Thus, the data from a total of 91 participants (64 females, 27 males) were analyzed for Experiment 1. Participants ranged in age from 18-27 (mean age= 20.2 years). Participants completed the experiment in exchange for course credit. Because left handed individuals often show different organization of language in the hemispheres than right handed individuals (Bourne, 2006), all participants in the current study were right handed, as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971). This inventory assigns a participant a value on a scale from -1 (left handed) to 1 (right handed) through a participant self report on hand preference for various activities (e.g., writing, drawing). In Experiment 1, participants had a mean laterality quotient of 0.89. Participants were all native speakers of English, did not have any history of neurological disorder or disease, and had normal or corrected-to-normal (i.e., contacts or eyeglasses) vision.

<u>Materials</u>

Texts Three sets of 48 texts were used in this study (which were also used in previous studies: Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Each of the texts consists of 4 sentences. The first three sentences introduced a scenario. For the fourth sentence, one set of 48 texts promoted a strongly constrained predictive inference. A second set of 48 texts promoted a weakly constrained predictive inference. The third set of 48 texts did not promote a predictive inference (see table 1). A pilot experiment showed that participants stated the predictive inference related target word more often when the text was strongly constrained than when the text was weakly constrained (Virtue et al., 2006). The pilot study also showed that participants indicated the inference related target word would occur next more often when reading an inference text than when reading a neutral text.

Targets For each set of three texts (strongly constrained inference text, weakly constrained inference text, and neutral text), a corresponding target word (e.g., *spray)* was assigned to each text (see table 1). The target word was identical for all three texts. Thus, there were 48 experimental target words. After the presentation of a strongly constrained inference text, a weakly constrained inference text, or a neutral text, participants were presented with a corresponding target word or a nonword. The target word was related to the predictive inference promoted in the strongly and weakly constrained inference texts, but was not related to the neutral text. For example, in table 1, it is unlikely that participants would infer "*spray"* after reading the neutral text. This neutral condition allowed a baseline measurement of activation in each hemisphere. This neutral condition is important because there is a general left hemisphere advantage for language processing. To properly compare response time differences in the hemispheres taking this general left hemisphere advantage into account, response times to the experimental conditions are subtracted from the neutral condition to determine the level of facilitation above baseline in each hemisphere. Therefore, the neutral condition is necessary to directly compare facilitation across the left and right hemispheres for strongly and weakly constrained predictive inference targets. All targets were 1 to 2 syllable action verbs that are similar in the number of letters and word frequency according to Francis & Kucera (1982) (taken from Virtue et al., 2006).

Table 1: Example Text (Virtue et al., 2006)

Inference Text
After the rugby match, Justin's friends teased him for not knowing the rules. He gathered around his friends and joked about beating them next time. Next, Justin went to grab a drink from the cooler.
Strongly Constrained Condition With a big grin, he shook and twisted the lid off a bottle of soda, aiming at his friends.
Weakly Constrained Condition With a grin, he twisted the lid off a bottle of soda, looking for his friends.
Target spray
Neutral Text
Janet's coffee table had recently become wobbly. She planned to pick up some glue to fix the lose leg. Somehow, she never could find the time to stop at the store after work. She always wanted to get home and watch television after work.
Target Spray

In addition to 48 target words there were also 48 pronounceable target nonwords (e.g., *korf*). These targets were included to avoid a response bias in the lexical decision task. Specifically, if only real word targets were included in the experiment, participants would likely develop expectations about upcoming word targets. This expectation would result in faster responses in the lexical decision task over time that would not accurately reflect priming for inference related texts (Antos, 1979). Nonword targets were created by rearranging the letters of words that are similar in frequency to the corresponding word targets (e.g., *fork*) and scrambling them into pronounceable nonwords (e.g., *korf*). Therefore, each participant saw 96 targets total. Target presentation was randomized across participants.

Comprehension Questions To ensure participants comprehended the texts, 12 comprehension questions were included throughout the experiment. These questions were *yes/no* questions that were presented immediately after the target for a subset of the experimental texts. Participants were presented with the cue "Comprehension Question" for 3 seconds prior to the presentation of the question, which remained on the screen until an answer was given via a button press. The comprehension questions asked about an explicitly stated piece of information from the preceding text. For example, for the text, *It was Chuck's daughter's first day of school. He came home from work early to hear all about her day. She was the youngest of his three children. She had been very excited to be going to school just like her two older brothers.* The comprehension question was *Did Chuck have three children?* After participants made a yes/ no response by pressing a specific button, the next text was presented on the computer screen.

Counterbalancing The targets were counterbalanced across 6 experimental lists so that each participant only saw each target one time. Targets were counterbalanced across visual field of presentation (right visual field-left hemisphere; left visual field-right hemisphere) and level of textual constraint (strong, weak, neutral). In addition, the hand used to respond was also counterbalanced so that 50% of the participants used their left hand to respond in the lexical decision task, and 50% of participants used their right hand to respond in the lexical decision task. The hand used to respond was counterbalanced because a response bias may occur when the hand used to respond and the side of the screen the target is presented match (e.g., the participant is using their right hand to respond and the target is presented on the right side of the computer screen) compared to when the hand used to respond is opposite of the side of the screen where the target is presented (Bourne, 2006).

Procedure

This study used a priming paradigm to investigate the activation of predictive inferences in the hemispheres. In the current study, an inference promoting text was used to prime an inference related target word. In addition, this study used the divided visual field paradigm to determine if similar information is activated in the right and left hemisphere during reading. The position of the target words and target nonwords was determined by measuring the visual angle from the participant's eyes to the computer screen (Bourne, 2006). Targets were presented approximately 3.2 degrees of visual angle to the left or right of the center of the computer screen. This visual angle ensures that targets are initially presented to only the right visual field-left hemisphere or left visual field-right hemisphere. To ensure that participants could not move their eyes to the center of the target and thus initially process the targets in both hemispheres, targets were presented very rapidly (176 ms) (Bourne, 2006). Participants then indicated if the target was a word or a nonword (e.g., a lexical decision) as quickly and as accurately as possible by pressing corresponding buttons on a Serial Response button box.

Participants were seated 50 cm from the computer screen. To maintain this distance throughout the experiment, participants placed their head in a chinrest. This placement ensured the targets were presented approximately 3.2 degrees of visual angle to the right or left of the center of the screen. All experiments were run on a PC using EPrime version 2.0. In Experiment 1, participants were given instructions to read for understanding. Thus, in Experiment 1, participants were instructed to read the texts carefully, and make lexical decisions to the target.

Before starting the experimental trials, participants first completed a practice session. During this session, 10 four sentence texts were presented to participants. Participants read each sentence in a self-paced manner, and pressed a button to continue to the next sentence. After each text, a small fixation "+" appeared on the computer screen for 500 ms, followed by the lateralized presentation of a target. Participants were then given 3000 ms (3 seconds) to make a lexical decision to the target. After this amount of time, the response was recorded as incorrect, and the next text was presented on the computer screen. After each lexical decision, feedback was presented in the center of the screen for the practice session.

After the practice session, participants were given a chance to ask the researcher any procedural questions, and then they continued onto the experimental trials. The experimental trials were similar to the practice session with two exceptions. First, feedback was no longer presented in the center of the computer screen after each button press during the lexical decision task. Second, after a subset of texts, a comprehension question was presented after participants made their lexical decisions. After participants answered the comprehension question, the first sentence of the next text was shown on the computer screen.

After the experiment was completed, participants were given a debriefing survey. This survey was a collection of questions aimed at determining if the participant paid attention, followed instructions, understood the task, or had any specific difficulties or comments. Responses to these questionnaires were examined to determine if any participant should be removed from the analyses for failing to follow instructions, along with any procedural violations noted by the researcher (e.g., not keeping chin in the chin rest or moving the button box during the experiment).

Experiment 2

Participants

One hundred participants (82 females, 18 males) were recruited for participation in Experiment 2. All participants were recruited for participation in this experiment through the Introductory Psychology Subject Pool at DePaul University. Twelve participants were removed prior to data analyses. Specifically, four females and one male were removed for not following instructions, one female was removed because data was missing for one experimental condition, one female and one male were removed because they was unable to complete the experiment due to a computer error, and four female participants were removed because they had previously completed Experiment 1. Thus, the data from a total of 88 participants (72 females, 16 males) were analyzed for Experiment 2.   Participants ranged in age from 18-22 (mean age= 19.8 years). Participants completed the experiment in exchange for course credit. All participants were right handed, as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971). Participants in Experiment 2 had a mean laterality quotient of 0.84. Participants were all native speakers of English, did not have any history of neurological disorder or disease, and had normal or corrected-to-normal (i.e., contacts or eyeglasses) vision.

Materials and Procedure

The texts presented in Experiment 1 were also presented in Experiment 2. In addition, the identical procedure from Experiment 1 was used in Experiment 2. However, since Experiment 2 examined how reading goals influenced predictive inference generation, participants in Experiment 2 heard different instructions than participants in Experiment 1. Specifically, participants were instructed to *study* the texts while reading. For example, participants were told the following: *Your task in this experiment is to study short texts. In this experiment, you will be presented with short, 4 sentence long passages. After several of the passages, you will be tested on the content of the passages and your score will be recorded. Therefore, it is EXTREMELY important to carefully study the text as you are reading it.* In addition, participants were reminded of the importance of studying the text while reading. Finally, participants were told that they would be given test questions about the texts both during and after the experiment. The “test questions” participants answered during Experiment 2 were the same comprehension questions used in Experiment 1. The instructions for Experiment 2 have been used in previous studies examining the influence of instructions on predictive inference activation in the hemispheres (Motyka Joss & Virtue, unpublished), and were modeled off instructions used in previous studies examining the influence of reading goals on inference activation (van den Broek et al., 2001).

Although participants in Experiment 2 were told that they would be given a test at the end of the experiment, they were only given the debriefing survey at the end of the experiment. To determine if participants actively engaged a specific study strategy during reading, the debriefing survey also included questions that specifically ask about the participants' study strategy. Specifically, participants asked if they adopted a study strategy during the experiment, what strategy they adopted, and what percentage of the time that strategy was used.

Experiment 3

Participants

One hundred participants (84 females, 16 males) were recruited for participation in Experiment 3. All participants were recruited for participation in this experiment through the Introductory Psychology Subject Pool at DePaul University. Fifteen participants were removed prior to data analyses. Specifically, four females and three males were removed because of equipment failure, five females were removed for not following instructions, and three females was removed because data was missing for one experimental condition. Thus, the data from a total of 85 participants (72 females, 13 males) were analyzed for Experiment 3. Participants ranged in age from 18-24 (mean age= 19.8 years). Participants completed the experiment in exchange for course credit. All participants were right handed, as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971). Participants in Experiment 3 had a mean laterality quotient of 0.82. Participants were all native speakers of English, did not have any history of neurological disorder or disease, and had normal or corrected-to-normal (i.e., contacts or eyeglasses) vision.

Materials and Procedure

The same texts presented in Experiments 1 and 2 were also presented in Experiment 3. In addition, the same procedure and instructions from Experiment 1 was used in Experiment 3. However, since Experiment 3 examined the influence of hemispheric processing of predictive inferences at a later time point, a long SOA of 1000 ms was used between the final sentence and the target (i.e., the amount of time the "+" sign was on the computer screen) instead of the 500 ms SOA used in Experiments 1 and 2.

Experiment 4

Participants

One hundred participants (76 females, 24 males) were recruited for participation in Experiment 4. All participants were recruited for participation in this experiment through the Introductory Psychology Subject Pool at

DePaul University. Thirteen participants were removed prior to data analyses. Specifically, four females and three males were removed because of equipment failure, five females were removed for not following instructions, and one male was removed because data was missing for one experimental condition. Thus, the data from a total of 87 participants (72 females, 15 males) were analyzed in Experiment 4. Participants ranged in age from 18-25 (mean age= 20.2 years). Participants completed the experiment in exchange for course credit. All participants were right handed, as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971). Participants in Experiment 4 had a mean laterality quotient of 0.90. Participants were all native speakers of English, did not have any history of neurological disorder or disease, and had normal or corrected-to-normal (i.e., contacts or eyeglasses) vision.

Materials and Procedure

The same texts presented in Experiments 1-3 were also presented in Experiment 4. In addition, the same procedure and instructions from Experiment 2 was used in Experiment 4. However, since Experiment 4 examined the influence of reading goals on the hemispheric processing of predictive inferences at a later time point, a long SOA of 1000 ms was used between the final sentence and the target (i.e., the amount of time the "+" sign was on the computer screen) instead of the 500 ms SOA used in Experiments 1 and 2.

Chapter III

Results

Experiment 1

It was predicted that textual constraint would influence hemispheric processing of predictive inferences. Specifically, based on the Time Course Hypothesis (Koivisto, 1997), it was predicted that at an earlier time point in predictive inference processing (a 500 ms SOA), both strongly and weakly constrained inferential targets would show significant levels of facilitation when targets were presented to the left hemisphere. In contrast, it was predicted that only strongly constrained inferential targets would show significant levels of facilitation in the right hemisphere at an earlier time point in predictive inference processing. To investigate these hypotheses, lexical decision response times and accuracy rates to target words were collected for participants in Experiment 1. To minimize outliers, the longest and shortest 1% of the data was removed within each condition (see Ratcliff, 1993 for a description of this method of outlier removal). Only targets that were responded to correctly were included in the response time analyses. All analyses included the by-participant variables of gender, hand used to respond, age, and counterbalancing condition. Because no significant effects of gender, hand used to respond, age, or counterbalancing condition were found, no further analyses regarding these variables are reported. In addition, all participants in Experiment 1 had over 70% accuracy rates for comprehension questions (M=89.2%, SE= .05). No participants were removed for having less than 70% accuracy rates for comprehension questions. An alpha level of .05 was used to determine significance. In all tests reported, F_1 refers to by participant analyses, and F_2 refers to by item analyses.

Table 2. Mean response times and mean accuracy rates for strongly constrained, weakly constrained, and neutral targets in Experiment 1.

	rvf-LH		lvf-RH	
Condition	RT	AC	RT	AC
Strongly Constrained	440.06 (14.36)	0.94 (0.01)	459.70 (16.20)	0.94 (0.01)
Weakly Constrained	473.92 (15.01)	0.93 (0.01)	469.21 (15.93)	0.92 (0.01)
Neutral	505.04 (16.80)	0.92 (0.01)	503.50 (15.47)	0.91 (0.01)

Note: RT=response time, AC=accuracy, standard errors in parentheses.

<u>Facilitation Effects</u>

To directly compare the facilitation effects for inference-related targets in strongly and weakly constrained texts across the hemispheres, facilitation scores were calculated by subtracting the response times to the strongly and weakly constrained targets from the response times to the neutral targets. Next, a repeated measures analysis of variance (ANOVA) was conducted on the facilitation scores. The within-subject independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strongly constrained or weakly constrained). There was no main effect of visual field, F_1 (1,90)= .53, p =.52, F_2(1,47)= .47, p= .47. A main effect of textual constraint was found, F_1 (1,90)= 6.92, $p < .05$, F_2(1,47)= 5.53, p= .18. Strongly constrained targets (*M*=54.39, *SE*=7.29) showed greater facilitation than weakly constrained targets, (*M*=34.28, *SE*=7.08). Additionally, a significant two way interaction was found between textual constraint and visual field-hemisphere, F_1 (1,90)= 4.21, $p < .05$, F_2(1,47)= 2.18, p= .15. Follow up paired sample *t* tests indicate that in the left hemisphere, strongly constrained targets (*M*=64.98, *SE*=10.39) showed greater facilitation than weakly constrained targets (*M*=31.12, *SE*=10.66), $t_1(90)=3.66$, $p < .05$, $t_2(47)=2.73$, $p < .05$. In the right hemisphere, strongly constrained targets (*M*=43.79, *SE*=10.17) and weakly constrained targets (*M*=34.28, *SE*=9.38) did not show significantly different levels of facilitation, $t_1(90)=0.62$, $p =0.52$, $t_2(47)=0.73$, $p =0.47$ (see figure 8). In addition, there were no significant facilitation differences across the hemispheres for either strongly constrained targets, $t_1(90)= -1.58$, $p =0.12$, $t_2(47)=1.36$, $p =.18$, or weakly constrained targets, $t_1(90)= 0.52$, $p =0.60$, $t_2(47)= -0.05$, $p =.96$.

Finally, one sample *t* tests were conducted to determine if facilitation was significantly greater than zero in each condition. One sample *t* tests showed that in the left hemisphere, facilitation was greater than zero for both strongly constrained targets, $t_1(90)=6.17$, $p < .05$, $t_2(47)= 3.95$, $p <.05$, and weakly constrained targets, $t_1(90)=2.80$, $p < .05$, $t_2(47)= 3.21$, $p <.05$. In addition, one sample *t* tests showed that in the right hemisphere, facilitation was greater than zero for both strongly constrained targets, t_1 $(90)=4.25$, $p < .05$, $t_2(47)= 3.82$, $p <.05$, and weakly constrained targets, t_1 $(90)=4.01$, $p < .05$, $t_2(47)= 1.36$, $p =.18$. Thus, the findings from Experiment 1 show that strongly and weakly constrained predictive inferences showed significant levels of facilitation in the right and left hemisphere. However, textual constraint differently influenced processing in the right and left hemispheres, such that strongly constrained predictive inferences showed greater levels of facilitation than weakly constrained predictive inferences in the left hemisphere. In contrast, strongly and weakly constrained predictive inferences showed similar levels of facilitation in the right hemisphere.

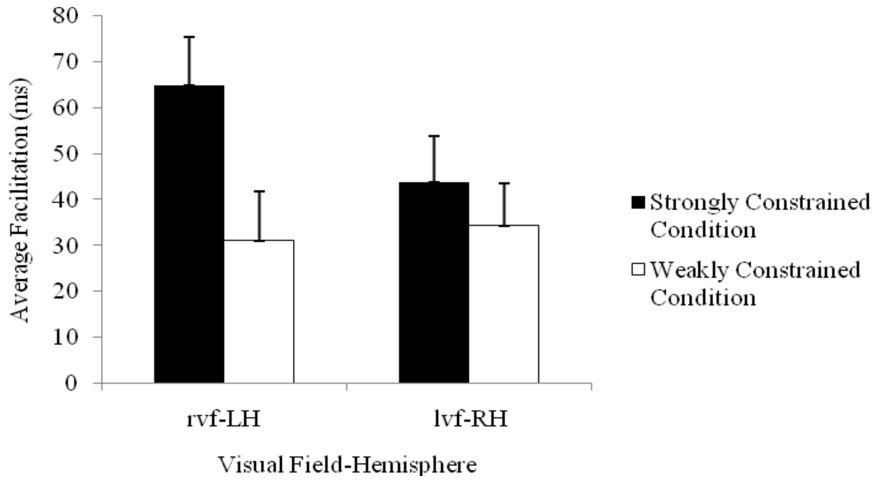


Figure 8. Mean facilitation for strongly and weakly constrained predictive inference targets in Experiment 1.

Experiment 2

It was predicted that giving participants specific reading goals (i.e., reading to study) would influence hemispheric processing of strongly and weakly constrained predictive inferences. Specifically, based on findings that instructions lead to faster activation of predictive inferences (Calvo et al., 2006), and delays in activation of weakly constrained information are specific to the right hemisphere (Koivisto, 1997), it was predicted that reading with a study goal will lead to similar levels of facilitation for strongly and weakly constrained predictive inferences in the right and left hemispheres. To investigate these hypotheses, lexical decision response times and accuracy rates to target words were collected for participants in Experiment 2. To minimize outliers, the longest and shortest 1% of the data was removed within each condition (see Ratcliff, 1993 for a description of this method of outlier removal). Only targets that were responded to correctly were included in the response time analyses. All analyses included the by-participant variables of gender, hand used to respond, and counterbalancing condition. Because no significant effects of gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. An alpha level of .05 was used to determine significance. In all tests reported, F_1 refers to by participant analyses, and F_2 refers to by item analyses.

Table 3. Mean response times and mean accuracy rates for strongly constrained, weakly constrained, and neutral targets in Experiment 2.

	rvf-LH		lvf-RH	
Condition	RT	AC	RT	AC
Strongly Constrained	433.72 (14.27)	0.95 (0.02)	450.56(16.92)	0.95(0.01)
Weakly Constrained	468.69 (16.26)	0.92 (0.02)	471.52 (16.09)	0.93(0.01)
Neutral	498.31 (14.76)	0.92 (0.01)	489.90 (14.60)	0.91(0.02)

Note: RT=response time, AC=accuracy, standard errors in parentheses.

<u>Facilitation Effects</u>

To directly compare inference-related targets for strongly and weakly constrained texts across the hemispheres when readers were given instructions to read for study, facilitation scores were calculated by subtracting the response times to the strongly and weakly constrained targets from the response times to the neutral targets (see table 3 for the average response times for each condition). Next, a repeated measures ANOVA was conducted on the facilitation scores. The within-subject independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strong or weak). There was no main effect of visual field, F_1 (1,87)= 3.10, p = .08, F_2(1,47)= 1.74, p= .19. A main effect of textual constraint was found, F_1 (1,87)= 26.39, $p < .05$, F_2(1,47)= 9.45, $p < .05$. Specifically, strongly constrained targets (*M*=51.97, *SE*=6.07) showed greater facilitation than weakly constrained targets, (*M*=23.99, *SE*=7.13). Additionally, a significant two way interaction was not found between textual constraint, and visual field-hemisphere, F_1 (1,87)= .99, p =.32, F_2(1,47)= .98, p= .49 (see figure 9).

Follow up paired samples *t* tests were conducted to more thoroughly investigate how constraint influenced the processing of inferential targets in each hemisphere. Follow up paired sample *t* tests showed that in the left hemisphere, strongly constrained targets (*M*=64.62, *SE*=8.68) showed greater levels of facilitation than weakly constrained targets (*M*=29.63, *SE*=10.37), t_1 (87)= 3.82, $p < .05$, t_2(47)= 2.62, $p < .05$. In addition, in the right hemisphere, strongly constrained targets (*M*=39.34, *SE*=8.32) showed greater levels of facilitation than weakly constrained targets (*M*=19.37, *SE*=9.23), t_1 (87)= 2.43, $p < .05$, t_2(47)= 2.21, $p < .05$. Finally, across the hemispheres, there was a left hemisphere advantage for strongly constrained targets, t_1 (87)= -2.28, $p < .05$, t_2(47)= -1.44, p =.16. There was no advantage in either hemisphere for weakly constrained targets, t_1 (87)= 0.82, p =.42, t_2(47)= 0.82, p =.42.

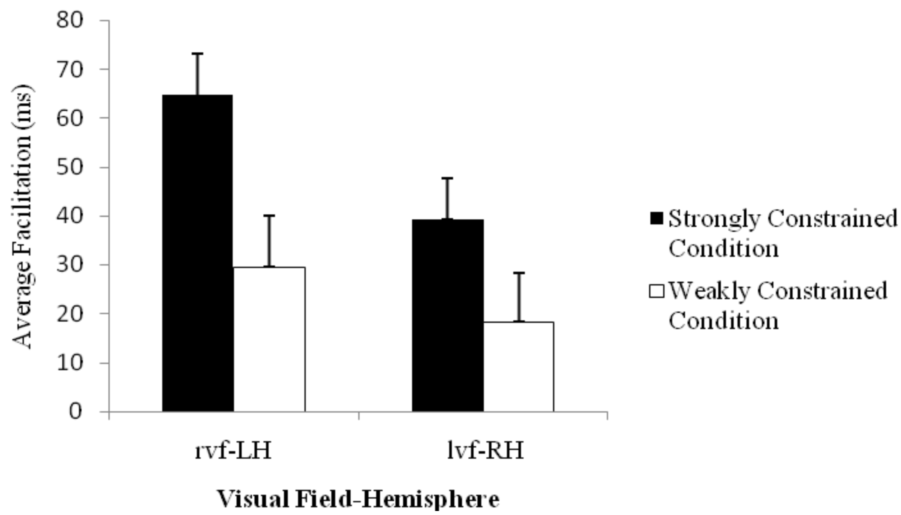


Figure 9. Mean facilitation for the strongly constrained and weakly constrained condition in Experiment 2.

