THE INTERACTION OF GOAL AND TEMPORAL SHIFTS IN SITUATION MODELS

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Abstract

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Situation model theory is a framework for understanding the representations of deep comprehension of information derived from a text (see Zwaan & Radvansky, 1998). Several components of a situation model (including space, time, causality, entities, and information and protagonists) are updated into the situation model. The inter-relation of the time and goal dimensions was investigated in two experiments. Although goal and time information are typically related to one another in a narrative (given that goals take time to complete), no work has investigated how changes along these dimensions interact within the situation model. Three plausible relations among the dimensions (no relation, augmenting, and weakening) were investigated by manipulating discontinuities in goal and/or time information within a narrative. The results supported a weakening relation of the dimensions, meaning that a discontinuity along one dimension reduced the observed effect of a discontinuity along the other. Potential reasons for a weakening relation are discussed.
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CHAPTER 1
INTRODUCTION

To comprehend language, people must mentally represent the information that is presented to them. The form of this representation is important because it impacts overall comprehension, and later recall. It is generally accepted that in language comprehension there are different levels of mental representation (e.g., Kintsch, 1988; Schmalhofer & Glavanov, 1986). Specifically, with regard to text comprehension, there are three levels: the surface form, the propositional textbase, and the situation model. The most basic level is the surface form. This level of representation captures the surface features of text, such as actual words and syntax. The middle level is the propositional textbase. This level is more abstract than the surface form and contains the idea units presented in the text, apart from the specific wording used. The highest level of representation is the situation model, which is the type of representation studied here. The situation model represents what the text is about, rather than the text itself, which is the case for the surface form and textbase levels (Glenberg, Meyer, & Lindem, 1987). The situation model represents the gist of a situation, and is the level most associated with deep understanding.

The situation model captures a number of dimensions that reflect the structure of the real world and how people interact in it (for a review see Zwaan & Radvansky, 1998). Primary dimensions of situation models include space, time, causality, entities, as well as
information about objects and protagonists, including their goals and emotions. The purpose of the present study is to further investigate these dimensions. Specifically, the focus is on the goal and time dimensions and how they interact. Most research on situation models has focused on a single dimension, and has not considered the importance of interactions due to multidimensionality.

A crucial aspect of situation models is that, in addition to information in the text itself, they also contain inferences made by the reader. In constructing a situation model, readers are actively imposing their own structure on what they read, integrating real-world knowledge with information from a text (Duffy, Shinjo, & Myers, 1990; Suh & Trabasso, 1993; Trabasso & Sperry, 1985). This real-world knowledge, along with the text, allows the reader to make inferences that become part of the situation model. Given that the situation model as a whole is used in comprehension, the reader’s inferences early on can affect subsequent inferences. These inferences affect how information within a text is structured during comprehension, and impact later recall (Graesser, 1981; Keenan, Baillet, & Brown, 1984; Schank & Abelson, 1977). To guide inferences, it appears that causality and the intentions or goals of characters in a text are of central importance. Specifically, readers create a causal structure of a story that serves as a backbone to model construction, making it easier for goal-related inferences to be made (e.g., Fletcher & Bloom, 1988; Foss & Bower, 1986). This causal structure is created from the intentional information of the story; particularly character’s goals, actions taken to achieve these goals, and the success/failure status of the goals.

Creating a causal structure also makes it easier for the reader to retrieve information about goals by allowing new goal information to be more easily integrated.
with old information. The reader can use causal information to retrieve aspects of the story, such as actions the character has taken to achieve a goal. These inferred actions, as well as the goal information from the text, are stored in the situation model. One specific aim of the present study is to further explore the impact of goal information on other aspects of situation model construction. It is important to keep in mind that a situation model represents multiple dimensions that may or may not interact with one another (Zwaan & Radvansky, 1998). Although goal information has typically been treated independently of other aspects of the text, character goals are usually related to other components. For example, goal information may be related to character emotions in that a failure to achieve a goal would elicit an emotion (e.g., frustration) and emotions may motivate goals (e.g., disappointment with current income level).

Goal information appears to have a particularly critical relationship with the time dimension. For any goal to be completed, the actions needed will take some amount of time. Therefore, goal completion is directly related to temporal extent. Given this strong relation, a fuller understanding of the interaction of the goal and time dimensions is of interest. In addition, a systematic study of the relation between these dimensions will aid the general understanding of how dimensions of a situation model interact with one another. For example, there are many questions regarding whether the dimensions are represented simultaneously, and if so, whether the state of one dimension has an effect on others (Zwaan & Radvansky, 1998; Zwaan, Magliano, & Graesser, 1995). In the following sections, the general framework of situation model processing will be introduced, followed by a detailed description of the unique roles of goal and time.
information within the model. The discussion will then move towards the multidimensional nature of the situation model, considering the inter-relation of the dimensions of interest.

1.1 Situation Model Construction and Updating

The framework for constructing a situation model is as follows. As the initial situation in a text is read, a model is created that represents the elements of that situation with tokens corresponding to the various important entities. Any of the information represented by one of the primary components of the situation (e.g., space, time, entities, intentions, causality) is coded into this model. As new information is encountered, readers alter their existing model. This process is referred to as updating.

There are three types of updating that can occur. First, new information about a situation is incorporated into the existing model. For example, consider a story that begins with the text: “There was a lady named Mary who wanted to become a lawyer”. The initial situation model constructed by the reader would contain information about a protagonist (Mary), as well as information about her intention (becoming a lawyer). If the next piece of text were: “Mary entered a courtroom”, a token for the new location (courtroom) would be updated into the existing model, along with the spatial information of entering a courtroom. Importantly, not all information about a situation is updated into the existing model with the same facility. Specifically, the greater the relevance of a new element, the more likely it will be incorporated into the model. A piece of information that is highly relevant to a previous situation is related to a number of components represented in the previous model, which makes it easier to incorporate
the new information (Radvansky & Copeland, 2000; Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998).

The second way that readers update situation models is by removing information that becomes irrelevant. When new information is encountered, this sometimes causes old information to lose its relevance (Lutz & Radvansky, 1997; Suh & Trabasso, 1993). For example, consider reading a situation about a man who plans on going to the store after work to buy aspirin for his headache. You then read that the man’s headache quickly goes away. At this point, information about the man going to the store is no longer relevant because he no longer has a need for a pain reliever. Under these circumstances, this goal information would be removed from the reader’s situation model and become less accessible.

The third way that a model is updated is that, when a situational shift has occurred, some of the information from the previous situation will need to be maintained. Old information needs to be maintained when there is an otherwise large shift in the situation, and that information continues to be relevant. Maintaining such information is often crucial to adequately comprehend a situation. The reader’s ability to maintain information about distal situations aids both a global, as well as a local understanding of the story. Consider a man walking through the park on a hot summer day. The man is becoming dehydrated and is in need of water. Suddenly, he runs into his best friend from college who asks him to go to his house to talk about old times. In this situation, even though the context of the story is shifting, it remains important for the main protagonist to get water. This will remain a goal of the protagonist and should be continuously updated into the reader’s situation model until the protagonist satisfies this goal.
The causal relevance of text information plays a large role in determining what information will be updated into the situation model. Information is relevant when it is causally related (connected) to the components of the existing situation model. Information relevance increases with increased numbers of causal connections. Relevance also plays a large role in determining the ease of retrieving information from a situation model. Information at high levels of relevance is foregrounded in the model, with a retrieval cue for this information maintained in short-term working memory (Ericsson & Kintsch, 1995). When information is foregrounded, it is more accessible to the reader, and is easier to recognize and recall than information that is not foregrounded. Foregrounding can also cause information to be available at a global level because it is of greater relevance to the overall story, and can help a person make a wide range of inferences (e.g., Bower & Rinck, 1999). Of particular interest here is the notion that current goal information is a part of the text that is foregrounded. Information about the goals of a protagonist, such as a desire to change jobs, can be used to make inferences about a variety of actions of the protagonist (e.g., Fletcher & Bloom, 1988).

1.1.1 Situation Model Components

The exact taxonomy of components represented in the situation model is still under investigation. However, there is a great deal of evidence that at least a subset of these represent aspects of space, time, causality, object and entity information, and the intentions (or goals) of entities in the situation (Zwaan & Radvansky, 1998; Zwaan, Langston, & Graesser, 1995; Zwaan, Magliano, & Graesser, 1998). The following subsections provide a detailed description of the goal and time dimensions, which are of primary interest here.
1.1.1.1 Intentionality and Goals. Goals are the cause of people’s intentional actions (Schank & Abelson, 1977; Trabasso, van den Broek, & Suh, 1989). Tracking goals in a story aids causal understanding because goals are typically connected with many events that occur in various sections of a story. This interconnectedness gives the reader a source of cohesion among the text events. For example, readers who keep track of goals are more likely to understand the main theme of a story (van den Broek, Lynch, Naslund, Ievers-Landis, & Verduin, 2003). Given this, goals and intentions are an important component of situation models.

