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The impact of language proficiency, attention, and working memory on situational model updating

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Abstract

When individuals read a narrative text, they construct a mental representation known as a situational model to comprehend the unfolding story. These models require updates at meaningful changes in the story to reflect current information accurately. Existing research highlights the attentional and working memory demands of these updating mechanisms. Surprisingly, there is a lack of exploration into the role of language proficiency in these processes. In this study, bilingual English and Spanish speakers read narratives depicting everyday activities in their dominant and non-dominant languages and intermittently performed a recognition task related to character or spatial information. The use of bilingual participants allowed for examining within-individual differences in reading proficiency and its potential impact on situational model updating. The results revealed different updating patterns based on attentional capacity and language proficiency levels. At low levels of attentional capacity, participants exhibited patterns inconsistent with incremental or global updating. However, participants engaged more in global updating at higher levels of attentional capacity. Similarly, lower language proficiency levels exhibited patterns inconsistent with incremental or global updating, suggesting difficulties in constructing and updating situational models. This was supported by findings of longer reaction times and lower accuracy in individuals with lower language proficiency levels. However, participants with higher language proficiency engaged in global updating of spatial information but reactivation (rather than updating) of character information any time a meaningful change in the text occurred, suggesting that in the current study, participants may have prioritized maintaining information about all characters represented in the stories. These findings underscore the influence of attentional capacity and language proficiency on situational model updating. Individuals build and update more cohesive situational models at higher language proficiency levels due to the reduced attentional demands of language processing. Additionally, the reduced demands for language processing at higher levels of language proficiency allow individuals to reallocate attentional resources to aspects of the story they deem relevant.

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Chapter 1. Introduction

The process of comprehending a text is a complex cognitive task that involves several mental processes and resources. When individuals read a story, they engage in a dynamic interaction between their prior knowledge, language processing, and cognitive abilities to construct a coherent working memory representation of the text. This mental representation, often called a situational model, allows readers to go beyond the text's literal words and comprehend the text's underlying meaning and implications (Zwaan, Magliano, et al., 1995). Understanding a text requires individuals to draw upon their semantic knowledge and previous experiences, activate relevant text knowledge (e.g., previous sections, chapters, books), and allocate cognitive resources (i.e., attention and working memory) to decode and interpret the written information (Speer et al., 2009).

One crucial aspect of reading comprehension is updating the situational model with more current and accurate information (Kurby & Zacks, 2012; Zacks et al., 2007; Zwaan & Radvansky, 1998). As readers progress through a text, they continuously update and revise their situational models to integrate new information and reconcile inconsistencies or contradictions. These situational models provide a framework for organizing and structuring the information presented in the text, enabling readers to create a coherent mental narrative of the events, characters, and relationships described. Updating situational models involves actively allocating cognitive resources, such as attention and working memory, as well as activating information in long-term memory. Readers must allocate attention to relevant information, hold and manipulate information in working memory, and draw inferences based on the available information and their prior knowledge. These cognitive resources are essential for integrating information,

generating predictions, monitoring comprehension, and updating the situational model in real-time (Kurby & Zacks, 2012; Zacks et al., 2007; Zwaan & Radvansky, 1998).

Although researchers have a strong consensus regarding the mechanisms (i.e., attention, working memory, and long-term memory) involved in updating situation models, it is not entirely clear how language proficiency influences these updating mechanisms. Reading with lower proficiency presents additional cognitive challenges due to higher demands in lexical and syntactic processing and weaker reading skills compared to reading with higher proficiency (Perez et al., 2019). The processing demands of reading with low proficiency can place a heavier cognitive load on individuals, potentially affecting the efficiency and effectiveness of the updating mechanisms involved in reading comprehension (Pérez Muñoz & Bajo, 2022). Thus, understanding how language proficiency influences situational model updating is crucial to help elucidate how the underlying mechanisms are employed and adapted under different levels of load and task constraints. This knowledge is essential to better serve populations with low-language proficiency, such as adults with limited education, children in the early stages of reading development, and non-native speakers. In the following sections, we provide a more detailed summary of the current literature on theories of situational model construction, the overlapping cognitive mechanisms proposed by each theory, and reading processes in people who speak more than one language.

1.1 Theories of Situational Model Construction and Updating

Overall, a majority of researchers of discourse processing agree that readers activate multiple levels of nodes of knowledge to understand text (for a review, see Graesser, Arthur & Forsyth, 1997). These nodes contain information about concepts, referents, and propositions at multiple levels of representation. The first level is the *surface code*, which includes exact

wording and syntax. The surface code is maintained briefly in short-term memory but rarely reaches long-term memory unless the surface code is deemed necessary, such as when telling a joke or utilizing a quote. The second level is the *textbase*, where readers extract meaning from propositions and make inferences. The final level consists of the *situational model*, a working memory representation constructed by the inferences drawn from the textbase, general knowledge about the world, and previous experiences. Thus, the situational model blends the textbase propositions and the reader's understanding of the world with little to no information about the surface code. Beyond the levels of representation in discourse processing, different models/theories of discourse processing provide a more detailed account of how the situational model is generated, maintained, and updated, as well as the implications of these processes and mechanisms.

1.1.1 The Landscape Model of Reading

One such model is the Landscape (LS) model of reading, which explains that reading comprehension relies on coherent mental representations formed by establishing meaningful connections between concepts, propositions, and the reader's general knowledge (Linderholm et al., 2004; Yeari & van den Broek, 2011). These connections are created and strengthened as the reader proceeds through the text. The LS model assumes that four sources of information are used for comprehension and that text is parsed in cycles using these four sources.

The first and second sources of information are the actual text (i.e., surface code) and any information carried over from the previous cycle (i.e., recent textbase information). The third source is the reinstatement of prior reading cycles; in other words, information not necessarily presented in the last cycle but perhaps in the previous paragraph (i.e., older textbase information). For example, even though the LS model has not been referenced since the last

paragraph, as the reader, you may understand that the sources being described are part of the LS model. The fourth and final source is the activation of conceptual information that is not part of the text but aids in understanding (i.e., situational model); it is derived from semantic knowledge, general knowledge, and previous experiences. Both bottom-up and top-down processes can drive this last source. In other words, the text itself activates the reader's knowledge to achieve coherence (i.e., bottom-up). However, if this process is insufficient to achieve coherence, the reader employs strategies until coherence reaches the desired level (i.e., top-down) (Graesser, Arthur & Forsyth, 1997). Consider the example "the sun came out, and the snow melted"; reading the words "sun" and "snow" results in the activation of the concepts of sun and snow (i.e., bottom-up). However, top-down processing activates the concepts and the reader's knowledge that snow melts as temperatures increase, filling in the missing information, "the snow melted because the sun came out".

1.1.2 Event Segmentation Theory

Another theory that explains how readers create and maintain situational models is Event Segmentation Theory [EST; (Zacks & Swallow, 2007)]. Although EST has mainly been used to explain the perception of everyday activities, the theory can and has been applied to processing narrative text (Bailey et al., 2017; Bailey & Zacks, 2015; Kurby & Zacks, 2012; Speer et al., 2009; Swets & Kurby, 2016; Zacks et al., 2007, 2009; Zacks & Tversky, 2001). EST suggests that readers segment a continuous text into units or events based on meaningful changes in the texts. Readers naturally look for cues that signal transitions between different events or topics within the text and use these cues to update situational models, providing an organized sequence of events that mirror the text's structure (Zacks, 2020). As a result, readers can remember the content more effectively to facilitate reading comprehension.

One key aspect of EST is the assumption that the current situational model is replaced by a new model when we encounter a change (Bailey & Zacks, 2015; Zacks et al., 2007). In other words, information is either lost or transferred into long-term memory, where it remains accessible but takes longer to retrieve. Support for the construction of new situational models mainly comes from real-world situations (Radvansky et al., 2010, 2011, 2015; Radvansky & Copeland, 2006; Swallow et al., 2011). In these studies, participants had problems retrieving information presented before a meaningful change. For example, having participants recall an object presented in a room, placed in a box, and carried over to another room (a spatial shift) caused memory interference for the object. In other words, switching rooms triggered updating of the working memory representation, making retrieving the information regarding the object more difficult even though that object was still present in and relevant to the new environment. Similar findings are also evident during discourse processing (Bailey et al., 2017; Bailey & Zacks, 2015; Kurby & Zacks, 2012).

1.1.3 Event-indexing model

As with the previously mentioned models, the Event-indexing model [EI; (Zwaan, Langston, & Graesser, 1995)] also provides an explanation for how situational models are updated. The EI model explains that a combination of propositions, general knowledge, and previous experiences allows the reader to maintain, monitor, and update multiple dimensions of the text (i.e., characters, their goals, time, and space). See Table 1 for a full description of each type of dimensional shift and Table 2 for a coded passage example. This lets the reader detect when a meaningful change has occurred in one or more dimensions (Zwaan et al., 1998; Zwaan, Langston, et al., 1995). As a result, the situational model is updated only in the changed dimension(s) to fit the current state, improving upcoming information processing and overall

reading comprehension. In theory, only the changed dimensions should be updated, while all other dimensions remain static in the situational model and readily accessible.

Table 1: Description of Dimensional Shifts

Type	Description	Example(s)
Cause	A clause where the reader has to infer a causal link between the current and previous sentence(s)	"It was raining, and John left his umbrella at home. He exited his car and ran to this office building as fast as possible."
Character	A clause where the text's focus is switched from one character to another.	“Ana got up quickly out of bed, realizing she was late for work, Raul had the day off and had planned to sleep in late.”
Goal	An event or action described by the text that is not related to a goal that was stated or inferred in the previous sentence(s)	“Christian was hungry and ready to eat, he put his phone to charge before making a sandwich for himself.”
Object	A clause where a new or old object is reinstated or *inferred*.	“Christian pounded the nail *[with a hammer]* on the wall.”
Space	A clause that describes events, states, and actions that take place in a different spatial setting than the previous sentences	“Ashley had decided to drive her car today because it was a practical sedan with a spacious backseat to hold their purchases.”
Time	A clause that describes an event, state, or action outside the time interval as the previous sentence	“The next day, Jessica visited her grandparents.”

The table was published in Zwaan, et al.(1995)

Table 2: Dimensional Coding of a Narrative Text

Clause	Cause	Character	Goal	Object	Space	Time
As soon as [Mrs. Logan] made a check mark on his paper,		●				●
[Raymond] hurried back to his desk.		●	●		●	
Nearing his desk,						
he crumpled the paper, seemingly without any disappointment or anxiety.	●			●	●	
His expression was one of "Well, that's that and I'm through."						
The teacher called to him pleasantly, "Did I grade your book?"	●	●	●			
Raymond answered with a negative shake of his head.		●	●			
He picked up his English workbook				●		
and returned to her desk.					●	
He walked briskly.						●
He laid his workbook on the desk.				●		

The table was published in Speer, Reynolds, Zacks, & Swallow (2009)

It is important to note that while both the EI model and EST highlight the importance of updating situational models, EST suggests a complete replacement of the situational model with each change (i.e., global updating), with information either being lost or transferred to long-term memory (Bailey & Zacks, 2015; Zacks et al., 2007). In contrast, the EI model suggests that only the changed dimension(s) are updated (i.e., incremental updating), and all other dimensions remain static in working memory (Zwaan et al., 1998; Zwaan, Langston, et al., 1995). These distinct updating mechanisms have different effects on the processing and manipulation of unchanged information within the situational model, with global updating involving the transfer of information to long-term memory and incremental updating maintaining the information within working memory for easier access. Yet, the specific factors determining when and why individuals engage in global or incremental updating are not fully understood. However, research suggests that individual differences in cognitive abilities (i.e., attention and working memory), processing load (e.g., presence of complex concepts, unfamiliar concepts, or information not

consistent with the current information), or attentional focus by the reader (i.e., the reader's goal) may play a role in causing people to shift between these updating mechanisms (Bailey et al., 2017; Bailey & Zacks, 2015). Therefore, updating situational models is not exclusively done globally or incrementally. Rather, shifting between the two updating methods can occur. One model that accounts for such shifts is the Structure Building Framework [SBF; (Gernsbacher, 1997)].

1.1.4 Structure Building Framework

The Structure Building Framework [SBF; (Gernsbacher, 1997)] explains that for readers to reach comprehension, they must first build a foundational structure. As they encounter new information, they map it onto or integrate it into the existing structure if it corresponds or relates to the previously processed information. However, when the incoming information is less consistent or unrelated, readers undergo a substantial restructuring process to create a new substructure for new mapping to occur.

Thus, a process akin to global updating occurs when the incoming information does not coincide with the current structure or when it is too difficult to process and integrate into that structure. For example, reading about a character cooking breakfast in the morning and then reading about that character switching their location from the stove to the fridge while they are still making breakfast might not require creating a new structure. Instead, individuals may be able to map or integrate this new location information onto the existing structure, a process similar to updating information in an incremental rather than global fashion. However, reading about a larger location change, such as when the character leaves the kitchen after cooking breakfast, would likely require creating a wholly new structure to understand the new details of what is happening with the character. This would occur because of the high level of uncertainty

and potential introduction of new goals, characters, spatial information, and time shifts with this shift in location.

1.2 Influence of Cognitive Resources During Situational Model Construction and Updating

It is clear that creating and maintaining situational models is a cognitively demanding task that requires attention, working memory, activation of semantic knowledge, and activation of memories of previous experiences (Linderholm et al., 2004; Pérez Muñoz & Bajo, 2022; Zacks et al., 2007; Zwaan & Radvansky, 1998). In theory, demands should be higher when meaningful changes are occurring in the narrative text, and the situational model must be updated to reflect these changes. Evidence of this comes from studies showing slower reading of sentences containing a meaningful change (Rinck & Weber, 2003; Speer et al., 2004; Zwaan et al., 1998; Zwaan, Magliano, et al., 1995). Eye movement behavior further supports the operation of an updating mechanism that requires cognitive effort and attention (Swets & Kurby, 2016). For example, Swets & Kurby (2016) demonstrated that fixation times were longer when readers encountered a clause that included a meaningful change, suggesting that these individuals experienced more difficulty during the updating process and may have experienced a higher cognitive load. Regressive saccades (i.e., short, rapid movements to previous text) were also more likely to land on clauses that contained meaningful changes. Furthermore, readers were less likely to regress out of a clause with a meaningful change. Once the situational model is updated, the previously relevant information becomes obsolete, reducing the need for regressions to that specific information (Kurby & Zacks, 2012; Zacks et al., 2007; Zwaan, 1996; Zwaan & Radvansky, 1998).

Furthermore, a study by Bailey et al. (2017) demonstrated that attentional focus affects how events are segmented and updated in narrative text. Specifically, when asked to track spatial changes, participants were more sensitive to spatial changes than participants who were asked to track character changes or participants who were not given specific instructions. Thus, attentional focus can affect readers' ability to integrate dynamic information across multiple dimensions into the situational model. These results highlight the attentional demands of keeping track of multiple dimensions. Therefore, having fewer attentional resources for discourse processing or amplifying discourse processing demands should affect how readers parse a text. For example, older adults, who generally show a decline in executive function ability compared to younger adults, have been shown to have difficulty tracking newly introduced characters (Rim & Stine-Morrow, 2009). Specifically, when older adults read about a new character, they tend to have trouble encoding information about the new character and accessing information about the previous character.

In addition, Bailey & Zacks (2015) studied situational updating processes in younger and older adults. In this study, participants performed a probe recognition task while reading a narrative text. Some probes were presented after a shift (either character or spatial shift) and either referenced the changed dimension or the unchanged dimension. Young and older adults performed equally well in their recognition accuracy, suggesting that overall comprehension of the text did not differ between groups. However, older adults took longer to respond to probes referencing the unchanged dimension after a shift had occurred in the opposite dimension in the text compared to young adults. Their response times to probes referencing the unchanged dimension were similar to probes referencing the changed dimension, suggesting that after a shift, they hard a harder time accessing information from either dimension, even if one of the

dimensions remained unchanged during the shift. This suggests that older adults updated their situational model more globally when encountering a dimensional shift than young adults, who showed more incremental updating. As mentioned earlier, global updating reduces the need to maintain unchanged information in working memory, and while it might delay access to information, it does not appear to affect comprehension. From an EST perspective, unchanged or static information is either transferred from working memory into long-term memory or lost during (global) situational model updating (Bailey & Zacks, 2015). This allows the older adult reader to reallocate attentional resources to updating the more dynamic dimensions of the situational model while maintaining the static information in long-term memory where it can be accessed if needed.

Event Segmentation Theory, the Event Indexing model, the Landscape model of reading, and the Structure Building Framework are complementary. They all assume that information portrayed by the text and general knowledge merge to create coherent representations, with Event Segmentation Theory, the Event Indexing model, and the Structure Building Framework further arguing that changes in the text trigger updating. However, in their current state, all of these models lack an explanation of how situational model updating, which is known to require cognitive resources (Pérez Muñoz & Bajo, 2022; Yildiz & Çetinkaya, 2017), is modulated by language proficiency. Furthermore, all three models' assumptions were based on the performance of native-speaking monolinguals. Therefore, it is crucial to understand how other groups of individuals with a larger spectrum of language proficiency, like bilinguals who sometimes are required to read in a non-dominant language, engage in the creation and updating of situational models. One key point to remember about reading in a non-dominant language is that comprehension skills and language proficiency, which are influential components of reading

comprehension, are typically weaker than when reading in a dominant language (Pérez Muñoz & Bajo, 2022). The following sections elaborate on the current findings of reading strategies in a non-dominant language with an attempt to make connections to the previously discussed discourse processing models and cognitive resources related to situational model updating.

1.3 Discourse Processing and Language Proficiency

As explained in the previous sections, reading comprehension is a multifaceted cognitive process that begins with the surface code and evolves into the situational model. At the earliest stage of the process (i.e., word recognition), the higher demands for reading in a non-dominant language are evident; compared to monolinguals, bilinguals tend to have more difficulty with tasks requiring lexical access, like picture naming tasks (Gollan et al., 2005, 2008; Ivanova & Costa, 2008). The weaker links hypothesis (Gollan et al., 2005, 2008) explains that due to the divided language exposure between two languages, bilinguals use words less frequently in each language compared to monolinguals. This results in weaker lexical representations in each language for bilinguals, with each language showing high-frequency words having stronger and faster lexical access than low-frequency words. The frequency-lag hypothesis likewise explains that lexical representations are weaker in bilinguals due to divided language exposure. However, the frequency-lag hypothesis emphasizes that this effect should be more pronounced in the low-frequency words of the non-dominant language than in the dominant language (Emmorey et al., 2013; Gollan et al., 2011).

Therefore, while reading in a non-dominant language, the demands caused by lexical access at the early stage of discourse processing could potentially disrupt higher stages of reading comprehension. Furthermore, theories of bilingual reading comprehension generally agree that in order to read in a non-dominant language successfully, a threshold of language

proficiency in the non-dominant language must be met before any reading abilities (e.g., vocabulary knowledge, grammar knowledge, text structure, and comprehension monitoring) from the dominant language can transfer over to the non-dominant language (Carrell, 1991; Clarke, 1979, 1980; Cummins, 1979; Lee & Schallert, 1997).