Finally, one sample *t* tests were conducted to determine if facilitation was significantly greater than zero in each condition. One sample *t* tests showed that in the left hemisphere, facilitation was greater than zero for both strongly constrained targets, t_1 (87)=7.44, $p < .05$, t_2(47)= 4.92, $p <.05$, and weakly constrained targets, t_1 (87)=2.89, $p < .05$, t_2(47)= 1.97, $p < .05$. In addition, one sample *t* tests showed that in the right hemisphere, facilitation was greater than zero for strongly constrained targets, t_1 (87)=7.44, $p < .05$, t_2(47)= 3.39, $p < .05$, and weakly constrained targets, t_1 (87)=1.99, $p < .05$, t_2(47)= 1.89, $p =.07$. Thus, the findings from Experiment 2 show that reading goals influenced the processing of strongly and weakly constrained predictive inferences in the right and left hemispheres. Specifically, in both hemispheres, strongly constrained predictive inferences showed greater levels of facilitation than weakly constrained predictive inferences when readers were given a reading goal.

Combined Experiment 1 and 2 Analyses

To further examine the influence of reading goals and textual constraint on the hemispheric processing of predictive inferences, facilitation scores from Experiment 1 and 2 were entered into a between subjects repeated measures ANOVA. The between subjects variables was reading goal (no reading goal given, reading goal given). The within subjects variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strongly constrained or weakly constrained).

There was no significant interaction between reading goal and visual field-hemisphere, F_1 (1,177)= 0.52, p =.42, F_2(1,94)= 1.94, p= .17. There was also no significant interaction between reading goal and textual constraint, F_1 (1,177)= 0.54, p =.43, F_2(1,94)= 0.42, p= .52. Finally, there was no significant interaction between reading goal, visual field-hemisphere, and textual constraint, F_1 (1,177)= 0.50, p =.48, F_2(1,94)= 0.42, p= .52.

Follow up independent sample *t* tests were conducted to further examine how reading instructions influenced the hemispheric processing of strongly and weakly constrained predictive inferences. Independent t tests showed no significant facilitation differences between the goal condition and no goal condition for strongly constrained or weakly constrained targets in either the right or the left hemisphere. In addition, there was no main effect of visual field-hemisphere, F_1 (1,178)= 2.79, p =.0.10, F_2(1,95)= 0.70, p= .79. There was a main effect of textual constraint, F_1 (1,178)= 25.45, $p < .05$, F_2(1,95)= 14.85, $p < .05$.

To further test this main effect, follow up paired samples *t* tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples *t* tests indicate that strongly constrained targets (*M*=51.97, *SE*=.6.07) showed greater levels of facilitation than weakly constrained targets, (*M*=24.00, *SE*=7.13), t_1 (357)=4.99 $p < .05$, t_2(191)= 4.59, $p < .05$.

Finally, there was a significant interaction between visual field-hemisphere and textual constraint, F_1 (1,178) = 4.58, $p < .05$ F_2(1,94)= 2.44, $p = .12$ (see figure 10). Follow up paired sample *t* tests showed that in the left hemisphere, strongly constrained targets (*M*= 64.6, *SE*=8.68) showed greater levels of facilitation than weakly constrained targets, (*M*= 29.63, *SE*=8.32), t_1 (178)=-3.74, $p < .05$, t_2(95)= 3.58, $p < .05$. In the right hemisphere, strongly constrained targets showed greater facilitation than weakly constrained targets, t_1 (178) =-2.35, $p < .05$, t_2(95)= 2.88, $p < .05$. In addition, across the hemispheres, strongly constrained targets showed greater levels of facilitation in the left hemisphere over the right hemisphere, t_1 (178) =-2.22, $p < .05$, t_2(95)= 1.45, $p = .07$.

Finally, one sample *t* tests were conducted to determine if facilitation was significantly greater than zero in each condition. One sample *t* tests showed that in the left hemisphere, facilitation was significantly greater than zero for both strongly constrained targets, t_1 (178) =-9.49, $p < .05$, t_2(95)= 5.85, $p = .07$, and weakly constrained targets, t_1 (178) = 4.01, $p < .05$, t_2(95)= 2.41, $p < .05$. In the right hemisphere, facilitation was significantly greater than zero for both strongly constrained targets, t_1 (178) =6.28, $p < .05$, t_2(95)= 5.81, $p < .05$, and weakly constrained targets, t_1 (178) = 4.01, $p < .05$, t_2(95)= 2.41, $p < .07$.

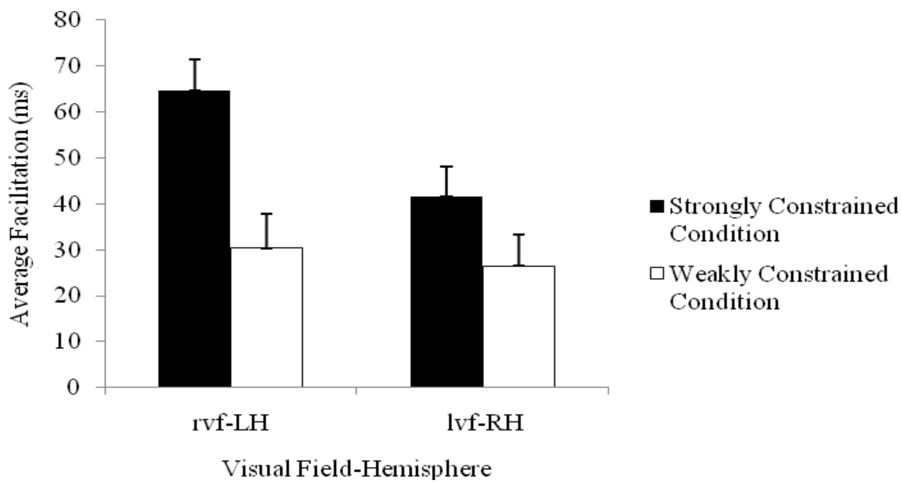


Figure 10. Average facilitation (ms) for strongly and weakly constrained targets in Experiments 1 and 2.

<u>Reading Time Analyses</u>

Reading time analyses were conducted to determine if reading times significantly differed for participants in Experiment 1 and 2. An independent samples *t* test indicated that participants did not spend a significantly different amount of time reading the text when participants were given a reading goal was given compared to participants were not given a specific reading goal (see table 3 for the average reading time per condition and per sentence for Experiment 1 and 2), $t(176)=1.40$, $p =.16$. However, since it was possible that participants who were given goal instructions (Experiment 2) may have read the final sentence longer than participants who were not given specific goal instructions (Experiment 1), an independent samples *t* test was conducted on the reading times for the final sentence. There was no significant difference between participants who were not given a reading goal (Experiment 1) and participants who were given a specific reading goal (Experiment 2) for the reading times for the final sentence of the text, $t(176)=.83$, $p=.29$.

Table 4: Average reading time (ms) for Experiments 1 and 2 by condition.

	Experiment 1				Experiment 2			
Condition	S1	S2	S3	S4	S1	S2	S3	S4
Strongly Constrained	3276.32 (92.82)	2311.59 (58.14)	2357.82 (58.26)	2849.29 (65.27)	3453.00 (94.64)	2889.21 (80.27)	2573.45 (74.53)	2981.81 (86.73)
Weakly Constrained	3240.29 (89.84)	2393.11 (58.14)	2366.01 (58.26)	2782.75 (65.27)	3346.29 (96.21)	2540.55 (69.78)	2593.53 (69.77)	2878.00 (77.43)
Neutral	2692.86 (68.76)	2188.40 (56.61)	3247.78 (60.96)	2558.73 (70.76)	2940.78 (93.19)	2382.71 (93.91)	2571.99 (66.79)	2653.65 (71.19)

Note: S1=sentence 1, S2=sentence 2, S3=sentence 3, and S4=sentence 4. Standard errors are in parentheses.

Experiment 3

It was predicted that textual constraint would influence hemispheric processing of predictive inferences after 1000 ms had passed between the presentation of the text and the presentation of a target. Specifically, based on the Time Course Hypothesis (Koivisto, 1997), it was predicted that at a long SOA of 1000 ms, strongly constrained targets would show significant levels of facilitation when presented to the left hemisphere. In contrast, it was predicted that both strongly constrained and weakly constrained targets would show significant levels of facilitation in the right hemisphere at a later time point. To investigate these hypotheses, lexical decision response times and accuracy rates to target words were collected for participants in Experiment 3. To minimize outliers, the longest and shortest 1% of the data was removed within each condition (see Ratcliff, 1993 for a description of this method of outlier removal). Only targets that were responded to correctly were included in the response time analyses. All analyses included the by-participant variables of age, gender, hand used to respond, and counterbalancing condition. Because no significant effects of age, gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. In addition, all participants in Experiment 1 had over 70% accuracy rates for comprehension questions (*M*=85.2%, *SE*= .02). An alpha level of .05 was used to determine significance. In all tests reported, F_1 refers to by participant analyses, and F_2 refers to by item analyses.

Table 5: Mean response times and accuracy rates for strongly constrained, weakly constrained, and neutral targets in Experiment 3.

	rvf-LH		lvf-RH	
Condition	RT	AC	RT	AC
Strongly Constrained	447.41 (15.92)	0.95 (0.01)	458.89 (16.26)	0.97(0.01)
Weakly Constrained	486.96 (16.46)	0.95 (0.01)	465.26 (17.30)	0.95(0.01)
Neutral	501.58 (18.75)	0.94 (0.01)	494.71 (17.81)	0.95(0.01)

Note: RT=response time, AC=accuracy, standard errors in parentheses.

Facilitation Effects

To directly compare inference-related targets for strongly and weakly constrained texts across the hemispheres when readers were not given a specific reading goal at a longer SOA of 1000ms, facilitation scores were calculated by subtracting the response times to the strongly and weakly constrained targets from the response times to the neutral targets. Next, a repeated measures ANOVA was conducted on the facilitation scores. The within-subject independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strong or weak). There was no main effect of visual field, F_1 (1,84)= .03, p =.86, F_2(1,47)= .25, p= .61. A main effect of textual constraint was found, F_1 (1,84)= 10.81, $p < .05$, F_2(1,47)= 6.26, p= .18. Specifically, strongly constrained targets (*M*=45.00, *SE*=10.11) showed greater facilitation than weakly constrained targets, (*M*=22.03, *SE*=10.44). Additionally, a significant two way interaction was found between textual constraint, and visual field-hemisphere, F_1 (1,84)= 4.69, $p < .05$, F_2(1,47)= 1.74, p= .19 (see figure 11). Follow up paired sample *t* tests indicate that in the left hemisphere, strongly constrained targets (*M*=54.17, *SE*=14.62) showed greater facilitation than weakly constrained targets (*M*=11.61, *SE*=12.10), t_1(84)=3.66, $p < .05$, t_2(47)=2.73, $p < .05$. In the right hemisphere, strongly constrained targets (*M*=35.83, *SE*=8.52) and weakly constrained targets (*M*=29.45, *SE*=8.46) did not show significantly different levels of facilitation, t_1(84)=0.62, p =0.52, t_2(47)=0.73, p =0.47 (see figure 11). In addition, across the hemispheres, no significant facilitation differences were evident for strongly constrained targets, t_1(84)= -1.58, p =0.12, t_2(47)=1.36, p =.18. There were significant differences across the hemispheres for weakly constrained targets, t_1(84)= 2.02, $p < .05$, t_2(47)= 1.32, p = .09.

Finally, one sample *t* tests were conducted to determine if facilitation was significantly greater than zero in each condition. One sample *t* tests showed that in the left hemisphere, facilitation was greater than zero for strongly constrained targets, t_1 (84)=6.17, p < .05, t_2(47)= 3.95, p <.05 but not for weakly constrained targets, t_1 (84)=1.35, p < .18, t_2(47)= 1.22, p =.23. In addition, one sample *t* tests showed that in the right hemisphere, facilitation was greater than zero for strongly constrained targets, t_1 (84)=4.31, p < .05, t_2(47)= 2.93, p <.05, and weakly constrained targets, t_1 (84)=3.44, p < .05, t_2(47)= 1.87, p =.06.

Thus, the findings from Experiment 3 show that textual constraint influences the processing of strongly and weakly constrained predictive inferences in the hemispheres differently at a later time point in predictive inference processing. Specifically, in the left hemisphere, strongly constrained predictive inferences showed greater levels of facilitation than weakly constrained predictive inferences. In addition, there was no evidence of facilitation for weakly constrained predictive inferences in the left hemisphere. In contrast, in the right hemisphere, strongly constrained and weakly constrained predictive inferences showed similar levels of facilitation. Across the hemispheres, there was a right hemisphere advantage for weakly constrained predictive inferences over the left hemisphere.

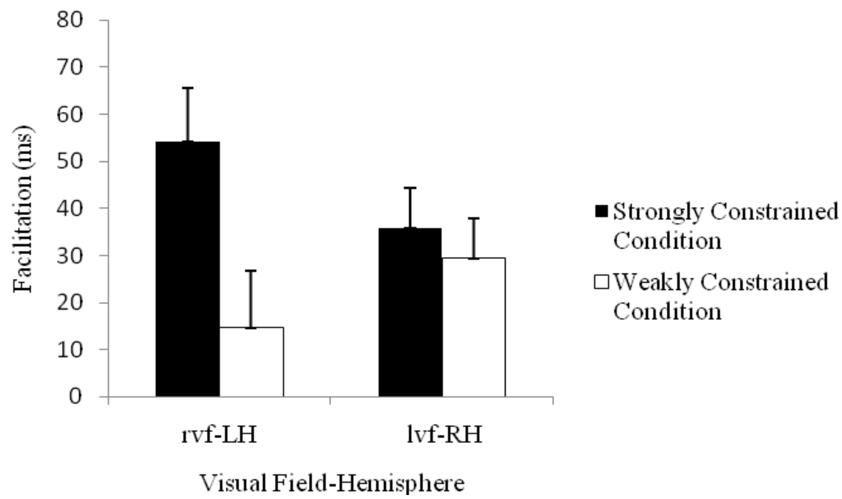


Figure 11: Mean facilitation for strongly and weakly constrained predictive inference targets for Experiment 3.

Experiment 4

It was predicted that textual constraint would influence hemispheric processing of predictive inferences at a longer SOA. Specifically, based on the Time Course Hypothesis (Koivisto, 1997), it was predicted that at a later time point (i.e., a long SOA of 1000 ms), weakly constrained inferential targets would show significant levels of facilitation when targets were presented to both the left hemisphere and the right hemisphere. In addition, strongly constrained inferential targets were expected to show significant levels of facilitation when targets were presented to both the left hemisphere and right hemisphere at a later time point. To investigate these hypotheses, lexical decision response times and accuracy rates to target words were collected for participants in Experiment 4. To minimize outliers, the longest and shortest 1% of the data was removed within each condition (see Ratcliff, 1993 for a description of this method of outlier removal). Only targets that were responded to correctly were included in the response time analyses. All analyses included the by-participant variables of gender, hand used to respond, age, and counterbalancing condition. Because no significant effects of gender, hand used to respond, age, or counterbalancing condition were found, no further analyses regarding these variables are reported. In addition, all participants in Experiment 4 had over 70% accuracy rates for comprehension questions (*M*=84.2%, *SE*= .015). An alpha level of .05 was used to determine significance. In all tests reported, F_1 refers to by participant analyses, and F_2 refers to by item analyses.

Table 6: Mean response times and mean accuracy rates for strongly constrained, weakly constrained, and neutral targets in Experiment 4.

	rvf-LH		lvf-RH	
Condition	RT	AC	RT	AC
Strongly Constrained	468.01 (18.13)	0.96 (0.01)	462.98 (16.38)	0.95(0.01)
Weakly Constrained	479.93 (18.26)	0.94 (0.01)	501.96 (17.08)	0.95(0.01)
Neutral	529.19 (23.21)	0.95 (0.01)	523.83 (17.28)	0.94(0.01)

Note: RT=response time, AC=accuracy, standard errors in parentheses.

Facilitation Effects

To directly compare inference-related targets for strongly and weakly constrained texts across the hemispheres when readers were given instructions to read for study, facilitation scores were calculated by subtracting the response times to the strongly and weakly constrained targets from the response times to the neutral targets (see table 6 for the mean response times per condition). Next, a repeated measures analysis of variance (ANOVA) was conducted on the facilitation scores. The within-subject independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strongly constrained or weakly constrained). There was no main effect of visual field, F_1 (1,86)= .67, p =.41, F_2(1,47)= .01, p= .98. A main effect of textual constraint was found, F_1 (1,86)= 8.85, $p < .05$, F_2(1,47)= 4.57, $p< .05$. Specifically, strongly constrained targets (*M*=64.22, *SE*=6.90) showed greater facilitation than weakly constrained targets, (*M*=40.49, *SE*=7.70). There was no significant interaction found between textual constraint, and visual field-hemisphere, F_1 (1,86)= 0.03, p =.85, F_2(1,47)= 0.34, p= .56. Follow up paired samples *t* tests were conducted to more thoroughly investigate facilitation differences in the hemispheres (see figure 12). Follow up paired sample *t* tests indicate that in the left hemisphere, strongly constrained targets (*M*=65.29, *SE*=12.37) did not show greater facilitation than weakly constrained targets (*M*=49.27, *SE*=13.97), t_1(86)=137, p =.17, t_2(47)=1.05, p = .30. In the right hemisphere, strongly constrained targets (*M*=63.15, *SE*=11.02) showed significantly greater facilitation than weakly constrained targets (*M*=31.71, *SE*=11.75) t_1(86)=2.68, $p < .05$, t_2(47)=2.24, $p < .05$ (see figure 12). In addition, across the hemispheres, there were no significant facilitation differences for strongly constrained targets, t_1(86)= -0.15, p =.88, t_2(47)=-0.41, p =.68, or for weakly constrained targets, t_1(86)= -1.16, p =.24, t_2(47)= -0.39, p =.69.

Finally, one sample *t* tests were conducted to determine if facilitation was significantly greater than zero in each condition. One sample *t* tests showed that in the left hemisphere, facilitation was greater than zero for both strongly constrained targets, t_1 (86) = 5.91, $p < .05$, t_2(47)= 4.59, $p <.05$ and weakly constrained targets, t_1 (86)=3.26, $p < .05$, $t_2(47) = 3.36$, $p <.05$. In addition, one sample *t* tests showed that in the right hemisphere, facilitation was greater than zero for both strongly constrained targets, t_1 (86)=7.56, $p < .05$, $t_2(47)= 4.40$, $p <.05$, and weakly constrained targets, t_1 (85)=3.26, $p < .05$, $t_2(47)= 2.50$, $p < .05$.

Thus, the findings from Experiment 4 show that reading goals influence the processing of strongly and weakly constrained predictive inferences at a later time point in predictive inference processing. Specifically, in the left hemisphere, strongly and weakly constrained predictive inferences show similar levels of facilitation when readers were given a reading goal. In contrast, in the right hemisphere strongly constrained predictive inferences showed greater levels of facilitation than weakly constrained predictive inferences when readers were given a reading goal. In addition, across the hemispheres, there was a left hemisphere advantage for strongly constrained predictive inferences.

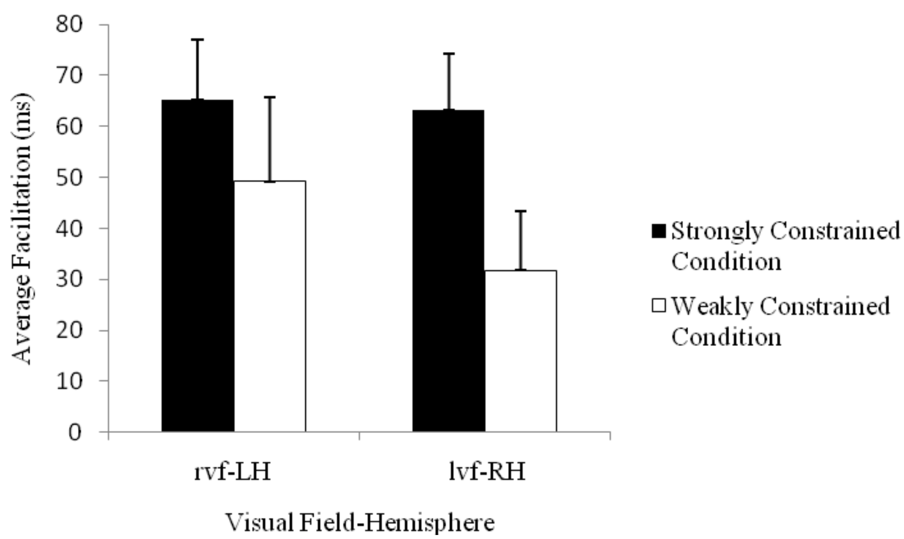


Figure 12. Mean facilitation for strongly and weakly constrained predictive inference targets for Experiment 4.

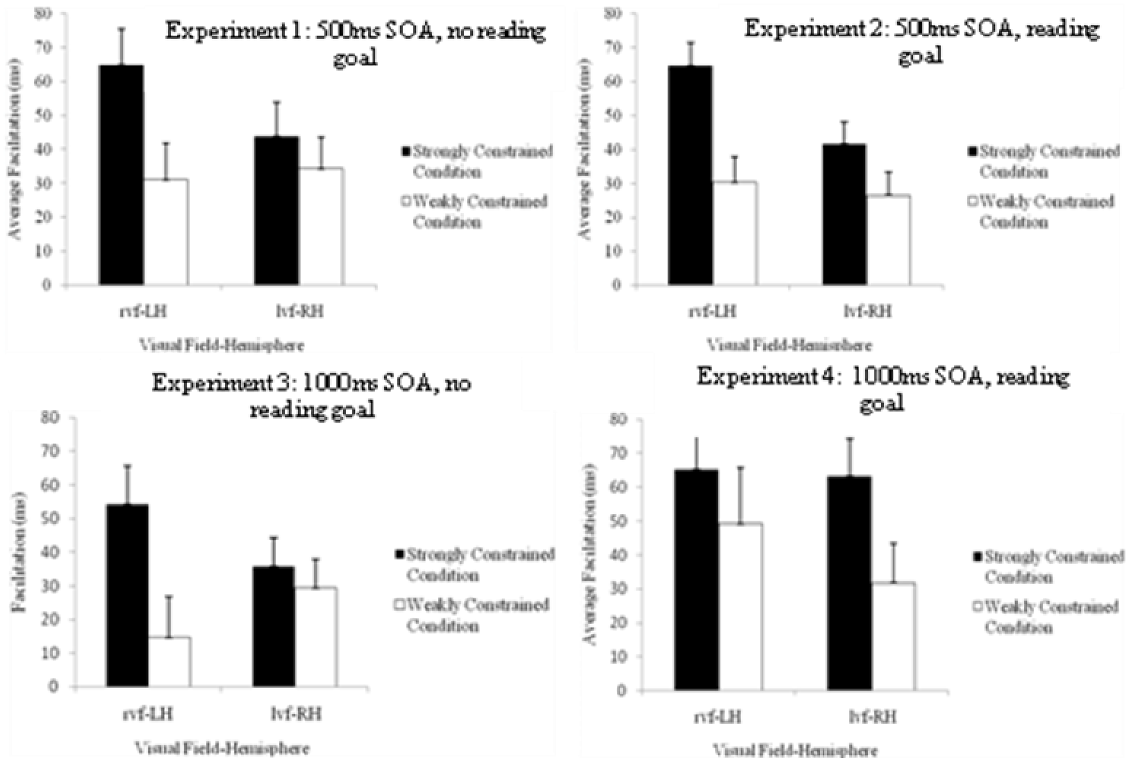


Figure 13. Mean facilitation for Experiments 1-4

<u>Combined Experiments 3 and 4 Analyses</u>

To further examine the influence of reading goals and textual constraint on the hemispheric processing of predictive inferences, facilitation scores from Experiment 3 and 4 were entered into a between subjects repeated measures ANOVA. The between subjects variables was reading goal (no specific reading goal given, no specific reading goal given). The within subjects variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strongly constrained or weakly constrained). There was no significant interaction between reading goal and visual field-hemisphere, F_1 (1, 170)= .23, p =.63, F_2(1,94)= .02, p= .95. In addition, there was not a significant interaction between reading goal and textual constraint, F_1 (1, 170)= .01, p =.94, F_2(1,94)= .09, p= .91. Most importantly, there was a three way interaction between reading goal, textual constraint, and visual field-hemisphere, F_1 (1, 170) = 4.78, $p < .05$, F_2(1,94)= 1.76, p= .15. There was a significant main effect of reading goal, F_1 (1, 170) = 3.64, $p < .05$, F_2(1,94)= 1.42, p= .22. Follow up independent samples *t* tests show that facilitation was greater in the reading goal condition, (M= 60.10, SE=6.59) than in the no reading goal condition, (M= 43.47, SE=7.13), t_1(170)= -1.79, $p < .05$, t_2(94)=-1.94, p = .07.