Introduction of New Goals

Research has shown that readers keep track of the goals of protagonists as they read a text (e.g., Suh & Trabasso, 1993), thereby introducing goal information to the situation model. Changes in a protagonist’s intentions causes the reader to take longer to read a situation than when there is no such change (e.g., Rinck & Weber, 2003; Zwaan, Radvansky, Hilliard, & Curiel, 1998). The slower reading times, given a goal change, is assumed to occur because it takes some amount of time for the reader to incorporate the new goal information into their existing situation model.

Goal Removal and Maintenance

Once goal information has been represented in a situation model, it is updated as the situation changes. For example, when the reader encounters text in which a goal is completed, the goal information is updated to reflect that the goal is no longer motivating the protagonist. Suh and Trabasso (1993) tested the availability of goal information when the protagonist’s goal was either completed or failed. In their experiment, a goal was
introduced followed by a few filler sentences. The sentences following the goal contained either a description of the protagonist completing the goal, or failing to complete the goal. After this, people were asked true/false probe questions about the goal of the protagonist, causing them to access the goal information. Although the text distance between the introduction of the goal and the probe was the same in both conditions, response times were faster for information about the failed goal, indicating that it was at a higher level of availability.

The point of these results is that failed goal information is maintained in the updated situation model, as the situation develops. Another important point is that when the reader encounters a completed goal, that goal information is reduced in availability. A failed goal behaves as a better foregrounding device than a completed goal, possibly because it is more likely to continue to motivate the actions of the protagonist than is a completed goal.

While completed goal information does play less of a role in a reader’s situation model, evidence has suggested that it is not entirely removed from the integrated situation model. Lutz and Radvansky (1997) compared the availability of completed goal information to neutral (non-goal) information. The overall structure of the experiment was similar to that used by Suh and Trabasso (1993), but one condition was added which included neutral story information. This condition contained the same information as in the goal conditions, except that it did not set up the need for the reader to connect this information to subsequent information in the text for comprehension. Lutz and Radvansky found shorter RTs when probing the reader about the completed goal, indicating that this information was more available to the reader than neutral information.
This suggests that completed goal information still plays a larger role than neutral information, probably because it can remain important to the overall causal structure of the text, and is part of the story as a whole.

Recent evidence also suggests that certain types of goals may be removed entirely from the situation model if the goal becomes irrelevant. For example, suppose that a Freshman switches majors from Psychology to Biology. Suddenly, their prior goal of getting into a fully enrolled Abnormal Psychology class is no longer relevant. Such irrelevant and inappropriate goal information is less accessible than neutral information, and is assumed to be removed or inhibited from the situation model. Linderholm, Gernsbacher, van den Broek, Neninde, Robertson, and Sundermier (2004) probed readers after a goal was introduced, as well as after the goal was followed by three conditions. The goal was either re-mentioned, neutral information was presented, or a new goal (irrelevant to the first) was introduced. They found that response times were slowest after a new goal was introduced, and the previous goal information was made irrelevant. This suggests that the more recent goal information can have an impact on prior goal information. More generally, this study suggests that switches in goals can cause information that was relevant to become irrelevant and subsequently removed from the reader’s situation model.

Magliano and Radvansky (2001) also demonstrated the importance of recent goal information. Specifically, they considered the effect that new unrelated goal information has on prior goal information, as well as the reverse, but not in the context of a goal switch. They found that subsequent goals cause earlier goals to become less available, yet the reverse was not found. The presence of a more recent goal diminished the availability
of prior goals. This supports the idea that the most recent goal is the most causally relevant for the reader, and is updated into the situation model, while the continued updating of previous goals suffers.

Researchers have also looked at the relevance of goals that are related to one another. There can exist a hierarchy of main goals and subgoals, which are referred to as superordinate and subordinate goals, respectively. The superordinate goal is the main goal that the protagonist wants to achieve. To achieve this goal, it is common for the protagonist to first achieve a series of subordinate goals. Each of these subgoals is directly related to the main goal, and achieving the subgoal moves the protagonist closer to completing the main goal. For example, consider a protagonist who wants to earn a degree in biology. Earning the degree will require the accomplishment of a series of subgoals including acceptance to a college, enrolling in classes, and achieving a passing grade. In a study looking at the effect of subgoals, Suh and Trabasso (1993) presented readers with stories containing superordinate and subordinate goals. Readers were probed for information about each goal when it was introduced. They found that the most recent uncompleted subordinate goal was the most salient to the reader. They also found that the reader had heightened access to the superordinate goal. This highlights the importance of superordinate goals in understanding the overall causal structure of the story, and although a recent subgoal may be related to the main goal, it suggests that main goals are continuously updated in the situation model, along with the most recent subgoal.

Evidence also suggests that goal inferences are made at the superordinate level (Graesser & Clark, 1985; Graesser et al., 1994; Long & Golding, 1993; Long, Golding, Graesser, & Clark, 1990). Readers include inferences about superordinate goals when
recalling a story, and when answering why-questions about the protagonist’s actions in a story (e.g., Abbott & Black, 1986; Graesser, 1981; Graesser & Clark, 1985). This illustrates the importance of superordinate goals, yet, there is the possibility that inferred goals could be generated at the time of recall, and do not necessarily play a role in on-line comprehension. Long and Golding (1993), however, did a study using a rapid visual presentation procedure to get at on-line comprehension latencies. Their study showed that superordinate goals were generated at the time of comprehension, and the generation of superordinate goals happened more often than generation of subordinate goals. For example, when reading a story about a dragon that kidnaps a child, a reader will likely infer that the dragon wants to eat the child. This helps motivate the actions of the main character, and aids the overall understanding of the story. This further supports the use of superordinate goal inferences to aid in the causal understanding of the overall text.

1.1.2 Theories of Causal Inferences

For a reader to make goal-related inferences, which is crucial to situation model construction and updating, the reader must abstract the causal structure of the story. Not surprisingly, the causal structure is often related to the intentions of the characters in the story. Specifically, by keeping track of the goals of the protagonist, as well as the actions taken to accomplish those goals, and whether they succeed, the reader forms a cohesive structure of the situation. Therefore, the use of goal information is an essential part of forming a useful causal structure, and in turn a viable situation model.

Several theories have been offered to account for how readers use goal information to establish causal relations. The largest distinction among these theories concerns whether the use of goal information provides causal structure only at the local
level, or if it can also be used at a more global level. A theory by van den Broek (1990) was very clear in that, so long as the story maintains local coherence, global inferences are not made. He proposed a causal inference maker, in which the reader only makes causal connections between the current and most recently read text to maintain local coherence. Similarly, Fletcher and Bloom (1988) suggested that capacity constraints limit the ability of readers to establish global causal inferences. They proposed a current-state selection strategy, in which current text information is causally connected with information in short-term memory. Under this framework, global inferences only occur when an unfulfilled goal remains in short-term memory for a substantial amount of time.

Another issue is whether readers actively structure goal information to infer causal structure during comprehension (e.g., Fletcher & Bloom, 1988; Graesser, Singer, & Trabasso, 1994). One class of theories assumes that comprehension is primarily driven by the information in the text (e.g., Guillund & Shiffrin, 1984; McKoon & Ratcliff, 1992). Only text information about the content of the current and most recent sentences is stored in long-term memory. During comprehension, nothing about world knowledge is incorporated into the story representation. To activate previous information in the text, a passive resonance process occurs, in which contextually relevant information in long-term memory, along with information from real-world knowledge resonates in response to current text. This allows for global, as well as local inferences to be made. However, these inferences are passive and only occur after the initial comprehension process (e.g., Keenen, Baillet, & Brown, 1984; Myers, Shinjo, & Duffy, 1987).

In contrast, there is a great deal of support for an alternative view in which readers search for meaning as they comprehend text. This is the constructionist view (e.g.,
Graesser et al., 1994; Singer, Graesser, & Trabasso, 1994), and it focuses on the use of global causes (such as main goals) in aiding comprehension for actions and events that are current in the text. Even when a text is locally coherent, global causal connections are assumed to play a major role in comprehension. The reader actively constructs a causal structure that affects the accessibility of goal information, and aspects of the text that are causally related to this information. In addition, the causal structure does not have to be explicitly present in the text. Readers appear to use causal reasoning to make inferences about the cause of events and actions based on the text, as well as their knowledge of the world (Graesser et al., 1994; Singer et al., 1994; Suh & Trabasso, 1993). Unlike passive resonance, the process of inference generation proposed by the constructionist model is active, occurring on-line during comprehension. Furthermore, the model implies that an inferred causal structure made by the reader during comprehension not only affects later memory; it also affects how subsequent information in the text is comprehended. The constructionist model is most consistent with how goal information is used to create causal inferences within situation models. It is assumed that, in addition to representing the causal structure in the text, representations of causal inferences made during comprehension are also represented in the situation model.

1.1.2.1 Time. The temporal dimension has been given less attention than the other dimensions, although it appears to be studied more as of late (Rinck & Bower, 2000; Rinck, Hahnel, & Guido Becker, 2001). Time is an intriguing dimension within a story because events can occur in a non-chronological manner, violating our real-world knowledge about the passage of time. For example, the amount of time that passes for a reader while comprehending a story (discourse time) often differs from the amount of
time that is described to have passed in the story (story time). It has been proposed that readers make the assumption that events explained in a text happen in a chronological order, much as they do in real life. This is known as the iconicity assumption, and has been supported by numerous studies (Chafe, 1979; Givon, 1992; Hopper, 1979). The general results show that when the order of events in a story is not chronological, such as when a flashback occurs, story comprehension suffers (Mandler, 1986; Ohtsuka & Brewer, 1992).