However, previous research has found that as reading exposure increases in the non-dominant language, reading proficiency fluency increases in the non-dominant language, but reading proficiency fluency decreases in the dominant language (Whitford & Titone, 2012, 2015). Through eye-tracking data, Whitford & Titone (2015) demonstrated that bilinguals with high non-dominant language exposure exhibited shorter fixation durations, more skipping, and shorter total reading times during reading in the non-dominant language, but longer fixation durations and less skipping during reading in the dominant language compared with low non-dominant language exposure bilinguals.

Several studies of discourse comprehension in bilinguals also suggest that reading in a non-dominant language may require more effortful strategies (Leon Guerrero et al., 2021; Schleicher & Schwartz, 2021; Zwaan, 1996). Bilinguals rely on the dominant language sentence integration skills when reading in the non-dominant language, especially if the text is complex (Leon Guerrero et al., 2021). Also, integrating revised knowledge learned in the non-dominant language with information learned in the dominant language takes more effort and requires a refutation-style structure (i.e., explicit statement of the revised fact) to incorporate knowledge across languages (Schleicher & Schwartz, 2021). Thus, language proficiency and general comprehension skills interact during discourse processing. As a result, bilinguals construct more detailed, integrated, and coherent situation models while reading in their dominant than in their non-dominant language (Zwaan & Brown, 1996). This indicates that the language processing

challenges faced during reading in the non-dominant language can have an influence on the construction and maintenance of situational models.

When individuals engage in discourse processing in their non-dominant language, the demands of working memory increase (Alptekin & Erçetin, 2011; Pérez Muñoz & Bajo, 2022; Shin et al., 2019). For example, Alptekin and Erçetin (2011) found that, in general, proficient non-dominant language readers can understand the literal meaning of text, however, those with higher working memory capacity were more likely to make inferences and draw conclusions from the text compared to those with lower working memory capacity. Similarly, Shin and colleagues (2019) found that, when reading in their non-dominant language, bilinguals with higher working memory capacity were better at using background knowledge than bilinguals with lower working memory capacity. Together, this suggests that working memory capacity plays a crucial role in the construction of situational models during non-dominant language reading. Specifically, better working memory capacity helps one construct situational models that more successfully organize and connect information to general knowledge to increase overall comprehension.

Therefore, readers may rely more on attentional control and working memory adaptations during non-dominant language reading to understand the text. These adaptations likely involve managing cognitive resources used for updating mental representations and accessing conceptual knowledge. Reduced access to these cognitive resources during meaningful changes could affect how situational models are constructed or updated. One possible prediction is that when readers read in their non-dominant language, they adapt to the demands by more often employing a global updating rather than an incremental approach.

A substantial body of literature exists regarding bilinguals in the context of reading; however, notable differences among studies exist. These differences primarily arise from variations in how bilingualism is defined (i.e., language dominance, age of acquisition, language usage, etc.), what type of reading is assessed (i.e., narrative, expository, etc.), and what level of discourse processing is being assessed (i.e., surface code, textbase or situational model) (Pérez Muñoz & Bajo, 2022). For instance, some studies focus on early aspects of reading comprehension, such as word prediction or word activation, which largely rely on surface-level information (Gullifer et al., 2013; Starreveld et al., 2014; Van Assche et al., 2009). In general, these studies suggest that language activation is not exclusive at the early stages of language processing, and elements from both languages are co-activated, even when only one language is required. Other studies explore how inferences are made at the sentence level, thus exploring the comprehension of textbase information (Perez et al., 2019; Zirnstein et al., 2018). These studies generally find that reading in the non-dominant language requires more cognitive control, and individuals with higher cognitive control and working memory are better at making inferences.

Still, other studies investigate overall comprehension, including the construction and integration of situational models or representations, but with a broader scope that extends beyond working memory and encompasses long-term memory (Friesen & Frid, 2021; Friesen & Jared, 2007; Schleicher & Schwartz, 2021). In general, it appears that knowledge transfers across languages, but revisions to acquired knowledge require more effort when the new information is presented in the non-dominant language (Schleicher & Schwartz, 2021). However, to the best of our knowledge, there is a lack of research on how readers update their situational models in real-time in working memory during non-dominant language reading. Understanding how readers update their situational models in real-time during reading in their non-dominant language would

significantly enhance our understanding of the impacts of language processing on these updating mechanism. This research could shed light on the cognitive mechanisms involved in constructing and updating meaningful situational models to reach comprehension in individuals with differing levels of language proficiency. Additionally, this research would be beneficial to inform current discourse processing models that currently do not account for language proficiency or individual differences in attentional and working memory capacity.

1.4 THE CURRENT STUDY

This experiment explores how language proficiency and individual differences in working memory and attention influence the construction and updating of situational models in real-time. One advantage in examining situation model updating in bilinguals is that their reading proficiency is typically unbalanced across their two languages, with one being significantly less dominant. This allows bilinguals to serve as their own controls, effectively eliminating potential individual differences that are commonly observed in between-subject designs. Hence, any differences in updating cannot be attributed to differences across participants but to differences in language proficiency.

To explore the influences of language proficiency, attentional, and working memory capacity, we asked bilingual participants to read narrative texts and complete the same recognition task used by Bailey & Zacks (2015). Considering discourse and language processing demands, it was anticipated that individuals with lower language proficiency would predominantly engage in global updating when encountering a meaningful change in either the character or spatial dimension to alleviate attentional and working memory resource demands during the updating process (Bailey & Zacks, 2015). This global updating pattern should be reflected in slower and less accurate responses to probes referencing both the changed and

unchanged dimension after a meaningful dimension change in the text compared to probes presented after no meaningful change in the text occurred (see Appendix Table 1A for a description and example of each condition). At high levels of proficiency, patterns of incremental updating were anticipated where participants should respond more quickly and accurately to probes after no meaningful change and to probes referencing the unchanged dimension after a meaningful dimension change in the text compared to probes referencing the changed dimension (see Appendix Figure 1A for samples of global and incremental updating patterns in reaction time and accuracy). Furthermore, we predicted that cognitive abilities, such as attention and working memory capacity, would modulate situational model updating patterns. Specifically, higher attentional and working memory capacity should be associated with more incremental updating.

Chapter 2. Situational Model Updating Experiment

This experiment aimed to investigate how language proficiency, working memory capacity, and attentional capacity influence the updating of situational models when people read texts. We expected more robust evidence of global updating for individuals with lower language proficiency. We also expected stronger evidence of global updating in individuals with lower attention and working memory capacity.

2.1 Method

2.1.1 Power and Sample Size

The sample size was estimated using the Power Curve function from the simr package in R (Green & Macleod, 2016). This function compares a full model to a reduced model to calculate sample size to reach a desired power. The function requires preliminary data to generate Monte Carlo simulations. We used data from 45 participants to calculate the required sample size to reach a power of 80%. Our full model included the interaction terms between language proficiency (continuous variable), shift type (No Shift, Unchanged, Changed), and probe type (Character or Space). The reduced model did not include the interaction terms, only the main effects. We calculated power for reaction time data only, given that this is where previous research found meaningful differences in updating (Bailey & Zacks, 2015). The results of the reaction time power analysis indicated a need for around 525 correct trials for each combination of shift type by probe type. Our final sample size included over 500 correct trials in each combination of shift type by probe type (Range: 517 – 635). See Table 3 for the number of correct trials we collected and Figure 1 for the power analysis results. The post hoc power analysis revealed that our model had an observed power of 83%.

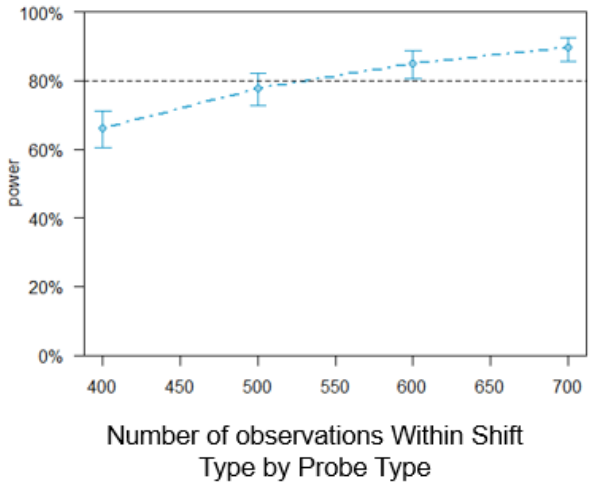


Figure 1. Sample Size Required for Each Combination of Shift Type and Probe Type to Reach a Power of 80%

Table 3: Number of Correct Trials Used for Final Analysis in Each Study Condition

	Shift Type		
Probe Type	*No Shift*	*Unchanged*	*Changed*
Character	619	615	635
Space	561	517	525

2.1.2 Participants

One hundred and twenty-four English-Spanish bilingual college students (average age 20.54 ± 3.27 years; 89 females) were recruited from the University of Texas at El Paso (UTEP) psychology department subject pool or via flyers from the general UTEP population. Participants were compensated with course credit or $10 per hour, or a combination of both. The study was approved by UTEP's Institutional Review Board. Data from 10 participants was removed due to attrition, 5 for computer errors, and 15 for not meeting a minimum 60%[1] threshold on the

[1] A 60% accuracy threshold was chosen to ensure that the results were higher than chance but also not too restrictive given performance that might be expected by those individuals with lower language proficiency.

True/False comprehension scores for the narrative text in either language. Thus, the final sample size was 94 participants. See Table 4 for descriptive statistics of self-reported language characteristics of the final 94 participants.

Table 4: Average Self-Reported Percent Language Usage in the Past Month and Age of Acquisition from the ESPADA Questionnaire

	English	Spanish	Mixture of Both
Speaking	42.2	35.7	22.0
Listening	48.3	31.1	20.6
Reading	75.7	16.6	7.8
Writing	79.9	14.1	5.9
Average Age of Acquisition	6.0 (4.3)	0.3 (0.6)	

Note: Values in parentheses represent the standard deviation.

2.1.3 Materials

2.1.3.1 Narrative text

We used 10 texts (2 practice texts and 8 experimental texts) describing actors engaged in everyday activities from a third-person perspective. These texts have been used previously in the event cognition literature and were specifically designed to highlight character or spatial dimension shifts and have a similar level of difficulty and length (Bailey et al., 2017; Bailey & Zacks, 2015). To ensure accuracy, three bilingual research assistants translated the texts into Spanish. Given the grammatical differences between the two languages, we prioritized preserving the story's overall meaning and dimensional shifts rather than pursuing a word-for-word translation. See Table 5 for a description of each text and Appendix B for the English version of each story. Each participant received half of the texts (1 practice and 4 experimental) in English and the other half in Spanish. The assignment of the experimental text to language was counterbalanced across participants. One practice text was always presented in English, and the other was in Spanish.

Table 5: Description of Narrative Texts and Word Count.

Name	Description	Word Count	
		English	Spanish
Spanish Practice	Raymond runs into Susan after school. After some light, laughing conversation, they begin a game of chase across the school lawn, running through bushes and laughing.	N/A	278
English Practice	Mr. Birch practices casting with a fishing rod rigged with a spark plug in the yard. His son, Raymond, excitedly chases the movements of the plug with each cast, interacting joyfully with their dog, and exploring the surroundings.	440	N/A
Aquarium	Linda takes her son Jimmy, who has a new interest in marine life, to the local aquarium. Throughout their visit, they explore various exhibits, including jellyfish, penguins, Sharks, and a dolphin show, with each exhibit evoking distinct emotions and experiences.	1182	1202
Camping	Jim and Kathy, decide to take their kids on their first camping trip. Their journey involves last-minute shopping, a scenic drive up a mountainside, and the satisfaction of setting up camp, promising a fulfilling outdoor adventure for the family.	1337	1342
Castle	College friends Haley and John, embark on a trip to Germany together. The story captures their unique dynamics, balancing John's historical curiosity with Haley's artistic inspiration.	1329	1302
Hospital	Holly and her boyfriend, Brian, visit her Grandma Rita in the hospital after her hip surgery. Their visit captures the early stages of their relationship, highlighting Brian's occasional self-centeredness and his efforts to make amends, all set against the background of Holly's family concerns and hospital surroundings.	1286	1301
Morning	The Johnson family, Martin and Molly and their sons Zach and Jonathan, navigate a typical morning of preparing for work and school. While Martin is a cheerful early riser, Molly struggles with mornings, and both parents handle their kids' morning grogginess and occasional disputes	1205	1136
Office	Mike struggles with a difficult morning, feeling a sense of existential discontent and grappling with personal dissatisfaction as he prepares for work. After dealing with a difficult day at work, Mike decides to take a positive step towards self-improvement by considering a jog, embracing the idea that small efforts can lead to significant changes.	1404	1411
Shopping	Ashley and Maria, college roommates with contrasting backgrounds, embark on a Christmas shopping trip at the mall. While Ashley, a music major from a modest background, focuses on thoughtful gifts for her boyfriend, Maria, a marketing major from a wealthier background, grapples with the unfamiliar concept of budgeting and using coupons.	1316	1303
Zoo	Liz, an exhausted babysitter, takes the spoiled and temperamental five-year-old Violet to the zoo. After a series of mishaps, Liz finds a brief break in a Children's Center where Violet joins a Workshop. The workshop improves Violet's mood, allowing the pair to enjoy the rest of their day at the zoo.	1043	1038

2.1.3.2 Cognitive assessments

2.1.3.2.1 Attentional control. We used the Selective Visual Array (Draheim et al., 2021) task to assess participants' attentional control. The task was presented using E-Prime 3.0 (Psychology Software tools, Inc., 2016). The Selective Visual Array task is a non-linguistic interference/conflict resolution task. In this task, participants saw an array of blue and red rectangles oriented vertically, diagonally, or horizontally. They were cued to only attend to rectangles in one color. The array was presented for 250 ms, followed by a blank screen for 900 ms, and then a screen showing the target color rectangles with one rectangle marked with a white dot. Participants had to indicate whether the orientation of the marked rectangle changed or remained in the same position from the original presentation array by pressing the number 5 key or the number 6 key on the number pad, respectively. There was no time limit for their response. The orientation of the marked rectangle changed in half of the trials. See Figure 2 for a visual representation of a trial and how it appeared on the computer screen.

Performance was calculated using the EngleLab R package (Tsukahara, 2022). This package calculates an average *k*, an attentional capacity score (see Cowan et al., 2005; Shipstead, Lindsey, Marshall, & Engle, 2014). The calculation is k = N(Hits + Correct Rejection – 1), where N is the set size for a particular array (i.e., 10 or 14 total blue and red rectangles). This calculation results in two separate k scores, one per set size. The final measure used was the average k across these two set sizes. Although the task has been associated with visual working memory capacity, recent research has argued that the task can be used as a measure of attentional control (Draheim et al., 2021; Martina et al., 2021). Draheim and colleagues (2021) argue that when the task requires participants to ignore distractors presented along with the target,

performance is driven mainly by individual variation in attention control rather than working memory capacity.

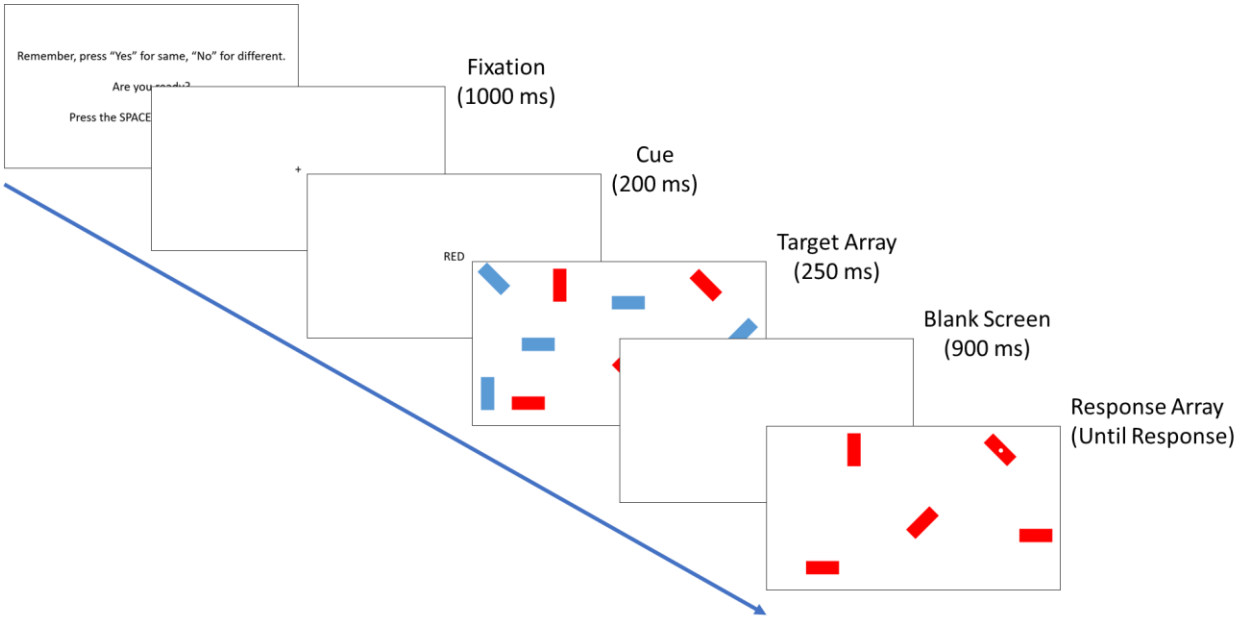


Figure 2. A Visual Representation of an Unchanged Trial in the Visual Array Task

2.1.3.2.2 Working memory. We used the rotation span to assess participants' working memory capacity (Draheim et al., 2018). The task was presented using E-Prime 3.0 (Psychology Software tools, Inc., 2016). The rotation span is a non-linguistic task where participants are asked to judge the orientation of letters and remember a sequence of arrows. Participants were first presented with a rotated letter and had to determine if it was backward (i.e., mirror-imaged) or normal (i.e., not mirror-imaged). After making their judgment, participants were presented with an arrow, followed by another letter, and so on, until the screen prompted them to recall all the arrows they saw in the order in which they were presented. The arrows radiated from the center of the screen and had eight possible directions with two different sizes (16 total possible arrows). The set size varied between 3 and 10. See Figure 3 for a visual representation of a trial and how it appeared on the computer screen. We used the partial span score as a measure of

working memory. The partial span score is the total number of arrows recalled in the proper serial position across all trials (Conway et al., 2005).