Independent samples *t* tests were conducted to examine differences in the levels of facilitation for strongly and weakly constrained targets presented to the right visual field-left hemisphere and the left visual field-right hemisphere in Experiment 3 and 4. Independent samples *t* tests showed that in the left hemisphere, there was not a significant difference in levels of facilitation for strongly constrained targets between Experiment 3 and 4, t_1(170)= .69, p= .48, t_2(94)=.26, p = .79; however, facilitation for weakly constrained targets did differ significantly across Experiment 3 and 4, t_1(170)= 2.04, $p< .05$, t_2(94)=1.86, p = .08. In the right hemisphere, there was a significant difference in levels of facilitation for strongly constrained targets between Experiment 3 and 4, t_1(170)= 2.29, $p< .05$, t_2(94)=1.96, p = .05. There was not a significant difference in the levels of facilitation for weakly constrained targets between Experiment 3 and 4 in the right hemisphere, t_1(170)= 0.18, p= .86, t_2(94)=.26, p = .85.

In addition, there was not a main effect of visual field-hemisphere, F_1 (1, 170)= 19.79, $p < .05$, F_2(1,94)= .003, p= .97. There was a main effect of textual constraint, F_1 (1, 170)= .01, p =.94, F_2(1,94)= 5.79, p < .05. Paired sample follow up t tests were conducted to further examine this main effect. Paired sample t tests showed that strongly constrained targets (M= 60.85, SE=5.01) showed greater levels of facilitation than weakly constrained targets (M= 36.84, SE=5.49). Finally, there was no interaction between visual field-hemisphere and textual constraint, F_1 (1, 170) = .63, p = .43, F_2(1,94)= .03, p= .95.

Reading Time Analyses

Reading time analyses were conducted to determine if reading times significantly differed for participants in Experiment 3 and 4 (see table 7 for the mean reading times for each sentence in each condition). An independent samples t test indicated that participants did not spend a significantly different amount of time reading the passages when given a specific reading goal compared to participants who were not given a specific reading goal (see table 3 for the average reading time per condition and per sentence for Experiments 3 and 4, t(172)=-0.73, p =.23. However, since it was possible that participants who were given a reading goal (Experiment 4) may have read the final sentence longer than participants who were not given a specific reading goal (Experiment 3), an independent samples t test was conducted on the reading times for the final sentence. There was no significant difference between Experiment 3 and 4 for the reading times for the final sentence, t(170)=.63, p =.35.

Table 7: Average reading time (ms) for Experiments 3 and 4 by condition.

	Experiment 3	Experiment 4

Condition	S1	S2	S3	S4	S1	S2	S3	S4
Strongly Constrained	2983.57 (93.74)	2585.09 (96.44)	2610.09 (88.89)	2710.87 (99.75)	2855.73 (109.64)	2759.35 (91.67)	2775.35 (89.79)	2870.00 (107.25)
Weakly Constrained	2856.88 (103.27)	2693.32 (87.23)	2577.22 (91.05)	2592.66 (72.12)	2831.59 (96.64)	2749.19 (84.77)	2728.76 (86.67)	2827.05 (97.59)
Neutral	2592.36 (98.54)	2510.72 (56.61)	2485.21 (88.31)	2438.19 (86.32)	2603.48 (85.89)	2512.48 (73.16)	2557.45 (79.15)	2569.24 (87.12)

Note: S1=sentence 1, S2=sentence 2, S3=sentence 3, and S4=sentence 4. Standard errors are in parentheses.

Combined Analyses for Experiments 1-4

To further examine the influence of reading goals and textual constraint on the hemispheric processing of predictive inferences, facilitation scores from Experiments 1-4 were entered into a between subjects repeated measures ANOVA. The between subjects variables was reading goal (study instructions given vs. no study instructions given), and SOA (500 ms or 1000 ms). The within subjects variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and textual constraint (strongly constrained or weakly constrained). Due to the large number of potential interactions and main effects, only the significant interactions and main effects will be reported. There was a significant main effect of textual constraint, F_1 (1, 348)= 45.66, $p <$ .05, F_2(1,187)= 1.84 p= .18. Follow up paired sample t tests indicate that strongly constrained targets (M= 52.67 SE= 3.44) showed greater levels of facilitation than weakly constrained targets, (M= 28.17, SE=3.59), t_1 (703)= 6.93, p < .05, t_2(383)= 5.86, p< .05. In addition, there was a significant interaction between visual field-hemisphere and textual constraint, F_1 (1, 348)= 4.51, p < .05, F_2(1,187)= 2.58 p= .20. Paired samples t tests showed that in the left hemisphere, strongly constrained targets (M= 62.34, SE= 5.12) showed greater levels of facilitation than weakly constrained targets, (M= 28.40, SE= 5.49), t_1 (351)= 6.98, p < .05, F_2(191)= 4.62 p= .20 . In the right hemisphere, strongly constrained targets (M= 42.98, SE= 4.48) showed greater levels of facilitation than weakly constrained targets, (M= 27.93, SE= 4.65), t_1 (351)= 2.96, p < .05, t_2(191)= 3.63 p< .05. Across the hemispheres, strongly constrained targets showed greater levels of facilitation in the left hemisphere than in the right hemisphere, t_1 (1, 348)= 4.51, p < .05, t_2(191)= -.75 p= .22. In contrast, weakly constrained targets showed similar levels of facilitation in the right and left hemispheres, t_1 (351)= -.06, p =.47, F_2(191)= .22, p= .41.

Chapter IV

Discussion

Experiment 1

The primary aim of Experiment 1 was to investigate how textual constraint influences the hemispheric processing of predictive inferences at a short (500 ms) stimulus onset asynchrony (SOA). The results from Experiment 1 suggest that textual constraint differently influences predictive inference generation in the cerebral hemispheres. Specifically, in the left hemisphere, strongly constrained predictive inference targets showed greater levels of facilitation than weakly constrained predictive inference targets. In contrast, strongly and weakly constrained predictive inference targets showed similar levels of facilitation in the right hemisphere. In addition, both strongly and weakly constrained targets showed significant levels of facilitation in the right and left hemispheres. These findings demonstrate that strongly and weakly constrained predictive inferences are processed differently in the cerebral hemispheres.

As predicted, facilitation was greater for strongly constrained inferential targets than weakly constrained inferential targets in the left hemisphere. This finding is consistent with previous findings that examined the influence of textual constraint on predictive inference processing in the hemispheres at a later time point in predictive inference processing (Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Specifically, both Virtue et al. (2006) and Motyka Joss & Virtue (unpublished) found that strongly constrained inferential targets showed greater levels of facilitation than weakly constrained inferential targets in the left hemisphere when an SOA of 750ms was used. The current finding is also consistent with the Time Course Hypothesis (Koivisto, 1997). The Time Course Hypothesis states that at shorter SOAs, both strongly and weakly semantically related information is activated in the left hemisphere. The current findings also expand upon the Time Course Hypothesis by demonstrating that at short SOAs, both strongly and weakly constrained *inferential* information is also activated in the left hemisphere. This finding is important because it suggests that the activation of inferential information in the hemispheres may be similar to the activation of semantic information during reading.

In addition, the finding that both strongly and weakly constrained targets showed significant levels of facilitation in the left hemisphere at an earlier time point in predictive inference processing is different from previous studies examining textual constraint and hemispheric processing of predictive inferences at a later time point in predictive inference processing (Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Specifically, both of the previous studies found significant levels of facilitation for strongly constrained inferential targets in the left hemisphere, but not significant levels of facilitation for weakly constrained inferential targets. In addition, at a longer SOA, strongly semantically related information is activated in the left hemisphere, but weakly semantically related information is not activated in the left hemisphere (Burgess & Simpson, 1988; Atchley, Burgess, & Keeney, 1999; Yochim et al., 2005). However, at a short SOA, strongly and weakly semantically related information is activated in the left hemisphere (Koivisto, 1997; Abernethy & Coney, 1993). Thus, the current finding showing a significant level of facilitation in the left hemisphere for strongly *and* weakly constrained inferential information at a short SOA is important because it extents the Time Course Hypothesis by demonstrating that weakly constrained information may initially become activated in the left hemisphere, similar to weakly semantically related information.

In addition, the results from Experiment 1 show that at an earlier time point in predictive inference processing, strongly and weakly constrained inferential targets show similar levels of facilitation in the right hemisphere. This finding is not consistent with the predictions for Experiment 1. Specifically, it was predicted that in the right hemisphere, only strongly constrained predictive inference targets would show significant levels of facilitation at an early time point in predictive inference processing. However, both strongly and weakly constrained predictive inference targets showed significant levels of facilitation in the right hemisphere. According to the Time Course Hypothesis, only strongly semantically related information is activated at a short SOA in the right hemisphere, but not weakly semantically related information (Koivisto, 1997). It is possible, however, that the SOA of 500ms was a long enough amount of time for weakly constrained information to become activated in the right hemisphere. Although the current right hemisphere findings did not match the predictions for Experiment 1, the current findings are also consistent with previous research that examined the influence of textual constraint on predictive inference processing in the hemispheres at longer SOAs (e.g., 750 ms) (Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Specifically, both Virtue et al. (2006) and Motyka Joss & Virtue (unpublished) found that strongly constrained and weakly constrained inferential targets showed similar levels of facilitation in the right hemisphere. Unlike previous studies, the current findings from Experiment 1 did not show a right hemisphere advantage for weakly constrained inferential targets. It is possible that no right hemisphere advantage for weakly constrained inferential targets was found because information related to weakly constrained predictive inferences may not be as activated at an earlier time point in predictive inference processing as at a later time point in predictive inference processing. Specifically, weakly related semantic information is not immediately activated in the right hemisphere, and instead takes time to become activated (Koivisto, 1997; Atchley et al., 1999). Additionally, the Time Course Hypothesis states that weakly related semantic information takes longer to become activated in the right hemisphere than strongly constrained semantic information. Although weakly constrained inferential information became activated in the right hemisphere in the current study, it is likely that the SOA of 500 ms may not have been long enough for weakly constrained inferential information to show significantly higher levels of facilitation in the right hemisphere than in the left hemisphere. If readers were given a longer SOA, it is possible that weakly constrained predictive inferences may have shown a right hemisphere advantage at a later time point in predictive inference processing (this possibility was examined in Experiments 3 and 4).

The findings from the current study regarding the left hemisphere are also consistent with the Fine Coarse Coding Theory (Beeman et al., 1994). Specifically, the Fine Coarse Coding Theory states that in the left hemisphere, strongly related semantic information is activated in the left hemisphere during reading. In the current study, strongly constrained inferential targets showed greater levels of facilitation than weakly constrained inferential targets in the left hemisphere, which is consistent with the Fine Coarse Coding Theory's prediction of a left hemisphere advantage for strongly related information. However, unlike the predictions of the Fine Coarse Coding Theory, which predicts that *only* strongly related information is activated in the left hemisphere (Beeman, 1993; Beeman et al., 1994), both strongly and weakly constrained information was activated in the left hemisphere at an earlier time point in predictive inference processing. Had the current findings precisely matched the predictions of the Fine Coarse Coding Theory, the results would have shown significant levels of facilitation for only strongly constrained targets in the left hemisphere (Beeman et al., 1994; Beeman et al., 2000). One difference between the current study and previous studies examining the Fine Coarse Coding Theory is that the current study used a short SOA, whereas previous studies used a longer SOA of at least 750 ms to examine the predictions of the Fine Coarse Coding Theory and inference generation in the hemispheres (Beeman et al., 2000; Virtue et al., 2006; Sundmeier et al., 2006). Thus, it is possible that the inconsistency between the current findings and the predictions of the Fine Coarse Coding Theory may be due to the short SOA used in the current study.

In addition, the finding that strongly and weakly constrained inferential targets showed similar levels of facilitation in the right hemisphere is consistent with the predictions regarding the right hemisphere of the Fine Coarse Coding Theory. Specifically, the Fine Coarse Coding Theory predicts that both strongly and weakly related information will be processed in the right hemisphere (Beeman et al., 1994). For example, strongly and weakly semantically related information is similarly processed in the right hemisphere (Burgess & Simpson, 1988; Atchley et al., 1999; Chiarello et al., 2003). Previous results are consistent with the current set of findings for the right hemisphere. Thus, it appears that even at a short SOA, both weakly and strongly inferential information is activated in the right hemisphere.

In addition to providing new information about how predictive inferences are processed in the hemispheres, the findings from the current study also provide information about how textual constraint influences predictive inferences at short SOAs. In Experiment 1, participants showed significant levels of facilitation for both strongly constrained and weakly constrained text. This finding is consistent with the suggestion that readers can generate predictive inferences when the text is weakly as well as strongly constrained at short SOAs (e.g., Klin, Murray, Levine & Guzman, 1999). However, this finding is in contrast to some research findings that suggest that predictive inferences are not frequently generated during reading (Potts, Keenan, & Golding, 1988; Magliano, Baggett, Johnson, & Graesser, 1993; Fincher-Keifer, 1993), or that the text must be strongly constrained to generate predictive inferences (Murray, Klin, & Meyers, 1993; Klin, Guzman, & Levine, 1999). In addition, significant facilitation for both strongly and weakly constrained predictive inferences demonstrates that the text does not necessarily need to be strongly constrained for predictive inferences to be activated at short SOAs (Calvo, 2000). Consistent with previous studies, the current study showed that strongly constrained predictive inferences exhibited greater levels of facilitation and accuracy than weakly constrained predictive inferences (Calvo, Meseguir, & Carreiras, 2001; Weingartner et al., 2003). Thus, both strongly and weakly constrained predictive inferences can be activated at SOAs of 500 ms. Further, strongly constrained predictive inferences may be generated faster than weakly constrained predictive inferences when readers are given a short amount of time after reading to generate an inference.

In sum, the current findings may offer a possible explanation for conflicting findings regarding predictive inference generation at earlier time points in predictive inference processing (Calvo, 2000; Klin, Murray, Guzman & Levine, 1999). Specifically, one reason that previous research suggests readers cannot generate predictive inferences at an earlier time point may be that previous texts were not strongly constrained enough for readers to generate a predictive inference. The current finding that weakly constrained inferences do not show as high of a level of facilitation or accuracy as strongly constrained predictive inferences at an earlier time point may suggest that readers need more time to generate weakly constrained predictive inferences. Thus, it is possible that readers are more likely to draw predictive inferences from strongly constrained text than from weakly constrained text. In addition, the findings from Experiment 1 provide new information about how predictive inferences are processed in the hemispheres at an earlier time point. Specifically, the current findings provide support for the Fine Coarse Coding Theory, and suggests that strongly and weakly constrained predictive inferences are activated differently in the left hemisphere, but similarly in the right hemisphere. In addition, given that the current findings did not show the right hemisphere advantage for weakly constrained predictive inferences at an earlier time point that has been previously shown at a longer time point, the current findings provide support for the Time Course Hypothesis' prediction that weakly related information may take a longer amount of time to become activated in the right hemisphere.

Experiment 2

The primary aim of Experiment 2 was to examine the influence of reading instructions and textual constraint on the hemispheric processing of predictive inferences. The findings from the current study show that when readers are instructed to study, strongly and weakly constrained texts are processed similarly in the cerebral hemispheres. Specifically, in both the right and left hemisphere, an advantage for strongly constrained predictive inferences was observed over weakly constrained predictive inferences. In addition, both strongly and weakly constrained targets showed significant levels of facilitation in the right and left hemisphere. Finally, strongly constrained predictive inferences showed a left hemisphere advantage over the right hemisphere. This pattern of facilitation for strongly and weakly constrained predictive inference targets is different from the pattern observed in Experiment 1 (in which no reading goal was given). Specifically, in the right hemisphere, strongly constrained predictive inference targets did not show significantly different levels of facilitation from weakly constrained predictive inferences in Experiment 1. However, in Experiment 2, strongly constrained predictive inference targets did show significantly different levels of facilitation from weakly constrained predictive inference targets. Thus, the findings from Experiment 2 demonstrate that reading goals can influence the pattern of predictive inference generation in the hemispheres.

As predicted, strongly constrained inferential targets showed greater levels of facilitation than weakly constrained inferential targets in the left and right hemispheres. These findings are consistent with previous findings that examined the influence of reading instructions and textual constraint on predictive inference processing in the hemispheres at later time points (e.g., 750 ms after reading a text) (Motyka Joss & Virtue, unpublished). Specifically, Motyka Joss & Virtue (unpublished) also found that strongly constrained inferential targets showed greater levels of facilitation than weakly constrained inferential targets in the left and right hemispheres when readers were instructed to study prior to reading. However, it was unclear if a similar pattern of facilitation in the hemispheres for predictive inferences would be observed with study instructions at a shorter SOA. Thus, the current findings suggest that when readers adopt a study goal prior to reading, this can influence the pattern of predictive inference generation in the hemispheres at an earlier time point in predictive inference processing.

The findings from Experiment 2 are not consistent with the predictions of the Time Course Hypothesis (Koivisto, 1997). Specifically, the Time Course Hypothesis predicts that at short SOAs, strongly and weakly related information is similarly activated in the left hemisphere. In addition, in the right hemisphere, only strongly related information is activated at short SOAs. However, in the current set of findings, strongly constrained information showed greater facilitation than weakly constrained information in both hemispheres at an earlier time point in predictive inference processing. It is possible that strongly constrained information showed greater levels of facilitation than weakly constrained information in the hemispheres because the reading goal may have influenced the processing of strongly constrained information at an earlier time point in predictive inference processing. Specifically, previous research shows that giving readers specific reading goals can lead to faster predictive inference generation (Calvo et al., 2006). However, previous research did not examine the influence of textual constraint on predictive inference generation when readers are given specific reading goals. Based on the current set of findings in Experiment 2, it is possible that a longer SOA is needed for reading goals to influence predictive inferences that are generated from weakly constrained text. Specifically, if weakly constrained predictive inferences have a right hemisphere advantage (Virtue et al., 2006; Motyka Joss & Virtue, unpublished), and it takes a longer amount of time for weakly constrained information to become activated in the right hemisphere (Koivisto, 1997), then it makes sense that reading goals might not influence predictive inference generation when a short SOA is used. Thus, a longer amount of time might be needed for readers to generate predictive inferences when a text is weakly constrained. This possibility is examined in Experiment 4.

In addition, the current findings regarding facilitation in the left hemisphere are consistent with the predictions of the Fine Coarse Coding Theory (Beeman et al., 1994), which predicts a left hemisphere advantage when readers process strongly related information. The left hemisphere advantage found over the right hemisphere for strongly constrained information was surprising, especially given that previous studies have shown similar levels of facilitation for strongly constrained targets in the hemispheres when readers are given a specific reading goal (Motyka Joss & Virtue, unpublished). It is possible that the current findings may have differed from previous findings because previous research used a longer SOA of 750 ms, whereas the current study used a shorter SOA of 500 ms. The short SOA may not have allowed enough time for strongly constrained information to become as activated in the right hemisphere as in the left hemisphere. Previous research has shown that more time is needed in the right hemisphere to activate strongly related information compared to activation in the left hemisphere (Koivisto, 1997; Abernanthy et al., 1999). Thus, the current findings show that when readers are given a specific reading goal, strongly and weakly constrained information is processed differently in the left hemisphere at an earlier time point in predictive inference processing.

In contrast, the current findings regarding the role of the right hemisphere are not consistent with the Fine Coarse Coding Theory (Beeman et al., 1994), which predicts a right hemisphere advantage for weakly related information. Instead, the current findings show that when readers are given a reading goal, they show similar levels of facilitation for strongly and weakly constrained targets in the right and left hemisphere. Specifically, high levels of facilitation were found for both strongly and weakly constrained inferential targets in the right and left hemispheres. Thus, it is possible that reading goal and textual constraint may interact to differently influence how predictive inferences are generated in the right hemisphere.

In addition to providing new information about how reading goals influence early predictive inference processing in the hemispheres, the findings from Experiment 2 also provide information about how reading goals influence predictive inferences in general. Specifically, the findings from Experiment 2 show that strongly constrained predictive inferences had greater levels of facilitation than weakly constrained predictive inferences. This finding is important because it shows that even when readers are given a specific reading goal, readers may be more likely to generate a predictive inference from strongly constrained text than from weakly constrained text. Although reading goals may influence the pattern of predictive inference processing for strongly constrained text in the cerebral hemispheres, it is possible that 500 ms is not enough time for reading goals to influence predictive inference generation for weakly constrained text. Specifically, if the right hemisphere plays a key role in processing weakly constrained text (Virtue et al., 2006), and it takes more time for readers to activate weakly constrained information in the right hemisphere than strongly constrained information (Koivisto, 1997), it is likely that more time is needed for reading goals to influence predictive inference generation when the text is weakly constrained. In sum, the findings from Experiment 2 suggest that reading goals may influence predictive inference generation, particularly strongly constrained predictive inferences at an earlier time point.

General Discussion for Experiments 1 and 2

The findings from Experiments 1 and 2 provide information about how reading goals and textual constraint interact to influence predictive inference generation at a short SOA. Specifically, at a short SOA, the goal of the reader did not significantly interact with the level of textual constraint to influence predictive inference generation in the hemispheres. Even though slightly different patterns were observed for strongly and weakly constrained predictive inferences in the right and left hemispheres in Experiments 1 and 2, these differences were not large enough to indicate that reading goals influence predictive inference processing in the hemispheres. Given that previous research (Motyka Joss & Virtue, unpublished) have found that reading goal and textual constraint interact to influence predictive inference processing in the hemispheres, it is likely that a longer amount of time is needed for reading goals to influence hemispheric processing of predictive inferences. Thus, Experiments 3 and 4 will examine how readers process strongly and weakly constrained predictive inferences at longer time points (i.e., an SOA of 1000 ms).

In addition, the findings from the combined analysis of Experiments 1 and 2 show that strongly constrained information is processed differently in the cerebral hemispheres at early time points, regardless of reading goal. Specifically, a left hemisphere advantage was evident for strongly constrained information compared to the right hemisphere across Experiments 1 and 2. This finding is consistent with the predictions of the Time Course Hypothesis regarding the activation of strongly and weakly related information in the hemispheres (Koivisto, 1997). In addition, this finding is consistent with the predictions of the Fine Coarse Coding Theory regarding a left hemisphere advantage for strongly related information (Beeman et al., 1994). In addition, the finding that strongly constrained information showed greater levels of facilitation in the right hemisphere over weakly constrained information is consistent with the Time Course Hypothesis' prediction that strongly related information is activated more quickly in the right hemisphere than weakly related information. However, the current right hemisphere findings are not consistent with the Fine Coarse Coding Theory's prediction that strongly and weakly related information is processed similarly in the right hemisphere. When the current findings are taken together with previous research, studies examining inference generation may need to consider using an SOA of at least 750 ms to examine predictive inference generation at a later time point (Till et al., 1988; Fincher-Keifer, 1995; Calvo, 2000). Specifically, while earlier time points may be useful when examining the processing of strongly constrained inferences, using a later time point may be more beneficial when also examining how weakly constrained inferences are processed during reading.