Temporal information is an important component of situation models. Although it does appear that relative time, which consists of knowledge about the temporal order of events, is stored in the situation model, it is likely that absolute time (e.g., exact dates and times) are often not explicitly represented in the situation model. For example, unless critical to comprehension, exact times and dates are probably not represented (Radvansky, Zwaan, Curiel, & Copeland, 2001). Instead, time has implications about the state of other types of information within the text. This is consistent with the idea that temporal information, like goal information, is a salient dimension, and aids in structuring the representations of the other dimensions.

Introduction of Temporal Information

Van der Meer, Kruger, and Nuthmann (1999) provided evidence that the temporal cues in a situation affect the speed with which descriptions of a situation are read. They presented pairs of items that were temporally connected in a chronological manner, such as after heating and warm, or in a reverse chronological manner such as after heating and cold. They found that the items that appeared in chronological order (after heating and warm) were processed faster than those that appeared in reverse order (after heating and
cold). The pairings did not differ in semantic complexity, suggesting that the differences in reading times were due to the reader’s representation of the temporal information contained in the pairing. This evidence supports the assumption that readers incorporate chronological information into their situation model.

Further evidence comes from temporal information conveyed by word tense, which has been shown to affect comprehension. Trueswell and Tanenhaus (1991) demonstrated that the speed of reading a sentence containing a past tense verb is dependant on the temporal context of the sentence, suggesting that the reader represents the temporal context of the situation. Carreiras, Carriedo, Alonso, and Fernandez (1997) also demonstrated that verb tense affects reading comprehension. They presented readers with narratives that varied only in the tense of one aspect of character information such as “now she works” verses “sometime in the past she worked”. They found that present tense information about the character was recalled faster than information presented in past tense, indicating that readers incorporate temporal information into their understanding of the story, which has a subsequent effect on comprehension.

Additional studies have provided evidence that readers keep track of temporal continuity by updating temporal information into their situation model. Zwaan and colleagues have investigated the effect that situational discontinuity has on comprehension (Zwaan et al., 1995; Zwaan et al., 1998). The basic logic is that temporal information is easier to incorporate into a situation model if the time period in the story remains constant. Disrupting the continuity of temporal information by introducing non-linear temporal shifts makes it harder for the reader to accurately incorporate this information into their situational model, which in turn causes comprehension to suffer.
This is precisely what they found. Discontinuities in temporal information led to increases in reading times. Temporal information that maintained continuity was read faster, suggesting that continuous temporal information is more easily integrated into the developing model.

*Updating, Removal, and Maintenance*

The time component of a situation model is influential in indicating that irrelevant information should be removed from an existing model. Zwaan (1996) presented readers with sentences containing phrases such as “a moment later”, “a day later”, or “an hour later”. He found that larger shifts in story time (e.g., an hour later) resulted in less accessibility of the surrounding information in the text, providing evidence that updating is more challenging when the integrated model does not represent the most recent event. This suggests that readers both update temporal information into the situation model, and use this information as a basis for updating other types (components) of information.

Temporal information also indicates when information should be removed from a situation model because it is no longer relevant. Long shifts in time are typically accompanied by changes along multiple dimensions, and are an important cue that an existing situation model needs to be overhauled. If the model is not drastically changed, little information will integrate across models and comprehension will suffer. Consider reading about a boy who is going to elementary school. You are familiarized with his friends, teachers, etc. when suddenly the story jumps ahead a year. Most aspects of the boy’s school life will probably be different, and to follow the story it is important to obtain all of the new information about the boy. Information about his life a year ago, however, is probably not as important.
There is evidence that readers create new situation models using temporal information. A. Anderson et al. (1983) performed a study in which a story was presented that contained one of two lengths of temporal shifts. Only one of the shifts was short enough so that it could be considered part of the same situation. For example, in a situation where someone is taking an exam, a 5 minute shift would be part of the same situation, but a 3 hour shift would not. They found that the reading times for information about objects or characters other than the main protagonist were longer after the longer time shift than the shorter one. These results indicated that character and object information was no longer represented in the current situation model once a long temporal shift occurred.

Further evidence of the use of time to organize information in situation models comes from Radvansky, Zwaan, Federico, and Franklin (1998). They suggested that elements of a sentence with a great deal of overlap are easily integrated into a single situation model. Those that do not overlap, however, will be difficult to integrate within an existing model. To test this, readers studied sentences that were composed of a person, activity, and an event. Events were manipulated in order to vary the amount of temporal overlap. For example, temporal overlap for the following sentences would be maximal: *The carpenter was adjusting his glasses when the alarm sounded* and *The doctor was fastening his shoe when the alarm sounded*. Temporal overlap would decrease if a different time period was signified by another event: *The doctor was fastening his shoe when lightening struck*. Readers’ ability to recognize the sentences was then timed. Consistent with a fan effect (Anderson, 1974), they found that as the number of non-overlapping studied items increased, so did response times. Longer reaction times given
less temporal overlap were thought to result from the construction of additional situation models, which interfered with each other during recognition.

The next section discusses in further detail a clearer picture of how information is updated in the situation model and can be obtained by evaluating the relationship among the time and goal dimensions.

1.1.3 Component Interaction

A variety of situation components are incorporated into a reader’s representation of a story. The event-indexing model has been proposed as a theoretical account of how multiple components of a situation are tracked within situation models (Zwaan, 1999; Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998). Given that several components of a situation model are updated, it is important to consider the relative contributions of each one to the overall representation of the situation. Only a small amount of work has been done to understand the relation among components of situation models. Most components have been considered in isolation, which is potentially problematic when you consider the misleading results that emerge if shifts in one dimension influence another dimension. Attempts have been made at studying the relative importance of different dimensions. Magliano, Miller, and Zwaan (2001), for example, looked at the comprehension of narrative films to assess the effect that shifts in time, space, and movement of the protagonist had on whether a situation was seen as continuous or changed. They found that certain components were much more likely to shift together than were others. Although this evidence is of a correlational nature, it suggests that the inter-relation of situational components is informative, and that
comprehension of a situation will benefit from simultaneous representation of the components.

Zwaan, Magliano, and Graesser (1995) directly investigated the simultaneous processing of the components in text. They found evidence in support of the event-indexing model by assessing the influence of breaks in the continuity (shifts) along the time, space and causal dimensions using multiple regression analyses. The number of component breaks was compared to the time it took to read the text. The results showed that the readers simultaneously monitored the temporal and causal dimensions, as shifts in both dimensions were related to increases in reading times. Shifts in the spatial dimension, however, did not result in reliably larger reading times, suggesting that the dimensions are differentially monitored.

Zwaan, Radvansky, Hilliard, and Curiel (1998) added to these findings. In addition to replicating the findings of Zwaan et al. (1995) regarding the temporal and causal dimensions, they also found that shifts along goal and protagonist information led to increases in reading times. They also failed to find an effect of the spatial dimension unless it was manipulated to be made more salient, but they did demonstrate that readers monitor several dimensions of a single situation.

A common change in a situation that accompanies temporal changes is changes in spatial location. Seldom do aspects of a story, especially protagonists, remain in the same place for long amounts of time. Rinck and Bower (2000) considered the impact of the temporal dimension on the updating of the spatial dimension by manipulating these dimensions within a narrative. Participants studied the layout of a building containing objects. They then read narratives about a character moving through the rooms of the
building, and were probed about objects along their path. Temporal distance was varied by introducing either minutes or hours of time passing while the protagonist completed a task in the building. The spatial dimension was varied by probing the participant about objects that were either located in an unmentioned room along the protagonist's path, or in a location room that was mentioned directly. They found that the accessibility of the spatial dimension depended in part on the temporal dimension. Overall, reading time was slower when the spatial information was less accessible. Also taking into account the temporal dimension, reading time for the highly accessible spatial information was 2.57 sec when accompanied by a long temporal shift, but shortened to 2.40 sec when accompanied by a short temporal shift. The accessibility of highly available spatial information was made more accessible when accompanied by a short, rather than a long temporal shift.

A few recent studies have focused on experimental investigations of the relation amongst the dimensions. Much of the other work done in this area has relied on a correlational approach by relating the number of dimensional shifts with increases in reading time. Rich and Taylor (2000) investigated the inter-relation of the protagonist, time, and space dimensions. They experimentally manipulated narratives to contain shifts in protagonists, shifts in location, and shifts in time. They found that sentences that contained shifts along each dimension caused increases in reading time as compared to continuous sentences. Rinck and Weber (2003) noted that the sentences that composed each shift were different for each dimension, and confounds might exist for lack of counterbalancing. They repeated the investigation of the protagonist, location, and time dimensions, using a full combination of shift and no-shift along all dimensions with
counterbalancing of materials along each experimental condition. They found that target sentence reading times that were discontinuous on a single dimension were accompanied by an increase in processing time. When additional dimensions followed with inconsistencies, they were also accompanied by a significant increase in processing time, but not as large as from the first inconsistency. A pooled analysis of reading times across dimensional shifts resulted in a 56 ms increase in reading times moving from no shift to a single shift (164 ms vs. 220 ms), but only an 11 ms increase in reading times moving from a single shift to two shifts (220 ms vs. 231 ms).