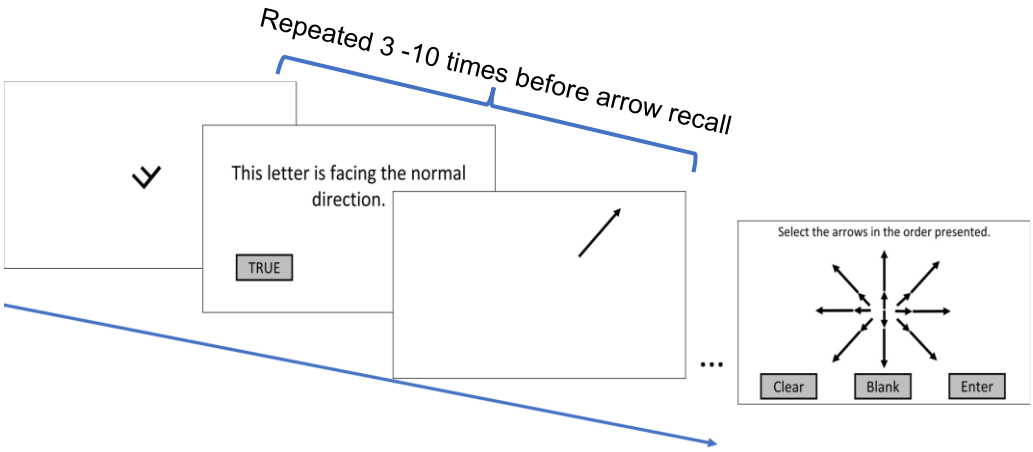


Figure 3. A Visual Representation of a Trial in the Rotation Span Task

2.1.3.3 Language proficiency assessments

Objective measurement. The verbal analogies and passage comprehension subtests of the Woodcock-Muñoz Language Survey-Revised (WMLS-R; Woodcock, Muñoz-Sandoval, Ruef, & Alvarado, 2005) were used to assess participants' language dominance. Verbal analogies consist of an analogy mapping task where participants are given the first part of the analogy and must complete the second part (e.g., *"You hear with your ears, and you see with your…"* [expected answer: *eyes*]). The passage comprehension assesses students' ability to deduce meaning from a passage by creating mental representations of the words and sentences they are reading to complete a fragmented sentence (e.g., *"There was a fire next door. The house was_____."* [expected answer: *burning*]). We used the W scores to assess participants' language dominance. The W score is an equal-interval growth scale calculated from the Rasch model of data analysis, which is based on item response theory (Woodcock, Muñoz-Sandoval, Ruef, & Alvarado, 2005). See Table 6 for the Woodcock-Muñoz results. We also used a lexical decision task (LDT) to

measure objective vocabulary proficiency in English and Spanish. The LDT task was created and presented using E-Prime 3.0 (Psychology Software tools, Inc., 2016), see Table 7 for the LDT results from the current study.

Table 6: English and Spanish Woodcock-Muñoz Average Performance

	English		Spanish	
Assessment	*W Score*	*Age Equivalence*	*W Score*	*Age Equivalence*
Verbal Analogies	506.1 (12.4)	14.1 (6.7)	505.6 (31.1)	17.5 (9.4)
Passage Comprehension	509.2 (14.4)	13.5 (5.7)	512.0 (16.4)	16.0 (8.2)

Note: Values in parentheses represent the standard deviation.

Table 7: Lexical Decision Task Average Performance

	English	Spanish
Reaction Time (Milliseconds)	1164.5 (420.1)	1305.3 (514.0)
Accuracy	88.4% (7.3)	86.4% (6.6)

Note: Values in parentheses represent the standard deviation.

Subjective measurement. We used the English-Spanish Proficiency and Dominance Assessment (ESPADA*;* Francis & Strobach, 2013) to assess self-reported English and Spanish proficiency. This questionnaire is an untimed, self-report questionnaire that considers multiple dimensions of a participant's language background. The items include information on the age of language acquisition, information regarding where the participant has lived (U.S., Mexico, or other Spanish-speaking countries), family language usage, social language usage, educational language usage, self-rated proficiency levels on reading, writing, and speaking in each language, and other general language background information.

2.1.3.4 Measure of Situational Model Updating

We used the same probe recognition task implemented by Bailey & Zacks (2015). The task consisted of participants reading a story and periodically responding to probes referencing dimensions (character or space) of the text they recently read. Each text contained 12 trials. For half of the trials, the probe was a phrase from the text (i.e., target), and for the other half, it was not part of the text but highly possible (i.e., foil). On each trial participants read five sentences; the first sentence contained the phrase later used for the probe, followed by three filler sentences, and a final sentence containing a spatial shift, a character shift, or no shift. After reading the 5th sentence, participants were given the recognition task for the target probe phrase or foil probe phrase. Participants were asked to determine whether the probe phrase was one they had read. After responding to the probe, the reading resumed, and the procedure was repeated. See Figure 4 for a structural example of the three types of trials and Figure 5 for a visual representation of a trial and how it appeared on the computer screen. Half of the twelve recognition probes were character probes, and half were spatial probes. The probe type (character or spatial) was crossed with the type of dimension shift (character shift, spatial shift, and no shift), resulting in six different conditions. There was one trial per condition per narrative text for a total of eight trials total (four per language). See Table 8 for a representation of all the types of conditions.

	Set-up Sentences (Introduction)	One Saturday morning, Linda took her son Jimmy to the local aquarium.
Trial 1 No Shift – Space Probe	**Probe word Sentence**	They entered the lobby, which had a life-size model of a whale hanging **from the ceiling**.
	Filler 1	Jimmy was impressed by the size of the lobby and the whale, with its ribcage the size of a school bus.
	Filler 2	The high ceiling was painted to resemble the surface of the ocean.
	Filler 3	He looked around in awe at the colorful coral reefs.
	No Shift Sentence	Jimmy gaped up at the whale's belly and smiled.
	Probe-Space	"FROM THE CEILING" (target); "FROM THE ENTRANCE" (foil)
	Filler 4	He pointed out to his mom the painted schools of fish on the ceiling. He saw striped angelfish, graceful manta rays, and clownfish like Nemo from the Disney movie.
	Filler 5	Crabs, too, like the ones they'd seen at seafood restaurants, with their tool-like pinchers.
Trial 2 Changed – Character Probe	**Probe word Sentence**	He finally looked down from the ceiling and rubbed his **stiffening neck**.
	Filler 1	Jimmy noticed a picture of a shark on the wall, and his eyes widened.
	Filler 2	He loved sharks.
	Filler 3	In fact, he was wearing his favorite shark t-shirt.
	Character Shift Sentence	Linda got her money out, and checked the prices above the ticket window.
	Probe-Character	"STIFFENING NECK" (target); "OBNOXIOUS VOICE" (foil)
	Filler 4	A surgeon at the local hospital, Linda was glad she had found time between shifts to bring Jimmy to the aquarium.
Trial 3 Unchanged – Character Probe	**Probe word Sentence**	Linda's **baby-blue eyes** widened when she saw how expensive the tickets were.
	Filler 1	She hadn't been to the aquarium in years and was surprised at how the prices had gone up.
	Filler 2	She was a single mom, so money could have been tight.
	Filler 3	She was glad she had such a great job.
	Spatial Shift Sentence	Linda paid for the tickets, and they walked down the hall and turned left into the jellyfish room.
	Probe-Character	"BABY-BLUE EYES" (target); "DIRTY FINGERS" (foil)

Note: Each trial consisted of a sentence containing a probe phrase, three filler sentences, and a change or no change sentence. Participants indicated whether or not they had read the probe phrase in a recent sentence.

Figure 4. Visual Representation of Three Trials in the Probe Recognition Task

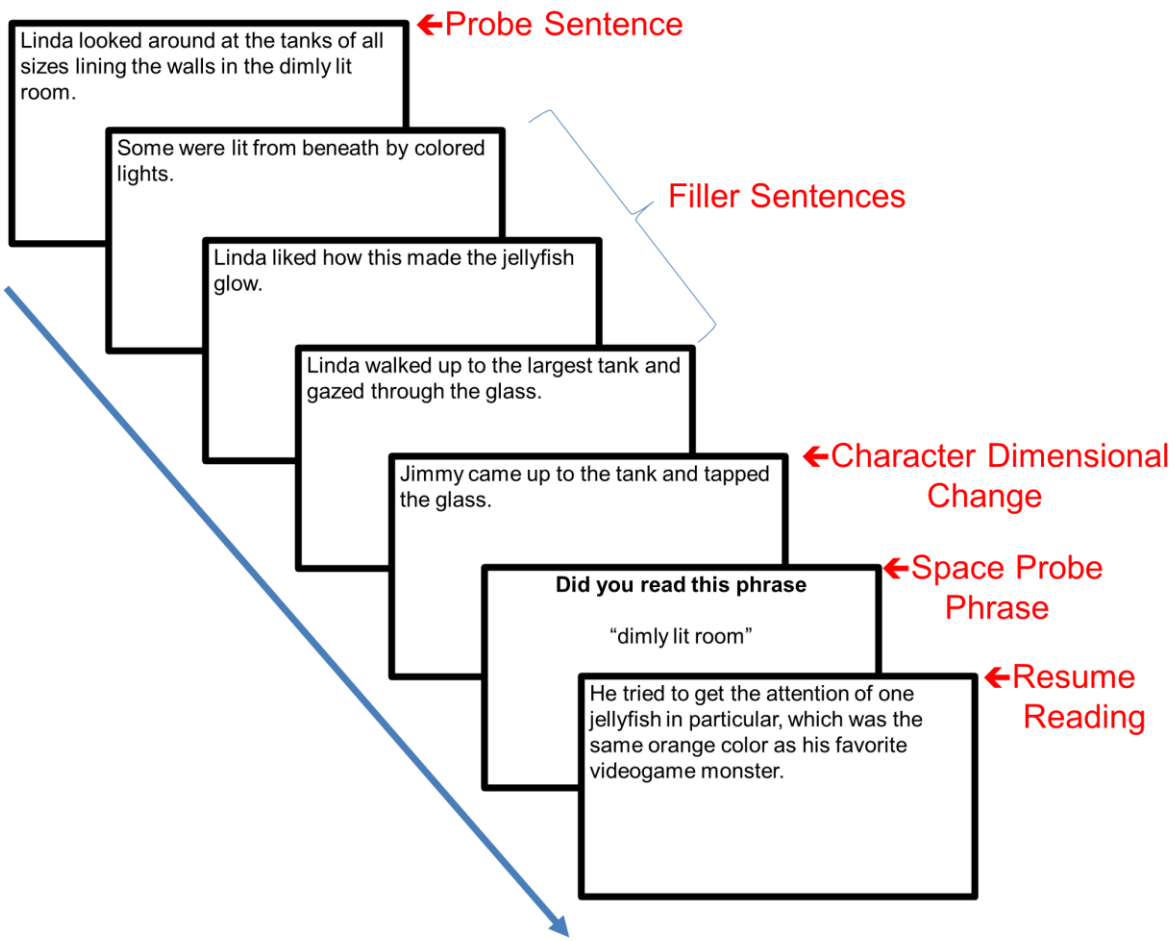


Figure 5. Representation of a Trial and How It Appeared on the Computer Screen in the Probe Recognition Task

Table 8: Situational Model Task Conditions

	Shift Type		
Probe Type	No Shift	Character	Spatial
Character	*No Shift*	*Changed Condition*	*Unchanged Condition*
Spatial	*No Shift*	*Unchanged Condition*	*Changed Condition*

Note: There were 12 trials, 6 targets, and 6 foils. Each story had one target trial per combination of the probe type by shift type.

2.1.3.5 Reading Comprehension Assessment

Twenty true/false statements were generated per text. Half of the statements were true, and half were false. Ten statements were designed to be easy, and ten to be difficult to evaluate a range of comprehension levels of the text, see Appendix table 1C. A 60% accuracy criterion was used in either language to eliminate participants from the final data analysis. Previous research used a 70% criterion to drop participants (Bailey & Zacks, 2015). However, the participants in previous research were monolinguals. Therefore, we used a less restrictive criterion, given that bilinguals have the same amount of language exposure as monolinguals, but this exposure is split across their two languages (Dijkstra & van Heuven, 2002). It is also important to note that Bailey & Zacks (2015) applied the 70% criteria to the probe recognition task. We applied our criteria to the comprehension assessments since we are interested in how bilinguals update situational models to reach comprehension across their two languages. Thus, the reading comprehension questions should be a better assessment of overall comprehension of the text than the probe recognition task. The final 94 participants had an average accuracy of 83.55% (SD = 8.11%) in English and 80.34% (SD = 8.48%) in Spanish.

2.1.4 Procedure

The experiment took 4 hours to complete across two days (2 hours each day). On day 1, participants completed the consent form, a demographics questionnaire, the cognitive assessments, and the language assessments. The demographics and subjective language questionnaires were completed online via Question Pro. On the second day, participants were instructed to read each text at their own pace. The order of the texts was partially randomized; a random list of sequences was generated, and a subset of those possible combinations was selected randomly to create the set of text sequences assigned to participants. This procedure

insured that one story was not presented more frequently in Spanish than in English or in a particular ordinal position more frequently than others. Language presentation was blocked and counterbalanced between participants. In other words, participants read four stories in English first, then four stories in Spanish, or vice versa. The language order was counterbalanced. The practice text was presented first in each language block and was offered in the second language block but not required.

All texts were presented one sentence at a time using E-Prime 3.0 (Psychology Software tools, Inc., 2016). Participants were instructed to read each sentence and press the spacebar to continue to the next sentence. They were told that a recognition task would occur periodically as they read the text and that for this task, they had to decide if a phrase was presented to them earlier during the text. They were instructed to decide whether the probed phrase was a sentence they had recently read in the text or not (see Figure 5). Participants were asked to press "Q" as quickly as possible if the probed sentence was a sentence they had recently read or press "P" as quickly as possible if they had not recently read it. Accuracy and reaction time were recorded.

2.2 Data Preparation

Reaction time and accuracy data were analyzed with linear mixed models (LMM) in R using the packages lme4 (Bates et al., 2015), lmer Test (Kuznetsova et al., 2017), and the emmeans package (Russell, 2021). We only analyzed target trials (i.e., trials that consisted of sentences presented in the text participants read) to ensure we assessed the representations of the actual text. All reaction time analyses included only correct trials. Additionally, any reaction times greater than 3.5 standard deviations from the participant's average reaction time were removed from the analysis. This resulted in the deletion of 60 trials (i.e., 1% of data) from the analysis. For the reaction time models, the random effects for subject and stories were added to

the model. An ANOVA test was performed to assess the significance of the random factors. The same procedure was used for the accuracy models. The final models retained all the random effects.

There were three separate analyses: (1) the base model analysis, where we assessed the main effects and interaction between Language Proficiency (i.e., the W scores of the Woodcock-Munoz Passage Comprehension Assessment; the most closely related measure to reading comprehension), Shift Type (i.e., No shift, Unchanged and Changed) and Probe Type (i.e., Character or Space probe) (2) an analysis where we added attentional capacity (i.e., the k scores from the Selective Visual Array task) to the base model and (3) an analysis where we added working memory (i.e., the partial span score from the Rotation Span task) to the base model. Language proficiency was mean-centered for the base model. For the subsequent models, language proficiency, attentional capacity, and working memory were standardized for model convergence purposes. Please see Table 9 for the list of models.

Table 9: List of Linear Mixed Models

Number	Model Fixed Effects
1	Language Proficiency * Shift Type * Probe Type
2	Attentional Capacity * Language Proficiency * Shift Type * Probe Type
3	Working Memory Capacity * Language Proficiency * Shift Type * Probe Type

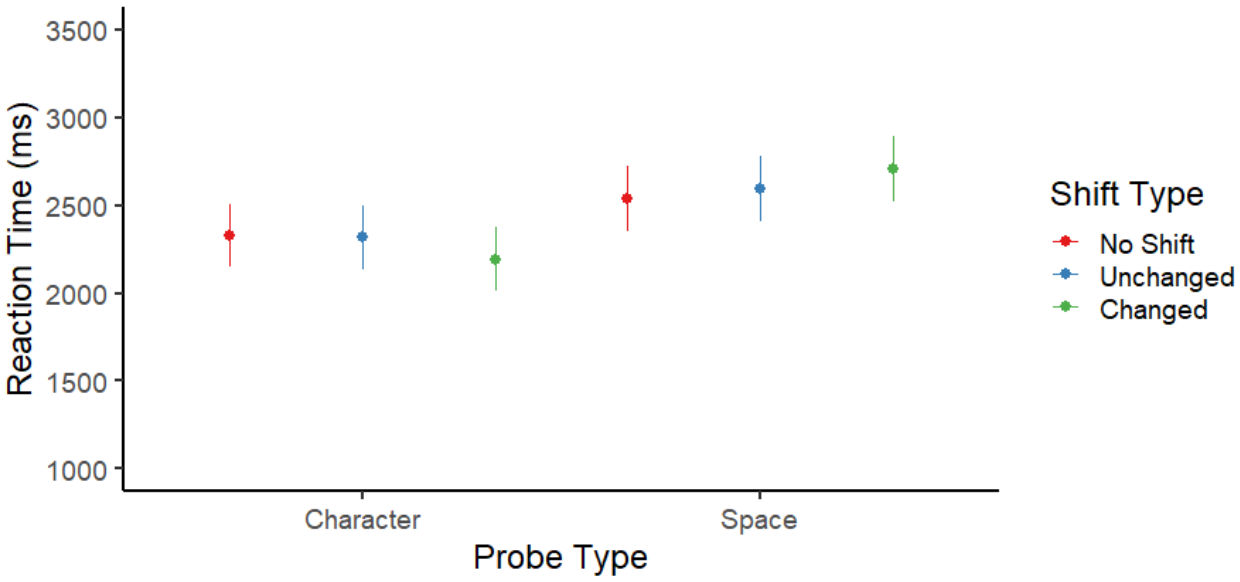
Note: The random effects always included random intercepts by subject (i.e., 1|subject) and story (i.e., 1|Story).

Chapter 3. Results

3.1 Base Model

3.1.1 Reaction Time

The results showed a main effect of language proficiency on reaction time, $p = .005$. Participants with lower language proficiency took longer to respond to probes than participants with higher language proficiency, see Figure 6. The main effect of probe type was also statistically significant, $p < .001$. Participants took longer to respond to space probes ($M = 2612$, $SE = 82.5$) than character probes ($M = 2278$, $SE = 81.7$). However, there were no reliable differences in reaction time between the shift type conditions, all $p > .69$. The interaction between probe type and shift type was statistically significant, $p = .004$, demonstrating that the degree of difference in reaction time between different shift types differed depending on probe type (see Appendix Table 1D for the pairwise results). Specifically, while reaction time appeared to decrease across the no shift, unchanged, and changed shift types for character probes, the opposite pattern was seen for spatial probes, with increasing reaction times across these shift types (see Figure 6). None of the two-way or three-way interactions between language proficiency, shift type, and probe type were statistically significant, all $p > .10$. See Table 10 for the LMM results.