Experiment 3

The primary aim of Experiment 3 was to investigate how textual constraint influences the hemispheric processing of predictive inferences at a later time point in predictive inference processing (i.e., a SOA of 1000 ms). The results from Experiment 3 suggest that textual constraint differently influences predictive inference generation in the cerebral hemispheres. Specifically, strongly constrained information showed greater levels of facilitation than weakly constrained information in the left hemisphere. In contrast, strongly and weakly constrained information showed similar levels of facilitation in the right hemisphere. In addition, there was a right hemisphere for weakly constrained information over the left hemisphere. These findings demonstrate that the right and left hemisphere play specific roles during the generation of predictive inferences at a later time point during inference generation.

As predicted, there was a greater facilitation for strongly constrained inferential targets than weakly constrained inferential targets in the left hemisphere. In addition, there was no evidence of facilitation for weakly constrained predictive inferences in the left hemisphere. These findings fit nicely with the Time Course Hypothesis (Koivisto, 1997), which predicts that only strongly related information should be activated in the left hemisphere at a long SOA. In addition, this finding is consistent with some research that examines how semantic information is processed in the hemispheres. For example, findings show that strongly semantically related information has a processing advantage in the left hemisphere at long SOAs (Burgess & Simpson, 1988; Chiarello et al., 2003), whereas both strongly and weakly semantically related information is activated in the right hemisphere at long SOAs (Atchley et al., 1999). Thus, the current findings expand upon the Time Course Hypothesis by demonstrating that strongly constrained *inferential* information has a processing advantage in the left hemisphere compared to weakly constrained inferential information at a later time point in predictive inference processing, whereas weakly constrained and strongly constrained inferential information is processed similarly in the right hemisphere at a later time point in predictive inference processing.

The current findings are also consistent with the Fine Coarse Coding Theory (Beeman et al., 1994), which predicts a left hemisphere advantage for strongly constrained information and a right hemisphere advantage for weakly constrained information. The current findings show facilitation for strongly constrained inferential targets, but did not find facilitation for weakly constrained inferential targets in the left hemisphere at a later time point in predictive inference processing, which precisely fits the predictions of the Fine Coarse Coding Theory. In addition, the finding of a right hemisphere advantage for weakly constrained information fits nicely with the predictions of the Fine Coarse Coding Theory. The current set of findings is also consistent with previous findings that have examined the role of sentence constraint and the hemispheric processing of semantic information (Faust & Gernsbacher, 1996; Schmidt, DeBuse, & Seger, 2007). Specifically, the current findings show that in the left hemisphere, strongly and weakly constrained information is processed differently, whereas in the right hemisphere, strongly and weakly constrained information is processed similarly. Importantly, the current findings replicate previous findings regarding textual constraint and predictive inferences in the hemispheres that have used a shorter SOA of 750 ms (Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Thus, the current findings suggest that strongly and weakly constrained predictive inferences are processed in a similar pattern over time in the right and left cerebral hemispheres at a later time point in predictive inference processing.

The current findings are also consistent with higher order language processing studies that examine how text is processed in the cerebral hemispheres (Coulson & Williams, 2005; Virtue & van den Broek, 2005; Sundermeier et al., 2006). For example, an ERP study examined joke comprehension in the hemispheres by presenting participants with sentence fragments (e.g., *"A replacement player hit a homerun with my…"*), followed by a target word that would make the fragment a pun (i.e., figurative language where the intended meaning does not match the literal meaning) (e.g., *girl*), or a literal statement (e.g., *ball*) (Coulson & Williams, 2005). Target pun words were thought to be more distantly related to the meaning of the sentence than literal target words. Similar N400 wave amplitudes were found for both pun and literal target words in the right hemisphere, whereas amplitudes significantly differed for literal and pun target words in the left hemisphere. Specifically, in the left hemisphere, N400 waves were greater for pun words than literal target words. These findings suggest that a wider array of information is activated in the right hemisphere than in the left hemisphere during higher order language processing. These findings demonstrate that the Fine Coarse Coding Theory's suggestion that a wider array of information is activated in the right hemisphere during reading can be extended to include predictions regarding higher order language processes, such as inference generation.

Although weakly constrained predictive inferences showed significant levels of facilitation in the right hemisphere, in general, strongly constrained predictive inferences showed greater levels of facilitation than weakly constrained predictive inferences. This finding was surprising, especially given that research suggests that readers similarly generate predictive inferences under strongly and weakly constrained text conditions when a long SOA is used (Calvo & Castillo, 1998; Calvo, 2000). However, other findings suggest that readers are more likely to generate a predictive inference when a text is strongly constrained (McKoon & Ratcliff, 1992; Murray et al., 1993). While it is possible that readers can generate predictive inferences from both strongly and weakly constrained text, it is also possible that readers might be more likely to generate predictive inferences when a text is strongly constrained.

Experiment 4

The primary aim of Experiment 4 was to investigate how reading goals influence the hemispheric processing of strongly and weakly constrained predictive inferences at a later time point (i.e., a 1000ms SOA). The results from Experiment 4 suggest that reading goals influence predictive inference generation in the cerebral hemispheres at a later time point. Specifically, strongly and weakly constrained predictive inferences showed similar levels of facilitation in the left hemisphere. In contrast, strongly constrained predictive inferences showed an advantage in the right hemisphere compared to weakly constrained predictive inferences. These findings are different from findings from Experiment 3 (in which different processing patterns were observed in the right and left hemispheres for strongly and weakly constrained predictive inferences), suggesting that reading goals and textual constraint may interact to influence predictive inference generation at a later time point during inference generation.

The finding that strongly and weakly constrained predictive inferences showed similar levels of facilitation in the left hemisphere is not consistent with the Time Course Hypothesis. Specifically, if the current findings closely matched the predictions of the Time Course Hypothesis, then only significant levels of facilitation would have been observed for strongly constrained targets, but not weakly constrained targets. However, the current study showed significant levels of facilitation for both strongly and weakly constrained inferential targets. In addition, the findings regarding left hemisphere facilitation are not consistent with the Fine Coarse Coding Theory, which predicts a processing advantage in the left hemisphere for strongly related information. It is possible that significant facilitation was observed in the left hemisphere for weakly constrained inferences because the reading goal increased the level of cognitive resources (i.e., increased the level of cognitive demand) used by the reader. For example, some research suggests that when a task is more difficult, and thus requires the reader to apply more cognitive resources during reading (e.g., making more attempts to memorize the text), predictive inferences remain activated longer than when a task is less difficult, and thus requires less cognitive resources to complete the task (Keefe & McDaniel, 1993). Keefe & McDaniel (1993) presented participants with texts that either suggested a predictive inference or did not suggest a predictive inference. In one condition, an inference related target was presented immediately after reading a sentence that suggested a predictive inference (i.e., the immediate text condition). In another condition, an inference related target was presented after participants read a second sentence that elaborated on the predictive inference sentence (i.e., the delayed text condition). In addition, two conditions that manipulated the level of difficulty were used: one in which the text was presented normally (e.g. less difficult to read and less cognitively demanding), and one in which the some of the letters included in the text were replaced with blanks (e.g., more difficult to read and more cognitively demanding). Priming for the predictive inference target was found in the immediate condition for both the difficult and less difficult conditions. However, priming for the predictive inference target was only found in the delayed text condition when the task was more difficult, but not when the task was less difficult (Keefe & McDaniel, 1993). In addition, behavioral research has shown that college students self report that when reading to study, they undergo additional cognitive processes during reading. For example, college students reading to study make more attempts to memorize the text and think more about information in the text (Lorch et al., 1993). Researchers have suggested that giving readers additional goals during reading, such as reading to study, also increases cognitive resources readers devote to a task (van den Broek et al., 2001; Linderolm & van den Broek, 2002). It is possible, then, that the addition of a specific reading goal led to different cognitive processes during reading for readers in this condition compared to readers in the no goal condition. Although the Time Course Hypothesis (Koivisto, 1997) suggests that only strongly constrained information is activated in the left hemisphere at a later time point, it is possible that reading goals enable readers the ability to maintain facilitation for weakly constrained information in the left hemisphere.

In addition to the finding that weakly constrained information is activated in the left hemisphere at a later time point, the advantage evident for strongly constrained targets in the right hemisphere is inconsistent with the Time Course Hypothesis, which suggests that at a long SOA, strongly and weakly related semantic information is similarly activated in the right hemisphere. In the current findings, however, strongly constrained inferential target showed greater levels of facilitation than weakly constrained inferential targets in the right hemisphere. In addition, the current findings are not consistent with the predictions of the Fine Coarse Coding Theory, which predicts that both strongly and weakly related information is similarly processed in the right hemisphere. It is possible that different levels of facilitation were observed for strongly and weakly constrained predictive inferences in the right hemisphere because reading goals changed reader's level of attention to the text. Specifically, previous research examining the influence of reading goals on predictive inference generation suggests that readers that are instructed to study pay more attention to the text when they are instructed to read for study compared to when they are instructed to read for entertainment (van den Broek et al., 2001; Linderholm & van den Broek, 2002). Additionally, lexical decisions to strongly semantically related targets presented to the right hemisphere were responded to faster when participants were able to pay more attention to the task than when participants were asked to also perform an auditory shadowing task (Nakagawa, 1991). However, there was no difference in lexical decision response times across attention conditions for weakly semantically related targets in the right hemisphere. The current findings suggest that the level of attention paid to the text specifically influences the processing of strongly related information in the right hemisphere. Thus, it is possible that reading goals influenced how readers processed strongly constrained information in the right hemisphere, leading to a different pattern of hemispheric processing than observed previously (Virtue et al., 2006).

In addition, the current findings demonstrate that strongly constrained predictive inferences show greater levels of facilitation than weakly constrained predictive inferences at a later time point in general. This finding does not match the prediction that strongly and weakly constrained predictive inferences would show similar levels of facilitation when readers were given a reading goal prior to reading. It is possible that reading goals may increase the level of facilitation for weakly constrained predictive inferences, but that an advantage may still be evident for strongly constrained predictive inferences compared to weakly constrained predictive inferences. This suggestion is consistent with previous research findings that suggest that readers are more likely to generate predictive inferences when texts are strongly constrained (e.g., McKoon & Ratcliff, 1992). Although evidence of predictive inference generation from strongly and weakly constrained text has been shown at a later time point, response times to predictive inference targets are shorter when the text is strongly constrained compared to when the text is weakly constrained. Thus, the current findings suggest that reading goals may increase the likelihood that readers generate predictive inferences during the processing of weakly constrained text, but readers may be quicker to generate predictive inferences when processing strongly constrained text.

In sum, the findings from Experiment 4 demonstrate that reading goals interact with textual constraint to influence the activation of predictive inferences during reading. These findings are not consistent with existing theoretical frameworks such as the Time Course Hypothesis and the Fine Coarse Coding

Theory regarding predictive inference generation and the cerebral hemispheres. Thus, these findings add new information to the existing literature regarding how reading goals influence predictive inference activation in the hemispheres. Specifically, the current findings suggest that at a later time point, predictive inferences are activated differently in the hemispheres than at earlier time points when readers are given a specific reading goal. At a later time point, strongly and weakly constrained information is processed similarly in the left hemisphere when readers have a specific reading goal, whereas at an earlier time point, strongly constrained information is processed more quickly than weakly constrained information when readers have a specific reading goal. In contrast, in the right hemisphere, strongly and weakly constrained information is processed differently at both an earlier and later time point when readers are given specific reading goals. These findings constrain existing theoretical frameworks such as the Time Course Hypothesis by demonstrating that giving readers a specific reading goal may increase the amount of time weakly constrained information remains activated in the left hemisphere. In addition, these findings constrain the Fine Coarse Coding Theory by demonstrating that giving readers a specific reading goal can influence how strongly and weakly constrained information is activated in the left hemisphere and right hemisphere. Thus, reading goals may play a key role in how strongly and weakly constrained predictive inferences are activated during reading at a later time point.

Combined Experiments 3 and 4 Discussion

The results from the combined analysis of Experiment 3 and 4 suggest that reading goals influence the pattern of hemispheric processing during predictive inference generation. Specifically, when participants were given a reading goal, they showed greater levels of facilitation for predictive inferences than when they were not given a reading goal. This finding is consistent with previous findings showing that reading goals can led to faster predictive inference generation (Calvo et al., 2006). In addition, reading goals interacted with textual constraint and the visual field-hemisphere to differently influence the processing of predictive inferences. Specifically, when readers are not given a reading goal, strongly and weakly constrained predictive inferences show different patterns of facilitation in the right and left hemisphere. However, when readers are given a reading goal, strongly and weakly constrained predictive inferences show similar patterns of facilitation in the right and left hemisphere. These findings are different from the findings from Experiment 1 and 2, which used a shorter SOA, and suggest that when the SOA is longer, textual constraint and reading goals interact to influence predictive inference generation in the hemispheres.

In addition, when readers were given a reading goal, strongly constrained predictive inferences showed greater facilitation in the right hemisphere than when readers were not given a reading goal. However, reading goals did not influence the level of facilitation for weakly constrained inferences in the right hemisphere. This finding suggests that reading goals specifically influence the processing of strongly constrained information in the right hemisphere. In contrast, reading goals did not significantly affect the level of facilitation for strongly constrained inferences in the left hemisphere, the level of facilitation for weakly constrained inferences was greater when readers were given a reading goal. Taken together, these findings suggest that reading goals affect processing of strongly and weakly constrained predictive inferences in the hemispheres, such that the typical pattern of a left hemisphere advantage for strongly related information and a right hemisphere advantage for weakly related information is no longer evident. Specifically, when readers adopt a reading goal, the hemispheres and textual constraint no longer interact during predictive inference generation. These findings are consistent with the previous suggestion that reading goals can influence the level of attention readers devote the text during comprehension (Linderholm & van den Broek, 2002). In addition, the current findings are consistent with the finding that the level of attention readers pay to a text during reading differently influences processing in the right and left hemispheres (Nakagawa, 1991).

The current findings from Experiment 3 and 4 may provide an explanation for some of the conflicting evidence found regarding the processing of strongly and weakly related information in the hemispheres. Though a large amount of research supports the Fine Coarse Coding Theory (e.g., Beeman et al., 1994; Faust & Gernsbacher, 1996; Faust & Chiarello, 1999; Virtue & van den Broek, 2005; Virtue et al., 2006), several findings suggest that strongly and weakly related information is processed similarly in the hemispheres (e.g., Richards & Chiarello, 1995; Coney, 2000; Livesay & Burgess, 2003; Kanhadai & Federmeier, 2007). It is possible that conflicting findings exist because specific experimental instructions may have led readers to adopt a unique reading goal during reading. Because the exact experimental instructions are generally not included in research reports, it is currently unclear if the instructions used could potentially explain some of these conflicting findings.

General Discussion

The purpose of the current studies was to use a cognitive neuroscience approach to investigate how reading goals and textual constraint influenced predictive inference generation. Specifically, a divided visual field paradigm was used to investigate how strongly and weakly constrained predictive inferences were processed in the right and left hemispheres at a short (500 ms) and long (1000 ms) SOA when readers were either given a specific reading goal (i.e., a study goal) or not given a specific reading goal. When a short SOA was given (Experiment 1), weakly constrained information did not show a right hemisphere advantage (as predicted by the Fine Coarse Coding Theory), and strongly constrained information did not show a left hemisphere advantage (as predicted by the Time Course Hypothesis). When readers were given a reading goal, strongly constrained information showed greater levels of facilitation than weakly constrained information in both the right and left hemisphere (Experiment 2). In addition, the differences in the levels of facilitation for strongly and weakly constrained predictive inferences when a reading goal was given (Experiment 2) compared to when a reading goal was not given (Experiment 1) was not significant. However, when a long SOA was given (Experiment 3), the pattern of hemispheric processing of strongly and weakly constrained predictive inferences was consistent with the predictions of the Fine Coarse Coding Theory and the Time Course Hypothesis. At a long SOA, reading goal, textual constraint, and visual field-hemisphere were found to interact to differently influence predictive inference generation (Experiment 3 and Experiment 4). Thus, a key finding from the current study is that to examine predictive inference generation in the hemispheres, predictive inference processing should be examined at a later time point after reading.

A second key finding from the current study is that at a later time point in predictive inference processing (Experiment 4) reading goals and textual constraint interact to influence predictive inference generation in the hemispheres. This finding is important for two reasons. First, it provides new information about how different factors interact to influence the cognitive processes that occur during predictive inference generation. Interestingly, it appears that reading goals increase the facilitation in each hemisphere, but for different types of text. Specifically, reading goals increase facilitation for strongly constrained information in the right hemisphere, and reading goals increase facilitation for weakly constrained information in the left hemisphere. This pattern of facilitation is the opposite of what is generally observed in the hemispheres during reading (Virtue et al., 2006; Motyka Joss & Virtue, unpublished). Second, because reading goals only seem to significantly affect hemispheric processing at a later time point and not an earlier time point, the current findings suggest that predictive inferences may be activated at a short SOA (Experiment 1 and

Experiment 2), but that strategic processing may be needed for specific factors, such as reading goals, to impact predictive inference generation.

It is possible that participants in the reading goal conditions (Experiment 2 and Experiment 4) specifically elaborated on the text during reading, which would influence the amount of time they read each text. Because participants in the current study read each sentence in a self-paced manner, and had as much time as they wanted to elaborate on the text before moving on to the next sentence, an analysis of the reading times for each condition was warranted. Specifically, it is possible that participants in the goal condition might have spent more time on the final sentence of each text (which contained the predictive inference inducing text) before moving onto the lexical decision task. If participants in the goal condition (Experiments 2 and 4) spent more time reading each text than participants in the no goal condition (Experiments 1 and 3), then it is likely that readers were using different reading strategies during reading. When examining the reading time analysis, participants who were given a specific reading goal did not spend a significantly longer amount of time reading each text (or the final sentence of each text) compared to participants who were not given a specific reading goal. This finding suggests that reading goals did not seem to influence the amount of time the text was read. This finding is consistent with previous research examining the influence of reading goals and reading strategy (Linderholm, Cong, & Zhao, 2008; Linderholm & Zhao, 2008). Specifically, giving readers different reading goals influenced text recall, but reading goals did not influence the amount of time spent reading (Linderholm, Cong, & Zhao, 2008). Thus, the difference observed between participants who were given a reading goal and participants who were not given a reading goal in the current study does not seem to be driven by reading time differences.

A third key finding from the current study is that overall (Experiments 1-4), textual constraint and visual field-hemisphere did interact to influence predictive inference generation. Specifically, a left hemisphere advantage was evident for strongly constrained information. This finding is consistent with the Fine Coarse Coding Theory, which predicts a left hemisphere advantage for strongly constrained information during semantic processing. Surprisingly, strongly constrained information showed significantly greater levels of facilitation than weakly constrained information in both the right and left hemispheres across all four studies. This pattern of results in the right hemisphere is not consistent with the predictions of the Fine Coarse Coding Theory, which states that strongly and weakly constrained information is processed similarly in the right hemisphere. However, because the current data included both a short and a long SOA, and both a reading goal and a no reading goal condition, it is possible that the interaction of reading goal and textual constraint led to a different pattern of results than previous findings.

Finally, a fourth key finding from the current study was that overall, strongly constrained targets showed greater levels of facilitation than weakly constrained targets. It is possible that predictive inferences are generated automatically when a text is strongly constrained (McKoon & Ratcliff, 1992; Fincher-Kiefer, 1995) but not when a text is weakly constrained (Calvo, 2000).

Thus, it is possible that different cognitive processes are carried out when a predictive inference is generated under strongly constrained text conditions than under weakly constrained text conditions. Additionally, this finding is consistent with previous results showing that strongly constrained predictive inference targets are responded to faster than weakly constrained predictive inference targets (Linderholm, 2002). Although different levels of facilitation for strongly and weakly constrained texts was found in the current study, the current study suggest that readers may be able to generate predictive inferences when reading weakly constrained text. Thus, textual constraint appears to be an influential factor in the level of facilitation observed for predictive inferences during reading.

In sum, the current findings from Experiments 1-4 show that several factors can influence predictive inference generation during text comprehension. Specifically, the amount of time a reader is given to generate a predictive inference, the level of textual constraint, the visual field-hemisphere of processing, and the goal of the reader combine in a variety of ways to influence predictive inference generation. Thus, to obtain a clear understanding of predictive inference generation, it is important to take into account a variety of textual and reader characteristics.

Limitations & Future Directions

One potential limitation of the current study is that the manner or reading influenced the level of facilitation observed for inferential targets. For example, participants read each text in a self-paced manner. By allowing participants to read in a self paced manner, participants may have engaged in specific reading strategies, or have re-read some sentences before moving on to the next sentence. In contrast, several studies examining the time course of inference generation have used rapid serial visual presentation (RSVP) to control how long information is presented on the computer screen. In a typical RSVP procedure, sentences are presented to participants one word at a time for a fixed amount of time (Calvo & Castillo 1996, 1998, 2001). This RSVP procedure controls the amount of time the participant has to read each sentence, and presumably provides more control of strategic processing during reading (Calvo et al., 2006). Although RSVP allows for control of strategic processes during reading, self-paced reading procedures are more naturalistic than RSVP procedures (Klin, Murray, Guzman, & Levine, 1999; Calvo & Castillo, 2001), which increases the external validity of a study (Sundermeier et al., 2006). To compare the current findings to the existing literature on this topic, it was important to use a similar methodology as was used previously to examine the hemispheric processing of predictive inferences (e.g., Beeman et al., 2000; Virtue et al., 2006). Thus, the use of self-paced reading in the current study was appropriate to fully examine how reading goals, SOA, and textual constraint influenced the activation of predictive inferences in the hemispheres, but it would be important to examine the time course of predictive inferences using a RSVP procedure in future studies.

A second limitation of the current study is that the type of text used may have influenced how predictive inferences were activated during reading. For example, only narrative texts were used to examine the influence of reading goals and textual constraint on predictive inference generation in the hemispheres. Narrative texts were used in the current study for several reasons. First, narrative texts are often constructed by the researcher, and thus confounding variables, such as word frequency, familiarity, or passage length can be controlled across different experimental conditions (Graesser, Millis, & Zwaan, 1997). Second, previous studies that have examined the influence of reading goals also used narrative texts (Narvaez et al., 1999). In future studies, it would be important to examine the influence of reading goals and textual constraint on predictive inference generation in the hemispheres using different types of texts, such as expository texts. Some studies that have examined the role of reading goals during predictive inference generation have used both expository and narrative texts, and did not find differences in the number of predictive inferences generated based on the type of text (Narvaez et al., 1999). Thus, while it is possible that different results may be obtained with expository text instead of narrative text, evidence (Narvaez et al., 1999) suggests that reading goals may similarly influence inference generation from expository and narrative texts. However, it is unclear how expository and narrative texts may differently influence inference generation in the hemispheres.

A third limitation of the current study is that semantic priming of inference related words influenced the observed levels of facilitation for strongly and weakly constrained inferential targets. For example, the semantic information in the text may have led to the priming measured in this experiment, rather than the priming for the specific predictive inference. Specifically, some research suggests that decreased response times to inferential targets in a lexical decision task may be caused by a priming effect from semantic associates (i.e., other inference related words) included in a text. For example, when readers are presented with the text, *"The housewife was learning to be a seamstress and needed practice, so she got out the skirt she was making and threaded her needle."*, it is likely that readers will infer the housewife will *sew* next in the text (McKoon & Ratcliff, 1989). However, it is also likely that words from the text that are related to the inference (e.g., *needle*) could have primed the inference related target word *(e.g., sew*). This semantic priming could have led to faster response times for inference related target words (e.g., sew) compared to a control word that does not reflect inference generation. This possibility has been investigated in several studies (McKoon & Ratcliff, 1986; Potts et al., 1988; Campion & Rossi, 2001). For example, McKoon & Ratcliff (1986) presented participants with either a text that suggested a predictive inference, such as *"The director and the camera man were ready to shoot close-ups when suddenly the actress fell from the 14th story window."*, or a control text that included many of the same words, but in a different order so as not to suggest a predictive inference, such as *Suddenly, the director fell upon to camera man and demanded close-ups of the actress on the 14th story window*. Readers then decided whether a target word (e.g., *dead*), was included in the preceding text. After reading the predictive inference text, readers should be more likely to predict the actress *died* next, and should take longer to respond to the target word, whereas after reading the control text, readers should be less likely to predict the actress *died* next and should take less time to respond to the target word (McKoon & Ratcliff, 1986). Findings showed that readers were slower and less accurate to respond to target words related to the predictive inference (e.g., *dead*) after reading the predictive inference texts than after reading the control text. Although semantic priming occurs during reading, it cannot fully explain readers' faster responses to inference related targets than control targets.