1.1.4 Relating the Goal and Time Components

To date, no work has looked at the interaction of the goal and time components. This relation is important because almost all goal information exists on a temporal continuum. Some amount of time must pass during which a character takes the actions needed to complete a goal. Moreover, it is evident that different types of goals require different amounts of time for their completion. For example, on the one hand, completing a goal such as wanting to eat lunch should not take very long (hours, minutes). On the other hand, wanting to lose 50 pounds will take longer (weeks, months, or years). It is also possible for goals to be continuous. For example, wanting to maintain body weight after losing 50 pounds. In this situation, the protagonist must continually make efforts to achieve this goal, and there is no specific point in time during which this goal is met.

Given the strong relation between the time and goal dimensions, it seems reasonable that these dimensions might be related to one another and interact. As described previously, changes in the accessibility of information across dimensions are
often correlated, especially with the temporal dimension. There are several ways that the
time and goal dimensions could combine to affect comprehension.

A number of factors are considered to make predictions about the interaction of
the goal and time dimensions. These include the impact of one dimension on the other,
and the influence of the size of a dimensional shift, as well as the symmetry of influence
of the dimensions on one another. To ease exposition, there are separate
sections handling each of these factors.

1.2 Impact of One Dimension on a Second

Below are three ways that the time and goal dimensions might influence one
another during comprehension. Each relation provides unique predictions for the effect of
dimensional shifts on comprehension. These predictions are grounded on the assumption
that dimensional shifts that are detected and processed will complicate reading
comprehension, resulting in longer reading times. To provide extensive coverage, two
sets of predictions are presented for each theoretical view, depending on whether the time
and goal dimensions shift simultaneously (as part of the same clause or sentence) or
sequentially (one directly after another).

An example of a sequential shift is as follows: Andy’s mother was going to take
him to see Santa Claus. She changed her mind when she saw how long the line was. They
ran into a family friend an hour later. This example demonstrates a goal shift in the
second sentence, followed by a temporal shift in the third. With sequential shifts, reading
times for both dimensions are obtained separately, allowing for direct comparison of the
reading times for sentences containing both types of shifts. An example of a simultaneous
shift is as follows: Andy’s mother was going to take him to see Santa Claus. Because of
how long the line was, she changed her mind and an hour later they ran into a family friend. The goal and time dimensions undergo a shift in the second sentence of this example. With simultaneously shifting dimensions, a single reading time is obtained, reflecting the overall impact of both types of shifts.

1.2.1 No Relation

The simplest relation is that time and goal shifts are processed independently of one another. In this case, the state of the goal dimension would have no effect on processing of the time dimension and vice versa. This is consistent with a situation in which comprehension is affected equally by each dimension. No relation among the dimensions would occur if all dimensions are monitored by the reader to the same extent, but they are processed independently because they refer to different qualities of information. Predictions for no relation among the dimensions is separated into two sections for sequentially vs. simultaneously shifting dimensions, as they result in different predictions.

1.2.1.1 Sequential Presentation. Figure 1.1 provides predictions for reading times for sequential shifts along generic Dimensions A and B, where Dimension A shifts first. Reading times to sentences with shifts can be compared to a control reading time where there is no shift, and to reading times for each of the single dimensions having undergone shifts in isolation. For no relation amongst the dimensions, reading times for the second dimension (for either the goal or time dimensions) are predicted to be the same regardless of whether or not the preceding text contained a shift. Reading times for shifts along each
of these dimensions is predicted to be the same as the reading time for a shift along a single dimension (isolated), but larger than the control reading time.

![Bar graph showing reading times for different dimensional shifts.](image)

**Figure 1.1.** Predicted reading times for sequentially presented goal and time shifts. A and B refer to generic situation model dimensions. Control = reading time when there are no shifting dimensions. Isolation = reading time for a single shifting dimension, not accompanied by other shifts.

Several studies show that shifts along a single dimension result in increased reading times (e.g., Zwaan et. al, 1995), but to date there has not been an experimental investigation of dimensional relations given controlled sequential shifts.

### 1.2.1.2 Simultaneous Presentation

When dimensions shift simultaneously, reading times reflect shifts along both dimensions. Although both dimensions can contribute to overall reading time, the dimensions do not necessarily influence each other. The situation here is not as straightforward as it is for sequential presentation. There is an added concern of whether the separate processing of the dimensions occurs in parallel or serially.
**Parallel Processing**

If processing occurs in parallel, it is expected that the reading time will be the same as the slower of the two shift processes. This relation is presented in Figure 1.2, which provides reading times for simultaneous shifts along generic Dimensions A and B, when the dimensions are processed in parallel. No relation results in a reading time that is the same as Dimension B, which is the slower of the isolated shifts.

![Figure 1.2. Predicted reading time for simultaneously presented goal and time shifts where dimensions are processed in parallel. A and B refer to dimensions that shift in isolation.](image)

Support for this sort of relation comes from a study mentioned previously by Rinck and Weber (2003) that investigated the protagonist and spatial dimensions. They presented a factorial combination of shift and no-shift conditions along the two dimensions, with multiple shifts occurring simultaneously. Shifts were manipulated by altering a target sentence at the end of a narrative. A shift along both dimensions, for example, occurred when the target sentence contained a protagonist name (Paul) and a location (house) that was different than that mentioned in previous sentences of the
narrative. No shift occurred when these pieces of information remained constant. They found that the presence of a shift resulted in longer reading times, and shifts along both dimensions resulted in longer reading times than shifts along a single dimension. However, a no relation view was supported because the second shift did not increase reading time. When there were no shifts along the dimensions, the average reading time was 186 ms. Reading time increased to 233 ms with a shift along the protagonist dimension, and a shift along the protagonist and location dimension resulted in a reading time of 231 ms.

_Serial Processing_

If processing of the two dimensions occurs serially, then the predictions for a lack of relation among the dimensions takes the form of an additive relation, where overall reading time reflects the accessibility of information from each dimension. This relation is illustrated in Figure 1.3, which provides reading times for simultaneous shifts along generic dimensions A and B, when the dimensions are processed in serial. For no relation among the dimensions, reading time is predicted to reflect the increases in Dimension A and Dimension B above the control reading time. As illustrated in Figure 1.3, the additive reading time is equal to the 200 ms for the control, plus 100 ms increase of Dimension A above the control, and 150 ms increase for Dimension B above the control (resulting in a total reading time of 450 ms).
As described previously, Zwaan et al. (1998) reported data that they argued support an additive relation. They combined data across three experiments into categories consisting of reading times when there was no-shift, one shift, and two or more shifts per sentence. Processing time increased significantly with each increase in the number of dimensional shifts. Although they interpreted these findings as support for an additive relation, it is not clear if the increases in reading times actually reflect this, or an inhibiting relation as will be discussed next. The main thing that can be inferred if there is no relation among the dimensions, given that two dimensional shifts resulted in a longer reading time than a single shift, is that the dimensions appear to be processed in a serial order.

1.2.2 Inhibiting Relation

Another possible relation is where a shift along one dimension causes the size of the observed effect of a shift along another dimension to be augmented. For the time and goal dimensions, shifts along the goal dimension would cause shifts along the time dimension to have a greater effect than in the absence of a goal shift, and vice versa.
Given evidence that more than one dimension affects reading times within a single situation (e.g., Zwaan et al., 1995), it is likely that several dimensions of a situation are at least partially monitored simultaneously. If this is the case, then an inhibiting relation could result if a shift along one dimension causes another partially monitored dimension to be more noticeable, resulting in that dimension having a greater impact on comprehension.

1.2.2.1 Sequential Presentation. Figure 1.1 displays predicted reading times for sequentially presented dimensions A and B given an inhibiting relation. The first dimensional shift is predicted to result in the same increase in reading time as for an isolated dimensional shift. The second dimensional shift, however, is predicted to be longer than the first, which in turn is longer than the reading time for the control. This relation could occur if the reader becomes more likely to notice a change in a second dimension after previously noticing a change along another dimension.

1.2.2.2 Simultaneous Presentation.

Parallel processing

Parallel processing of both dimensions, given an inhibiting relation, would result in a reading time that is slower than the reading time for the slowest of the two single dimensional shifts. This relation is presented in Figure 1.2. The inhibiting relation is predicted to result in a longer reading time because, across measures, it is expected that the longer of the two dimensions will be increased in time. This longer time would be reflected as a longer overall reading time.
Serial Processing

Reading times for serial processing of the dimensions given an inhibiting relation is presented in Figure 1.3. As before, reading time is predicted to reflect the added combination of increases in Dimension A and Dimension B above the control reading time. Referring to Figure 1.3, the inhibiting reading time is equal to the 200 ms for the control, plus the additional 100 ms increase of Dimension A above the control, and the additional 150 ms increase for Dimension B above the control, plus any additional time included by the augmented relation (resulting in a total reading time of 500 ms). Given that that reading time for the second dimension has been augmented, the overall reading time is larger than what is predicted given no relation among the dimensions when they are processed in serial.