Note: The graph shows the mean reaction time by shift type and probe type. Error bars show standard errors of the means.

Figure 6. Linear Mixed Model Results: Mean Reaction Times (Shift Type by Probe Type)

Table 10: Linear Mixed Models Results for Reaction Time and Accuracy (Base Model)

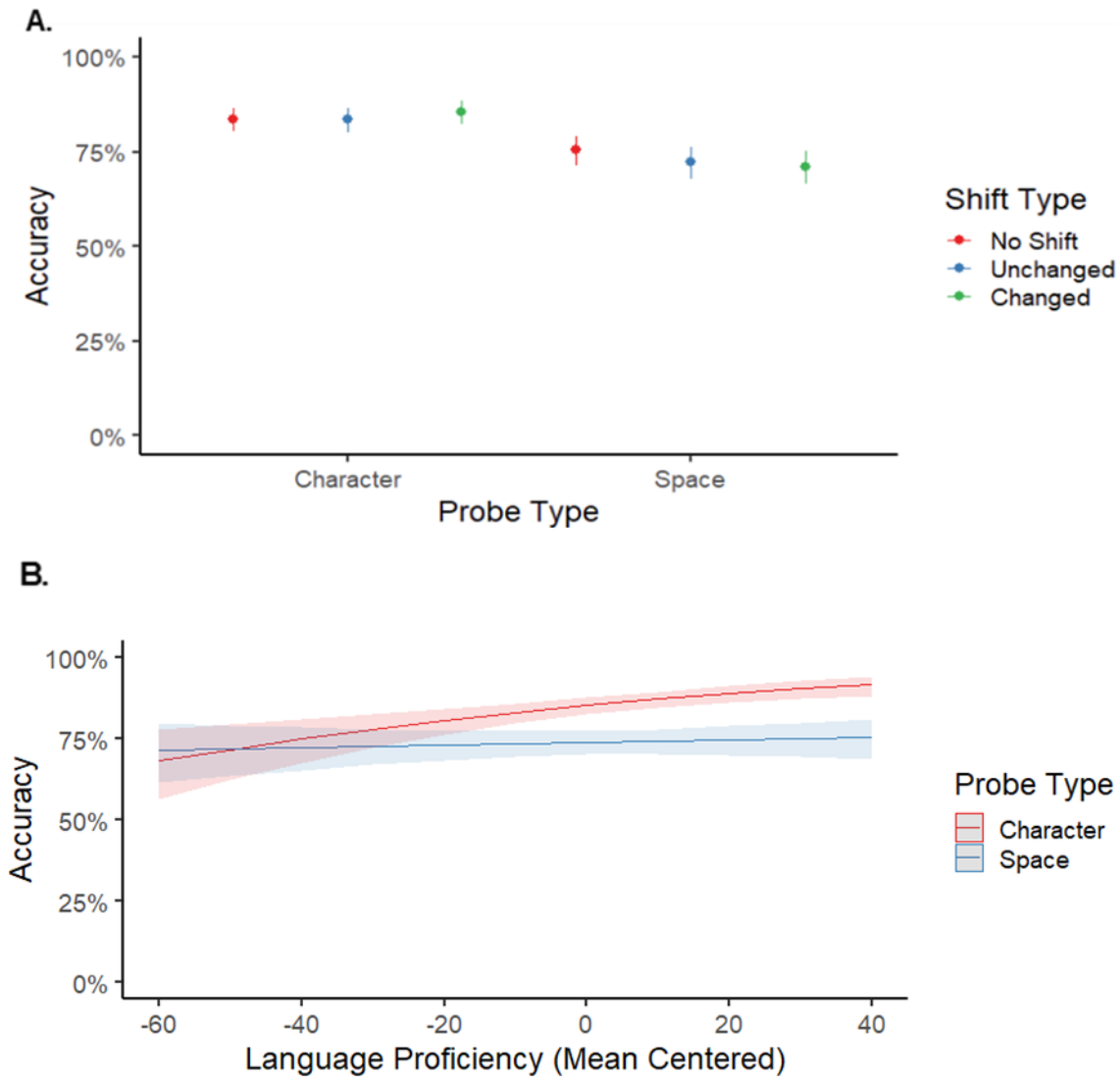
	Reaction Time			Accuracy		
Predictors	*Coefficients*	*CI*	*p*	*Odds Ratio*	*CI*	*p*
(Intercept)	2272.88	2101.95 – 2443.80	**< .001**	5.66	4.63 – 6.92	**< .001**
Language Proficiency	-6.63	-9.12 – -1.64	**.005**	1.01	1.00 – 1.01	**.005**
Shift Type [No Shift vs. Unchanged]	20.75	-81.54 – 122.58	.693	0.91	0.76 – 1.08	.281
Shift Type [No Shift vs. Changed]	3.46	-98.05 – 104.96	.947	0.93	0.78 – 1.11	.431
Shift Type [Unchanged vs. Changed]	-17.07	-119.42 – 85.29	.744	1.03	0.86 – 1.22	.769
Probe Type [Character vs. Space]	333.16	249.94 – 416.38	**< .001**	0.50	0.43 – 0.58	**< .001**
Probe Type * Shift Type	302.51	98.92 – 506.09	**.004**	0.68	0.48 – 0.98	**.040**
Language Prof. * Shift Type	2.95	-3.67 – 9.58	.382	0.99	0.98 – 1.00	.254
Language Prof. * Probe Type	3.77	-1.63 – 9.17	.171	0.99	0.98 – 1.00	**.003**
Language Prof. * Probe Type * Shift Type	11.10	-2.15 – 24.35	.101	1.03	1.00 – 1.05	**.027**

Note: CI = 95% confidence interval.

3.1.2 Accuracy

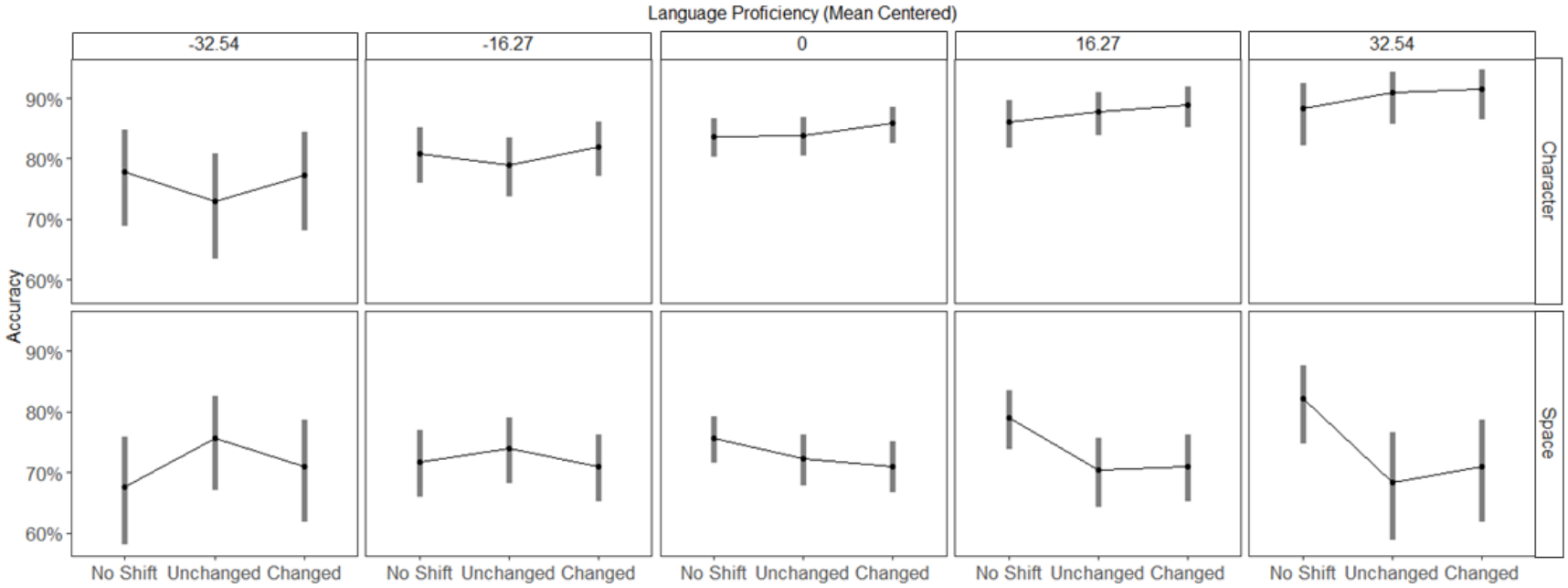
The results showed a main effect of language proficiency, $p = .005$. Participants with higher language proficiency responded more accurately to the probes than participants with lower language proficiency. The main effect of probe type was also statistically significant, $p < .001$. Participants responded less accurately to the space probes ($M = 0.73$, $SE = 0.02$) than the character probes ($M = 0.84$, $SE = 0.01$). Regarding the main effect of shift type, the results showed no statistically significant differences between any of the shift type conditions, all $p > .281$. The interaction between probe type and shift type was statistically significant $p = .04$. For character probes, accuracy increased across the no shift, unchanged, and changed conditions.

However, the pattern was in the opposite direction for spatial probes; accuracy decreased across no shift, unchanged, and changed conditions (see Figure 7(a) and Appendix Table 2D for the pairwise results). The language proficiency by probe type interaction was also statistically significant, $p = .003$. Character probe accuracy increased with higher levels of language proficiency. However, language proficiency did not impact the accuracy of space probes (see Figure 7(b)). The three-way interaction was also statistically significant, $p = .023$. Character probe accuracy increased with higher levels of language proficiency across all levels of shift type with no difference between the shift type conditions. On the other hand, for spatial probes, higher levels of language proficiency were associated with lower accuracy in the unchanged and changed condition compared to the no shift condition. These results suggest a global updating effect for spatial information at high levels of language proficiency. See Figure 8 and Appendix Table 3D for the pairwise comparisons from the three-way interaction. See Table 10 for the LMM results.



Note: Graph A shows the mean accuracy by shift type and probe type. Graph B shows the mean accuracy by language proficiency. Error bars (graph A) and color bands (graph B) show standard errors of the means.

Figure 7. Linear Mixed Model Results for Accuracy



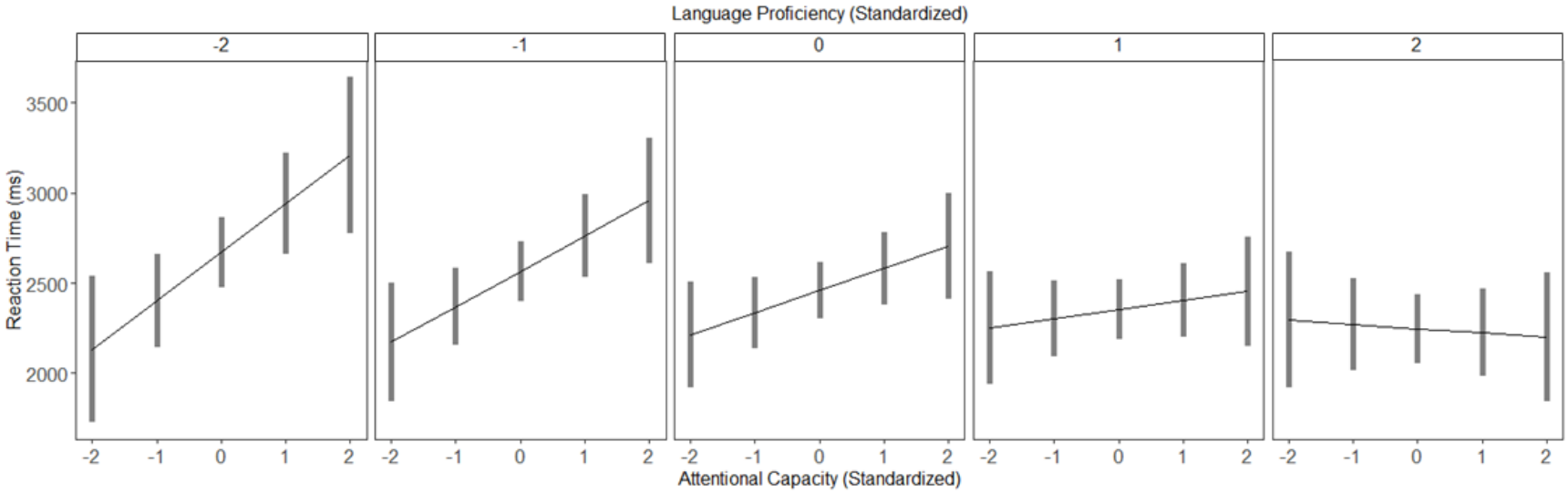
Note: The graph shows the mean accuracy by shift type and probe type at different levels of language proficiency. Error bars show standard errors of the means. The language proficiency values selected represent the values from two standard deviations below and above the mean.

Figure 8. Linear Mixed Model Results for Accuracy (Three-way Interaction)

3.2 Attentional Capacity Model

3.2.1 Reaction Time

The main effect of attentional capacity was not statistically significant, $p = .14$. However, the interaction between language proficiency and attentional capacity was significant, $p = .015$. Participants with higher attentional capacity and low language proficiency took longer to respond to the probes than participants with higher attentional capacity and higher language proficiency (see Figure 9). No other two-way, three-way, or four-way interactions between attentional capacity, language proficiency, shift type, and probe type were statistically significant, all $p > .208$. See Table 11 for the LMM results.



Note: The graph shows the mean reaction time at different levels of attentional capacity and language proficiency. Error bars show standard errors of the means.

Figure 9. Linear Mixed Model Results for Reaction Time (Attentional Capacity by Language Proficiency)

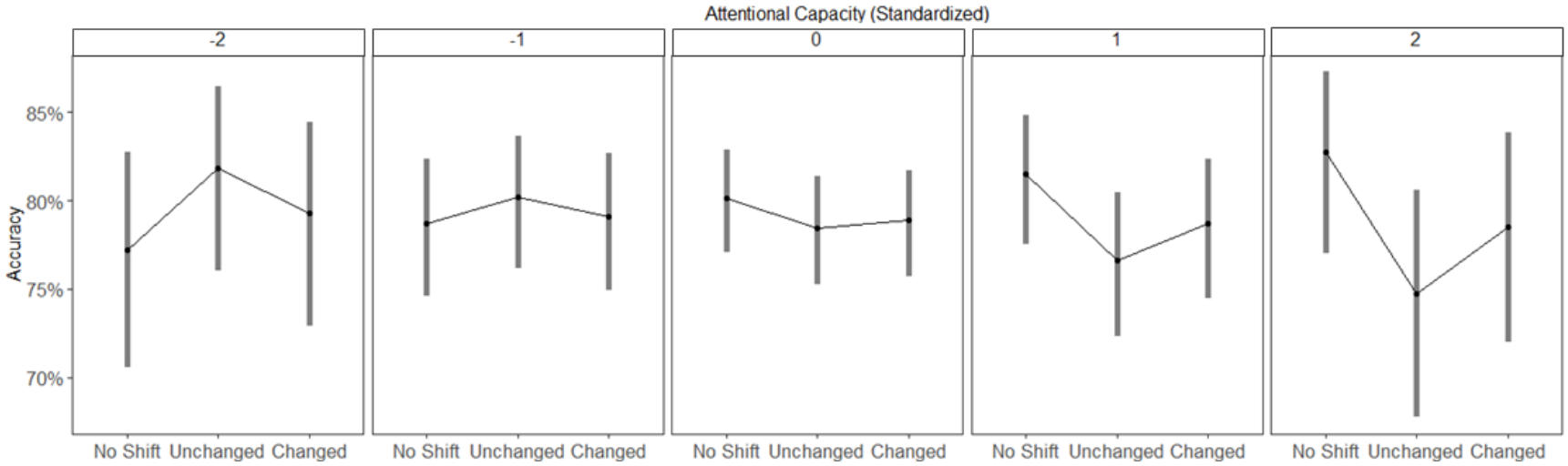
Table 11: Linear Mixed Models Results for Reaction Time and Accuracy (Attentional Control Model)

	Reaction Time			**Accuracy**		
Predictors	*Estimates*	*CI*	*p*	*Odds Ratio*	*CI*	*p*
Attentional Capacity	96.53	-28.53 – 221.60	.130	0.99	0.89 – 1.10	.806
Att. Cap. * Language Prof.	-73.02	-131.93 – -14.11	**.015**	1.00	0.91 – 1.09	.948
Att. Cap. * Shift Type [No Shift vs. Unchanged]	-42.53	-144.36 – 59.30	.413	0.83	0.69 – 0.99	**.035**
Att. Cap. * Shift Type [No Shift vs. Changed]	-22.56	-125.62 – 80.50	.668	0.91	0.76 – 1.09	.287
Att. Cap. * Shift Type [Unchanged vs. Changed]	19.97	-80.92 – 120.86	.698	1.10	0.92 – 1.31	.300
Att. Cap. * Probe Type [Character vs. Space]	-47.08	-130.38 – 36.22	.268	1.02	0.88 – 1.19	.752
Att. Cap. * Probe Type * Shift Type	133.36	-74.23 – 340.94	.208	1.33	0.93 – 1.92	.120
Att. Cap. * Language Prof. * Probe Type * Shift Type	-113.38	-307.22 – 80.45	.252	0.95	0.67 – 1.35	.780

Note: CI = 95% confidence interval.

3.2.2 Accuracy

The main effect of attentional capacity was not statistically significant, $p = .806$. Similarly, the interaction between language proficiency and attentional capacity was not statistically significant, $p = .948$. However, the interaction between attentional capacity and shift type was statistically significant, $p = .035$. Higher attentional capacity was associated with a decrease in accuracy after a change in the opposite dimension (i.e., unchanged) and an increase in accuracy after no meaningful change, see Figure 10. None of the other interactions between attentional capacity, language proficiency, shift type, and probe type were significant, all $p > .120$. See Table 11 for the LMM results.



Note: The graph shows the mean accuracy by shift type at different levels of attentional capacity. Error bars show standard errors of the means.

Figure 10. Linear Mixed Model Results for Accuracy (Attentional Capacity by Shift Type)

3.3 Working Memory Capacity Model

3.3.1 Reaction Time

There was no main effect of work memory capacity on reaction time, $p = .411$. Similarly, none of the interactions between working memory capacity, language proficiency, shift type, or probe type were significant, all $p > .182$. See Appendix Table 1E for the LMM results.

3.3.2 Accuracy

There was no main effect of working memory capacity on accuracy, $p = .497$. None of the two-way, three-way, or four-way interactions between working memory capacity, language proficiency, shift type, or probe type were significant, all $p > .291$. See Appendix Table 1E for the LMM results.