A fourth limitation of the current study is that several by item analyses were not significant, despite significant by participant findings. Given this lack of significant findings, an additional, less conservative analysis, such as a mixed model analysis, might be appropriate in the future. Specifically, mixed model analyses may be more appropriate for examining by item variability.

Although the current study demonstrated that textual factors, such as the level of textual constraint, and reader characteristics, such as the goal of the reader, influence predictive inference generation, it would be important for future studies to examine how individual differences interact with reading goals and textual constraint to influence predictive inference generation. Specifically, differences in working memory capacity have been shown to influence predictive inference generation (Estevez & Calvo, 2000; Linderholm, 2002). It is possible that the goal of the reader may differently influence readers with high and readers with low working memory capacities. For example, when high working memory capacity individuals were instructed to read expository texts for study, they made more predictive inferences than low working memory capacity individuals who were instructed to read to study (Linderholm & van den Broek, 2002). In addition, working memory has been shown to influence predictive inference generation under strongly and weakly constrained text conditions. Specifically, individuals who have high working memory capacities show evidence of predictive inference generation when a text is both strongly and weakly constrained, whereas individuals who have low working memory capacities show evidence of predictive inference generation only when a text is strongly constrained (Linderholm, 2002). Thus, working memory capacity, reading goals, and textual constraint may interact to influence predictive inference generation.

In addition, individual differences may influence the time course of predictive inference generation. For example, differences in the time course of predictive inference generation has been shown in individuals with different levels of vocabulary knowledge (Calvo, Estevez, & Dowens, 2005; Calvo, 2005) or different working memory capacities (Estevez & Calvo, 2000). Specifically, individuals who were considered high in vocabulary knowledge showed evidence of predictive inference generation after a short SOA (i.e., 500 ms), whereas individuals considered low in vocabulary knowledge did not show evidence of predictive inference generation at a short SOA. Interestingly, all participants in Calvo et al. (2005) showed evidence of predictive inference generation at a longer SOA (i.e., 1000 ms). Other research shows that individuals who have high working memory capacities generate predictive inferences at both a short and long SOA, whereas individuals who have low working memory capacities did not show evidence of predictive inference generation at either SOA (Linderholm, 2000). Currently, little research has examined how reading goals, textual constraint, and individual differences influence the time course of predictive inference generation.

Theoretical Implications

This research study has several implications to expand upon existing theoretical frameworks of language processing. First, the findings from Experiment 1 and 3 expand upon the Time Course Hypothesis (Koivisto, 1997), and suggest that inferential information follows a similar pattern of activation over time in the right and left hemispheres as semantic information. Specifically, in the left hemisphere, strongly and weakly constrained inferential information is activated at an earlier time point during reading. Over time, however, there is only evidence of the activation of strongly constrained inferential information in the left hemisphere. In contrast, in the right hemisphere, strongly and weakly constrained inferential information is activated at a short SOA. This hemispheric pattern of facilitation is similar to the hemispheric pattern observed when semantic information is encountered. Specifically, strongly and weakly related semantic information is activated in the left hemisphere at a short SOA, and only strongly semantically related information is activated at a long SOA (Koivisto, 1997). In the right hemisphere, strongly related semantic information is activated at a short SOA, followed shortly by the activation of weakly related semantic information. Then, both strongly and weakly semantically related information is also activated at a longer SOA. Thus, it is possible that inferential information may take longer to initially become activated than semantic information (Till et al., 1988), but the hemispheric pattern of activation of inferential information may be similar to semantic information in the hemispheres.

Second, the current findings from Experiment 2 and 4 suggest that reading goals can influence the time course of predictive inference generation, particularly in the left hemisphere. Although the right hemisphere finding of significant levels of facilitation for strongly and weakly constrained predictive inferences are consistent with the predictions of the Time Course Hypothesis, the left hemisphere showed significant levels of facilitation at both a short and long SOA for strongly and weakly constrained information. This left hemisphere finding is different from the predictions of the Time Course Hypothesis, and suggest that other factors, such as reading goals, interacts with textual constraint to influence the time course of activation of inferential information in the hemispheres.

Third, the current findings show that the predictions of the Fine Coarse Coding Theory may not extend to inferential information at an earlier time point. Since there is no time course component to the Fine Coarse Coding Theory (Atchley et al., 1999), and little research has specifically tested the predictions of the Fine Coarse Coding Theory at short SOAs, the current research provides new insight about the time course of semantic activation proposed by the Fine Coarse Coding Theory. In addition, the current findings show that a relatively longer SOA is needed to achieve the hemispheric pattern of inference processing predicted by the Fine Coarse Coding Theory.

Fourth, the finding that reading goals influence the processing of strongly and weakly constrained predictive inferences at a long SOA, but show less evidence of influencing processing of strongly and weakly constrained predictive inferences at a short SOA support theoretical frameworks such as the Minimalist Hypothesis (McKoon & Ratcliff, 1992) and the Constructionist Theory (Graesser et al., 1994). Specifically, these theoretical frameworks suggest that predictive inference generation is an elaborative process that requires time to develop (Calvo & Castillo, 1998; Calvo et al., 1999). It is possible that at a long SOA, when participants were given a reading goal, they elaborated on the text more and activated inferences while reading both strongly and weakly constrained texts to a greater degree than when participants who were not given a reading goal. However, at a short SOA, participants who were given a reading goal may not have had enough time to elaborate on the text and did not show evidence of different levels of facilitation for predictive inferences compared to participants who were not given a reading goal. In sum, these findings suggest that readers may require additional time for reading goals to influence predictive inference generation.

Fifth, the findings from the current study provide additional information regarding the roles of the right and left hemisphere during language processing. Specifically, it was previously suggested that language processing occurred in the left hemisphere. However, more recent findings have demonstrated that the right hemisphere is uniquely involved in language processing during reading (e.g., Beeman, 1993; Burgess & Simpson, 1988; Chiarello & Richards, 1991), such as during inference generation (e.g., Beeman et al., 2000; Virtue & van den Broek, 2005; Virtue et al., 2006; Sundermeier et al., 2006). Although it is clear the right hemisphere is involved in inference processing, it is not clear what specific role the right hemisphere has in processing text. An explanation for the role of the right hemisphere in language processing is the Spillover Hypothesis. This hypothesis suggests that when a language task becomes too cognitively demanding for the left hemisphere to successfully process a text, right hemisphere regions are recruited to complete the task (Just et al., 1996). For example, in one fMRI study, increased right hemisphere activation occurred when the sentence the participant was asked to read was more complex, which created a more difficult text processing condition, than when it was less complex (Just et al., 1996). However, the current findings suggest that the right hemisphere is also involved in language processing during less difficult tasks. Specifically, if difficulty was driving right hemisphere involvement in language processing, then it would be reasonable to expect the right hemisphere to have shown facilitation for weakly constrained predictive inferences only, which should have been more difficult to process than strongly constrained predictive inferences. However, the current findings show right hemisphere involvement with both strongly and weakly constrained predictive inferences. Thus, the current findings suggest that the right hemisphere is not only involved in processing text when the task is difficult.

Another explanation for the role of the right hemisphere in language processing is that the right hemisphere may be involved in processing specific inferences, such as predictive inferences (Beeman et al., 2000). However, other findings show that both hemispheres are involved in predictive inference processing, but that different factors that influence predictive inference processing, such as textual constraint, are processed differently in the right and left hemispheres (Virtue et al., 2006). The current findings demonstrate that additional factors, such as reading goals, also influence predictive inference processing differently in the hemispheres. Specifically, giving participants a reading goal increased the level of facilitation observed for predictive inferences compared to when participants were not given a reading goal. In addition, the current findings show that reading goals interacted with textual constraint to influence predictive inference processing in the hemispheres. Specifically, giving participants a specific reading goal led to increased facilitation in the left hemisphere for weakly constrained predictive inferences, whereas giving participants a specific reading goal led to increased facilitation in the right hemisphere for strongly constrained predictive inferences. Thus, the current findings support previous suggestions that different factors influence processing differently in the right and left hemispheres.

Finally, the finding that reading goals can influence predictive inference generation suggests that adopting reading goals may improve a reader's predictive inference generation during reading. Importantly, the ability to generate predictive inferences has been linked to improved reading comprehension (Magliano et al., 1994). Thus, educators may consider giving students specific instructions prior to reading a text. Research has shown that giving grade school aged children specific reading goals can influence the generation of bridging inferences during reading

(Casteel, 1993). Specifically, third and fifth grade students who were told they would be answering questions about the passages after reading (i.e., were given a specific reading goal), showed more evidence of inference generation than third and fifth grade students who were not given a specific reason for reading (Casteel, 1993). In addition, third and fifth grade students who were given a reading goal also showed improved text recall over third and fifth grade students who were not given a specific reading goal (Casteel, 1993). Finally, third and fifth grade students who were given a reading goal showed slower reading times than third and fifth grade students who were not given a reading goal. Interestingly, adults did not show this same difference in reading times across goal conditions. Thus, reading goals may be a particularly helpful tool in improving text comprehension in children.

Chapter V

Summary

During reading, individuals activate information that is not explicitly stated to make connections (i.e., inferences) about what is occurring in a text. Readers often make connections between events in a text and their background knowledge by generating expectations about what will occur next (i.e., generating a predictive inference). Although predictive inferences have been shown to improve text comprehension (Magliano et al., 1994), it is currently unclear whether readers routinely generate predictive inferences during reading. Multiple factors have been shown to influence predictive inference generation (e.g., Murray & Burke, 2003; Linderholm, 2002). For example, characteristics of the text (such as the level of textual constraint) and characteristics of the reader (such as an individual's goal during reading) influence how readers process predictive inferences. Specifically, readers generate more predictive inferences when a text is strongly constrained (Virtue, van den Broek, & Linderholm, 2006) and when readers have a study goal prior to reading (Linderholm & van den Broek, 2002). In addition, the amount of time (i.e., the synchronized onset asymmetry, or SOA) a reader is given to generate a predictive inference can influence how predictive inferences are processed (Till, Mross, & Kintsch, 1988). Specifically, some research does not find evidence of predictive inferences unless readers are given approximately 1000 ms to generate an inference (Calvo & Castillo, 1996), whereas other research shows evidence of predictive inference generation after only 500 ms (Klin, Murray, Guzman, & Levine, 1999). Thus, conflicting findings exist regarding the generation of predictive inferences.

To further examine predictive inference generation, researchers can use a cognitive neuroscience approach to gain a better understanding of how predictive inferences are processed in the cerebral hemispheres. Thus, the current study used a divided visual field paradigm to investigate how reading goals, textual constraint, and SOA influence predictive inference generation in the right and left hemisphere. Four experimental studies were conducted in which participants were presented texts that either strongly led to a specific outcome (i.e., were strongly constrained towards a specific predictive inference) or weakly led to a specific outcome (i.e., were weakly constrained towards a specific predictive inference).

Participants then made lexical decisions to related target words that were presented to either the right visual field-left hemisphere or the left visual field-right hemisphere. In Experiment 1 and Experiment 2, participants were given an SOA of 500 ms to generate the predictive inference to examine an early time point during inference generation. In Experiment 3 and 4, participants were given an SOA of 1000 ms to generate the predictive inference to examine a later time point during inference generation. Additionally, participants in Experiment 2 and Experiment 4 were instructed to read as if they were preparing for an upcoming exam (i.e., they were given a study goal).

Findings showed that reading goals influenced predictive inference generation in the right and left hemisphere at a long SOA, but not at a short SOA. Specifically, when readers were given a reading goal, strongly and weakly constrained predictive inferences were processed similarly in the left hemisphere at a long SOA, whereas strongly constrained predictive inferences showed greater facilitation than weakly constrained predictive inferences in the right hemisphere. In contrast, when readers were not given a specific reading goal, strongly constrained predictive inferences showed a processing advantage in the left hemisphere, whereas strongly and weakly constrained predictive inferences were processed similarly in the right hemisphere at a long SOA. These findings suggest that reading goals differently influence how predictive inferences are processed in the hemispheres during reading. In addition, findings showed that overall, strongly constrained predictive inferences had a processing advantage over weakly constrained predictive inferences. These findings are consistent with existing theoretical frameworks.

References

Aberthey, M. & Coney, J. (1993). Associative priming in the hemispheres as a function of SOA. *Neuropsychologia, 31(12)*, 1397-1409.

Allbritton, D. (2004). Strategic production of predictive inferences during reading. *Discourse Processes, 38(3),* 309-322.

Antos, S. J. (1979). Processing facilitation in a lexical decision task. *Journal of Experimental Psychology: Human Perception and Performance. 5(3),* 527-545.

Atchley, R.A., Burgess, C., & Keeney, M. (1999). The Effect of time course and context on the facilitation of semantic features in the cerebral hemispheres. *Neuropsychology, 13(3),* 389-403.

Beeman, M. (1993). Semantic processing in the right hemisphere may contribute to drawing inferences from discourse. *Brain and Language, 44,* 80-120.

Beeman, M, Friedman, R.B., Grafman, J., Perez, E., Diamond, S., & Lindsay, M.B. (1994). Summation priming and coarse semantic coding in the right hemisphere. *Journal of Cognitive Neuroscience, 6,* 26-45.

Beeman, M.J., & Chiarello, C. (1998). Complementary right- and left-hemisphere language comprehension. *Current Directions in Psychological Science, 7(1)*, 2-8.

Beeman, M.J., Bowden, E.M., & Gernsbacher, M.A. (2000). Right and left hemisphere cooperation for drawing predictive and coherence inferences during normal story comprehension. *Brain and Language, 77,* 310-336.

Binder, K.S., Chace, K.H., & Manning, M.C., (2007). Sentential and discourse context effects: Adults who are learning to read compared to skilled readers. *Journal of Research in Reading, 30(4),* 360-378.

Blake, M.L., & Lesniewicz, K.S. (2005). Contextual bias and predictive inferencing in adults with and without right hemisphere brain damage. *Aphasiology, 19(3-5),* 423-434.

Bouaffre, S., & Faita-Ainseba, F. (2007). Hemispheric differences in the time course of semantic priming processing: Evidence from event related potentials (ERPS). *Brain and Cognition, 63(2),* 123-135.

Bourne, V. (2006). The divided visual field paradigm: Methodological considerations. *Laterality, 11(4),* 373-393.

Burgess, C., & Simpson, G.B. (1985). Activation and selection processes in the recognition of ambiguous words. *Journal of Experimental Psychology: Human Perception and Performance, 11(1),* 28-31.

Burgess, C., & Simpson, G.B. (1988). Cerebral hemispheric mechanisms in the retrieval of ambiguous word meanings. *Brain and Language, 33,* 86-103.

Calvo, M.G., & Castillo, M.D. (1996). Predictive inferences occur online, but with delay: Converging evidence from naming and reading times. *Discourse Processes, 22,* 57-78.

Calvo, M.G., & Castillo, M.D. (1998). Predictive inferences take time to develop. *Psychological Research, 61*, 241-260.

Calvo, M.G., Castillo, M.D., & Estevez, A. (1999). On-line predictive inferences in reading: Processing time *during* vs. *after* the priming context. *Memory and Cognition, 27(5),* 834-843.

Calvo, M.G. (2000). The time course of predictive inferences depends on contextual constraints. *Language and Cognitive Processes, 15(3),* 293-319.

Calvo, M.G., & Castillo, M.D., (2001). Bias in predictive inferences during reading. *Discourse Processes, 32(1),* 43-71.

Calvo, M.G., Meseguer, E., & Carreiras, M. (2001). Inferences about predictable events: Eye movements during reading. *Psychological Research, 65(3),* 158-169.

Calvo, M.G., Estevez, A., & Dowens, M.G., (2003). Time course of elaborative inferences as a function of prior vocabulary knowledge. *Learning and Instruction, 13(6),* 611-631.

Calvo, M.G., Castillo, M.D., & Schmalhofer, F. (2006). Strategic influence on the time course of predictive inferences in reading. *Memory and Cognition, 34(1),* 68-77.

Casteel, M. (1993). Effects of inference necessity and reading goal on children's inferential generation. *Developmental Psychology, 29(2),* 346-357.

Chiarello, C., Liu, S., Shears, C., Quan, N., Kacinik, N. (2003). Priming of strong semantic relations in the left and right visual fields: A time course investigation. *Neuropsycholgia, 41,* 721-732.

Cook, A.E., Limber, J.E., & O'Brien, E.J. (2001). Situation-based context and the availability of predictive inferences. *Journal of Memory and Language, 44*, 220-234.

Estevez, A., & Calvo, M.G., (2000). Working memory capacity and time course of predictive inferences. *Memory, 8(1),* 51-61.

Faust, M., & Lavidor, M. (2003). Semantically convergent and semantically divergent priming in the cerebral hemispheres: Lexical decision and semantic judgment. *Cognitive Brain Research, 17,* 585-597.

Faust, M., Bar-lev, A., & Chiarello, C. (2003). Sentence priming effects in the two cerebral hemispheres: Influences of lexical relatedness, word order, and sentence anomaly. *Neuropsychologia, 44,* 721-732.

Faust, M., Barack, O., & Chiarello, C. (2006). The effect of multiple script priming on word recognition by the two cerebral hemispheres: Implications for discourse processing. *Brain and Language, 97,* 12-24.

Federmeier, K.D., & Kutas, M. (1999). Right words and left words: Electrophysiological evidence for hemispheric differences in meaning processing. *Journal of Memory and Language, 41,* 469-495.

Federmeier, K.D., & Kutas, M. (2002). Picture the difference: Electrophysiological investigations of picture processing in the cerebral hemispheres. *Neuropsychologia, 40,* 730-747.

Federmeier, K.D. (2007). Thinking ahead: The roles and roots of prediction in language comprehension. *Psychophysiology, 44*, 491-505.

Fincher-Keifer, R. (1993). The role of predictive inferences in situation model construction. *Discourse Processes, 16(1),* 99-124.

Fincher-Kiefer, R. (1995). Relative inhibition following the encoding of bridging and predictive inferences. *Journal of Experimental Psychology: Learning, Memory, and Cognition. 21(4),* 981-995.

Fincher-Kiefer, R. (1996). Encoding differences between bridging and predictive inferences. *Discourse Processes, 22,* 225-246.

Graesser, A.C, Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101(3),* 371-395.

Just, M.A., Carpenter, P.A., Keller, T.A., Eddy, W.F., & Thulborn, K.R., (1996). Brain activation modulated by sentence comprehension. *Science, 274 (5284)*, 114-116.

Keefe, D.E. & McDaniel, M.A. (1993). The time course and durability of predictive inferences. *Journal of Memory and Language, 32,* 446-463.

Kintsch, W., & van Dijk, T.A. (1978). Toward a model of text comprehension. *Psychological Review, 85*, 363-394.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model, *Psychological Review, 95*, 163-182.

Klin, C. M., Guzman, A. E., & Levine, W. H. (1999). Prevalence and persistence of predictive inferences. *Journal of Memory and Language. 40,* 593-604.

Klin, C.M., Murray, J.D., Levine, W.H., & Guzman, A.E. (1999). Forward inferences: From activation to long term memory. *Discourse Processes, 27(3),* 241-260.

Koivisto, M. (1997). Time course of semantic activation in the cerebral hemispheres. *Neuropsychologia, 35(4),* 497-504.

Kornses, M.S., & Magnussen, S., (2007). Automatic semantic priming in the left and right hemispheres. *Scandinavian Journal of Psychology, 48*, 197-202.

Lehman Blake, M., & Tompkins, C. (2001). Predictive inferencing in adults with right hemisphere brain damage. *Journal of Speech, Language, and Hearing Research, 44,* 639-354.

Linderholm, T. (2002). Predictive inference generation as a function of working memory capacity and causal text constraints. *Discourse Processes, 34,* 259-280.

Linderholm, T., & van den Broek, P. (2002). The effect of reading purpose and working memory capacity on the processing of expository text. *Journal of Educational Psychology, 94(4)*, 778-784.

Linderholm, T., Cong, X., & Zhao, Q. (2008). Differences in low and high working memory capacity readers cognitive and metacognitive processing patterns as a function of reading for different purposes. *Reading Psychology, 29*, 61-85.

Livesay, K., & Burgess, C. (2003). Mediated priming in the cerebral hemispheres. *Brain and Cognition, 53,* 283-286.

Long, D.L., Oppy, B.J., & Seely, M.R. (1994). Individual differences in the time course of inferential processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 1456-1470.

Lorch, R.F., Lorch, E.P., & Klusewitz, M.A. (1993). College students' conditional knowledge about reading. *Journal of Educational Psychology, 85(2),* 239-252.

Magliano, J.P., Baggett, W.B., Johnson, B.K., & Graesser, A.C. (1993). The time course of generating causal antecedent and causal consequence inferences. *Discourse Processes, 16,* 35-53.

Magliano, J. P., Trabasso, T, & Graesser, A. C. (1999). Strategic processing during comprehension. *Journal of Educational Psychology. 91.* 615-629.

Mason, R.A., & Just, M.A. (2004). How the brain processes causal inferences in a text:; A theoretical account of inference generation and integration component processes utilizing both cerebral hemispheres. *Psychological Science, 15,* 1-7.

McDaniel, M. A., Schmalhofer, F., & Keefe, D. E. (2001). What is minimal about predictive inferences? *Psychonomic Bulletin & Review. 8,* 840-846.

McKoon, G., & Ratcliff, R., (1980).Priming in item recognition: The organization of propositions in memory for text. *Journal of Verbal Learning and Verbal Behavior, 19.* 369-386.

McKoon, G., & Ratcliff, R. (1986). Inferences about predictable events. *Journal of Experimental Psychology: Learning. Memory, and Cognition*, *12,* 82-91.

McKoon, G., & Ratcliff, R. (1992). Inference during reading. *Psychological Review, 99,* 440-466.

Motyka Joss, L., & Virtue S., (unpublished). The influence of textual constraint and reading goals on predictive inference generation in the cerebral hemispheres.

Murray, J. D., Klin, C. M., & Myers, J. L. (1993). Forward inferences in narrative text. *Journal of Memory and Language. 32.* 464-473.

Murray, J.D., & Burke, K.A. (2003). Activation and encoding of predictive inferences: The role of reading skill. *Discourse Processes, 35(2),* 81-102.

Narvaez, D., van den Broek, P., & Ruiz, A. B. (1999). The influence of reading purpose on inference generation and comprehension in reading. *Journal of Educational Psychology. 91.* 488-496.

Peracchi, K.A., & O'Brien, E.J. (2004). Character profiles and the activation of predictive inferences. *Memory and Cognition, 32,* 1044-1052.

Potts, G. R., Keenan, J. M., & Golding, J. M. (1988). Assessing the occurrence of elaborative inference: Lexical decision versus naming. *Journal of Memory and Language. 27.* 399-415.

Rapp, D.N., & Kendeou, P. (2007). Revising what readers know: Updating text representations during narrative comprehension. *Memory and Cognition, 35(8)*, 2019-2032.

Richards, L., & Chiarello, C., (1995). Depth of associated activation in the cerebral hemispheres: mediated vs. direct priming. *Neuropsycholgia, 33(2)*, 171-179.