Zwaan et al. (1995) found some support that the spatial and causal dimensions interact in an inhibiting relationship. Reading times were longer for a causal shift when that shift was also accompanied by a spatial shift than when it was not. The authors noted a crossover interaction, however, in that reading times given shifts along a causal dimension resulted in longer reading times in the presence rather than absence of a spatial shift. But, causal shifts resulted in the longest reading times, regardless if they were accompanied by a continuous or shifting spatial dimension. Overall, causal shifts led to a 216 ms increase in reading times, whereas temporal and spatial shifts led to 189 ms and 107 ms increases, respectively. This suggests that the most important factor driving the results was shifts along the causal dimension, and that the interaction should be interpreted with caution.
1.2.3 Facilitating Relation

In contrast to an inhibiting relation, a facilitating relation could exist. In this case, a shift along one dimension weakens the observed effect of a shift along the other. For the time and goal dimensions, a shift along the goal dimension would cause shifts along the time dimension to have a weaker effect than in the absence of a goal shift, and vice versa.

This relation might occur if a shift that occurs along one dimension is a sufficient indicator that a change of events has taken place. As a result, the influence of any further dimensional shifts on updating is redundant as some of the processing in updating the situation model has begun. For example, consider a rather extreme shift in goals, such as a man who decides to pursue a master’s degree rather than going straight into the workforce. Such a shift is most likely a sufficient indicator to a reader that a new situation model should be constructed. In this case, multiple shifts may be read very quickly, given that each dimension should be updated into the new situation model with less effort.

A facilitating relation might also occur if the reader is occupied processing one dimensional shift and does not have the resources to update an additional shift along another dimension. In this case, the reader cannot put in additional effort. They are only processing a single shift, not necessarily because the shift is a sufficient indicator, but because they do not have additional resources to process more information. If this were the case, it seems reasonable to assume that it would be associated with a cost in terms of story comprehension. However, this possibility seems unlikely given that if this were true, people would not be able to process multiple shifts, and clearly they can.
1.2.3.1 Sequential Presentation. When dimensions shift sequentially, a facilitating relation is predicted to result in shorter reading times for the second dimension than that expected if the second dimension is not preceded by a shift. This relation is presented in Figure 1.1. The first dimensional shift is predicted to result in the same increase in reading time as for an isolated dimensional shift. The second dimensional shift, however, is predicted to be shorter than the first. It is possible that reading times for the second shift may be shorter than the control, given that a facilitating relation could result in a lack of processing the second shift. Even though the control condition does not contain any shifts that will slow down the reader, the information may be processed to a fuller extent than expected due to facilitation.

1.2.3.2 Simultaneous Presentation.

Parallel Processing

Parallel processing given a facilitating relation is predicted to result in a reading time that is at least faster than the slower of the reading times for the slower of the two dimensions in isolation. This takes into account that the effect of one of the dimensions has been weakened. Figure 1.2 illustrates such a facilitating effect. When processed simultaneously, the overall reading time reflects a general speed-up in processing. Comparing this with the other predictions, the reading time given a facilitating relation is smaller than that of an inhibiting relation, and smaller than when there is no relation.

Serial Processing

Reading times for serial processing of the dimensions given a facilitating relation is presented in Figure 1.3. Once again, reading time is predicted to reflect the increases in
Dimension A and Dimension B relative to the control reading time. The facilitating effect would be a reading time that is less than the sum of the 200 ms for the control, plus the 100 ms increase of Dimension A above the control, and a 150 ms increase for Dimension B above the control (such as a total reading time of 400 ms). Given that reading time for Dimension B has been weakened, the overall reading time is smaller than what is predicted given no relation among the dimensions, or an inhibiting relation.

1.3 Size of Dimensional Shift

The effect that a dimensional shift has on the accessibility of a situation is relative to the size of the shift. It has been found that large shifts result in longer reading times than smaller shifts. For example, referring back to the research of A. Anderson et al. (1983), they found that longer time shifts, that could not be considered part of the same situation, resulted in longer reading times that did shorter shifts. There is also evidence that this relationship may be more complex. Zwaan (1996) found that reading times were longer for sentences involving a large temporal shift (an hour later and a day later) than for sentences beginning with a smaller temporal shift (a moment later). The longer shifts of an hour and a day later resulted in longer reading times (1,654 ms and 1,668 ms respectively) than did the reading time for the smaller shift (1,558 ms). Interestingly, however, the difference between the two longer shifts was not significant, and provides evidence that increases in the magnitude of a shift will not always make information less accessible.

Shifts along the goal dimension are also expected to affect comprehension to an extent that is relative to the size of the shift. The extent of a goal shift can be classified in terms of a change in a superordinate vs. a subordinate goal. Given that superordinate
goals are the main goal of the reader, a shift of a superordinate goal is considered a larger shift than that of a subordinate goal. As noted previously, uncompleted superordinate goals are more accessible than uncompleted subordinate goals (e.g., Suh & Trabasso, 1993). Disrupting such highly accessible information by introducing a superordinate goal shift should result in a greater disruption on comprehension than for a subordinate goal shift.

It is predicted that the accessibility of situational information will be affected not only by whether or not there is a shift to the goal and time dimensions, but also by the magnitude of each shift. If, for example, a large goal shift is accompanied by a large temporal shift, the effect on comprehension will be larger than if the same goal shift was accompanied by a small time shift. In addition, the size of a shift may have more of an effect on comprehension for one dimension than for another. For example, the relative size of a shift along the time dimension may not affect comprehension much once the shift is longer than a certain amount, but the size of a shift for the goal dimension may continue to affect comprehension when shifts are very large.

1.4 Symmetry of Influence

Another factor that needs to be taken into consideration is the relative effect that each dimension has on the other. There are two possible forms of this relation. First, the dimensions may consistently have the same impact on one another. In this case, the dimensions always affect each other equally, or one of the dimensions may always have a larger effect than the other. Second, the effect of the dimensions may change with changing situations. In this case, one dimension may have a larger effect in certain situations, but the relation might change/reverse in other situations. For example, the time
dimension may have a larger impact than the goal dimension in a situation that is centered around a character meeting a strict deadline, but not in a situation centered around a character enjoying a day at the beach.

Not all of the dimensions appear to have the same impact on overall comprehension. The most compelling evidence of this comes from findings that the temporal and causal dimensions have substantial impact on reading times, while the spatial dimension has little affect (Zwaan et al., 1995; Zwaan et al., 1998). This has been shown to change, however, when readers have prior knowledge about the spatial information (Zwaan et al., 1998). Given that certain manipulations can change the effect of isolated dimensions, it is likely that the effect of one dimension on another will also change depending on the specific circumstances of a situation.

1.5 Conclusion

The purpose of this study is to identify the relation among the goal and time dimensions of the situation model. This relation may take the form of an additive/no relation, inhibiting relation, or facilitating relation. Understanding how the dimensions are related is essential to a complete understanding of situation models. The overall representation of a situation is most likely reflective of contributions from several dimensions, and researchers have demonstrated that comprehension of a single situation is affected by more than one dimension (e.g., Zwaan et al. 1995; Zwaan et al., 1998). Despite a growing body of work investigating dimensional relations, there have been no studies that specifically address the relation of the goal and time dimensions. In addition, studies that have looked at multiple dimensions besides time and goals have not laid out predictions or support for the exact nature of the relation. While much more work has yet
to be done in order to obtain a comprehensive understanding of the dimensional relations, the current study aims to provide a detailed account of the relation amongst the time and goal dimensions.
2.1 Story Norming 1

Each experiment in this study required a set of thirty experimental stories (each with five versions of the critical sentence) and thirty filler stories. The main goal in creating the experimental stories was to allow for the possibility of detecting reading time effects due to shifts in the critical sentences in the experiments. One concern was that other factors, specifically, reader expectations or awkward sentence construction, could also affect reading time and may act as a confound. To deal with this concern, a norming study was done to select the most appropriate materials. This was done using sensibility ratings obtained for the critical sentences of a story.

2.1.1 Method

2.1.1.1 Participants. Eighty undergraduates at the University of Southern Mississippi participated for partial fulfillment of a course requirement. All participants were native English speakers.
2.1.1.2 Materials. In the first study, twice as many experimental stories (60) were constructed as would be used. For each story, five critical sentences were constructed. These critical sentences were to be used in the first experiment. Each of the five critical sentences (e.g., no shift, time shift only, etc.) was then divided into two sentences that corresponded to the critical materials needed in the second experiment. For example, the critical sentence in Experiment 1, in a story about a boy going to get his driver’s license was “He decided that he should just go home after he had stood in line for an hour.” In Experiment 2 this was broken into the following two sentences: “He decided that he should just go home. He had stood in line for an hour.” This resulted in 10 versions of the critical sentence(s) for each story.

2.1.1.3 Procedure. The stories were presented to participants one at a time. The first four sentences of each story were presented consecutively, followed by a dashed line, and then the critical sentence(s). Participants were asked to rate each critical sentence(s) for sensibility. Specifically, they were instructed to rate how well the sentence(s) that follow the dividing line fit with the story as a whole. That is, do they make sense, or do they seem strange? They indicated their judgment using a scale of 1 to 7, where 1 = “very strange”, 4 = “fits okay”, and 7 = “fits very well”.