Chapter 4. Discussion

The current study explored how language proficiency and individual differences in working memory and attentional capacity influence the construction and updating of situational models in real-time. Specifically, we examined how participants retained and updated character and spatial dimensions of narrative texts by asking them to read stories and make decisions about probe phrases regarding character or space information from the stories. Each probe phrase was presented after a meaningful change in the same or the alternative dimension or after no change in either dimension. We anticipated that language proficiency would modulate patterns of updating this information (character or space) in the situational model. Specifically, we predicted that participants would engage in more global updating at lower levels of language proficiency due to increased language processing demands during reading. In contrast, at higher levels of language proficiency, participants were expected to engage in more incremental updating because they would presumably have more resources available to maintain information about unchanged dimensions of the stories in favor of updating only the changed dimension. We also anticipated similar global updating patterns at low attention and working memory capacity levels and more incremental patterns at higher attention and working memory capacity levels.

4.1 The Influence of Language Proficiency and Attentional Capacity on Situational Model Updating

Unlike previous research (Bailey et al., 2017; Bailey & Zacks, 2015), we did not observe a general global or incremental updating pattern. Moreover, we did not find the expected pattern of more global updating at lower language proficiency levels and more incremental updating at higher language proficiency levels. We believe this was due to the modulating effect of language proficiency on the quality of the constructed situational models and the ability to flexibly

prioritize the maintenance of certain information in the situational model. Evidence of fragmented situational model construction was supported by the finding that lower language proficiency was associated with longer reaction times and lower accuracy. In other words, low language proficiency influenced how quickly participants accessed the probed information and the quality or amount of information that could be accessed. Thus, when constructing situational models, having low language proficiency likely interferes with the quality of the situational model that is constructed and held in working memory. This may be due to increased attentional demands caused by challenges in quickly interpreting sentence structures (i.e., surface code) and comprehending the meanings embedded in the text (i.e., textbase). This results in a fragmented situational model where information is difficult to access or is missing (Zwaan & Brown, 1996).

Additionally, not only does language proficiency affect how quickly and accurately information is retrieved, but also how and whether the information is updated in the situational model (see Figure 8). Our study revealed that participants treated character and spatial information differently, particularly at high levels of language proficiency. Character information appeared to remain accessible to participants across all shift types, with some indication that at higher levels of language proficiency, participants reactivate character information rather than removing no longer relevant character information from the situational model. This is counter to findings from prior studies where participants have shown patterns of updating this information (Bailey & Zacks, 2015). For spatial information in our study, participants likely used varying methods to update this information at low levels of language proficiency, resulting in an unclear updating pattern and poor recognition accuracy (71.5%). However, at high levels of language proficiency, participants updated spatial information globally, meaning that when there was a change in either character or space information in the story, participants removed and updated

space information, even when that information remained unchanged. One possible explanation for participants adopting a global updating approach with spatial information is that at high levels of language proficiency, the attentional demands of language processing are lower. This allowed participants to build more cohesive situational models and adjust the targets of their updating as necessary to attend to the character dimension. Given evidence that participants retained character information in the situational model, even when that information changed, participants may have had to reallocate resources that could have been used to retain space information in order to support retaining character information. This explanation is further supported by the fact that at high levels of language proficiency, accuracy for character information was close to 90%. Thus, at high levels of language proficiency, participants may have prioritized attending to the character-related information by removing spatial information from the situational model.

This pattern of reactivation of character information rather than updating in the situational model differs from what Bailey & Zacks (2015) found. One aspect that is different in our methodology is using true/false statements to measure reading comprehension instead of asking participants to summarize the stories as in Bailey & Zacks (2015). Unintentionally, these statements referenced character information more often than spatial information. This may have influenced how the participants attended to the text. Specifically, at higher levels of language proficiency, when attentional demands for language processing are low, participants may have intentionally allocated more attentional resources to the character dimension to support their subsequent performance on the true/false task. This is further supported by the findings of Bailey et al. (2017), where participants were given explicit instructions on what dimension to attend. Participants in this study were asked to either write a summary as in Bailey & Zacks (2015),

provide a detailed description of the characters, or draw a map of the spatial locations described in the text. The results demonstrated different updating patterns across the attentional groups when comprehension was assessed in this fashion. Thus, the goal of the reader can modulate how situational models are updated.

We also found that attentional capacity influenced how participants attended to the information and updated situational models (see Figure 10). At low levels of attentional capacity, participants likely used varying methods to attend to the information, resulting in an unclear updating pattern. However, at high levels of attentional capacity, participants seem to update information more globally. Specifically, after a meaningful change in the alternative dimension, all information was replaced in the situational model, and although the three-way interaction between attentional capacity, shift type, and probe type did not reach significance (but trended to significance), this is likely more true for spatial information in our study. With higher attentional capacity, more resources can be devoted to attending to the incoming information and updating the situational model accordingly.

Additionally, the current study found that language proficiency and attentional capacity influenced how quickly participants responded to the probe (see Figure 9). Specifically, we found that participants with low language proficiency and high attentional capacity responded more slowly. However, this slowed responding did not result in better accuracy. One possible explanation for this unexpected result is that participants with low language proficiency and high attentional capacity engage in a heightened conscious monitoring process of their performance due to a potentially poorer situational model representation. In other words, participants with high levels of attention (but low language proficiency) spent more time monitoring their decision-making, ensuring they arrived at a correct response. However, this did not improve

accuracy performance because the situational model is fragmented at low levels of language proficiency. At high levels of language proficiency, the situational model is more cohesive, making it easier to arrive at and verify correct responses.

4.2 The Role of Working Memory on Situational Model Updating

Counter to our predictions, the present study revealed no significant effect of working memory capacity on either reaction time or accuracy in the probe recognition task. The models of discourse processing discussed earlier consistently characterize working memory as a temporary storage for information (Gernsbacher, 1997; Zacks et al., 2007; Zwaan, Langston, et al., 1995). In other words, the role of working memory is to maintain information active rather than accessing and updating incoming information. Another consideration to take is that our study consisted of college students, a typically young demographic group with high levels of working memory capacity. Consequently, the complexity of the recognition task may not have been demanding enough to tax working memory resources. As a result, the probe recognition task might be more demanding on attentional resources than working memory.

4.3 General Differences in Character and Space

The current study found a significant difference in how fast and accurate participants responded to character and spatial information. Specifically, we found that participants were faster and more accurate at responding to character probes than spatial probes. Similarly, slower reaction times for spatial information have been found in previous studies (Bailey et al., 2017; Bailey & Zacks, 2015). However, these results typically fall outside the scope of the research, and as a result, little effort has been provided at trying to parse these differences. Given the results of the current study, we suggest that character and spatial information may be processed and updated differently. Specifically, character information is likely easier to track than spatial

information (Bailey et al., 2017). Characters are also typically the main focal point of narrative text, and their roles, interactions, and developments often form the core of the narrative. Furthermore, as explained earlier, the true/false statements used to assess reading comprehension referenced information about the characters more frequently than spatial information. Therefore, it is possible that participants adjusted how they manipulated the incoming information to make information related to characters relatively accessible in working memory.

4.4 Limitations and Future Directions for Research and Models of Discourse Processing

In their current state, the models of discourse processing described in this study lack an explanation as to how language proficiency modulates the updating of information in situational models. Thus, a revision is warranted to account for individual differences, particularly language proficiency and attentional capacity. Based on the current findings, language proficiency likely modulates the influence of attention capacity on reading comprehension. Specifically, there is a high demand for attentional resources at low levels of language proficiency to process the surface code. As a result, fewer resources are devoted to extracting meaning from sentences (textbase) and cohesively making inferences and connecting these inferences to previous information (situational model). The result is a fragmented situational model. Thus, current models of discourse processing should include a gating mechanism of attention influenced by language proficiency. This mechanism would determine how attentional resources are allocated to the different stages of discourse processing (i.e., surface code, textbase, and situational model), with challenges at early stages requiring more attentional resources at lower levels of language proficiency. However, because higher processing stages are concurrently demanding

attentional resources and attentional resources are limited, inadequate information is incorporated into the situational model.

Furthermore, the models do not account for how different dimensions of a text are likely processed differently. The current study and previous research support that character information is likely easier to track than spatial information (Bailey et al., 2017; Bailey & Zacks, 2015). There is also evidence that spatial information is easier to track than temporal information (Radvansky & Copeland, 2010). Thus, it is possible that when readers parse a text, some dimensional changes might be more cognitively demanding than others. How these dimensions are processed might depend on individual differences in language proficiency, attentional capacity, task constraints, or the reader's goal. Thus, further research should explore possible updating differences in other dimensions and how individual differences and task constraints might modulate updating strategies.

4.5 Conclusion

Our findings generally do not support overarching global or incremental updating patterns. However, further analyses shed light on the influence of language proficiency and attentional capacity on situational model updating. Specifically, we found that participants high in attentional capacity updated situational models more globally. Furthermore, higher levels of language proficiency were also associated with global updating of spatial information. Finally, we found that participants performed better when asked about character information than spatial information. The methodology of our study likely drove this result. Together, these results suggest a need to refine current models of discourse processing do incorporate predictions about the modulating effects of individual differences like language proficiency, attentional capacity, and the reader's goals, as well as task constraints on situational model construction and updating.

Appendix A

Table 1A. Description of The No Shift, Unchanged, and Changed Shift Type Conditions

Condition	Description and Example
No Shift	When there is a probe in either the character or spatial dimension and no meaningful change in either dimension before the probe. Example: No shift Character Probe *Linda pulled her sunglasses out of the pocket of her **green scrubs** and put them on to shield some of the glare from the sun reflecting off the water. She watched as the dolphins started their tricks, being rewarded every time by fish tossed to them by their trainer.* *Linda's favorite was when they balanced on their tails and scooted across the top of the water.* [RECOGNTION PROBE] *green scrubs*
Unchanged	When there is a probe in either the character or spatial dimension but a meaningful change in the opposite dimension. Example: Unchanged Character Probe ***Linda's blue eyes** widened when she saw how expensive the tickets were.* *Linda paid for the tickets, and they walked down the hall and turned left into the jellyfish room.* [RECOGNTION PROBE] *Linda's blue eyes*
Changed	When there is a probe in either the character or spatial dimension and a meaningful change in the same dimension. Example: Changed Character Probe *As one dolphin hit the water, Linda felt droplets splash up on **freckled arms.*** *Jimmy took out the kids' map he had been given and saw the picture of the shark.* [RECOGNTION PROBE] *freckled arms.*

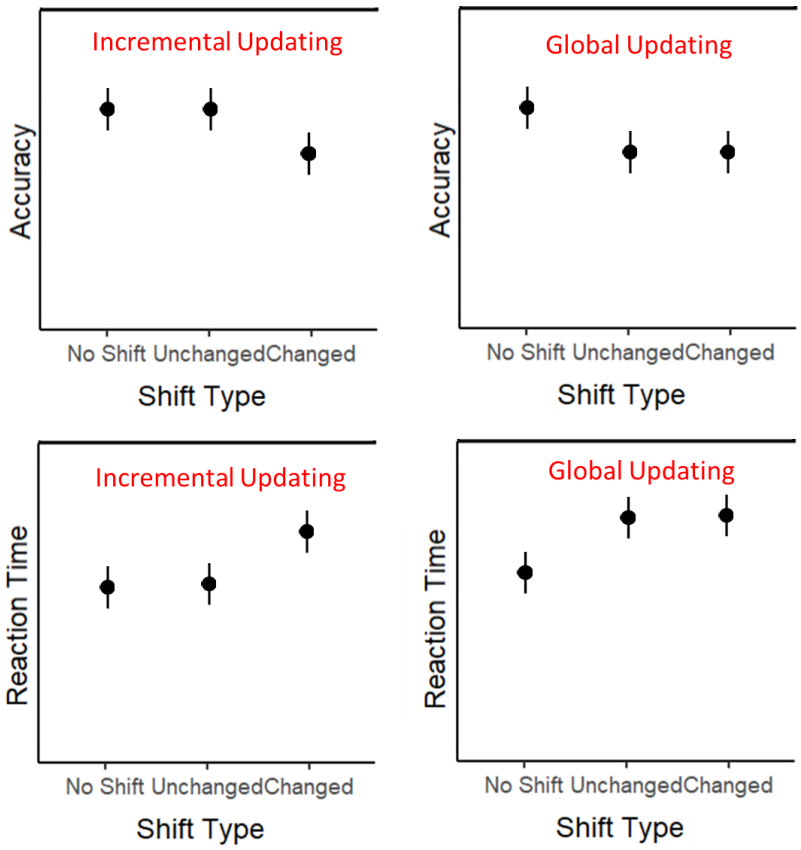


Figure 1A. Visual Representation of Global and Incremental Updating in Reaction Time and Accuracy

Appendix B

English Practice

Mr. Birch picked up a fishing rod, a short one with a spring in it, and started out the back door with it. The rod was rigged with a reel and a line at the end of which there was a spark plug. Mr. Birch walked out behind the house until he stood just west of the clothesline, facing the barn. Raymond followed right after his father. He stood watching his father prepare to cast. The barn was about fifty feet away. Mr. Birch cast, and the plug hit the barn. As soon as his father had cast, Raymond ran enthusiastically down to the end of the line. While Mr. Birch reeled in the line, Raymond ran along, following the jumping movements of the plug. Mr. Birch cast again. Raymond stood by his father and watched as the line was wound in. Honey came over to them. Raymond dropped down on his knees, petted and talked to the dog and ruffled her ears. Mr. Birch cast again and reeled in the weight. When it got caught he said, "Unhook me, Butch." Raymond ran immediately down to the end of the line and picked up the weight. He did this very happily. He caught hold of the plug and hung to it as his father reeled it in. Mr. Birch said, "I've got a big fish this time." Raymond smiled happily at this. When he got back to his father, Raymond grabbed Honey, carried her to the house, and raised her clear up to the kitchen window so that she could be seen by Mrs. Birch, who was working at the sink inside. Honey was fat enough to be quite a weight for Raymond to hold up that way. Raymond put Honey down and jumped a time or two as if for the sheer pleasure of jumping. He wandered about, coughing a little. His father cast again, and reeled in the plug. Raymond said, "Hey, daddy, what's under this?" He pointed to a slanting embankment next to the house. His father said, "Well, I guess the drain comes out under there." As Mr. Birch cast again, the plug came off. He said, "Well, I lost the plug," and added, "we'll have to find it." Raymond immediately ran down toward the barn looking for the plug. His father walked toward the barn to search for it. Raymond picked up a big rusty spike and said, "Here's a weight, daddy." This was offered as a joke. Mr. Birch answered mildly, "That would be just a little heavy." Just then he found the plug. They walked back together where Mr. Birch had been casting.

Aquarium

One Saturday morning, Linda took her son Jimmy to the local aquarium. Linda was eager to encourage her son's newfound interest in the ocean. Since Jimmy first saw the great white shark on a nature show last month, he'd started reading shark books and drawing crayon pictures of the ocean instead of playing violent videogames. Linda dreamed of her red-haired little boy as a future marine biologist. They entered the lobby, which had a life-size model of a whale hanging from the ceiling. Jimmy was impressed by the size of the lobby and the whale, with its ribcage the size of a school bus. The high ceiling was painted to resemble the surface of the ocean. He looked around in awe at the colorful coral reefs. Jimmy gaped up at the whale's belly and smiled. He pointed out to his mom the painted schools of fish on the ceiling. He saw striped angelfish, graceful manta rays, and clownfish like Nemo from the Disney movie. Crabs, too, like the ones they'd seen at seafood restaurants, with their tool-like pinchers. He finally looked down from the ceiling and rubbed his stiffening neck. Jimmy noticed a picture of a shark on the wall, and his eyes widened. He loved sharks. In fact, he was wearing his favorite shark t-shirt. Linda got her money out, and checked the prices above the ticket window. A surgeon at the local hospital, Linda was glad she had found time between shifts to bring Jimmy to the aquarium. Linda's blue eyes widened when she saw how expensive the tickets were. She hadn't been to the aquarium in years and was surprised at how the prices had gone up. She was a single mom, so money could have been tight. She was glad she had such a great job. Linda paid for the tickets, and they walked down the hall and turned left into the jellyfish room. Purple jellyfish were painted on either side of the doorway to mark the cool, cave-like room. Linda remembered how peaceful jellyfish look, like jello aliens drifting in outer space. She thought Jimmy would like this, and looked forward to see his reaction. Linda looked around at the tanks of all sizes lining the walls in the dimly lit room. Some were lit from beneath by colored lights. Linda liked how this made the jellyfish glow eerily. Linda walked up to the largest tank and gazed through the glass. Jimmy came up to the tank and tapped the glass. He tried to get the attention of one jellyfish in particular, which was the same orange color as his favorite videogame monster. He put his palm against the glass, imagining what it would feel like to touch the squishy creature. Then he looked up and saw a sign above the tank that read: "Do not touch the glass." Jimmy turned red and shuffled over to a tank near the exit. He had had enough of the jellyfish room. He wanted to move on. He slipped through the exit and found himself in the penguin room. Penguins in their black and white tuxedos were waddling across the ice, chasing fish. The room was chilly, and goosebumps appeared on Jimmy's freckled forearms. The room was crowded, but Jimmy was small and managed to push his way to the front of the crowd. It was the penguins' feeding time, and they were all energetically diving for the fish being thrown into the water by an aquarium employee. Jimmy watched wide-eyed until feeding time was over. Linda stepped up closer to get a better view of the feeding. She felt a surge of childlike excitement. She noticed one penguin as it dove into the water behind the glass, its rubbery body moving fast as a bullet. She looked again at the map she held, which also had times for the dolphin shows. There was a show starting in ten minutes. "There's a dolphin show starting soon; we should head over if we want to get good seats," she said. The pair left the penguin room and followed the signs pointing them to the right and out a set of double doors to the large outdoor pool where the dolphin shows were held. It was warm outside, but there was a nice breeze. They climbed the bleachers until they found a pair of empty seats near the center. Linda had loved watching dolphin shows since she was little. She was almost as excited as her son. The show started right on time. Linda clapped and cheered with the rest of the audience. It was easy to forget the stress of the hospital here, surrounded by

excited children. The operating room seemed far away. Linda pulled her sunglasses out of the pocket of her green scrubs, and put them on to shield some of the glare from the sun reflecting off the water. She watched as the dolphins started their tricks, being rewarded every time by fish tossed to them by their trainer. They jumped through hoops and did back flips. Linda's favorite was when they balanced on their tails and scooted across the top of the water. Linda began to take pictures. The breeze blew Linda's curly red hair into her face, and she brushed it out of the way so she could see to take pictures. It was hard to take pictures of the dolphins because they were constantly moving. She finally managed to get a picture of one dolphin balancing a ball on its nose. She also took a photo of the children's delighted faces as they got splashed in the front row. As one dolphin hit the water, Linda felt droplets splash up on her arms. She laughed out loud. The show only lasted about twenty minutes, but it was very entertaining and the audience cheered again when it was over. Jimmy took out the kids' map he had been given and saw the picture of the shark. The shark's jaws looked bigger than Jimmy's head. He loved how scary the dorsal fins looked, sticking out above the water. Jimmy turned to his mom with pleading eyes. "Mom, can we please go see the sharks now?" he asked. He was so excited he could barely stay in his seat on the bleachers. He was finally going to get to see what he had been waiting for. They entered the building through the same doors they had come out, and Jimmy led the way straight down the hallway to the shark tunnel. Jimmy thought of the scuba divers on the nature show as he walked into the dark glass tube. He imagined he was walking on the ocean floor, side by side with real wild sharks. Jimmy ran to the middle of the glass tunnel and grinned widely, showing his missing front tooth. He tipped his head back to see the sharks swimming over his head. Some kids might have been scared, but he wasn't. He thought sharks were awesome, especially the scary ones. He grinned as a hammerhead shark swam by—that was the shark on his t-shirt.