Schmalhofer, F., & Glavanov, D. (1986). Three components of understanding a programmer's manual: Verbatim, propositional, and situational representations. *Journal of Memory and Language, 25*, 279-294.

Simpson, G.B., & Burgess, C. (1985). Activation and selection processes in the recognition of ambiguous words. *Journal of Experimental Psychology: Human Perception and Performance, 11*, 28-39.

Singer, M., Graesser, A. C, & Trabasso, T. (1994). Minimal or global inference during reading. *Journal of Memory & Language*, *33*, 421-441.

Suh, S. Y., & Trabasso, T. (1993). Inferences during reading: Converging evidence from discourse analysis, talk-aloud protocols, and recognition priming. *Journal of Memory and Language, 32*, 279-300.

Sundermeier, B., Virtue, S., Masolek, C., & van den Broek, P. (2005). Evidence for dissociable neural mechanisms underlying inference generation in familiar and less-familiar scenarios. *Brain and Language, 95(3)*, 402-413.

Till,R.E., Mross, E.F., & Kintch, W. (1988). Time course of priming for associate and inference words in a discourse context. *Memory and Cognition, 16(4),* 283-298.

Trabasso, T., & Magliano, J.P. (1996). Conscious understanding during comprehension. *Discourse Processes, 21*, 255-287.

Valencia-Laver, D.L., & Light, L.L. (2000). The occurrence of bridging and predictive inferences in younger and older adults. *Discourse Processes, 30*, 27-56.

van den Broek, P., Lorch, R. E, Jr., Linderholm, T, & Gustafson, M. (2001). The effects of readers' goals on inference generation and memory for texts. *Memory & Cognition*, *29,* 1081-1087.

Virtue, S., & van den Broek, P. (2005). Hemispheric processing of anaphoric inferences: The activation of multiple antecedents. *Brain and Language, 93(3),*327-337.

Virtue, S., van den Broek, P., & Linderholm, T. (2006). Hemispheric processing of inferences: The influence of textual constraint and working memory capacity. *Memory and Cognition, 34(6)*, 1341-1354.

Virtue, S., Haberman, J., Clancy, Z., Parrish, T., & Beeman, M.J. (2006). Neural activity of inferences during story comprehension. *Brain Research, 1084,* 104-114.

Virtue, S., Parrish, T., & Jung-Beeman, M. (2008). Inferences during reading: Cortical recruitment affected by predictability of events and working memory capacity. *Journal of Cognitive Neuroscience*, *20,* 2274-2284.

Waring, D.A., & Kluttz, C.L. (1998). Effects of task on the activation of predictive inferences. *Psychological Reports, 83,* 1287-1296.

Weingartner, K. M., Guzman, A. E., Levine, W. H., & Klin, C. M. (2003). When throwing a vase has multiple consequences: Minimal encoding of predictive inferences. *Discourse Processes*, *36,* 131-146.

Whitney, P., Ritchie, B., & Crane, R. S. (1992). The effect of foregrounding on readers' use of predictive inferences. *Memory & Cognition*, *20,* 424-432.

Yochim, B., Kender, R., Abeare, C., Gufstason, A., & Whitman, D. (2005). Semantic activation within and across the hemispheres: What's left isn't right. *Laterality, 10,* 131-148.

Zipin, L.M., Tompkins, C.A., & Kasper, S.C. (2000). Effects of foregrounding on predictive inferences by normally aging adults. *Aphasiology, 14(2),* 115-131.

Zwaan, R. (1994). The effect of genre expectations on text comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 920-933.

APPENDIX 1: ACCURACY ANALYSES AND RESPONSE TIME ANALYSES

Experiment 1

Accuracy Effects

A repeated measures ANOVA was conducted on the accuracy of participants' responses in the lexical decision task. The independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and level of textual constraint (strongly constrained, weakly constrained, or neutral). Similar to the facilitation analyses, the by-participant variables of gender, hand used to respond, and counterbalancing condition were included in the analyses. Since no significant effects of gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. The mean accuracy for strongly constrained, weakly constrained, and neutral targets are presented in Table 2.

There was no main effect of visual field-hemisphere, F_1 (1,90)= .20, p =.66, F_2(1,47)= 2.61, p= .18. A main effect of textual constraint was found, F_1 (2,180)= 4.05, $p < .05$, F_2(2,94)= 2.61, p= .07. To further examine this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples t tests indicate that strongly constrained targets (M=0.94, SE=0.01) were responded to more accurately than neutral targets (M=0.91, SE=0.01), t_1(181)= 3.19, $p < .05$, t_2(95)=2.52, $p < .05$. Strongly constrained targets were not responded to more accurately than weakly constrained targets (M=0.92, SE=0.01), t_1(181)= 1.33, p =

.19, $t_2(95)$==1.41, p =.08. In addition, weakly constrained targets were not responded to more accurately than neutral targets, $t_1(181)$= 1.60, p = .11, $t_2(95)$==1.52, p =.07. Finally, there was no interaction between visual field-hemisphere and textual constraint, F_1 (2, 180)= 0.42, p =.66, $F_2(2,94)$= 0.15, p= .86.

Follow up paired samples t tests were conducted to more thoroughly investigate accuracy differences in the hemispheres (see figure 9). In the left hemisphere, strongly constrained targets were not responded to more accurately than weakly constrained targets, $t_1(91)$= 0.44, p = .66, $t_2(47)$==0.19, p =.42, and neutral targets, $t_1(90)$= 1.45, p = .15**,** $t_2(47)$==1.26, p =.11. In addition, weakly constrained targets did not differ in accuracy from neutral targets, $t_1(90)$= 1.10, p = .27, $t_2(47)$==1.15, p =.13. In the right hemisphere, strongly constrained targets were responded to more accurately than weakly constrained targets, $t_1(90)$= 1.76, $p < .05$, $t_2(95)$==1.21, p =.12, and was responded to more accurately than neutral targets, $t_1(90)$= 3.54, $p < .05$, $t_2(47)$==2.40, $p < .05$. Weakly constrained targets were not responded to more accurately than neutral targets, $t_1(90)$= 1.14, p = .12, $t_2(47)$==0.99, p =.15.

Across the hemispheres, strongly constrained targets were not responded to more accurately in the left hemisphere compared to the right hemisphere, $t_1(90)$= 0.10, p =.46, $t_2(47)$==-0.39, p =0.35. In addition, weakly constrained targets were not responded to more accurately in the left hemisphere compared to the right hemisphere, $t_1(90)$= -0.80, p =.21, $t_2(47)$==-1.42, p =0.08. Finally, neutral targets were not responded to more accurately in the left hemisphere compared to the right hemisphere, $t_1(90)= -0.92$, $p =.19$, $t_2(47)==1.15$, $p =0.13$.

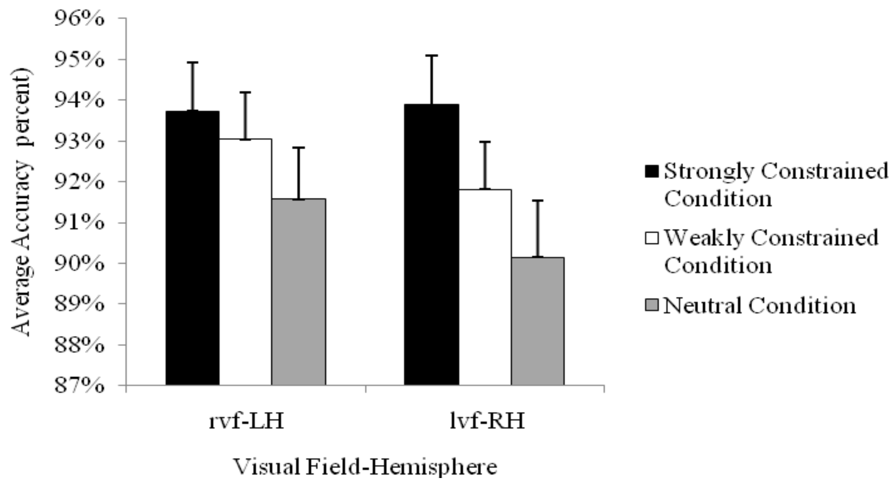


Figure 14. Mean accuracy for strongly constrained, weakly constrained, and neutral targets in Experiment 1.

<u>Response Time Analyses</u>

To examine response time differences between the experimental conditions, a repeated measures ANOVA was conducted on the response times to the target words. The independent variables were textual constraint (strongly constrained, weakly constrained, and neutral) and visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere). There was no main effect of visual field-hemisphere, F_1 (1,90)= 0.262, $p =.61$, $F_2(1,47)= 0.65$, $p= .42$. There was a main effect of constraint, F_1 (2, 180)= 24.26, $p < .05$, $F_2(2,94)= 13.47$, $p < .05$. To further test this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples *t* tests indicate that strongly constrained targets (M = 449.88, SE= 10.82) were responded to more quickly than weakly constrained targets (M = 471.57, SE= 10.91), $t_1(181)= -2.81$, $p < .05$, $t_2(95)=-3.03$, $p < .05$, and was responded to more quickly than neutral targets (M =504.27, SE= 11.37), $t_1(181)= -7.36$, $p < .05$, $t_2(95)=-5.81$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(181)= -4.75$, $p < .05$, $t_2(95)=-2.99$, $p < .05$.

In addition, there was no significant interaction between visual field-hemisphere and textual constraint, F_1 (2, 180)= 2.40, p =.10, $F_2(2,94)= 1.28$, p =.28. Despite the lack of a significant interaction between visual field-hemisphere and textual constraint, follow up paired samples t tests were conducted to more thoroughly investigate response time differences in the hemispheres. Paired sample t tests showed that in the left hemisphere, strongly constrained targets were responded to faster than weakly constrained targets, $t_1(90)= -3.62$, $p < .05$, $t_2(47)=-2.73$, $p < .05$, and neutral targets, $t_1(90)= -6.17$, $p < .05$, $t_2(47)=--3.82$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(90)= -2.81$, $p < .05$, $t_2(47)=-1.36$, p =.18 (see figure 10). In the right hemisphere, strongly constrained targets were not responded to faster than weakly constrained targets, $t_1(90)= -0.62$, p =.54, $t_2(47)=-0.73$, p =.47. Strongly constrained targets were responded to faster than neutral targets, $t_1(90)= -4.25$, $p < .05$, $t_2(47)=-3.95$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(90)= -4.01$, $p < .05$, $t_2(47)=-3.21$, $p < .05$ (see figure 10). Across the hemispheres, response times did not significantly differ for strongly constrained targets, $t_1(90)= -1.64$, p =.10, $t_2(47)=-1.29$, p =.21, weakly constrained targets, $t_1(90)= -0.59$, p =.55, $t_2(47)= -0.56$, p =.59, or neutral targets, $t_1(90)= -078$, p =.71, $t_2(47)=1.09$, p =.21.

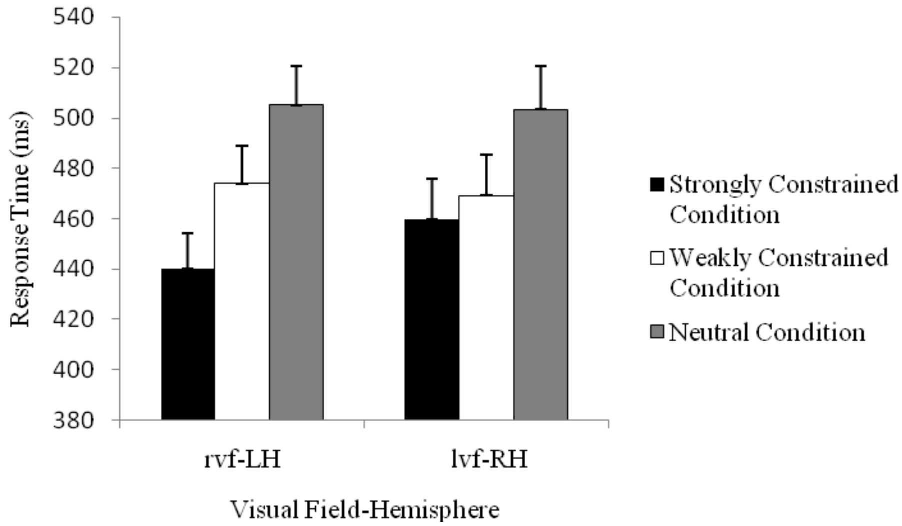


Figure 15. Mean response times for strongly constrained, weakly constrained, and neutral items for Experiment 1.

Experiment 2

Accuracy Effects

A repeated measures ANOVA was conducted on participants' lexical decision response accuracy. The independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and level of textual constraint (strongly constrained, weakly constrained, or neutral). Similar to the facilitation analyses, the by-participant variables of gender, hand used to respond, and counterbalancing condition were included in the analyses. Since no significant effects of gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. The mean accuracy for strongly constrained, weakly constrained, and neutral targets are presented in Table 3.

There was no main effect of visual field-hemisphere, F_1 (1,87)= .05, p =.82, F_2(1,47)= 0.20, p= .66. A main effect of textual constraint was found, F_1 (2,174)= 7.91, $p < .05$, F_2(2,94)= 5.55, $p < .05$. To further test this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples t tests indicate that strongly constrained targets (*M*=0.95, *SE*=.01) were responded to more accurately than weakly constrained targets (*M*=0.93, *SE*=.010), t_1 (87)=3.65 $p < .05$, t_2(47)= 2.56, $p < .05$, and neutral targets (*M*=0.91, *SE*=.012), t_1 (87)=3.99 $p < .05$, t_2(47)= 3.70, $p < .05$. Weakly constrained targets were not responded to more accurately than neutral targets, t_1 (87)=1.32 p = .09, t_2(47)= 1.26, p =.21. In addition, there was no significant interaction between visual field-hemisphere and constraint, F_1 (2,174)= 1.30, p =.28, F_2(2, 94)= 1.58, p= .21.

Follow up paired samples *t* tests were conducted to more thoroughly investigate accuracy differences in the hemispheres (see figure 11). In the left hemisphere, strongly constrained targets were responded to more accurately than weakly constrained targets, t_1 (87)=3.95, $p < .05$, t_2(47)= 2.33, $p < .05$, and more accurately than neutral targets, t_1 (87)=1.92, p =.06, t_2(47)= 2.33, $p < .05$**.** Weakly constrained targets were not responded to more accurately than neutral targets, t_1 (87)=0.03, p =.97, t_2(47)= -0.19, p =.85. In the right hemisphere, strongly constrained targets were not responded to more accurately than weakly constrained targets, t_1 (87)=1.58, p =.12, t_2(47)= 1.23, p =.22. Strongly constrained targets were responded to more accurately than neutral targets, t_1 (87)=2.89, $p < .05$, t_2(47)= 3.13, $p < .05$. Weakly constrained targets were not responded to more accurately than neutral targets, t_1 (87)=1.84, p =.07, t_2(47)= 1.88, p =.07. Across the hemispheres, there were no accuracy differences for strongly constrained targets, t_1 (87)=-0.05, p =.96, t_2(47)= 0.31, p =.76, weakly constrained targets, t_1 (87)=1.22, p <=.23, t_2(47)= 1.41, p =.17, or neutral targets, t_1 (87)=2-0.75, p = .46, t_2(47)= -1.05, p =.30.

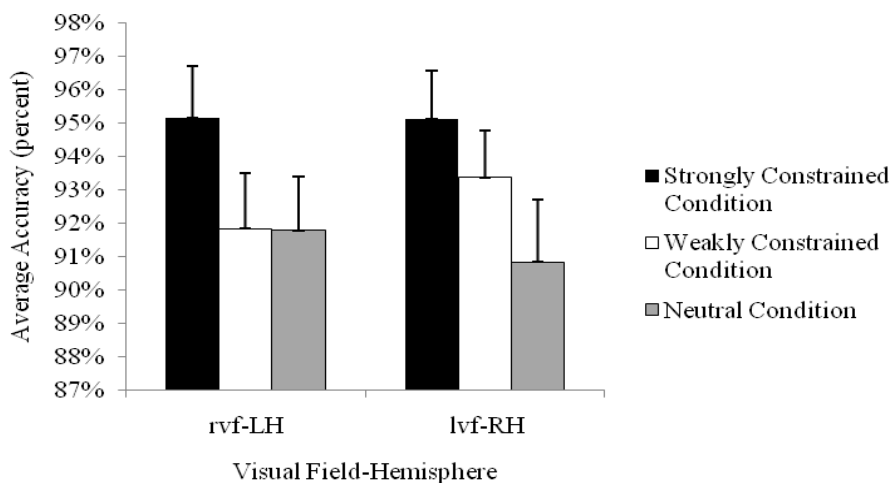


Figure 16. Mean accuracy for strongly constrained, weakly constrained, and neutral targets in Experiment 2

<u>Response Time Analyses</u>

To examine response time differences between the experimental conditions, a repeated measures ANOVA was conducted on the response times to the target words in the lexical decision task. The independent variables were textual constraint (strongly constrained, weakly constrained, and neutral) and visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere). There was no main effect of visual field-hemisphere, F_1 (1,87)= 0.22, p =.64, F_2(1,47)= 0.23, p= .63. There was a main effect of constraint, F_1 (2, 180)= 32.34, p < .05, F_2(2,94)= 13.78, p < .05. To further test this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples t tests indicate that strongly constrained targets (*M*=442.14, *SE*=11.05) were responded to more quickly than weakly constrained targets (*M*=470.11, *SE*=11.41), t_1(175)= -4.44, p < .05, t_2(95)=-3.47, p < .05, and neutral targets (*M*=494.11, *SE*=10.36), t_1(175)= -8.56, p < .05, t_2(95)=-5.89, p < .05. In addition, weakly constrained targets were responded to faster than neutral targets, t_1(175)= -3.36, p < .05, t_2(95)=-2.54, p < .05.

In addition, there was no significant interaction between visual field-hemisphere and textual constraint, F_1 (2, 174)= 1.87, p =.16, F_2(2,94)= 1.11, p =.34. Follow up paired samples t tests were conducted to more thoroughly investigate response time differences in the hemispheres (see figure 13). Paired sample t tests showed that in the left hemisphere, strongly constrained targets were responded to faster than weakly constrained targets, t_1(87)= -3.81, p < .05, t_2(47)=--2.66, p < .05, and neutral targets, t_1(87)= -7.44, p < .05, t_2(47)= -4.92, p < .05. In addition, weakly constrained targets were responded to faster than neutral targets, t_1(87)= -2.86, p < .05, t_2(47)= -1.98, p =.11 (see figure 9). In the right hemisphere, strongly constrained targets were responded to faster than weakly constrained targets, t_1(87)= -2.43, p < .05, t_2(47)= -2.21, p < .05, and neutral targets, $t_1(87)= -4.72$, $p < .05$, $t_2(47)=--3.40$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(87)= -1.87$, $p < .05$, $t_2(47)= -1.59$, $p =.11$ (see figure 9). Across the hemispheres, response times did not significantly differ for strongly constrained targets, $t_1(87)= -1.58$, $p =.11$, $t_2(47)= 1.32$, $p =.19$, weakly constrained targets, $t_1(87)= 0.25$, $p =.55$, $t_2(47)= 0.34$, $p =.59$, or neutral targets, $t_1(87)= -.77$, $p =.44$, $t_2(47)=-.68$, $p =.50$.

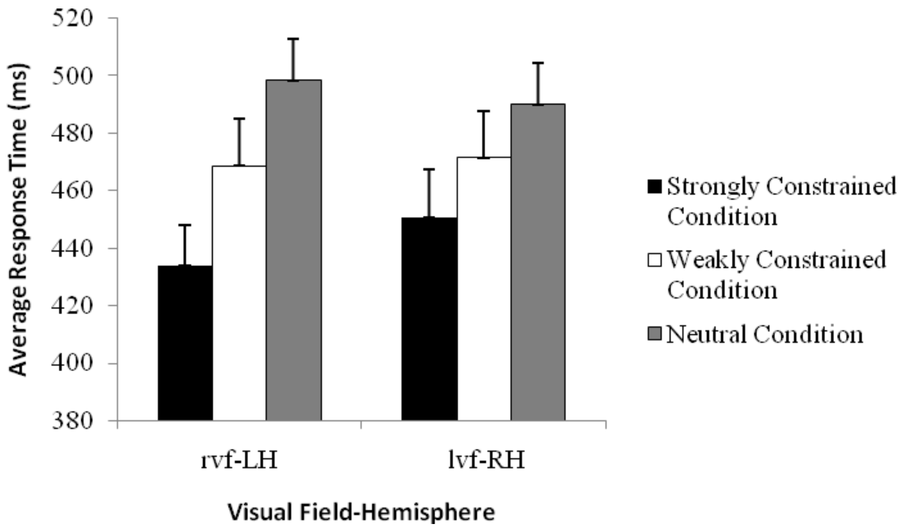


Figure 17. Mean response times for strongly constrained, weakly constrained, and neutral items for Experiment 2.

<u>Experiment 3</u>

<u>Accuracy Effects</u>

A repeated measures ANOVA was conducted on participants' lexical decision response accuracy. The independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and level of textual constraint (strongly constrained, weakly constrained, or neutral). Similar to the facilitation analyses, the by-participant variables of gender, hand used to respond, and counterbalancing condition were included in the analyses. Since no significant effects of gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. The mean accuracy for strongly constrained, weakly constrained, and neutral targets are presented in Table 5.

There was no main effect of visual field-hemisphere, F_1 (1,84)= 1.82, p =.18, F_2(1,47)= 2.15, p= .12. There was no main effect of textual constraint was found, F_1 (2,168)= 2.83, p =.07, F_2(2,94)= 1.75, p= .24. Finally, there was no interaction between visual field-hemisphere and textual constraint, F_1 (2, 180)= 0.42, p =.66, F_2(2,94)= 0.15, p= .86. Since all main effects and interactions were not significant, follow up paired samples t tests were not performed, and no further accuracy analyses are reported.

<u>Response Time Analyses</u>

To examine response time differences between the experimental conditions, a repeated measures ANOVA was conducted on the response times to the target words in the lexical decision task. The independent variables were textual constraint (strongly constrained, weakly constrained, and neutral) and visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere). There was no main effect of visual field-hemisphere, F_1 (1,84)= 0.26, p =.61, F_2(1,47)= 1.56, p= .21. There was a main effect of constraint, F_1 (2, 168)= 19.18, $p < .05$, F_2(2,94)= 9.72, $p < .05$. To further test this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2

refers to analyses based on by-item variability. Follow up paired samples t tests indicate that strongly constrained targets were responded to more quickly than weakly constrained targets, $t_1(169)= -3.27$, $p < .05$, $t_2(95)=-2.16$, $p < .05$, and neutral targets, $t_1(169)= -6.29$, $p < .05$, $t_2(95)=-4.46$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(169)= -2.98$, $p < .05$, $t_2(95)=2.56$, $p < .05$.

In addition, there was no significant interaction between visual field-hemisphere and textual constraint, F_1 (2, 168)= 2.34, $p =.10$, $F_2(2,94)= 1.13$, $p =.33$. Follow up paired samples *t* tests were conducted to more thoroughly investigate response time differences in the hemispheres. Paired sample *t* tests showed that in the left hemisphere, strongly constrained targets were responded to faster than weakly constrained targets, $t_1(84)= -3.44$, $p < .05$, $t_2(47)=-2.54$, $p < .05$, and faster than neutral targets, $t_1(84)= -4.66$, $p < .05$, $t_2(47)=-3.39$, $p < .05$. In addition, weakly constrained targets were not responded to faster than neutral targets, $t_1(84)= -1.36$, $p = .17$, $t_2(47)=-1.21$, $p =.22$ (see figure 16). In the right hemisphere, strongly constrained targets were not responded to faster than weakly constrained targets, $t_1(84)= -0.75$, $p =.45$, $t_2(47)=-0.98$, $p =.33$. Strongly constrained targets were responded to faster than neutral targets, $t_1(84)= -4.31$, $p < .05$, $t_2(47)=-2.93$, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, $t_1(84)= -3.43$, $p < .05$, $t_2(47)=-1.88$, $p =.07$ (see figure 16). Across the hemispheres, response times did not significantly differ for strongly constrained targets, $t_1(84)= -0.90$, $p =.37$, $t_2(47)=.46$, $p =.65$, weakly constrained targets, $t_1(84)$= -1.61, p =.11, $t_2(47)$= -1.54, p =.13, or neutral targets, $t_1(84)$= -.48, p =.63, $t_2(47)$=-1.05, p =.30.