2.1.2 Results

The average sensibility rating of the stories was 4.1, and the majority of critical versions had mean sensibility ratings less than 4.0. Overall, the ratings of the critical sentences in this study were somewhat low. Therefore, the 30 stories with the lowest
sensibility ratings (for any version) were eliminated. This resulted in stories being dropped with a sensibility rating that was less than 2.0 for any version.

Of the 30 remaining stories, differences in sensibility ratings across the critical versions of each story were analyzed. For the simultaneously shifting critical sentences, the no shift condition was significantly different from the other conditions. Specifically, it had significantly higher ratings than all of the other versions (no shift with: (1) time shift only, \( t(29) = 5.96, p < .001 \); (2) goal shift only, \( t(29) = 5.49, p < .001 \); (3) goal then time, \( t(29) = 8.54, p < .001 \); (3) time then goal, \( t(29) = 5.36, p < .001 \)). The same pattern was observed for the sequentially shifting critical sentences, with the no shift condition having significantly higher ratings than: (1) time shift only, \( t(29) = 7.96, p < .001 \); (2) goal shift only, \( t(29) = 5.51, p < .001 \); (3) goal then time, \( t(29) = 11.33, p < .001 \); (3) time then goal, \( t(29) = 6.10, p < .001 \)). In addition, the goal followed by time shift condition had significantly lower ratings than all of the other conditions (goal followed by time with: (1) time shift only, \( t(29) = 3.40, p < .05 \); (2) goal shift only, \( t(29) = 5.58, p < .001 \); (3) time followed by goal shift, \( t(29) = 5.24, p < .001 \).

2.2 Story Norming 2

Due to the low sensibility ratings of the critical sentences, it appeared that some of stories were awkwardly constructed. Therefore, a second norming study was done to further refine the stories.
2.2.1 Method

2.2.1.1 Participants. Eighty undergraduates at the University of Southern Mississippi participated for partial fulfillment of a course requirement. None had participated in the first norming experiment. All participants were native English speakers.

2.2.1.2 Materials. The best 30 stories from the first norming study were used, along with 15 new stories that were created to be similar to the ones from the first study that had the highest overall ratings. In addition to the 45 experimental stories, 20 stories were created that contained sentences that were intentionally non-sensible. These sentences, located in the same location as the critical sentences, were included to provide a context from which to judge sensibility. It is possible that sensibility ratings were low in the first study because participants were trying to use the entire range of the scale, giving both very high and low ratings at relatively similar proportions. Therefore, low sensibility ratings should be expected, even if none of the materials were actually low in sensibility. So, the non-sensible stories were included to provide a context from which to rate sensibility.

2.2.1.3 Procedure. The procedure was identical to that of first norming experiment.

2.2.2 Results

The average sensibility rating for this study was much higher (4.93) than in the first study (4.10), with most of the critical versions having mean ratings well above 4.0. This relieved concern regarding low sensibility ratings in the first experiment.

Of the 45 experimental stories that were constructed, 30 were chosen for the final materials. The mean and standard error of the sensibility ratings for each version of the
critical sentence are presented in Table 1. In selecting the final stories, it was important to eliminate differences in the sensibility ratings across any of the critical versions of a story. This could lead to differences in reading times unrelated to situational shifts. Therefore, rather than removing stories based on the lowest or average sensibility ratings, they were removed based on the amount of variability that existed in the mean ratings of each version. Specifically, stories were selected in which the standard deviation for all version ratings was the smallest, resulting in elimination of stories with standard deviations greater than 1.30 across the critical versions. Using this criterion, significant differences across critical sentences for the final stories were minimized. For the simultaneously shifting critical sentences, the no shift condition had significantly higher ratings than all versions except the isolated goal shift (no shift with: (1) time shift only, t(29) = 3.13, p < .05; (2) goal then time, t(29) = 4.04, p < .001; (3) time then goal, t(29) = 2.99, p < .05). For the sequentially shifting critical sentences, the no shift condition also had significantly higher ratings than all versions except the isolated goal shift (no shift with: (1) time shift only, t(29) = 4.34, p < .001; (2) goal then time, t(29) = 6.28, p < .001; (3) time then goal, t(29) = 2.97, p < .05). In addition, the isolated goal shift had significantly higher ratings than the goal shift followed by time shift, t(29) = 4.26, p < .001. Although differences were not completely eliminated, the number of significant differences was fewer than in the first pilot experiment. To deal with the remaining differences, the sensibility ratings were used as a covariate in the analyses comparing mean reading times.
TABLE 1
MEAN (M) AND STANDARD ERROR (SE) OF SENSIBILITY RATINGS FOR
EACH CRITICAL SENTENCE VERSION

<table>
<thead>
<tr>
<th>Critical Sentence</th>
<th>Simultaneous</th>
<th>Sequential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>No Shift</td>
<td>5.95</td>
<td>0.13</td>
</tr>
<tr>
<td>Time</td>
<td>5.05</td>
<td>0.21</td>
</tr>
<tr>
<td>Goal</td>
<td>5.10</td>
<td>0.19</td>
</tr>
<tr>
<td>Time, Goal</td>
<td>5.29</td>
<td>0.20</td>
</tr>
<tr>
<td>Goal, Time</td>
<td>4.82</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note: Simultaneous refers to sentences created where multiple shifts occur in a single sentence. Sequential refers to sentences where multiple shifts occur in adjacent sentences. Time, Goal = time shift followed by goal shift. Goal, Time = goal shift followed by time shift.
CHAPTER 3
EXPERIMENT 1

To test the predictions about the relationship between the time and goal
dimensions, experimental narratives were constructed using the normed materials,
containing a full combination of shifts and no shifts along these dimensions. The
narratives were also constructed so that shifts were counterbalanced. Experiment 1
consisted of experimental narratives designed to investigate comprehension when goal
and time shifts occurred simultaneously. Specifically, these shifts occurred within the
same sentence of a narrative. This served to provide evidence about whether the
dimensions are processed in serial or parallel, as well as the nature of the dimensional
relation. To obtain evidence about the symmetry of influence of each dimension, the
order of shifts was counterbalanced.

3.1 Method

3.1.1 Participants

Sixty-eight undergraduates at the University of Southern Mississippi participated
for partial fulfillment of a course requirement. None had participated in the norming
studies. All participants were native English speakers.
3.2 Materials

A total of sixty narratives were constructed. Thirty of the narratives were experimental stories that contained a critical sentence, and the other thirty were filler stories that did not contain a critical sentence. Five versions of each experimental story were constructed by manipulating shifts in goal and time information within the critical sentence. These manipulations reflect the comparisons necessary to test the predicted relation of the dimensions. The five versions were as follows: no shifts, goal shift only, time shift only, goal followed by time shift, and time followed by goal shift. The final set of stories used in this experiment can be found in the Appendix.

To avoid possible confounds due to differences in the experimental narratives, they all had a similar structure. Each narrative consisted of seven sentences. The first 4 sentences introduced a main character, along with a brief description of where the character is located, and what they are doing. These sentences set up the general setting of the situation. Examples include a taxi driver going to the airport, and a young man going on a first date. The fifth sentence of the narrative contained potential shifts in the goal of the main character and/or the story time.

The structure of the filler narratives was the same as the experimental narratives with the exception of the critical sentence. This sentence was replaced with a sentence that contained continuous goal and time information. The filler narratives were included to prevent readers from detecting a pattern in the location of the critical sentences within the narratives.

When there was a goal shift, a new intention of the main character was introduced. For example, a goal shift occurred if the man on a date decides that he wants
to go home. Continuity of the goal dimension occurred when the actions of the main character were not due to a newly introduced goal. Goal shifts were introduced explicitly, not requiring that the reader infer the shift from the context of the story. The goals were always uncompleted when introduced in the critical sentence, given that goal completion appears to affect accessibility (e.g., Zwaan & Radvansky, 1998). The size of the goal shift depended on the specific narrative, but was always large enough to create a major change in the current situation.

When there was a time shift, an on-going event was disrupted, and a new event was introduced. For example, the dinner that had just begun on the date will have ended, and the couple will be ready to drive home. Continuity of the time dimension occurred when the current event directly followed or overlapped with a previous event. All newly introduced events occurred in the future oriented, or forward direction in order to make the stories similar to real life situations. The size of the temporal shift varied depending on the story, but was always large enough to allow for a change in the current situation.

All of the other dimensions of the critical sentences remained continuous. This was to eliminate confounds, ensuring that reading times directly reflected shifts/continuity of the dimensions of interest. The final sentences wrapped up the narrative, and helped motivate sudden goal or time shifts. For example, when a goal shift was introduced in which a man on a date suddenly wants to go home, the final sentence explained that it was the most awkward date he had been on. This helped to make the narrative coherent as a whole.