Camping

Jim and Kathy were preparing to take their kids on their first camping trip, and they were a little nervous. They had waited longer than their friends to have children. Most of the time they were very happy with this decision; they relished the thought of being retired by the kids' late adolescence and having the time to take long trips with them. They felt they were wiser, more patient parents than they would have been twenty years ago. Both had been workaholics in their joint law practice, and it had paid off in a level of financial security. They could afford to slow down, to take time to really enjoy the kids. But they felt a distance from the other parents, and they were at times self-conscious about being perhaps a little less active. Camping was important. Jim picked up his keys from the basket by the front door and paused. The basket was supposed to be a place for just keys, but his were always buried under everything else in there. Jim hated how it became a place to keep junk. From now on he would keep it clean, he vowed. He found his keys and walked into the garage. “I don’t like the look of those clouds,” Jim thought. He remembered that the forecast said it would be in the upper seventies and sunny the rest of the weekend, so he felt the weather would improve. As soon as he entered the garage Jim spotted the tent he had stored in the rafters. He loved getting out into nature and was excited about getting everything ready for the trip. He knew he wasn’t very organized about this, but he figured he would find everything if he just looked around. Unfortunately he already had a nagging feeling that he’d probably forget something. He looked around for other things one would need for a camping trip. “Ah ha! There it is,” he exclaimed. On the top shelf in the corner, Jim saw the box that his wife had conveniently labeled “Camping Gear”. As he pulled it down, the sleeping bags that had been piled on top fell down around him. “At least I won’t forget those,” he muttered as the last one bounced off his shoulder. Opening the tote, he found matches, fire starter, camping dishes, and some random pieces of rope. Walking into the garage, Kathy laughed at the pile of stuff surrounding her husband. He was sitting on the floor, digging through the tote. “Jackpot,” he thought to himself. Kathy looked up at the rafters. Pulling back her short black hair, she asked, “Need some help?” Taking a step stool, she pulled the tent down from the rafters and handed it to her husband to load into the car. Putting the stool back, she walked over to the shelves in the corner. She pulled out the other box of camping gear that she herself had packed and labeled. Inside the box, on top of everything else, was a packing list for camping trips that she had made. The list was nicely organized by category. Kathy was glad she was so much more organized than her husband. She pulled out the list and passed the box to her husband to put in the car. She quickly scanned the list and, satisfied, put it into her pocket. “That’s everything from out here—I’ll go get the kids,” Kathy said. Jim leaned against his workbench to wait. Kathy thought the boys were probably downstairs playing. Jim heard her call to them as the screen door closed behind her. Jim scratched his graying beard as he waited. He was excited about taking the kids on this trip. They were going to the same place he had gone camping as a kid. It was halfway up the mountain that their town was named for. The drive would take them about two hours today because it was Memorial Day weekend and Jim knew traffic would be bad. He wondered what time it was. Jim drummed his fingers on the workbench as he began to become impatient. They still had to stop for gas, groceries, and breakfast at McDonald’s before they could even leave town! He was glad when his family came out, and he began loading their camping supplies into the car. ”Let’s go!” he said They pulled out of the driveway and, five minutes later, pulled up to a gas pump. Jim ran his credit card at the pump and took the nozzle to start filling the car. As the gas pumped, Jim watched the numbers whizzing higher. He was a little worried about sleeping on the ground tonight. He had been standing for five minutes and

already his achy back was bothering him. He mentally added aspirin to the grocery list. The list was getting longer, and he hoped it wouldn't take too long at the store. Fortunately, the gas had just finished pumping. Jim took his receipt and they drove to the grocery store. Jim grabbed a cart as he and Kathy walked into the store. He followed behind with it as they walked through the store. He paused to clean his bifocals. He was embarrassed that his eyesight was so bad already. Looking at the groceries on the shelf, he sometimes had to squint to read the brand names. "I hope the kids don't inherit my terrible eyesight," he thought as he grabbed the aspirin for his back. Kathy expertly led the way through the store, taking the things they needed from the shelves. She had her list organized by type of food and section of the store. It helped that it was summer and all the standard camping food items were at the front of the store. Kathy was very proud of what an efficient shopper she was. In addition to the hot dogs and hamburgers, Kathy picked up a bunch of snacks. She chose granola bars and trail mix, because she tried hard to keep her family healthy. Jim didn't like that there wasn't any candy going into the cart. Jim appreciated Kathy's attempts to make them eat well, but he was on vacation now and really just wanted some sugar. He knew the kids would agree. He liked to spoil them. They passed the candy aisle, and Jim took advantage of the opportunity. He grabbed a giant bag of M&Ms, plus a few other treats. He buried them in the cart beneath Kathy's bag of carrots. "We're getting stuff for s'mores, right?" he asked. Jim knew you couldn't have a camping trip without s'mores. "I guess we can," Kathy conceded. Jim grinned and threw the ingredients into the cart: marshmallows, chocolate bars, and graham crackers. He considered himself a devoted father, and was determined to give his kids the full childhood camping experience. He checked the cart; it seemed that they had everything they needed. "Let's check out and get out of here," Jim said. He paid for the groceries in the self-checkout to save time. He grabbed the bags, took them out and loaded them in the car, and they drove away. The drive up the mountainside towards the campgrounds was beautiful. The kids really seemed to enjoy the idea of camping on the mountain. They pulled up to their camp spot and began to unpack. Jim told the boys that if they helped him put the tent up that he would take them to check out the nearby stream. The tent went up easier than Jim and Kathy thought it would. "Just in time," they thought, because they were getting hungry again. Kathy set up the grill and started getting some burgers ready. She told Jim to take the kids to the stream and that the food would probably ready in half an hour or so. As she watched them walk off, she happily thought to herself that this was going to be a rewarding trip. She got to cooking and soaked in every second of being outside and on vacation.

Castle

Haley and John, college friends, were on a trip to Germany over spring break. They had met in a French class their freshman year and, although they were incredibly different, had become good friends. John was a nerdy History major and didn't care much about his appearance, which drove Haley, an artsy budding fashion designer, crazy. The two had been planning this trip for months. It had been difficult because they wanted to see such different things. Haley tended to be solitary and therefore hated tour groups, while John loved being in groups. John was eager to please and keep the peace, whereas Haley always spoke her mind, especially when it involved being annoyed with something, which was often. Mostly thanks to John's gentle diplomacy, they had negotiated a compromise on the places they would go on their trip. Today they were visiting a medieval castle, which had been John's idea. John pushed his thick glasses up on his nose and grinned widely as they walked through the castle armory. He was soaking up the history of this place like a sponge. The castle was filled with authentic furnishings, and John took a picture of everything they passed. He was so happy he and Haley had decided to visit the castle that day. Haley, on the other hand, was incredibly bored and cold. Haley pulled her sweater tighter around herself and shivered. She huffed her annoyance, a frown ruining her pretty features. The castle was freezing, and she hadn't wanted to come in the first place. She had really wanted to visit some of the shops in the town where their hotel was. She thought castles were musty and boring. So far, she was only being proven right. Haley was especially tired of the armory, where they had been standing for nearly fifteen minutes. However, she did have to admit that the sheer number of weapons on display in the room was impressive. The wall they were standing next to had various weapons hanging all along its length. Haley thought the swords looked really intimidating, and hoped they were securely fastened to the wall. She was sure the tour guide was explaining all the historical details, but she had stopped listening to him. She hoped he wasn't going to talk continuously during the entire tour. The group walked out of the armory and into the castle's outdoor courtyard. Haley was glad to be outside, where it was much warmer than inside. It was an unusually warm day for Germany in the middle of March. Just as they walked outside, a cloud moved away from in front of the sun. Haley squinted her hazel eyes against the suddenly bright sunlight. Her annoyance softened a little at seeing the beautiful courtyard. The spring flowers were just beginning to sprout. There was a beautiful fountain in the middle of it all. John pulled his camera out again. John was eagerly documenting the entire trip with pictures. He wanted to remember absolutely everything, so that he could write a full narrative once they returned. He was the editor of the school paper and thought the story would make a good article. "Go stand by the fountain," he said, motioning to Haley. He waited as she went over and sat down on the edge, and snapped the picture. "That's good," he said, and smiled. The two quickly caught up with the tour group and went back into the castle, entering the small chapel with its arched roof. John felt bad taking pictures in here, as the atmosphere was so quiet and respectful. There were numerous people scattered among the pews, sitting in quiet reverence. John reluctantly put his camera down and took a moment to look around. The best part of the chapel was the huge, intricate stained-glass window high on the wall near the ceiling. John listened to the tour guide explain that the chapel had been very humble when the castle was built, but more intricate decoration had been added as it became fashionable. John nodded, fascinated. These were the kinds of minute historical details that he loved. Now that art was involved, Haley was also completely in her element. Stained-glass windows reminded Haley of the kaleidoscopes she had loved as a kid, and these were particularly artistically inspiring. Haley slid into a pew to give another group room to pass in the aisle. "I'd really like to sketch the window," she said to John.

“You go ahead with the group, and I’ll catch up when I’m done.” She took off her backpack and sat down on the wooden pew. She looked for her sketchpad and pencils. Haley’s bag was always filled with everything she could possibly need, so it was constantly a mess. She always had to dig for several minutes just to find what she wanted. Haley tucked her wavy hair behind her ears like she always did when she was drawing. Resting her sketchpad on her knees, she began to draw. She drew quickly and lightly but exactly, outlining the intricate design of the large window. When she finished, she examined her work—the design on her page was beautiful and true to life, but without color it just wasn’t the same. She decided to get out her box of colored pencils. As Haley dug through her bag again, she quickly checked to make sure her wallet was still there. They had been in some very crowded places, and Haley was constantly afraid of being pickpocketed. Fortunately, she found her wallet as well as the box of colored pencils. As Haley opened the box, the pencils all spilled out on the stone floor. Haley laughed at herself and knelt down to pick them up. When she had collected them all, she began to color. It took her slightly longer to fill in all the color, but when she was done she was very pleased with her work. Packing up her things, Haley left the chapel and went down the hall to go in search of the tour group. The hallways within the castle were narrow and winding, and Haley could barely find her way around. She found the group in the master bedroom on the second floor. She was annoyed again at having to search so long to find the group. She was also annoyed that the tour guide was showing no signs of stopping soon. This enormous room was filled with ridiculous decorations, and Haley rolled her eyes to hear the tour guide talk rapturously about all of them. Her favorite was the random suit of armor standing next to the wardrobe. The bed was the best part of the room, though – it was enormous, and the four tall posts were topped with a luxurious-looking canopy. As a child, Haley had always wanted a canopy bed, and so she thought this would be a great place to spend the night. Unfortunately, Haley needed her bedroom very warm at night. Although the sun shone in through the window, the room, like the rest of the castle, was freezing. The giant fireplace in the corner would have taken care of the cold, though. Haley, mind wandering, thought about how scared she would be to light a fire in this room, for the sake of the beautiful tapestries that covered the walls. Her attention was jolted back by a bright flash in her peripheral vision. John laughed aloud when Haley noticeably jumped at his camera flashing in her face. Even John was beginning to get bored. The tour guide was incredibly long-winded, and they had been in the castle for over an hour and a half. He put his camera back into the pocket of his wrinkled pants. His stomach rumbled. He couldn’t believe they had stayed for so long. “I’m starving, want to leave and find some lunch?” he asked. Slipping away from the group, the two easily found their way outside and started down the stone path toward town.

Hospital

Holly and her boyfriend, Brian, had been dating for six months. Because it was a new relationship, Brian had only met Holly's family one time. Today, though, they were going to visit Holly's Grandma Rita in the hospital. Rita had just had surgery on her right hip and was going to be in the hospital recovering for a few more days. Holly sat in the quiet lobby worrying about her grandmother. She had a really close relationship with her Grandma Rita. Holly's favorite childhood memory was of sitting on her grandmother's porch eating fresh-baked cookies. She knew her grandmother was old, but she wasn't ready for anything to happen to her. She was still worrying as they got onto the elevator and pressed the button for the fourth floor. To add to Holly's anxiety about her grandma's health, she was anxious about getting on the elevator. Holly felt a little relief when she saw her reflection in the mirrors that made up the elevator's walls and made it seem a little bigger. She always felt slightly claustrophobic on elevators. She had an irrational fear that she would somehow get trapped inside one. She tried to think of her grandmother and not the size of the elevator. At the same time, Brian was thinking about how much he hated hospitals. Brian knew about Holly's claustrophobia, but he couldn't help feeling overwhelmed by his own phobia. He rubbed his hands over his close-shaven hair as he thought about all of his experiences in hospitals. Brian only had visited hospitals when somebody was sick. He had friends and family members who had surgeries. He also was in a hospital when he found out that his father had cancer. To make matters worse, Brian thought hospitals always had an unpleasant smell. They just smelled like illness. "Why can't they just use some lemon-scented cleaning products or something?", Brian thought to himself. The numbers on the display lit up indicating that they were moving from the 2nd floor to the 3rd floor. This was the slowest elevator that Brian had ever been on. It seemed as if a lifetime passed between each floor. He wondered if they would ever reach their destination. When the doors opened, Brian stepped off the elevator and turned left towards Rita's room, room number 4136. Brian had only met Rita at their family Christmas dinner, but thought that she was a nice woman. Right now, Rita was taking a nap and they weren't sure whether they should wake her up. So they pulled up two chairs near the bed. When Brian saw the clock on the nightstand, his green eyes widened because he realized he was missing the big game. His favorite football team was playing in the first round of the NFL playoffs this afternoon. Brian knew if they stayed at the hospital for too long he would miss the first half of the game. If he said that he was not feeling well, then maybe they could leave early. Holly saw the look on his face and was frustrated because she only wanted to spend an hour with her grandmother. Holly really enjoyed Brian's company, but had noticed that he could be self-absorbed at times. But she knew this wasn't the appropriate time to get into an argument. Instead, Holly wanted to focus on her grandma. She hated this room with its dreary gray walls and the chill in the air. Even the fact that there was a window didn't help, because the view was of the brick building next door. It was hard for Holly to see her grandmother in such a sad room. It was also difficult to see her grandmother so feeble. For as long as Holly could remember, her grandmother had been a strong and vivacious woman. Unlike many women of her generation, Rita had worked outside the home, spending nearly thirty years as a schoolteacher. People always said that Holly took after her hardworking Grandma Rita. Holly was proud to be so much like her grandma—they were both tall, and Holly also had her grandmother's button-shaped nose. She realized how lucky she was to have spent so much time with her grandma. They had spent many summer afternoons baking cookies and weeding the garden. Some of Holly's friends had never even met their grandparents. Rita opened her eyes and smiled brightly, delighted to have visitors. Rita found that the older she got, the more she

appreciated spending time with her family. She felt groggy and was alarmed by the IV that was taped to her slender forearm. It took her a few moments to remember where she was. Then she recalled that she was in the hospital for hip surgery. She had tripped while walking down the stairs, breaking her right hip. She was embarrassed because she thought only old people broke their hips, and Rita did not feel old. Luckily, Rita always carried her cell phone and was able to call 911. Even though she had only hurt her hip, she did not want to be a burden to her family. Rita was usually unshakable, but this incident had unsettled her because she lived by herself. Rita told her granddaughter, "I'm worried your mother thinks that I can't take care of myself anymore." "I'm too young to be put in a nursing home and lose my independence," she continued. Rita rationalized that she had just tripped, and it could have happened to anyone. Brian felt uncomfortable because this conversation seemed like a private family matter. Brian would have no part in the family's decision to let Rita go home or to move her into a nursing home. He was a compassionate person, but he didn't know Holly's family very well. He had just met them over the recent holidays. Brian had felt comfortable immediately with Holly's family and hoped to get to know them better. But at this point, he did not think this nursing home discussion was any of his business. Brian left the room and went back down to the hallway towards the elevators to look for the vending machines. Brian wondered whether his football game had started yet. He and his father were huge Green Bay Packer fans. Brian got very excited because the visitors' lounge had televisions, and no one was watching them. He found the remote and took a seat at the nearest table. He flipped through the channels to find the football game. It turned out that Brian had only missed the first four minutes of the game. Even better was the fact that his Packers were already up by seven points. Brian was surprised that they had scored the first touchdown. The Packers were the underdogs in this first-round game. He just hoped that they could hold onto the lead. Brian smiled, put his Converse-clad feet up onto a chair, and put his hands behind his head. This was the only thing that he had wanted to do all day. However, he couldn't shake a nagging feeling of guilt. Brian knew that Holly was really close to her grandma and understood why she wanted to visit the hospital. He decided he could suck it up for an hour and walked back to Rita's room. As Brian headed back to Rita's hospital room, he realized that one of his friends probably recorded the game. He smiled because now he could be the dependable boyfriend and still watch his Packers play later. To make up for his rude exit earlier, Brian bought Holly a coffee and her favorite candy bar. Certainly she would appreciate this thoughtful gesture and forgive him for leaving. Brian knew a few tricks to keeping a girlfriend happy.