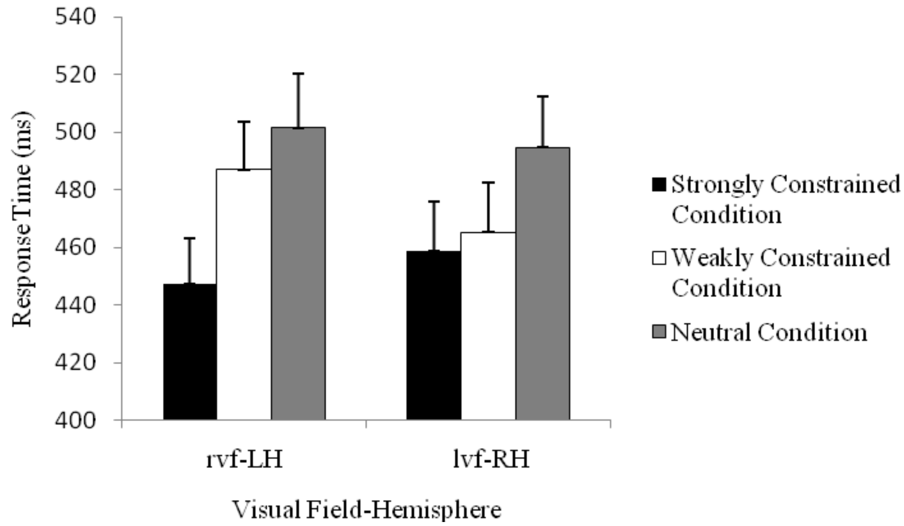


Figure 18. Average response times for strongly constrained, weakly constrained, and neutral items for Experiment 3.

Experiment 4

Accuracy Effects

A repeated measures ANOVA was conducted on participants' lexical decision accuracy. The independent variables were visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere) and level of textual constraint (strongly constrained, weakly constrained, or neutral). Similar to the facilitation analyses, the by-participant variables of gender, hand used to respond, and counterbalancing condition were included in the analyses. Since no significant effects of gender, hand used to respond, or counterbalancing condition were found, no further analyses regarding these variables are reported. The mean accuracy for strongly constrained, weakly constrained, and neutral targets are presented in Table 4. There was no main effect of visual field-hemisphere, F_1 (1,86)= .81, p =.37, F_2(1,47)= .04, p= .84. Additionally, there was no main effect of textual constraint, F_1 (2,172)= .81, p =.37, F_2(2, 95)= .04, p= .84. Finally, there was no significant interaction between visual field-hemisphere and textual constraint, F_1 (2, 172)= 2.71, p =.07, F_2(2,95)= .93, p= .39. Because there were no significant findings for participant's accuracy rates in Experiment 4, no further accuracy analyses were conducted.

Response Time Analyses

To examine response time differences between the experimental conditions, a repeated measures ANOVA was conducted on response times to the target words. The independent variables were textual constraint (strongly constrained, weakly constrained, and neutral) and visual field-hemisphere (right visual field-left hemisphere or left visual field-right hemisphere). There was no main effect of visual field-hemisphere, F_1 (1,86)= 0.18, p =.67, F_2(1,47)= 1.51, p= .22. There was a main effect of constraint, F_1 (2, 172)= 38.10, $p < .05$, F_2(2,94)= 18.55, $p < .05$. To further test this main effect, follow up paired samples t tests were conducted on the facilitation effects. In these analyses, t_1 refers to analyses based on by-participant variability, and t_2 refers to analyses based on by-item variability. Follow up paired samples t tests indicate that strongly constrained targets were responded to more quickly than weakly constrained targets, t_1(173)= -3.25, $p < .05$, t_2(95)=-2.23, $p < .05$, and neutral targets, t_1(173)= -8.87, $p < .05$, t_2(95)=-5.56, $p < .05$. In addition, weakly constrained targets were responded to faster than neutral targets, t_1(171)= -4.67, $p < .05$, t_2(95)=-2.10, $p < .05$.

In addition, there was no significant interaction between visual field-hemisphere and textual constraint, F_1 (2, 172)= 2.02, p =.14, F_2(2,94)= 0.45, p =.63. Despite the lack of a significant interaction between visual field-hemisphere and textual constraint, follow up paired samples t tests were conducted to more thoroughly investigate response time differences in the hemispheres (see figure 18). Paired sample t tests showed that in the left hemisphere, strongly constrained targets were not responded to faster than weakly constrained targets, t_1(86)= -1.05, p= .29, t_2(47)=-1.19, p = .23. Strongly constrained targets were responded to faster than neutral targets, t_1(86)= -5.45, p < .05, t_2(47)=-4.59, p < .05. In addition, weakly constrained targets were responded to faster than neutral targets, t_1(86)= -4.13, p < .05, t_2(47)=-3.27, p < .05 (see figure 18). In the right hemisphere, strongly constrained targets were responded to faster than weakly constrained targets, t_1(86)= -3.64, p < .05, t_2(47)=-3.06, p < .05, and neutral targets, t_1(86)= -7.56, p < .05, t_2(47)=-4.36, p < .05. In addition, weakly constrained targets were responded to faster than neutral targets, t_1(86)= -2.57, p < .05, t_2(47)=-2.19, p =.30 (see figure 18). Across the hemispheres, response times did not significantly differ for strongly constrained targets, t_1(86)= -.39, p =.69, t_2(47)=-.21, p =.83, weakly constrained targets, t_1(86)= 1.72, p =.09, t_2(47)= 1.37, p =.17, or neutral targets, t_1(86)= .41, p =.68, t_2(47)=.60, p =.55.

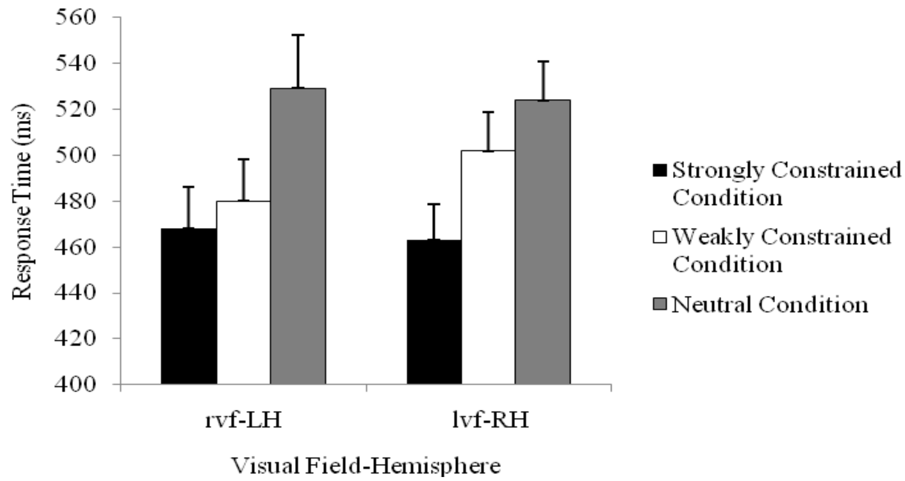


Figure 19. Average response times for strongly constrained, weakly constrained, and neutral items for Experiment 4.

APPENDIX 2: MATERIALS

Virtue, S., van den Broek, P., & Linderholm, T. (2006). Hemispheric Processing of Inferences: The effects of textual constraint and working-memory capacity. *Memory & Cognition, 34(6),* 1341-1354.

Predictive Inference Items: Strongly Constrained (targets in italics)

1. Tom and Krista were standing together holding hands.
Both of them were a little nervous, but mostly excited about today.
Tom imagined the future as he looked at Krista.
They were just pronounced as man and wife.
kiss

2. Troy and his colleague, Tanya, were out to lunch at Sammy Wong's Restaurant.
Tanya ordered the special of the day.
The waiter promptly served her meal.
Her eyes grew when she looked at her plate and saw a giant cockroach.
scream

3. Bill was a science teacher at a local middle school.
He thought the students were getting bored, so he decided to have them do an experiment.
Bill asked one student to poke different objects to see what would happen.
First, the student poked a balloon full of air with a pin.
pop

4. It was the end of a long week at work for Margie.
So, she finished up her work for the day and told her boss that she was going home.
She knew exactly what she was going to do when she got there.
When Margie arrived home, she got her pajamas on and turned off the lights.
sleep

5. It was the middle of January in Buffalo, New York.
Everyone Cindy knew at work had been terribly ill.
She had been ill just last week and was still feeling the effects.
In the middle of a meeting, she felt an annoying tickle rise in her throat.
cough

6. This was the final quarter of the Tigers' last football game of the season against the Bulldogs.
There were only thirty seconds left on the clock.

The athletes' hearts raced with excitement as the clock started up.
The Tigers were close to their opponents' end zone, on the 5-yard line, and they had the ball.
score

7. Tom was late for school.
He had an early class and had trouble getting up in the morning.
He went to the bus stop, hoping that the bus hadn't left yet.
As he arrived at the bus stop, he saw his bus was just pulling away.
Run

8. Jeff needed to pass this exam in order to get an A in the course.
His instructor passed out the exam to the class.
Jeff's hands were shaking as he read the first question.
Jeff realized that he had a clear view of another student's answers.
cheat

9. The airplane was in flight to Europe.
The passengers knew that they should soon be approaching their destination.
They looked out the window and saw a mountain range a few feet away from them.
The passengers knew they were too close and called out in terror.
crash

10. After the rugby match, Justin's friends teased him for not knowing the rules.
He gathered around his friends and joked about beating them next time.
Next, Justin went to grab a drink from the cooler.
With a big grin, he shook and twisted the lid off a bottle of soda, aiming at his friends.
spray

11. Mildred was driving on the highway late at night struggling to stay alert.
She smoked a cigarette to combat the monotony of the long drive.
After she finished her cigarette, Mildred pitched it out of the car window.
The cigarette landed on a pile of dry leaves on the side of the road.
fire

12. Amy's new car had a stick shift and she felt a bit insecure about driving it.
When she got home from school, she parked the car and went inside the house.
Then she realized that she had forgotten to put the emergency brake on.
As she looked outside, she saw that her car had been parked on a steep hill.
roll

13. A group of entertainers were in their tent preparing to perform for the annual Acme Company picnic.
Bobo the clown thought he looked silly in his clown getup.

Not only that, but his gigantic clown shoes didn't look quite right that day.
It wasn't until he attempted to leave the tent that he realized that someone had tied his shoestrings together.
trip

14. Several people were outside that day.
The air was colder than usual, but that didn't bother Bill.
Bill got ready to join his friends.
He was looking forward to getting some exercise out on the ice.
skate

15. Todd and his dog were enjoying a nice, long stroll on Daytona Beach.
He couldn't imagine a better way to spend his summer vacation.
Todd decided to take his shoes off and wade in the water.
With his next step, he didn't notice a piece of broken glass under his foot.
cut

16. The graduate student was working on his dissertation in the library.
He decided to bring his work home since it was getting late.
After a long evening, he gathered all of his papers and books together.
As he lifted his books, his arms suddenly became very weak.
drop

17. Kyle needed a vacation from the hustle and bustle of work, so he left his cell phone at home and drove north.
While driving through the country, he ran out of gas.
Kyle got out of his car and checked the contents of his trunk.
He knew the nearest gas station was a mile away and the spare gas can in the trunk was missing.
walk

18. At work, Albert received an important telephone call.
He drove directly to his mother's house.
He greeted his mother and asked if they could talk.
As he told his mother that he had cancer, she pulled out her handkerchief.
cry

19. The passengers had paid a great deal of money to take an historic ship across the Arctic Ocean.
The ship cruised through the ice-cold water at a brisk speed.
The ship's captain became distracted as the ship fell off course.
All of a sudden, the captain heard a crunching sound as the ship struck a large iceberg.
sink

20. Sheila often got angry with her employees when they missed deadlines or behaved incompetently.
The employees were meeting today to discuss a report they had been working on for 3 months.
At the meeting, Sheila's secretary passed out the report and Sheila began to look through it.
Sheila's face tensed and she looked directly at her secretary when she realized that several pages were missing.
yell

21. Rachel was constantly watching her diet because she competed in beauty contests.
At dinner, she looked at all of the food on her plate.
She hadn't eaten for nearly an entire day and was hungry.
Rachel had a hard time eating her soup because she accidentally swallowed a chicken bone.
choke

22. Grandma Johnson was arriving from Florida for a visit.
Her plane had just landed at the terminal.
Amy saw Grandma Johnson come off the airplane.
As Grandma Johnson arrived, Amy could see her Grandma's hands reaching out for her cheeks.
pinch

23. Brad was looking for a present for his wife's birthday.
He wanted to find something special for her, but he couldn't afford to buy anything nice.
In the accessories department, he saw an expensive scarf sitting on the counter.
Next, he made his way to the counter and took out his bag.
steal

24. The junior basketball star raced down the court.
He was in rare form that night.
His teammates had a hard time keeping up with him.
He stopped in the center of the court and looked at the basket.
throw

25. Walter was using his toy dump truck next to the living room window.
He liked to fill the truck with sand and then dump the sand out the window, down onto the street below.
As Walter was dumping sand, his truck fell out of the third-floor window.
He watched as the fragile, wooden truck fell toward the cement driveway.
break

26. Steve and Susan were having a romantic picnic in the park.

After they finished eating,
Steve looked at his beloved Susan.
He felt very close to her at this moment.
So, he got down to his knees and pulled out a diamond ring.
Propose

27. Claudia was hunting around in the kitchen closet.
She found several jars that were very pretty.
One of them looked especially interesting, so she removed the top.
As Claudia stuck her nose into the jar, she found that it was full of spicy pepper.
sneeze

28. The boys' high school baseball team was having tryouts for the spring season.
The coach decided to test the boys' baseball skills before he did anything else.
The first batter to step up to the plate was a new boy on the team.
As the pitcher released the ball, the boy raised his bat and the ball went directly to him.
hit

29. Hugo was stuck making pizzas for a living but really aspired to do something more creative.
After work, Hugo went to the crowded city park.
Once there, he looked around for pleasing scenery.
He saw the beautiful sunset over the lake, and took out his easel and brush.
paint

30. Jennifer was sitting in the very last row of her high school biology class.
She thought the instructor was a real nerd.
Jennifer watched as the instructor lectured to the class.
In the middle of the lecture, her instructor made a funny joke.
laugh

31. Dave and Penny had a stormy relationship.
They were in the middle of a heated discussion when Dave noticed a beautiful blonde pass by.
Dave's eyes followed the attractive woman down the street.
Penny turned to Dave and quickly raised her hand toward his cheek.
slap

32. Sandy's home was a century old and needed many repairs.
The roof, in particular, was in poor condition.
She noticed one evening that there were many holes in the roof that needed to be fixed.

Sandy became worried when she learned of the heavy rainfall.
leak

33. Patty sat down at the lunch room table and took out the shiny, red apple.
She bit into the apple.
Then she stared at it.
It had half a worm in it.
spit

34. As Jimmy was coming home one day, he ran into some of the kids from the neighborhood.
They asked him if he wanted to hang out with them.
They taught him a fun game that involved tossing things at a target to get points.
He missed, though, and knocked the door of a new car with a baseball.
Dent

35. The orchestra was warmed up and ready for the concert.
The performers had practiced all summer long.
A man in a tuxedo came on stage and looked at the orchestra.
He began the concert by stepping up to the podium.
conduct

36. Seymour had lived in the same place for 10 years.
During that time, a lot of junk had accumulated in his garage.
It was full of sentimental photographs, books, and old clothes.
Seymour entered the garage and grabbed a mop and a broom.
clean

37. Mrs. Merrill had been a widow for 5 years, and desperately needed money.
Her savings had been spent, and she was now barely getting by.
She had a ruby necklace, but would have a hard time parting with it.
She decided to go ask for help at a pawn shop.
sell

38. Jennifer was getting ready for her big date, so she started a bath.
She added her favorite aromatic oils to the water.
Before she could turn off the water, she got a phone call from a childhood friend.
After 45 minutes on the telephone, Jennifer realized her bath was still on.
flood

39. Don was building a tree house for his youngest son.
He had already finished the main part of the tree house.

He was now nailing the final pieces of wood for the entry way.
Don was almost done when his T-shirt got caught on a nail.
tear

40. The director and the cameraman were preparing for the next scene.
They were new in Hollywood and had a lot to learn.
The crew set up the cameras next to the building.
The actress stood on the edge of the 14th floor ledge and suddenly fell to the ground.
die

41. Julie sat down to read the newspaper in her living room.
It was Sunday, so she could spend some extra time reading the paper.
She picked up the paper and searched for the entertainment section.
The room was darker than she liked, so Julie went over to the blinds.
open

42. Lisa knew that her sister would love the chocolate cake that she was making for her birthday.
After mixing the cake batter, she put it into the square-shaped baking pan.
Then she turned on the oven, set the timer, and put the cake in the oven.
Lisa didn't realize that she set the oven temperature too high.
Burn

43. Ralph was late for school so he shoved a piece of bread in the old toaster.
After a few minutes, he could see that the bread was not coming out of the toaster.
Ralph didn't have anything else to eat and was determined to eat the toast.
He used a metal knife to dislodge the toast from the toaster, forgetting that it was still plugged in.
shock

44. Tonight, Alan was having a party for his friends.
He was always the life of the party.
Alan was trying to think of a fun way to entertain his guests tonight.
When an upbeat disco song came on the radio, he dramatically went to the center of the room.
dance

45. The rival gangs met outside the school yard.
Both of the gangs had taken a vow to become less violent.
The neighbors watched as the two gangs shouted back and forth to one another.

Finally, one member went over to the rival gang and put up his fists.
fight

46. The policeman saw the suspect trying to exit through the back door of Bank America.
The policeman knew that he had to do something fast.
The policeman pulled out his gun and shouted at the fleeing suspect.
The policeman aimed his gun directly at the suspect, but he still wouldn't stop.
shoot

47. Henry was very absentminded.
He rarely watched where he was going.
Today he was in a hurry to get home.
As he was heading home, he stepped on some ice.
slip

48. Suzie's parents were worried that she would get restless during their big vacation on the road.
Fortunately, little Suzie was kept entertained with her coloring books in the back seat.
She colored pictures of every state they drove through on their way to Los Vegas.
Once they arrived at their destination, Suzie threw her crayons in the hot, back window.
melt

<u>Predictive inference items: Weakly constrained (targets in italics)</u>
1. Tom and Krista were standing together holding hands.
Both of them were a little nervous, but mostly excited about today.
Tom imagined the future as he looked at Krista.
They were just announced as college graduates.
kiss

2. Troy and his colleague, Tanya, were out to lunch at Sammy Wong's Restaurant.
Tanya ordered the special of the day.
The waiter promptly served her meal.
Her eyes grew when she looked at her plate and saw some uncooked food.
scream

3. Bill was a science teacher at a local middle school.
He thought the students were getting bored, so he decided to have them do an experiment.
Bill asked one student to poke different objects to see what would happen.
First, the student poked a bag full of water with a pin.

pop

4. It was the end of a long week at work for Margie.
So, she finished up her work for the day and told her boss that she was going home.
She knew exactly what she was going to do when she got there.
When Margie arrived home, she got more comfortable and sat down on the couch.
sleep

5. It was the middle of January in Buffalo, New York.
Everyone Cindy knew at work had been terribly ill.
She had been ill just last week and was still feeling the effects.
In the middle of a meeting, she felt her throat become very sore.
cough

6. This was the final quarter of the Tigers' last football game of the season against the Bulldogs.
There were only thirty seconds left on the clock.
The athletes' hearts raced with excitement as the clock started up.
The Tigers were far from their opponents' end zone, on the 50-yard line, and they had the ball.
score

7. Tom was late for school.
He had an early class and had trouble getting up in the morning.
He went to the bus stop, hoping that the bus hadn't left yet.
As he arrived at the bus stop, he saw his bus was already 5 blocks away.
run

8. Jeff needed to pass this exam in order to get an A in the course.
His instructor passed out the exam to the class.
Jeff's hands were shaking as he read the first question.
Jeff realized that he had not prepared well enough for the exam.
cheat

9. The airplane was in flight to Europe.
The passengers knew that they should soon be approaching their destination.
They looked out the window and saw a mountain range a few feet away from them.
The passengers knew they were close and let out a big sigh.
crash

10. After the rugby match, Justin's friends teased him for not knowing the rules.
He gathered around his friends and joked about beating them next time.
Next, Justin went to grab a drink from the cooler.