Comprehension questions were created for each narrative to assess the reader’s knowledge of the story. These were yes-no questions that referred to general aspects of
the situation, but did not explicitly refer to the temporal or goal information. This was because this type of questioning may affect the way that the dimensions are processed. Refer to the Appendix for an example comprehension question. The comprehension questions were designed to make sure that the narratives were read for understanding. For example, a comprehension question about a man going on a date asked if the date was at a restaurant that was mentioned. Half of the comprehension questions required a “yes” response, whereas the other half required a “no” response. Reading times of participants with an error rate greater than 20% on the comprehension questions were not included in the analyses.

3.3 Procedure and Design

Participants were instructed to read a set of stories for comprehension. In order to record the reading times of each sentence, the stories were presented one sentence at a time on a computer screen using E-Prime software. Text was in black letters against a white background. Participants advanced through the sentences by pressing the space bar of the computer keyboard, and the computer recorded the reading time of each sentence. At the end of each story, participants were instructed to answer a comprehension question using the right button on the mouse to indicate “yes” and the left button to indicate “no”. Participants began by reading 2 practice stories to familiarize themselves with the procedure.

After practice, each participant read one version of each of the thirty experimental narratives, and all thirty of the filler narratives. The version of each experimental narrative presented to participants was counterbalanced using a 5 x5 Latin square. The order of presentation of narratives was randomized across participants.
3.2 Results

Outliers were defined as reading times that were more than 1.84 SDs away from a reader’s mean reading time. This was determined according to Van Selst and Jolicoeur (1994), whose approach takes into account sample size when identifying standard deviation cutoffs. In addition, participants with a 20% or higher error rate to comprehension questions were discarded. As a result, data from four participants were discarded.

3.2.1 ANCOVA

To assess differences due to goal and time shifts, a repeated-measures one-way analysis of covariance (ANCOVA) was carried out on reading time per syllable for the five conditions: no shift, goal shift only, time shift only, goal followed by time shift, and time followed by goal shift. Sensibility ratings gathered in the second norming study were used as a covariate to reduce any effect of sentence sensibility. The covariate was composed of the average sensibility rating to each story of each version. The specific goal of this analysis was to test the predictions presented in the introduction, which was done by performing a set of planned comparisons. The experimentwise error rate for the planned comparisons was controlled using the Bonferroni method. A significance level of .05 was adopted for all analyses.

The mean per syllable reading times for each of the five conditions are presented in Figure 3.1. As can be seen, the longest reading times occurred when there was an isolated shift of time (M = 206.95, SE = 4.99) and goal (M = 220.35, SE = 5.38). The next longest reading times occurred when there was no shift (M = 184.21, SE = 4.54). Finally, reading times when both dimensions shifted simultaneously resulted in the
shortest reading times (time then goal: M = 141.15, SE = 3.68; goal then time: M = 163.87, SE = 4.66). The results that follow use these means to test the specific prediction as to whether there is an inhibiting, facilitating, or no relation among the dimensions, as well as if the dimensions are processed in a serial or parallel fashion.

![Figure 3.1. Mean reading times per syllable for each condition.](image)

Figure 3.1. Mean reading times per syllable for each condition. None indicates the control condition with no shifts. Time = time shift only. Goal = goal shift only. G, T = goal shift followed by time shift. T, G = time shift followed by goal shift.

It was assumed that reading time when a goal or time shift occurred would be longer than when there was no shift, reflecting additional time needed to process the shift. To test this assumption, a set of planned comparisons were performed. Reading times for the control condition were compared to reading times when there was an isolated shift. Both shifts were longer than the control. A goal shift resulted in significantly longer reading times than the control (t(63) = 3.43, p < .001), as did a time shift (t(63) = 3.53, p < .001). These results support the assumption that the readers are updating goal and time information into their situation model.
Next, the relation of the dimensions was investigated by comparing reading times for isolated time shifts (either time or goal shift) to reading times when there were two shifts. This provides insight into how the effect of a shift is altered by an additional shift occurring before the initial shift. Overall, the mean reading times per syllable (in ms) for isolated shifts were significantly slower than for simultaneous shifts. Reading time when there was an isolated goal shift was significantly slower than reading time when the goal shift preceded by a time shift ($t(63) = 9.78, p < .001$). The same pattern was obtained for the time dimension. Reading time when there was an isolated time shift was significantly slower when preceded by a goal shift ($t(63) = 7.12, p < .001$).

This indicates that the addition of a second shift results in faster reading times than for a single shift, supporting a facilitating relation. This evidence also supports parallel rather than serial processing of the dimensions. If the dimensions were processed in serial, two shifts would necessarily take longer to process than one, reflecting the extra time to process each shift separately. The results show that reading times were significantly shorter with two shifts, ruling out serial processing of the dimensions.

A final set of planned comparisons was performed involving the no shift condition and the simultaneous shift conditions. Reading times for a time shift followed by a goal shift were significantly faster than when there were no shifts, $t(63) = 9.06, p < .001$. The same was true for a goal shift followed by a time shift, which was significantly faster than when there were no shifts, $t(63) = 11.31, p < .001$. This suggests that after an initial shift much of the time-consuming updating processes have already begun, and additional shifts will be processed very quickly.
3.2.2 Multiple Regression

The general regression approach implemented here is outlined by Lorch and Myers (1990). Multiple regression analyses were carried out on reading times taking into account goal and time shifts, as well as auxiliary variables that are not directly relevant to the study, but which contribute to overall reading time. The theoretical variables directly relevant are goal continuity (coded as shift, no shift), time continuity (coded as shift, no shift), and order of shift. The order of shifts was coded using two variables, one coding a time shift first (coded as time shift followed by goal shift, or no time shift followed by goal shift), and the other coding a goal shift first (coded as goal shift followed by time shift, or no goal shift followed by time shift).

Four auxiliary variables were included. The first variable was serial position of the sentences. Several studies have shown that the speed with which readers move through a narrative increases as they progress through a narrative (e.g., Just & Carpenter, 1980). It has also been shown that sentence length, in the form of the number of syllables, is a strong predictor of reading time (e.g., Just & Carpenter, 1980; Zwaan, Magliano, & Graesser, 1999). Given this, the number of syllables was included as the second predictor variable in the multiple regression analyses. In addition, changes in the specific wording of the critical sentence may lead to conditions that differ in overall word frequency. It has also been shown that word frequency is a significant predictor of reading times (Duffy & Rayner, 1990; Zwaan, Radvansky, Hilliard, & Curiel, 1998), and so this constituted the third auxiliary variable, and was assessed using the Kucera and Francis (1967) corpus. The fourth auxiliary variable consisted of the mean sensibility ratings to the critical sentences gathered in the norming study. This was included to
account for any contributions to reading time due to the remaining differences in sensibility ratings across the critical sentence versions. It is expected that reading times would be faster for sentences rated higher in sensibility.

Before performing the regression analyses, multicollinearity was assessed by regressing each variable on all other predictor variables in the equation. Multicollinearity arises when there is a high correlation between predictor variables. Multicollinearity was considered a problem for any multiple correlations that were greater than 0.2. For the auxiliary variables in Experiment 1, the only issue was with syllables ($R^2 = 0.35$). This variable was correlated with the goal first and time shift first variables that accounted for reading times when there were shifts in both dimensions. Given that both shifts occurred within a single critical sentence in this experiment, it is expected that sentences that convey changes in both dimensions will be longer than sentences conveying a single shift, resulting in the relationship with syllable number.

Multiple regression was performed separately for each participant. Reading times for each participant in each condition were regressed on the relevant and auxiliary variables. The resulting beta weights from all participants were subjected to single-sample $t$ tests to determine if the average beta weights were significantly different than zero. The larger the beta weight for a variable of interest, the more that variable can be considered to uniquely predict comprehension.

Table 2 provides the beta weights for the regression analyses. Of the auxiliary variables, word frequency ($t(61) = 0.77$, $p = .44$) and sensibility ($t(61) = 1.14$, $p = .26$) did not significantly predict reading times. Serial position resulted in a significantly negative beta weight, indicating that readers became faster as they progressed through the story,
t(61) = 3.12, \( p = .003 \). Syllable number was also a significant predictor, with a significantly positive beta weight, indicating that sentences containing more syllables took longer to read, \( t(61) = 39.16, p < .001 \).

### TABLE 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SE</th>
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</thead>
<tbody>
<tr>
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<td>Syllables</td>
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<td>Frequency</td>
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<td>.006</td>
</tr>
<tr>
<td>Sensibility</td>
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<td>.008</td>
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</table>
All but one of the theoretical variables contributed significantly to reading times. The presence of a goal shift resulted in a significantly positive beta weight \( t(59) = 3.66, p = .001 \), as did a time shift, \( t(61) = 6.68, p < .001 \). As expected, discontinuity of either dimension in isolation is associated with slower reading times that when there are no dimensional shifts. Of the variables dealing with the order of simultaneous shifts, the time first (time followed by goal shift) contributed significantly to reading times. The beta weight for this condition was significantly negative, \( t(61) = 3.04, p = .003 \). The goal first (goal followed by time shift) variable did not contribute significantly to reading times, \( t(61) = 1.18, p = .246 \). This evidence suggests that the time dimension has a larger effect on the goal dimension than vice versa.