Morning

The Johnson family, Martin and Molly and their sons Zach and Jonathan, were all preparing for their day of work and school. Martin, who got up first in the mornings, was always obnoxiously awake even at early hours. He had always been an early riser, which helped him get ready for work, but also had some negatives; he just couldn't seem to stay up late. Molly, on the other hand, tried to enjoy the mornings but she just couldn't seem to wake up fast enough. So, she typically walked around slightly annoyed in the mornings, though lately she was really trying hard to be in a better mood. Molly opened the curtains in the boys' shared bedroom. "Time to get up, boys," she said cheerfully. The bus left in an hour, and she knew how long it took her sons to get ready in the morning. "It's Friday," she said, hoping that would cheer them up. She left their bedroom just as they began stirring and groaning and went downstairs. She could hear them whining the whole time she was going down the stairs. "I don't want to go to school," she heard Zach say. "I remember the day that was cute, but, not anymore," Molly thought to herself. She walked into the dark kitchen. Going to the window above the sink, she opened the curtains to let the morning sunlight in. She turned to lean against the counter and yawned. It was going to be a long day, and she wished she had gotten another hour of sleep. Martin, wide-awake as usual, came in and smiled at her. "Ah, it looks like a nice day out there," Martin said. "You would say that," Molly shot back. "You just say the sweetest things in the morning," he joked. He poured a cup of coffee for his wife and reached up to grab another mug from the cabinet by the sink. He poured a second cup of coffee for himself. Just then, the toast he had put in the toaster popped up. He grabbed a plate and walked over to get it, giving Molly a peck on the cheek as he passed. He saw disappointedly that the toast was a little darker than he wanted. "Geez, I always do that," he said to himself. Martin sat down on a stool at the kitchen island with his plate and mug. He opened the newspaper that was sitting there. They lived in a small town, and, as usual, there was nothing going on. The biggest news that day was that the local marching band had gotten new uniforms. Jonathan came down the stairs and grabbed the Lucky Charms from the pantry. He was still so tired. He barely lifted his feet as he walked along the kitchen. His curly dark hair was sticking out at all angles. At ten years old, he hated combing his hair. He hoped his mom wouldn't notice. He had at least gotten dressed already—surely that counted for something. He yawned sleepily. Zach was in the kitchen now, getting himself a bowl of cereal too. Jonathan nudged him out of the way so that he could get to the counter. Jonathan rubbed his dark brown eyes. He pulled out a bowl and poured cereal and milk into it. Then he put the cereal and milk away, knowing his mom would yell at him if he didn't. He grabbed a spoon and sat down next to his dad. Molly came up behind her son and ran her fingers through his hair, smoothing it. She decided not to give him trouble, yet, for his unkempt hair. She'd wait until after he ate. She loved how much it was like her own brunette hair. "You need a haircut," she told her son. "Maybe sometime next week; I'll call today." She ignored his grumbling and picked her coffee up. "I need to go get ready," she told her family, leaving the kitchen and walking down the hall towards the bathroom she shared with her husband. "Mom, did I leave my Incredible Hulk hands in your room?" asked Jonathan. "Yes, I put them on the floor in your room," Molly yelled from down the hall. She walked into the bathroom. She flicked on the light switch by the mirror, and pulled out her makeup bag. As she put on her makeup, she remembered painting the walls right after they moved in. Her husband Martin hated the yellow walls, but Molly loved them. Inspired by the bright color, she put on brightly colored eyeshadow. She lined her eyes with brown eyeliner. "Not too shabby," she thought. Molly lightly dusted powder over her freckled nose. Taking out the mascara, she swiped a layer onto her eyelashes. She looked in the mirror and scrutinized the

results. I guess that's as good as it's going to get, she thought. she opened the door that led to the master bedroom and went to the closet. Opening her closet, she picked out her favorite sundress. When she worked she tried to look professional, but on her days off, like today, she liked to dress comfortably. Molly sat down on the bed. She picked up her planner. Today was going to be a busy day. A music teacher at the local middle school, Molly didn't work Fridays, but she had plenty of errands to run. Standing, she went back into the kitchen to make sure her family was going to be ready on time. She called from the hallway, "You guys almost done eating?" As soon as she walked in, a handful of Lucky Charms bounced off her flowered dress and fell onto the floor. Molly calmly took the box of cereal away from her fighting children. "Finish your breakfast and go upstairs to brush your teeth and comb your hair, please," she told them. Ignoring their cries of "He started it!" Molly put the cereal away and grabbed the broom. "I can do that honey", said Martin taking away the broom. "Guys, come on. Give your mother a break," Martin said to the kids. He set his glass in the sink and wiped his hands on his black pants. He was wasting time, trying not to leave for work. Although he liked his job as the owner and manager of the local bookstore, it had been a long week. Therefore, today he just wanted to be home. but duty called. Reluctantly he took his keys from the kitchen counter. "Don't forget we're going out to dinner tonight," he told his wife. "Oh, I won't forget; I've got Wanda the babysitter set up to come around 6," Molly said. She was excited about getting out of the house. They were going to a new sushi restaurant downtown that had some rave reviews. "Alright kids, time to go!" exclaimed Molly. They ran to the door, surprisingly ready. "Good job with your hair, Jonathan," Molly said, surprised. "Thanks Mom, " he said. A moment later, the bus pulled up. Molly felt lucky that the bus stop was practically right outside their door. She and Martin said goodbye to their kids, and watched them get on the bus. "That wasn't too bad this time," Martin said. Molly agreed.

Office

Mike opened his eyes on a morning that seemed to be brighter than usual. However, it was not the cheery, vibrant brightness Mike remembered from the mornings of his childhood. Rather, it was a stabbing brightness that penetrated the warm cocoon of sleep. Mike grabbed a pillow and held it over his face but it was no use. The sun, work and the loneliness that marked the days of Mike's life would not be ignored. Mike got out of bed scratching his chin and considered shaving. But laziness won out again, and the stubble survived another day. As he brushed his teeth, Mike stared at his gut in the bathroom mirror. It jiggled. He wondered if his feeling miserable was related to his cardiovascular health. As he rode the bus to work his mind played over the many times he had tried and failed to start a regular exercise regimen. In light of these failures, it was hard for Mike to believe in his own plans to try again, but he made them anyway. Mike stepped off the elevator on the 22nd floor of the Unilife building where he worked as an accountant. He generally tried to be friendly at work, but this morning his head was throbbing and he felt fat. He was pretty sure he was coming down with the flu. He wouldn't have even come to work if not for the meeting that was on his otherwise empty schedule. Maybe it had been canceled, he thought hopefully. Sometimes Mike felt like at least 20% of the scheduled meetings in his office never actually happened. This was for the best, however, because 90% of what went on in the meetings that DID occur was completely useless. Adjusting his wrinkled tie, Mike looked at the receptionist, Toby. This guy drove Mike crazy because it seemed he liked to ignore people. Mike saw that he was on the phone, but he was getting annoyed that Toby wouldn't even acknowledge his presence. He cleared his throat loudly, hoping to get Toby's attention. All he needed was to check his messages—if the meeting was canceled, he would sneak out of work in a heartbeat. Right now, though, Mike had to focus on where he was and on getting through the day at work. Mike was usually a patient man, but Toby never failed to get on his nerves. Mike stood tapping his foot impatiently but was still ignored. He even tried jumping up and down. Finally he gave up. He turned to the left and walked down the hallway to his windowless office. Mike was due for a bigger office but had gotten the run around every time he brought it up. The drop panel ceiling, the dusty air vents, all of it would be bearable if he only had a window. He threw his jacket on the old wooden coat rack by the door. His desk was neat as a pin. He flopped into his chair and logged onto his computer. Aside from a few advertisements, he had no new email. He tried to work on the report that was due Friday, but he couldn't concentrate. He clicked "refresh" on his inbox to make sure nothing had come in over the last 90 seconds. After wasting 10 minutes on eBay, the inbox was again fruitlessly refreshed, and then it was off to several other favorite time wasting web sites. Finally bored with the computer, Mike turned his eyes from the screen. He played with the red stapler that sat on the desk. He wished he had been able to check his phone messages. "What a worthless receptionist," he grumbled under his breath. He heard a noise at the door and looked up quickly. Toby stood there, perfectly still under the flickering fluorescent lights. The light was not doing Toby any favors. Toby had worn a sweater vest over a pastel oxford to work for the last 462 days and counting. Today, the shirt was yellow and the vest green Toby's bushy brows shot up. "I am so sorry," he said, voice dripping with sarcasm. "Next time I am on a call with our most important client, I will definitely put them on hold to give you your messages." "Not that you're actually important enough to have any," Toby added as he stormed off in a huff. Mike was glad when he was alone again. He felt very ill equipped to deal with any extra stress. Besides, Mike's small office didn't need Toby's giant ego taking up space. Mike poured coffee from his thermos into a mug and took a big swallow. He gathered his stuff to take notes in the meeting. As usual, he was well-prepared,

but his head still hurt. Picking everything up, he walked down the hall and into the room where the meeting was to be held. Not that long ago, one could count on finding a nice plate of doughnuts at these meetings. It was not clear to Mike why this custom had been terminated, but he considered it terrible for morale. At least, it was terrible for his morale. In the middle of the meeting room was a long black table. It was surrounded by high-backed vinyl chairs. Mike thought about how dumb it was that the shades in this room were always drawn. These windows had the best view on the whole floor. At the head of the table sat Ms. Greenpole, the razor-sharp CEO of the company. Ms. Smith had not had to claw her way to the top. She was simply the most competent executive the company had ever employed. She had long black hair and long fingers that could type like the wind. She worked at her laptop while half-listening to the buzz of conversation around her. She kept one eye on the clock as she worked. She was not one to start a meeting late. Mike's stomach tightened and his head pounded even more; meetings with her made him nervous. Mike fumbled his way around to a seat, making sure to keep his eyes glued to the carpet. He tucked in his shirt and sat down with his back to the shaded windows. He wanted to be able to see the door. If anyone left this thing early, he was going to follow suit. His mind was beginning to wander, and the meeting hadn't even started. When the presentation did start, he could only focus on a few sentences at a time. The words made sense but it became harder and harder for Mike to remain mentally engaged. After missing a few key pieces of the presentation it was hopeless, and Mike stopped even trying to pay attention. A couple of times he caught his stubbly chin starting to drop onto his chest. He was actually starting to nod off! Finally, the presenter reached the Q&A part of the presentation. Mike saw his chance and acted fast. He darted out of the door and jogged down the hall to the men's room. The bathroom was well air conditioned and even though the air was "less than fresh", the change of scenery brought Mike back to life somewhat. Mike walked over to the sink on the left side of the room. He splashed some water on his face and blew his nose. He looked at himself in the mirror to see if he looked as bad as he felt. "Just go back in there, ask a few questions, and get through this," he told himself. He smoothed his hair, smiled weakly at himself in the mirror, and walked back into the meeting room. To his great pleasure, Mike found that the meeting had broken up. People were gathering up their things to leave or huddled in groups of 2 or 3 discussing work or baseball or whatever. Mike had little trouble slipping through this setting unnoticed. He grabbed his things and scooted out the door. He shut his office door as he walked past and continued on, right past Toby and onto the elevator. As he rode down to the ground floor, he noticed that his headache had gone away and he was actually feeling better. He decided that he would go for a jog as soon as he got home. Whether it turned into a regular habit or not, the longest journeys start with one step. Baby steps, baby steps, he thought to himself.

Shopping

The university had paired up Ashley and Maria as roommates their freshman year, but they immediately became friends and decided to live together as sophomores. Ashley, a music major, was from a small Midwestern town and her parents were both professors. Maria, on the other hand, was a marketing major from Southern California and came from money. Maria was a little spoiled, but Ashley was sweet and liked her anyway. Despite their differences, they had a lot in common, including their love for running and for shopping. This morning was the first Saturday in December, which meant it was time to start their Christmas shopping. Ashley had decided to drive her car today, because it was a practical sedan that had a spacious backseat to hold their purchases. She was excited about all the shopping they were going to do. She loved everything about the Christmas season. She especially loved Christmas music. ”Oh, this is my favorite song!” she exclaimed. Ashley listened to “Silver Bells” in her car as she waited for Maria. She realized that this was a new version of the song she had never heard before. Someone must have recorded it this year. Ashley glanced down to the radio on the console to turn up the volume. She cranked up the music and sang loudly. Ashley knew the mall would be packed despite the early hour. They already had decided it would be easiest to drop off Maria at the department store and for Ashley to find a parking spot. Maria hopped into the car and said, “Come on, let’s get going.” Maria could tell that Ashley had gotten impatient while waiting on her to get ready. But there was no way that Maria would be caught at the mall without makeup. Maria rubbed her sleepy eyes and yawned. Even though she was not a morning person, she had been awake since 5:00 a.m. to catch all of the early-bird sales. Maria’s parents had threatened to cut her off financially if she didn’t raise her grades this semester. So she decided to shop smart and save some money, just in case. When they arrived at the mall, Maria jumped out of the car and walked through the nearest entrance of the department store. It was so early that Maria couldn’t remember into which department this entrance led. A Christmas tree decorated with hundreds of ornaments made a festive display in the window, but didn’t give any clue as to where she was. Then she realized that she was entering the women’s department. Maria was disappointed that she did not have time to shop for herself, because there were so many good sales. However, she reminded herself that she was only shopping for gifts today. She walked to the other side of the store, to the men’s department to look for some cologne for her father. Her father was hard to shop for because he had everything. Maria thought that cologne was always a safe gift. She caught a glimpse of her reflection in the glass of the counter and scowled at her messy hair. Maria had spent so much time on her makeup this morning that she did not have enough time to fix her hair. Today was a reminder for why she only took afternoon classes. She just hoped she did not see anyone she knew today. Browsing through the cologne selection, she was glad that she did not have to concentrate in class today. Maria knew that finals were right around the corner. In fact, they began in a week, but she tried to put them out of her mind. She only was to concentrate on Christmas shopping today. Maria noticed a new brand of cologne and, pushing up her sleeve, sprayed a little on her thin wrist. She was not sure yet which brand to buy for her father. She had not decided whether to get something he already had or a new brand. She thought that the prices might help her decide. Ashley walked up behind her and smelled the cologne. Ashley had never been a big fan of strong cologne. She wrinkled her nose and sneezed into the sleeve of her favorite sweater. She thought it smelled like a nursing home. Those types of cologne were musty, and she preferred the kind that her boyfriend wore. Thinking of him, Ashley remembered that she wanted to buy him a shirt and tie for work. She made her way over to the men’s clothing area, which was right behind the cologne counter. Surprisingly, the men’s clothing department

wasn't as crowded as she had expected. Under a sign that advertised a sale, Ashley saw a table of dress shirts with a tie rack on it. First, she looked through the shirts. She thought that it would be easier to choose a shirt and find a tie to match rather than the other way around. But there were so many shirts to choose from. Some shirts had stripes, some were plaid, and some were a solid color. Ashley's boyfriend did not have extra money to be spending on new clothing right now. So she was really excited to find him a nice dress shirt. At the far end of the long table, she noticed a nice purple shirt. Ashley decided to buy it because purple was her favorite color. Now all she needed was a matching tie. On the tie rack, she noticed a gray-and-purple-striped tie that was 50% off. Ashley was so excited about this great deal that she turned to her right and headed straight for the nearest checkout counter. Ashley did some quick mental math, because she and her boyfriend had set a $100 limit for Christmas presents. She would probably have enough left over to get him the new video game that he wanted. She may end up going a little over their limit, but the look on his face when he opened his gifts would be worth it! Black rope weaved left and right, creating an orderly line to the counter. Ashley was relieved that the line was not very long. It was a good idea to come to the mall so early. Ashley knew she was going to be hungry soon, though—maybe they could stop for breakfast. Maria joined Ashley at the checkout line and groaned. "All of these good sales and I didn't even get anything for myself!", Maria exclaimed. She pouted and idly played with her gold bracelet as she stood in line. She had decided to get her father another bottle of his favorite cologne. She had also found a big sale on purses. She had decided to get a silver clutch for her sister and a small handbag for her mother. Maria hoped that she would get better gifts than the ones she was buying for her family. She added up how much the cologne and two purses would cost. She dug around in her giant purse looking for a coupon that she had clipped from the sales ads. As she bit her manicured nail, Maria realized that she needed to focus more on school so she wouldn't have to worry about money anymore. She had never clipped a coupon before, but without it, these gifts would cost more than she had intended on spending. Fortunately, Maria the coupon was for 10% off her total purchase. This coupon would make the gifts even more affordable. Ashley smiled at her fortunate friend, who had never had to budget before. She knew that Maria could be materialistic at times, but Ashley knew that she was a great friend. They finally reached the front of the line and Ashley stepped up to the register pulling out her wallet. They had found a lot of gifts in the department store. It was a good start to what promised to be a productive day of shopping.

Zoo

Five-year-old Violet and her babysitter Liz were going to the zoo for the day. Neither of them was excited about it. Liz loved kids, but Violet was a pain to baby-sit. Violet was the only child of two rich parents, and as such was a complete spoiled brat. Liz was a sweet, happy person and always tried to be patient with Violet, but Violet constantly tried that patience. She just wanted to be done so she could go back to the beach with her friends. Violet wasn't happy about going to the zoo, either—she hated anything to do with the outdoors, and she hated when her mother went away and left her with Liz. Liz never gave her what she wanted. Liz paid the entrance fee at the zoo gate, keeping one wary eye on Violet. She took a zoo map and opened it. Liz sighed inwardly, hiding her exhaustion—she had already been babysitting for four hours, and she was tired. "Where do you want to go first?" she asked. Violet snatched the map away. Violet couldn't read it—she had no desire to learn how to read, so her mother didn't make her. That was the way things were run in her house—she was the princess. Today, like always, she was dressed like a little princess, in a frilly dress and matching pink shoes. Her hair was pulled into two perfect pigtails, just as it was every day. Violet's favorite animals were bunnies, so she decided she wanted to see those. "I want to see the bunnies," she said. She shoved the map back at Liz and marched out of the zoo's main building. Violet was immediately unhappy. It was too hot outside. There were other kids running everywhere. A drop of sweat ran down her rosy cheek. Violet scowled and shut her eyes to block out the glare. She clutched her ever-present stuffed bear, Mr. Cupcake. She wanted to go home. Liz said, "Don't run away, you have to stay by my side." The zoo was especially crowded today, and Liz was concerned about becoming separated from Violet. As exhausted as she was, she knew she would have to be extra careful. Liz flicked a bug off her tanned shoulder and reexamined the map. She was fairly certain there were no rabbits at the zoo. However, she wanted to be absolutely certain before she broke the news. No rabbits would almost certainly cause a fit. Instead of giving bad news, Liz thought she could create a distraction. There had to be other exciting animals at the zoo, Liz thought. She sat down on a bench and scanned the map. "Oh! There are penguins here," she said quickly. She looked up at Violet. Immediately Liz regretted her decision. Violet let out a shriek. Violet hated penguins. Penguins were nothing like bunnies. They weren't small or fluffy, they didn't hop, and they didn't have wiggly noses. Her big blue eyes were wide and filled with rage. "I," she said, pausing for dramatic effect. "HATE," she yelled, getting louder with every word. "PENGUINS!" she screamed, loud enough to make everyone around them wince. Turning, Violet sprinted away as fast as she could—unfortunately, she only made it as far as the first exhibit. Her chubby legs couldn't carry her very fast or very far. She stopped, next to the monkey cage. Plus, she hated running. She crossed her arms and turned around. Seeing her babysitter, she started sniffling and let a few tears fall down her face. Liz caught up easily. Liz was angry at Violet for running and at herself for letting that happen. It couldn't happen again. She breathed deeply, trying not to let her anger show, because she knew that wouldn't help anything. She squatted down by the fence. "Look at the cool lions," she said, ignoring the fake tears. "See how big they are?" Liz stood up and pulled out her map again. She knew there was a Children's Center somewhere in the zoo—maybe they could go there. That would provide both entertainment and containment. Liz looked down the path and saw the Children's Center on the left. She hoped they would have some activities that she didn't have to participate in. She was ready to let someone else deal with Violet for a while. "Let's go check out something else!" she said, putting as much excitement in her voice as possible. Liz leading the way, the two of them walked over and went into the Children's Center. Liz was impressed by the inside of the building, which was a large open space

clearly made for children. The walls were colorfully painted with pictures of all different kinds of animals. All the signs were near the ground so that children could read them easily. “Wow, look at all the animals,” Liz said. In front of them was a small ring of tables with a sign that said “Drawing Zoo Animals Workshop”. Liz thought that the woman leading it looked overly excited about her job. “Why don’t you go sit down and join them,” Liz suggested, sitting down on a bench. Liz chuckled to see that she was joining a group of weary parents. She leaned her head back and rested it on the wall. She happily closed her tired eyes. Only two more hours and she could go home. Her phone vibrated in her pocket. Not wanting to disturb the class, she went outside to answer it. The large glass door swung shut behind her. Liz took out her red phone and checked to see who was calling. She pushed her long blonde hair back from her ear to answer the phone. “Hey, Julia,” she said, smiling to hear her friend’s voice. She took off her backpack and sat down on a bench. The workshop inside had been going well, so she figured she had a few minutes to talk. She glanced in the window occasionally as they talked. By the time Liz was finished on the phone, Violet’s class was just finishing up. Liz was happy to find that Violet had actually enjoyed herself immensely and was in a much better mood. The two managed to enjoy the rest of their time at the zoo.