With a grin, he twisted the lid off a bottle of soda, looking for his friends.
spray

11. Mildred was driving on the highway late at night struggling to stay alert.
She smoked a cigarette to combat the monotony of the long drive.
After she finished her cigarette,
Mildred pitched it out of the car window.
The cigarette landed on a pile of damp leaves on the side of the road.
fire

12. Amy's new car had a stick shift and she felt a bit insecure about driving it.
When she got home from school,
She parked the car and went inside the house.
Then she realized that she had forgotten to put the emergency brake on.
As she looked outside, she saw that her car was parked in the driveway.
roll

13. A group of entertainers were in their tent preparing to perform for the annual Acme Company picnic.
Bobo the clown thought him
looked silly in his clown getup.
Not only that, but his gigantic clown shoes didn't look quite right that day.
It wasn't until he attempted to leave the tent that he realized that someone had played a trick on him.
trip

14. Several people were outside that day.
The air was colder than usual, but that didn't bother Bill.
Bill got ready to join his friends.
He was looking forward to getting some exercise outside today.
skate

15. Todd and his dog were enjoying a
Nice, long stroll on Daytona Beach.
He couldn't imagine a better way to spend his summer vacation.
Todd decided to take his shoes off and wade in the water.
With his next step, he didn't notice a beautiful seashell nearby.
cut

16. The graduate student was working on his dissertation in the library.
He decided to bring his work home since it was getting late.
After a long evening, he gathered all of his papers and books together.
As he lifted his books,
His back suddenly became very weak.
Drop

17. Kyle needed a vacation from the hustle and bustle of work, so he left his cell phone at home and drove north.
While driving through the country, he ran out of gas.
Kyle got out of his car and checked the contents of his trunk.
He knew the nearest gas station was a mile away and the spare gas can in the trunk was half full.
Walk

18. At work, Albert received an important telephone call.
He drove directly to his mother's house.
He greeted his mother and asked if they could talk.
As he told his mother that he didn't get accepted, into graduate school, she moved closer to him.
Cry

19. The passengers had paid a great deal of money to take an historic ship across the Arctic Ocean.
The ship cruised through the ice-cold water at a brisk speed.
The ship's captain became distracted as the ship fell off course.
All of a sudden, the captain heard a crunching sound as the ship bumped into a small piece of ice.
sink

20. Sheila often got angry with her employees when they missed deadlines or behaved incompetently.
The employees were meeting today to discuss a report they had been working on for 3 months.
At the meeting, Sheila's secretary passed out the report and Sheila began to look through it.
Sheila's face changed and she looked at her secretary when she realized that a comma was missing.
yell

21. Rachel was constantly watching her diet because she competed in beauty contests.
At dinner, she looked at all of the food on her plate.
She hadn't eaten for nearly an entire day and was hungry.
Rachel had a hard time eating her soup because she felt that she was too fat.
choke

22. Grandma Johnson was arriving from Florida for a visit.
Her plane had just landed at the terminal.
Amy saw Grandma Johnson come off the airplane.
As Grandma Johnson arrived, Amy could see
her Grandma's hands reaching out for her.

pinch

23. Brad was looking for a present for his wife's birthday.
He wanted to find something special for her, but he couldn't afford to buy anything nice.
In the accessories department, he saw an expensive scarf sitting on the counter.
Next, he made his way to the counter and examined it more closely.
steal

24. The junior basketball star raced down the court.
He was in rare form that night.
His teammates had a hard time keeping up with him.
He stopped in the center of the court and looked at the referee.
throw

25. Walter was using his toy dump truck next to the living room window.
He liked to fill the truck with sand and then dump the sand out the window, down onto the street below.
As Walter was dumping sand, his truck fell out of the third-floor window.
He watched as the wooden truck fell toward the bushes.
break

26. Steve and Susan were having a romantic picnic in the park.
After they finished eating, Steve looked at his beloved Susan.
He felt very close to her at this moment.
So, he bent over and picked a rose for her.
propose

27. Claudia was hunting around in the kitchen closet.
She found several jars that were very pretty.
One of them looked especially interesting, so she removed the top.
As Claudia stuck her nose under the jar, she found that it was full of sweet cinnamon.
sneeze

28. The boys' high school baseball team was having tryouts for the spring season.
The coach decided to test the boys baseball skills before he did anything else.
The first batter to step up to the plate was a new boy on the team.
As the pitcher released the ball, the boy raised his bat and lost his grip.
hit

29. Hugo was stuck making pizzas for a living but really aspired to do something more creative.
After work, Hugo went to the crowded city park.
Once there, he looked around for pleasing scenery.
He saw the beautiful sunset over the lake, and took out his pad of paper.

paint

30. Jennifer was sitting in the very last row of her high school biology class.
She thought the instructor was a real nerd.
Jennifer watched as the instructor lectured to the class.
In the middle of the lecture, her instructor lost his train of thought.
laugh

31. Dave and Penny had a stormy relationship.
They were in the middle of a heated discussion when Dave noticed a beautiful blonde pass by.
Dave's eyes followed the attractive woman down the street.
Penny turned to Dave and quickly raised her hand toward his arm.
slap

32. Sandy's home was a century old and needed many repairs.
The roof, in particular, was in poor condition.
She noticed one evening that there were many holes in the roof that needed to be fixed.
Sandy became worried when she learned of the approaching hurricane.
leak

33. Patty sat down at the lunch room table and took out the shiny, red apple.
She bit into the apple.
Then she stared at it.
It had no flavor to it.
spit

34. As Jimmy was coming home one day, he ran into some of the kids from the neighborhood.
They asked him if he wanted to hang out with them.
They taught him a fun game that involved tossing things at a target to get points.
He missed, though, and knocked the door of a new car with a snowball.
dent

35. The orchestra was warmed up and ready for the concert.
The performers had practiced all summer long.
A man in a tuxedo came on stage and looked at the orchestra.
He began the concert by stepping up to the microphone.
conduct

36. Seymour had lived in the same place for 10 years.
During that time, a lot of junk had accumulated in his garage.
It was full of sentimental photographs, books, and old clothes.
Seymour entered the garage and grabbed a box full of photos.
clean

37. Mrs. Merrill had been a widow for 5 years, and desperately needed money.
Her savings had been spent, and she was now barely getting by.
She had a ruby necklace, but would have a hard time parting with it.
She decided to go ask for help at a friend's house.
sell

38. Jennifer was getting ready for her big date, so she started a bath.
She added her favorite aromatic oils to the water.
Before she could turn off the water, she got a phone call from a childhood friend.
After 4 minutes on the telephone, Jennifer remembered her bath was still on.
flood

39. Don was building a tree house for his youngest son.
He had already finished the main part of the tree house.
He was now nailing the final
pieces of wood for the entry way.
Don was almost done when his shoe got caught on a nail.
tear

40. The director and the cameraman were preparing for the next scene.
They were new in Hollywood and had a lot to learn.
The crew set up the cameras next to the building.
The actress stood on the edge of the 2nd floor ledge and suddenly fell to the ground.
die

41. Julie sat down to read the newspaper in her living room.
It was Sunday, so she could spend some extra time reading the paper.
She picked up the paper and searched for the entertainment section.
The room was darker than she liked, so Julie went over to the balcony.
open

42. Lisa knew that her sister would love the chocolate cake that she was making for her birthday.
After mixing the cake batter, she put it into the square-shaped baking pan.
Then she turned on the oven, set the timer, and put the cake in the oven.
Lisa didn't realize that she set the timer off by a few minutes.
burn

43. Ralph was late for school so he shoved a piece of bread in the old toaster.
After a few minutes, he could see that
the bread was not coming out of the toaster.
Ralph didn't have anything else to eat and was determined to eat the toast.

He used his finger to dislodge the toast from the toaster, forgetting that it was still hot.
shock

44. Tonight, Alan was having a party for his friends.
He was always the life of the party.
Alan was trying to think of a fun way to entertain his guests tonight.
When a cheesy love song came on the radio, he dramatically went to the center of the room.
dance

45. The rival gangs met outside the school yard.
Both of the gangs had taken a vow to become less violent.
The neighbors watched as the two gangs shouted back and forth to one another.
Finally, one member went over to the rival gang and put out his hand.
fight

46. The policeman saw the suspect trying
to exit through the back door of Bank America.
The policeman knew that he had to do something fast.
The policeman pulled out his gun and shouted at the fleeing suspect.
The policeman aimed his gun directly at
the suspect and he immediately stopped.
shoot

47. Henry was very absentminded.
He rarely watched where he was going.
Today he was in a hurry to get home.
As he was heading home, he stepped in some mud.
slip

48. Suzie's parents were worried that she would get restless during their big vacation on the road.
Fortunately, little Suzie was kept entertained with her coloring books in the back seat.
She colored pictures of every state they drove through on their way to Los Vegas.
Once they arrived at their destination, Suzie threw her crayons in the back seat.
melt

<u>Neutral Items (targets in italics)</u>

1. The school yard was empty.
All the students were already on their summer vacation.
The groundskeeper had also taken his vacation.
It was strange to see the schoolyard with no students around.

kiss

2. The teenage boys were cruising on the streets of their town.
One of the boys had a nice new sports car.
The girls in town were impressed by the fast car.
They often rode around town in their shiny new Mustang.
shoot

3. The three women had been friends since childhood.
No matter where they were, they stayed in touch.
Currently, they were together to celebrate New Year's Eve.
The spent the evening discussing old memories and talking about the future.
run

4. The pig was quite pleased with himself.
He had managed to escape from the barn without his owner seeing him.
He also found a big pile of dirt to roll around in next to the barn.
Now, covered in dirt, the pig decided to lay down.
clean

5. Other kids at school often tormented the awkward girl in school.
The girl had tried to make friends, but at times it seemed hopeless.
She was terribly shy and her mother dressed her in old clothes.
To make matters worse, the little girl often smelled bad.
burn

6. Although he was only 15 years old, Harold was special.
He had an amazing ability.
He could play golf like a player twice his age.
His parents hoped he would grow up to be like Tiger Woods.
pinch

7. Janet's coffee table had recently become wobbly.
She planned to pick up some glue to fix the loose leg.
Somehow she could never find the time to stop at the store after work.
She always wanted to get home and watch television after word.
spray

8. The doctor shook her head.
Her last client was in terrible physical condition.
The last time he did any sort of physical exercise was 20 years ago.
As a result, he was extremely overweight and had high blood pressure.
spit

9. Oktoberfest was a smelly confusion of many different people and beer.
Nellie heard the German band from the back of the crowd.

She liked German music because her parents always played it when she was young.
Nellie looked at the crowd and thought how her parents would have enjoyed the music, too.
snow

10. The atmosphere on the remote island was getting tense.
The survivors had a hard time getting along with each other.
They didn't enjoy sharing the island with rats.
After only two days, the survivors were ready to leave.
cut

11. A woman stumbled onto the deck of her newly purchased yacht.
She was tall and her satin dress was elaborately embroidered.
She had someone pour her another cold drink.
She enjoyed drinking champagne on the deck of her yacht at sun set.
bark
12. The author worked the day and night on her new book.
She seldom rested, and if she did, it was only for an hour or two.
She had worked this way for years.
Her family worried that she would soon develop health problems.
fire

13. Dan worked at the package store on the late shift.
At about 2:00am, a scraggly looking man came in.
He roamed around the store for about 20 minutes.
Finally, he bought some gum and left the store.
yell

14. At sunset, the escape convict ducked into an abandoned old house.
He knew he shouldn't stay there too long tonight.
He had served the first 3 years of a life sentence in a maximum security prison.
He used his sweater as a pillow.
throw

15. On special occasions, the Rochester family had big outdoor parties.
They lived on a large, beautiful estate only 1 mile away from the ocean.
Parties typically started off with a small gathering on the beach.
Tonight, they would end the night with a clam bake.
wipe

16. The person directly next to Toni handed her an answer sheet.
Soon, this horrible bio-chemistry class would be over.
Toni was nervously reading over her notes one last time.
She repeated the chemical sequences aloud to herself.

choke

17. The high school band had practiced for months.
Their big performance was later that night.
Each year, the band had a big spring concert for the parents.
Many said it was usually their best concert of the year.
paint

18. The radio station was having its annual fund raiser.
Maria had decided to become a D.J.
She loved all types of music.
She didn't like to speak in front of crowds, but over the radio she was fine.
fall

19. The young couple had very little money.
They had just been married and their budget was tight.
The first thing they wanted to buy was a large stereo.
They asked for a loan from her parents and purchased one.
sink

20. The dog pulled at her leash and whined.
She blinked her sad brown eyes up at her owner.
Next, the dog laid on the ground.
Nellie's owner would still not let her off her leash.
slap

21. It was the first week of classes.
Jose had become infatuated with Gloria the moment he saw her.
There were in the same dormitory and bumped into each other often.
He felt he acted like a jerk every time he was around because he became nervous.
fail

22. Lynn and Tracy had been very close friends for many years.
They were both sad when Tracy had to move away.
They did manage to visit each other whenever they had free time.
Their visits were typically started off with talk about the old days.
sleep

23. The petting farm was Ben's favorite part of the zoo.
He liked to go and pet the horses.
Ben always remembered to bring his camera so that he could take a picture.
He hoped that he could one day have a pet horse of his own.
tear

24. Mrs. Mac Pherson was standing in her front doorway.
She was calling for her cat, Muffy.
The woman wore a neon green moo-moo and she had a purple flowered scarf in her hair.
Muffy, a big ginger tomcat, crawled out from under a bush.
melt
.
25. Rose called to her brother when she saw something by the river.
He waved to his sister, who was standing at the river's edge.
While standing completely still, they saw a crocodile.
It slid off a boulder into the water.
sneeze

26. Leslie had found a great apartment in Greenwich Village.
It was surrounded by little cafes and funky shops.
A shop next to her apartment had the most fashionable clothes in town.
A few blocks away was an old movie theatre that showed foreign films.
sit

27. Eric and Zelda decided that they wanted their son to appreciate the mysteries of life.
They decided to give him a pet as a birthday present.
They put up a sign in town asking if anyone had a baby animal to give away.
They got a call from a man who said that his dog was going to have puppies any day.
fight

28. Max was a cabbie in Chicago.
His first fare of the day was an expensively dressed man.
He asked Max to take him directly to the airport.
At the airport, the man gave Max a huge tip without saying a word.
dent

29. The rain came down gently to the earth.
It was late summer and the ground needed some moisture.
Eventually, small puddles grew into huge ponds of water.
After several days of rain, the ground became muddy.
dance

30. The Dutchess entered the ball.
Her reputation preceded her wherever she went.
She was currently dating a handsome man half her age.
Whispers surrounded her as she moved across the room.
slip.

31. Karen and Ruth had been working in the emergency room.
They had gotten their nursing degree two years ago.
This morning they watched the police bring in three young children.
They had gotten hurt on the jungle gym at their school.
shock

32. Halloween was a dark time for the citizens of Storyville.
Two young boys had disappeared the day before.
The last time they were seen was in a store with their mother.
The boys had been trying on Halloween costumes when they vanished.
forgive

33.Marie had wanted to be a doctor for as long as she could remember.

When she was a child, she was in awe of her father's medical things.

Once he let her try his stethoscope on.

She was fascinated by the sound of her own beating heart.

break

34. The restaurant owner was nervous.

He had just purchased the restaurant.

To attract large crowds, he had advertised free hors d'oeuvres.

He was pleased to see a huge line forming outside.

open

35. The defense attorney loudly called out an objection.

The prosecutor looked uneasily at the judge.

He waited for the judge's ruling.

The judge overruled the objection tersely, and told the prosecutor to hurry up with his testimony.

kick

36. Simon wasn't sure he was enjoying his long vacation in South America.

He was in the dark, steamy jungle.

It was filled with many dangerous snakes and insects.

As he maneuvered through the jungle,

he moved a vine that hung over the path.

wash

37. The state volleyball team was hot.

They had won all of their matches that year.

And, so far, there had been no injuries.

The volleyball team was destined for greatness.

scream

38. Marsha looked outside her window and she saw a beautiful sunrise.

She quickly got dressed in sweats and went outside.

Marsha lived near the beach and loved the mornings.

She liked the thought that the town was quiet.

score

39. Rudy and Susan had just become proud parents of a baby boy.

They decided to join a parenting group at the YMCA.

Neither of them knew much about raising a child.

They were both only 19 and hadn't planned on having a child so young.

push

40. The chef hurried into the kitchen.

The food critic had just arrived.

The chef made sure that the critic was served their very best bottle of Merlot.

Next, the critic examined every inch of the restaurant before leaving.

punch

41. The first thing Rebecca and Marla did the day after graduation was look for summer jobs.
They wanted to find a fun job that had fairly flexible hours.
They both read all of the want ads and could not finding anything.
So, they decided to meet some friends for drinks at their favorite bar.
die

42. The therapist was extremely bored with her job.
She was tired of hearing every one else's problems.
She had seen 10 clients that day, back to back.
She started thinking about an early retirement.
faint

43. Pam and Martin decided to search the attic for their missing lamp.
They had been putting off looking for it all spring.
They wanted to get to it before summer, when it was incredibly hot in the attic.
They thought that they may also find other items they needed that were stashed away.
laugh

44. It was Chuck's daughter's first day of elementary school.
He came home from work early to hear all about her day.
She was the youngest of his three children.
She had been very excited to finally be going to school just like her two older brothers.
eat

45. Summer was definitely in the air.
Parents were out strolling outside with their new babies.
The park was filled with kids playing on the swings.
Soon, it would be hot enough to swim in the lake near by.
drop

46. The small town was still reeling from the news.
A maverick mayor had just been elected.
Everyone wondered exactly who had voted for him.
The city was anxious to see how the new mayor would shake things up.
cry

47. Ellen and Fred had been working in New York City for six months.
Ellen's parents were coming to stay with them this weekend.

She was trying to be think about what fun tourist spots they would visit.
Ellen and Fred decided to take them to the Metropolitan Museum of Art first.
steal

48. Jenny put her fingers through her dirty hair.
The coffee was brewing and she gave a big yawn.
Next, she headed out to get the morning paper.
Wrapping a bathrobe tightly around her, she went out the door.
spank

Filler Items

Filler Items

1. The basket, filled with onions and potatoes, was getting heavy.
Helena switched the basket over to her other arm.
She thought how silly it was to   have bought the heavy things first.
Now she had to carry this stuff through the rest of the Farmer's Market.
drend

2. The Buckington Car Lodge was an English castle converted into a motel.
Pamela had arrived in England only that morning and was very excited.
Despite jet lag, she was having trouble getting comfortable.
She wandered around the Great Room, which served as the lobby.
uten

3. Victoria stood on the terrace overlooking the garden and shook her head.
Somehow, the garden no longer suited her tastes.
Now she wanted flowers, arranged in a variety of colors.
She picked up a shovel to dig up all of the carrots.
drail

4. Andrew, the new chauffeur, crossed the veranda.
He removed his cap in greeting, and his hair gleamed in the sunlight.
His uniform fit tightly across his shoulders.
The afternoon sun beat down so warmly that Andrew took off his shirt.
sarc

5. Maurice heard on the radio that flying saucers were taking over the Earth.
Making sure they had enough food, Maurice sealed the lab from the outside world.
As the days passed, the radio announced that all Earthlings were being enslaved.
Maurice knew he had to do something.
rutch

6. Within a few hours the waters would be high enough to float the ark.
Seth was afraid for the animals.
From the edge of the ark, he could see the damage the rains had already done.
His brother started to direct pairs of animals off the ark.
gath

7. Ron and Alice were setting up a cashier stand for their garage sale.
They were moving to Tennessee next week.

They needed to get rid of many things before they left.
It didn't pay to take some of the old furniture with them to their new home.
mup

8. Ethel and Jacques were baking cookies to send their daughter at college.
Ethel selected four dozen of the best ones.
Not finding a container on the shelf, Jacques surveyed the rest of the kitchen.
He decided to use an old shoebox.
abserbe

9. Willie was a talented songwriter.
He wrote beautiful but strange lyrics.
Willie had a hard time making a living, however.
His songs were too abstract for most audiences.
poub

10. Katmandu was sad.
He was used to being the only family pet.
Now, his owners had brought home another pet.
Katmandu was jealous of Molly, the golden retriever.
treg

11. Louis was always on the go.
He was a social worker.
His main duty was to help refugee families.
Louis helped immigrant families get settled in their new country.
lank

12. Camp Snoopy was alive with activity.
There was a huge celebration.
It was Snoopy's 60th birthday.
Children came from all over Minnesota to wish Snoopy a happy birthday.
smukes

13. Lee was an Internet junkie.
When he wasn't at work, he was surfing the Internet.
He did all of his shopping and communicating on the Internet.
Lee was beginning to lose touch with reality.
gaulle

14. Marlene was a terrible typist.
She was a professor, so it was important for her to have this skill.
She bought a typing tutorial program for her computer.
Marlene practiced typing for 3 hours each day.
skump

15. Morton wanted to provide security for his children.
He invested in stocks and bonds.
He watched his investments carefully.
Morton wanted to leave his children with a large sum of money.

urab

16. Maui loved to surf.
His real name wasn't Maui, but that's the name he went by.
He got the nickname by spending 4 months of the year in Hawaii.
Maui spent those months riding the waves.
pask

17. Jake was a unique person.
At age 65, he decided to grow a ponytail and become more creative.
Jake lived on a big ranch in western Nebraska.
There, he made tiny gold sculptures of birds.
sok

18. Lindy grew up on a farm in the Midwest.
He learned to occupy himself by carving wood.
He made whistles, flutes, and interesting figurines.
One year, Lindy won a ribbon in the county fair for one of his creations.
teck
19. Shannon loved Italian designer dresses, purses, and shoes.
She knew they were too expensive for her budget, but she had to have the latest styles.
She traveled to Italy last fall just to go shopping.
Shannon was thrilled with all of the new clothes she found there.
frain

20. The blue jay was rather angry at the squirrel.
The squirrel had taken all of the bird food in the feeder.
The blue jay told him that it was meant for him.
The squirrel replied by telling him that the early bird catches the worm.
dal

21. Donald was normally a sensitive male.
The only exception was when there was a football game on TV.
His eyes became fixated and he became aggressive.
No one could speak to Donald during a game.
tetch

22. Samantha had finally finished her Ph.D.
Now, she had was anxious to find a job.
She wanted to be a history professor.
After hard work, Samantha ended up getting a great job at the University of New Mexico.
tark

23. Karate was always an interest of William's.
He was somewhat shy and karate gave him confidence.
Karate helped him in many other ways, too.
Last summer, he earned his black belt.
brote

24. The latest fitness craze at
the gym was cycling.
Selma and Stacy couldn't get enough of it.
They had become somewhat addicted.
Their legs bulged from all of their intense exercise.
clak

25. It was Christmas time and
all of the children were excited.
Santa Claus was rumored
to be at the mall.
Children begged their
parents to see him.
Many children wanted their
pictures taken with Santa.
plest

26. The ancient Indian burial
ground was sacred to many.
It was a beautiful spot
on the top of a bluff.
The people of the village
made offerings to the spirits there.
Many thought it was wrong
to go there without an offering.
hibbe

27. The hikers scurried down the side of the huge mountain.
Local construction had caused an avalanche.
Rocks and debris tumbled everywhere.
Most of the hikers got to the bottom of the mountain safely.
healt

28. The small animals in the
lush forest were restless.
There had been a terrible storm the night before.
Several nests and dens had been disrupted.
Many animals had been injured.
crell

29. The two women greeted each. other in the park.
They were glad to catch up with each other.
One woman had gotten married only 2 months ago.
She told her friend all about her honeymoon in the French Riviera.
baze

30. The football game was about to start.
Mike put out the drinks and chips.
He hoped the Dallas Cowboys would win.
Mike was a big fan of the team.
domplet

31. Christie was in line at the grocery store.
She noticed the rack of magazines next to her.
On the cover of one was her favorite actor, Brad Pitt.
She read the article about him as she waited in line.
cripe

32. Julie was 5 months pregnant.
She just found out the baby was a girl.
Her husband thought of many beautiful female names.
They both knew they had to choose a name soon.
litch

33. The flea market was held every first Sunday of the month.
Kim liked to shop there as often as she could.
She decorated her house with items from there.
Kim even managed to find unique gifts for her friends there.
prack

34. The farmer had a tough season.

It hadn't rained for several weeks.
He feared that he would not have a good harvest.
He hoped that he would not have to give up his farm.
tul

35. The mailman enjoyed his work.
He had been on the same route for almost 7 years.
He loved meeting the people everyday on his route.
One day he delivered a gigantic package to Mr. Fletcher.
chush

36. The woman waited outside her
apartment for a taxi.
She was going to meet her sister while her car was being repaired.
Her sister was very impatient, and didn't like to wait for people.
She hoped her taxi would arrive soon.
phod

37. Samantha was driving to the mall.
She heard a strange sound.
She pulled over to the side of the road as soon as she could.
Samantha stepped out of the car, and saw that she had a flat tire.
ald

38. The man entered the busy highway to head home.
It was 5:00 p.m. and he was in the middle of rush hour traffic.
The highway was bumper to bumper. The man was having a very
hard time being patient.
lase

39. The old man examined the people walking by him on a busy corner downtown.
He no longer had any place to live and he didn't have any money.
He never imagined that he would ever be homeless.
The man huddled to keep warm.
fitch

40. The rafting excursion was very exciting for Todd.
He got into the raft and put his life vest on.
The guide gave him detailed paddling instructions.
He felt a big rush as he headed down the rocky river.
crube

41. The boy just had heart surgery.
He was scared, but very relieved when it was over.
His family anxiously entered into his hospital room.
He was happy to see that they brought him his favorite toy from home.
mide

42. The children's eyes became huge as they entered the candy store.
Their parents didn't usually let them have any sweets.
This was a special occasion.

It was the youngest child's fourth birthday, so they were allowed a treat.
pand

43. Jim entered his schedule into his electronic planner.
He was skeptical about using a computer instead of his old calendar.
Jim entered all of his important meetings into the planner.
He tapped one button and then suddenly he saw the screen go blank.
laut

44. The flight was crowded and hot, and the flight attendants were rude.
The flight was going from Chicago to Paris.
One passenger stood up and demanded a glass of water.
Next, another angry passenger began to stand up in protest also.
drobe

45. The mechanic fixed the starter on Ralph's car.
It took him several hours to finish the job.
He was experienced, but the shop was very busy that day.
He had to finish working on 5 other cars, before he could finally fix Ralph's car.
teave

46. Jennifer and her mother went shopping for a pair of shoes.
The shoes had to match Jennifer’s prom dress perfectly.
Her dress was a light shade of blue.
They hoped they would be able to find shoes in time for the prom.
tulle

47. The designer had a new dress ready for the Spring line.
It was a white, silk strapless dress that went to the knees.

She hoped that her boss would like the new design.
A moment later, she watched as her boss entered the room.
rov

48. The stock broker bought several shares of ENET.
ENET was a new internet browser company that was very popular.
He felt that this company would be very profitable.
He invested a lot of money into it.
farg