Appendix C

Table 1C: True/False Statements for Narrative Text

Story	Question	Level of Difficulty
Aquarium	At the dolphin show, Linda took a picture of the laughing children sitting at the front.	Difficult
Aquarium	In the lobby, the whale's rib cage was the size of a school bus.	Difficult
Aquarium	Jimmy got goosebumps in the penguins' room.	Difficult
Aquarium	Jimmy has black hair like his dad.	Difficult
Aquarium	Jimmy tapped the glass to get the attention of an orange jellyfish.	Difficult
Aquarium	Linda did not enjoy getting wet at the dolphin show.	Difficult
Aquarium	Linda has green-colored eyes.	Difficult
Aquarium	Linda has straight blond hair.	Difficult
Aquarium	Linda was wearing scrubs at the aquarium.	Difficult
Aquarium	The jellyfish room was shaped like a wrecked ship.	Difficult
Aquarium	Jimmy hated sharks.	Easy
Aquarium	Jimmy saw his first shark at the beach.	Easy
Aquarium	Jimmy was more into learning about the ocean than video games.	Easy
Aquarium	Jimmy's shirt had a white shark.	Easy
Aquarium	Linda is a single mom.	Easy
Aquarium	Linda is a surgeon.	Easy
Aquarium	Linda’s favorite dolphin trick is when they would balance on their tails, scooting across the water.	Easy
Aquarium	The last exhibit they visited was the shark room.	Easy
Aquarium	The lobby had a shark painted on the ceiling.	Easy
Aquarium	The second exhibit they visited was the jellyfish room.	Easy
Camping	Jim and Kathy loaded all the camping gear onto their truck.	Difficult
Camping	Jim sneaked the trail mix out of the shopping cart.	Difficult
Camping	Jim used his credit card to pay for gas.	Difficult
Camping	Jim vowed to keep the garage clean from now on.	Difficult
Camping	Jim's beard is graying.	Difficult
Camping	Kathy had a nagging feeling that she would probably forget something.	Difficult
Camping	Kathy had carrots in the shopping cart.	Difficult
Camping	The camping spot was the exact spot where Jim would camp as a kid.	Difficult
Camping	The trip was happening during the Labor Day weekend.	Difficult
Camping	Using a step stool, Kathy pulled the tent down from the rafters.	Difficult
Camping	At the store, Kathy made Jim put back the m&m's.	Easy
Camping	It started raining during the drive.	Easy
Camping	Jim and Kathy became parents at a late age.	Easy
Camping	Jim and Kathy had a law practice.	Easy
Camping	Jim and Kathy were taking their family camping.	Easy
Camping	Jim and the children would have preferred to stay home.	Easy
Camping	Jim is more organized than Kathy.	Easy

Table 1C: True/False Statements for Narrative Text

Story	Question	Level of Difficulty
Camping	Jim really wanted s'mores.	Easy
Camping	Jim spotted the tent on the rafters.	Easy
Camping	Kathy bought steaks to grill at the camp.	Easy
Castle	As a child, Haley had always wanted a canopy bed.	Difficult
Castle	Haley and John met in German class.	Difficult
Castle	Haley liked the suit of armor inside the master bedroom.	Difficult
Castle	Haley prefers small groups.	Difficult
Castle	Haley wanted to go hiking instead of visiting the castle.	Difficult
Castle	Haley was the editor of the school newspaper.	Difficult
Castle	Haley wore thick glasses.	Difficult
Castle	John did not take pictures inside the chapel out of respect.	Difficult
Castle	John has hazel eyes.	Difficult
Castle	The story takes place during the spring.	Difficult
Castle	Haley and John became bored and hungry at the end of the castle tour.	Easy
Castle	Haley and John stayed behind to sketch the window of the chapel.	Easy
Castle	Haley is an industrial design major.	Easy
Castle	It was John's idea to visit the castle.	Easy
Castle	John and Haley had been planning the Germany trip for months.	Easy
Castle	John and Haley spent less than an hour on the castle tour.	Easy
Castle	John got lost during the tour.	Easy
Castle	John is a history major.	Easy
Castle	The castle was hot.	Easy
Castle	The castles had many weapons.	Easy
Hospital	Brian has green eyes.	Difficult
Hospital	Brian met Holly's family during thanksgiving.	Difficult
Hospital	Brian's father had suffered from tuberculosis.	Difficult
Hospital	Brian's team had the lead during the first part of the game.	Difficult
Hospital	Grandma Rita tripped going down the stairs.	Difficult
Hospital	Grandma Rita's room was on the 3rd floor.	Difficult
Hospital	Holly and Brian have been dating for 8 months.	Difficult
Hospital	Holly used to eat homemade cake on her grandmother's porch.	Difficult
Hospital	Rita and Holly have the same button-shaped nose.	Difficult
Hospital	Rita was a schoolteacher before she retired.	Difficult
Hospital	At first, Brian wanted to leave early.	Easy
Hospital	Brian and his father were fans of the Dallas Cowboys.	Easy
Hospital	Brian bought Holly a soda and her favorite chips at the hospital.	Easy
Hospital	Grandma Rita had surgery for her Shoulder.	Easy
Hospital	Grandma Rita lives with her husband.	Easy
Hospital	Grandma Rita was scared her family would put her in a nursing home.	Easy
Hospital	Holly is claustrophobic.	Easy

Table 1C: True/False Statements for Narrative Text

Story	Question	Level of Difficulty
Hospital	Holly thinks Brian can be self-absorbed at times.	Easy
Hospital	Rita was the type of person who loved spending time with her loved ones.	Easy
Hospital	There were people at the visitor's lounge watching the game.	Easy
Morning	Jonathan asked Molly if he had left his Incredible Hulk hands in her room.	Difficult
Morning	Jonathan is ten years old.	Difficult
Morning	Martin sat down at the dinner table to eat his toast and coffee.	Difficult
Morning	Martin thought it looked like a nice day outside.	Difficult
Morning	Molly and Martin were going to a Hindu restaurant in the evening.	Difficult
Morning	Molly had to put away the milk and cereal because her kids forgot to do it.	Difficult
Morning	Molly has freckles.	Difficult
Morning	Molly is a music teacher for a local high school.	Difficult
Morning	Molly poured a cup of coffee for Martin.	Difficult
Morning	The story takes place on a Friday.	Difficult
Morning	Jonathan could not wait to go to school.	Easy
Morning	Jonathan went downstairs to eat his favorite cereal Cinnamon Toast Crunch.	Easy
Morning	Martin liked the yellow walls.	Easy
Morning	Martin was wearing khaki pants.	Easy
Morning	Molly drove the kids to school.	Easy
Morning	Molly knew it was going to be a long day.	Easy
Morning	Molly loves the mornings.	Easy
Morning	The family lived in a small town.	Easy
Morning	The local marching band got new uniforms.	Easy
Morning	Zach did not want to go to school.	Easy
office	Mike drove to work.	Difficult
office	Mike fixed his hair in the restroom.	Difficult
office	Mike had a report due Friday.	Difficult
office	Mike is due for a new office.	Difficult
office	Mike played with the black stapler on his desk.	Difficult
office	Mike spent 10 minutes on eBay.	Difficult
office	Mike thought he had the flu.	Difficult
office	Mike worked in the Novartis building.	Difficult
office	Mike worked on the 20th floor.	Difficult
office	Mike works as a sales representative.	Difficult
office	Mike got worried about his physical health.	Easy
office	Mike had to throw up, so he left the meeting.	Easy
office	Mike likes his job.	Easy
office	Mike thinks Toby is arrogant.	Easy
office	Mike tried to get Toby's attention but was ignored.	Easy
office	Mike was intimidated by Ms. Smith.	Easy
office	Mike was looking forward to his work meeting.	Easy

Table 1C: True/False Statements for Narrative Text

Story	Question	Level of Difficulty
office	The company no longer provides donuts during meetings.	Easy
office	Toby and Mike are good friends.	Easy
office	Toby typically wears a suit and tie.	Easy
Shopping	Ashley and Maria both loved running.	Difficult
Shopping	Ashley found a tie that was 40% off.	Difficult
Shopping	Maria bought a silver clutch for her sister.	Difficult
Shopping	Maria is a music major.	Difficult
Shopping	Maria set a 100-dollar spending limit.	Difficult
Shopping	Maria's parents are professors.	Difficult
Shopping	The entrance to the building led to the men's department.	Difficult
Shopping	The men's clothing department was located behind the cologne counter.	Difficult
Shopping	The story takes place on the first Saturday of December.	Difficult
Shopping	While waiting for Maria, Ashley listened to the "jingle bells" song in the car.	Difficult
Shopping	Ashley and Maria loved shopping.	Easy
Shopping	Ashley and Maria met during their senior year of college.	Easy
Shopping	Ashley came from a wealthy family.	Easy
Shopping	Ashley does not like strong cologne.	Easy
Shopping	Ashley is from Southern California.	Easy
Shopping	Ashley was shopping for her boyfriend.	Easy
Shopping	Maria bought a purse for herself.	Easy
Shopping	Maria forgot to do her make-up.	Easy
Shopping	Maria needed to improve her grades or her family would cut her off from their money.	Easy
Shopping	Maria used a coupon for the first time in her life.	Easy
Zoo	A young man led the Drawing Zoo Animals Workshop.	Difficult
Zoo	Liz got a call from a friend named Julia.	Difficult
Zoo	Liz had a backpack with her during the Zoo visit.	Difficult
Zoo	Liz has a red phone.	Difficult
Zoo	Violet came from a rich single-parent home.	Difficult
Zoo	Violet has fat legs.	Difficult
Zoo	Violet has green eyes.	Difficult
Zoo	Violet is the youngest of 3 siblings.	Difficult
Zoo	Violet named her teddy bear Mr. Cupcake.	Difficult
Zoo	Violet wore purple shoes to match her frilly dress.	Difficult
Zoo	Liz and Violet ended up having a bad day at the zoo.	Easy
Zoo	Liz enjoyed being around Violet.	Easy
Zoo	Liz felt Violet was spoiled.	Easy
Zoo	Neither Liz nor Violet wanted to go to the zoo.	Easy
Zoo	Violet finally got to see bunnies at the children’s center and got to draw them as well.	Easy
Zoo	Violet hated rabbits.	Easy
Zoo	Violet hated the penguins.	Easy

Table 1C: True/False Statements for Narrative Text

Story	Question	Level of Difficulty
Zoo	Violet threw a temper tantrum and ran away from Liz at the zoo.	Easy
Zoo	Violet was a sweet kid.	Easy
Zoo	Violet's mother did not enforce reading enough on her.	Easy

Appendix D

Table 1D: Reaction Time Pairwise Results for Probe Type by Shift Type

Comparison						
Probe Type	Shift Type(i)		Shift Type(j)	*Estimate (i-j)*	*SE*	*p*
Character vs. Character	Unchanged	-	No Shift	-11.24	70.78	1.00
	Unchanged	-	Changed	123.16	70.34	.50
	No Shift	-	Changed	134.40	70.25	.39
Space vs. Space	Unchanged	-	No Shift	55.17	76.54	.98
	Unchanged	-	Changed	-112.94	77.69	.69
	No Shift	-	Changed	-168.11	76.45	.24
Character vs. Space	Unchanged	-	No Shift	-221.98	72.98	**.03**
	Unchanged	-	Changed	-390.08	74.18	**< .01**
	Unchanged	-	Unchanged	-277.15	74.41	**< .01**
	No Shift	-	Unchanged	-265.91	74.34	**< .01**
	No Shift	-	Changed	-378.85	74.13	**< .01**
	No Shift	-	No Shift	-210.74	72.82	**.04**
	Changed	-	Unchanged	-400.31	73.92	**< .01**
	Changed	-	No Shift	-345.14	72.35	**< .01**
	Changed	-	Changed	-513.25	73.68	**< .01**

Note: The contrasting condition is on the right. SE = Standard Error.

Table 2D: Accuracy Pairwise Results for Probe Type by Shift Type

Comparison				*Odds Ratio (i-j)*	*SE*	*p*
Probe Type	Shift Type(i)		Shift Type(j)			
Character vs. Character	Unchanged	-	No Shift	1.00	.14	1.00
	Unchanged	-	Changed	0.86	.12	.89
	No Shift	-	Changed	0.86	.12	.89
Space vs. Space	Unchanged	-	No Shift	0.85	.10	.73
	Unchanged	-	Changed	1.06	.12	1.00
	No Shift	-	Changed	0.23	.12	.39
Character vs. Space	Unchanged	-	No Shift	1.65	.22	**< .01**
	Unchanged	-	Changed	2.08	.26	**< .01**
	Unchanged	-	Unchanged	1.95	.25	**< .01**
	No Shift	-	Unchanged	1.96	.25	**< .01**
	No Shift	-	Changed	2.08	.27	**< .01**
	No Shift	-	No Shift	1.66	.22	**< .01**
	Changed	-	Unchanged	2.28	.30	**< .01**
	Changed	-	No Shift	1.93	.26	**< .01**
	Changed	-	Changed	2.42	.32	**< .01**

Note: The contrasting condition is on the right. SE = Standard Error.

Table 3D: Accuracy Pairwise Results for Language Proficiency by Probe Type by Shift Type

Probe Type	Language Proficiency	Contrast	*Odds Ratio*	*SE*	*p*
Character	32.54	No Shift / Unchanged	0.75	.25	.67
		No Shift / Changed	0.70	.24	.56
		Unchanged / Changed	0.94	.33	.98
Space	32.54	No Shift / Unchanged	2.12	.61	**.02**
		No Shift / Changed	1.88	.53	**.07**
		Unchanged / Changed	0.89	.24	.90
Character	16.27	No Shift / Unchanged	0.86	.19	.76
		No Shift / Changed	0.77	.17	.46
		Unchanged / Changed	0.90	.20	.88
Space	16.27	No Shift / Unchanged	1.59	.28	**.02**
		No Shift / Changed	1.54	.27	**.04**
		Unchanged / Changed	0.97	.16	.98
Character	0.00	No Shift / Unchanged	0.99	.14	.99
		No Shift / Changed	0.85	.12	.48
		Unchanged / Changed	0.86	.12	.56
Space	0.00	No Shift / Unchanged	1.19	.14	.31
		No Shift / Changed	1.27	.15	.12
		Unchanged / Changed	1.06	.12	.87
Character	- 16.27	No Shift / Unchanged	1.13	.21	.79
		No Shift / Changed	0.93	.18	.93
		Unchanged / Changed	0.83	.16	.57
Space	-16.27	No Shift / Unchanged	0.89	.15	.79
		No Shift / Changed	1.04	.18	.97
		Unchanged / Changed	1.16	.20	.66
Character	-32.54	No Shift / Unchanged	1.30	.39	.67
		No Shift / Changed	1.03	.32	1.00
		Unchanged / Changed	0.79	.24	.73
Space	-32.54	No Shift / Unchanged	0.67	.19	.32
		No Shift / Changed	0.85	.23	.82
		Unchanged / Changed	1.27	.35	.66

Note: The language proficiency values selected represent the values from two standard deviations below and above the mean. SE = Standard Error.

Appendix E

Table 1E: Linear Mixed Models Results for Reaction Time and Accuracy (Working Memory Capacity Model)

	Reaction Time			**Accuracy**		
Predictors	*Estimates*	*CI*	*p*	*Odds Ratio*	*CI*	*p*
Working memory Capacity	52.99	-73.41 – 179.38	0.411	1.04	0.93 – 1.16	0.497
WM. Cap. * Language Prof.	34.80	-21.50 – 91.10	0.226	0.99	0.92 – 1.08	0.886
WM. Cap. * Shift Type [No Shift vs. Unchanged]	51.77	-50.89 – 154.42	0.323	0.97	0.81 – 1.15	0.710
WM. Cap. * Shift Type [No Shift vs. Changed]	3.29	-99.81 – 106.40	0.950	0.95	0.80 – 1.13	0.585
WM. Cap. * Shift Type [Unchanged vs. Changed]	-48.47	-150.16 – 53.22	0.350	0.98	0.83 – 1.17	0.859
WM. Cap. * Probe Type [Character vs. Space]	50.17	-33.65 – 133.98	0.241	1.01	0.87 – 1.17	0.882
WM. Cap. * Probe Type * Shift Type	5.74	-201.71 – 213.18	0.957	0.93	0.65 – 1.33	0.682
WM. Cap. * Language Prof. * Probe Type * Shift Type	127.86	-60.10 – 315.82	0.182	1.19	0.86 – 1.63	0.291

Note: CI = 95% confidence interval.

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Vita

Omar Carrasco's journey in psychology research began during his undergraduate years at The University of Texas at El Paso, where he collaborated with Dr. Ashley Bangert. His research focus encompassed time perception and event perception, delving into the intriguing interplay between event boundaries and time perception. Graduating with a B.S. in Psychology in 2013, he continued his academic pursuit, completing a Master's in Experimental Psychology in 2017 at the same institution. Mr. Carrasco has showcased his research findings at numerous conferences and was honored with the Distinguished Poster Award at the 25th Annual ARMADILLO Southwest Regional Conference in October 2017. He served as a graduate student representative on the Information Technology committee of the Faculty Senate at the University of Texas at El Paso, and as a program evaluator for the Center for Institutional Evaluation, Research, and Planning at the same institution, emphasizing his commitment to contributing to the academic community. Beyond academia, Mr. Carrasco has dedicated himself to serving the El Paso community in various capacities, including roles as a caseworker, therapist, program evaluator and teacher. Currently, he brings his analytical skills and expertise to the Juvenile Justice Center in El Paso, Texas, where he serves as a data analyst. His diverse background showcases Mr. Carrasco's dedication to both research excellence and community service.

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