3.2.3 Discussion

The ANCOVA and multiple regression analyses provide evidence of a facilitating relation. Both analyses show that an isolated shift along the time and the goal dimensions results in longer reading times, presumably due to situation model updating. Mean comparisons showed that the increase due to an isolated shift was lessened when preceded by a shift of the other dimension. This implies that the dimensions affect each other, and one dimension can lessen the effect of the other dimension. The regression analyses further showed that a time shift occurring prior to a goal shift resulted in shorter reading times. This lends further support for a facilitating relation. A goal shift occurring prior to a time shift, however, was not significantly associated with shorter reading times. This does not corroborate the result of the mean comparisons. As mentioned, reading times for a goal shift followed by a time shift were significantly faster than an isolated time shift. A direct mean comparison of reading times, however, showed that reading
times for a time shift followed by a goal shift are significantly faster than a goal shifts followed by a time shift. This evidence supports the regression finding that the time dimension has more of an effect on the goal dimension than vice versa, although there is still disagreement as to the extent of the effect that the goal dimension has on the time dimension.
CHAPTER 4
EXPERIMENT 2

It is possible that time and goal shifts only affect each other when each shift is current, and has not yet been organized into the situation model. If this is the case, then the dimensions should not affect each other when a shift along one dimension is integrated into the situation model before the introduction of another shift. One site of integration within a narrative is at the end of sentences. Reading times have been shown to be slower at the end of sentences where a period is present, reflecting a wrap-up process (Just & Carpenter, 1980; Rayner, Kambe, & Duffy, 2000; Rayner, Sereno, Morris, Schmauder, & Clifton, 1989). Experiment 2 investigated comprehension when the goal and time dimensions shifted sequentially. Sequential shifts were formed by introducing changes in goal and time information that occurred in separate but neighboring sentences. This provided evidence about the nature of the relation of the dimensions when initial processing of both shifts did not occur at the same time. This experiment also provided additional evidence about the directional effect that each dimension has on the other by manipulating the order of the shifts like in the first experiment.
4.1 Method

4.1.1 Participants

Sixty-four undergraduates at the University of Southern Mississippi participated for partial fulfillment of a course requirement. None had participated in the previous experiments. All participants were native English speakers.

4.1.2 Materials

The narratives were adapted from those in Experiment 1. The critical portion of each experimental narrative was changed to allow for reading times for sequential shifts of goal and time information. Changes involved dividing the critical sentences containing goal and time shifts into two separate sentences; one sentence contained the goal shift, and the other contained the time shift. The critical sentences made up the fifth and sixth sentences of the narrative, resulting in narratives that contain a total of eight sentences. One sentence was added to each of the thirty filler narratives used in Experiment 1 so that they also contained eight sentences.

Five versions of each of the experimental narratives were constructed as in Experiment 1, varying as a function of whether goal and time shifts occurred within the critical sentences. The versions were as follows: no shift, goal shift only, time shift only, goal shift followed by time shift, and time shift followed by goal shift. The comprehension questions from Experiment 1 were used, as they did not depend on the critical sentences. The Appendix contains an example of the five versions of a single narrative.
4.1.3 Procedure and Design

The procedure and design was identical to that of Experiment 1.

4.2 Results

The same criterion used in Experiment 1 was applied to trim outlier reading times more than 1.84 SD away from the mean. Data from six participants were discarded who had a 20% or higher error rate to comprehension questions.

4.2.1 ANCOVA

Mean reading times per syllable are presented in Figure 4.1. These reading times correspond to the second sentence of each set of two sequentially shifting sentences. This was done to determine the effect of one dimension on another (how reading times change when preceded by a shift of another dimension). The pattern here is more complicated than for the simultaneous shifts. There are no clear conditions that result in increased reading times. Reading time for the control condition (M = 218.67, SE = 8.26) was relatively long compared to the other conditions. One of the isolated shifts (time) resulted in faster reading times than expected (M = 163.89, SE = 4.95) as compared to an isolated goal shift (M = 231.02, SE = 7.46). One of the sequential shifts (goal followed by time) also resulted in fast reading times (M = 152.74, SE = 4.20). The overall pattern shows that reading was done very quickly when a time shift occurred in the second of the two critical sentences, regardless of what occurred in the first sentence.
To test the assumption that goal and time shifts resulted in additional processing time, reading times for isolated shifts were compared to the control condition. Reading time when a goal shift occurred was not significantly different than the control condition, $t(61) = 1.28, p = 1.0$. However, reading time when a time shift occurred was significantly faster than the control condition ($t(61) = 5.97, p < .001$). The assumption of longer reading times given a shift was not met in this experiment. However, this assumption was observed in the regression analyses that follow, which take into account the effect of auxiliary variables such as word frequency and syllable position. These factors were not taken into account for the mean comparisons because there were several different story versions, each with different auxiliary characteristics that went into the means used by the ANCOVA. That it was not met here suggests that the comparisons of mean reading times may be complicated due to auxiliary variables, and should be interpreted with caution.
The relation of the dimensions was investigated next by comparing reading times for isolated shifts to reading times when both dimensions shifted sequentially. Reading time when there was an isolated goal shift was no different than when a goal shift was preceded by a time shift, \( t(61) = 2.23, p = .265 \). The same pattern of results was found for the time dimension. An isolated time shift was not significantly different than a time shift preceded by a goal shift \( (t(61) = 1.88, p = .613) \). The results provide support for the idea that there is no relation among the dimensions. The effect of a shift on reading time is the same whether or not preceded by a shift of another dimension.

Finally, reading times for sequential shifts were compared to reading times when there were no shifts. Reading times for a goal shift followed by a time shift were significantly faster than when there were no shifts, \( t(61) = 7.08, p < .001 \). Reading times for a time shift followed by a goal shift were not significantly different than when there were no shifts, \( t(61) = 0.84, p = 1.0 \). Results for the goal followed by time shift are similar to Experiment 1. This condition resulted in faster reading times than when there was no shift, suggesting that much of the updating process has been signaled by the first dimension. Experiment 1 also showed significantly faster reading times for a time followed by goal shift, which was not supported here.

4.2.2 Multiple Regression

Multicollinearity was assessed using the same criterion as in Experiment 1. Syllable number was the only issue in Experiment 1, because sentences with simultaneous shifts tended to be longer. This was no longer an issue in the second experiment given that the multiple shifts were divided across two sentences. No other issues of multicollinearity were present in the second experiment.
Unlike the mean comparisons, the patterns of regression results in Experiment 2 were similar to those found in Experiment 1. When dimensional shifts occurred sequentially, all of the auxiliary variables except sensibility were significant predictors of reading time. Table 4 provides the beta weights for the regression analyses. As in Experiment 1, serial position resulted in a significantly negative beta weight, with readers becoming faster as they progressed through the story, t(61) = 6.40, p < .001. Syllable number was also a significant predictor, with sentences containing more syllables taking longer to read, t(61) = 44.89, p < .001. Unlike Experiment 1, word frequency was also a significant predictor. The beta weight was significantly negative, indicating that sentences containing higher frequency words were read faster, t(61) = 2.57, p = .013. Sensibility resulted in a negative but non-significant beta weight, indicating that the norming studies to remove differences due to sensibility were effective (t(61) = 0.20, p = .84).

All but one of the theoretical variables was significant. As before, a goal shift resulted in a significant increase in reading times (t(61) = 4.07, p < .001), as did a time shift (t(61) = 6.56, p < .001). Again, the time first variable (time followed by goal shift) resulted in significantly shorter reading times, t(61) = 5.41, p < .001. The goal first variable (goal followed by time shift) did not contribute significantly to reading times t(61) = 0.47, p = .640. This is further evidence that the time dimension has a larger effect on the goal dimension than goal on time.
TABLE 4

MEAN (M) AND STANDARD ERROR (SE) OF STANDARDIZED BETA WEIGHTS FOR READING TIMES IN EXPERIMENT 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SE</th>
</tr>
</thead>
<tbody>
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<td><strong>Theoretical</strong></td>
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</tr>
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<td>.099</td>
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<tr>
<td>Time shift</td>
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<td>Time shift first</td>
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</tr>
<tr>
<td>Sensibility</td>
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</tr>
</tbody>
</table>

Recall that the results of the planned comparison for a goal shift first compared to time shift first (for sequentially shifting dimensions) resulted in significantly faster reading times when the goal dimension shifted first. The regression results presented here do not support this finding. Given that all other sources of evidence indicate that the time dimension has a greater facilitating effect than the goal dimension, and given that the results of the planned comparisons may be questionable given that a shift did not result in
longer reading times, the regression analyses appear to more accurately capture the relationship.

4.2.3 Discussion

The results of the second experiment did not provide a clear pattern of evidence. First, the assumption that isolated shifts would result in longer reading times than the control condition was not met by the comparisons of mean reading times, but was met by the regression analyses. Given that the regression analyses accounted for more of the important factors that could have affected reading time (e.g., serial position), they are assumed to provide a more accurate indication of the underlying processes. In addition, the pattern of results provided by the regression analyses was almost identical to that found in Experiment 1, supporting a facilitating relation of the time dimension. A time shift occurring prior to a goal shift resulted in shorter reading times, whereas a goal shift prior to a time shift did not.
The main objective of this study was to determine the relation between the goal and time dimensions during situational shifts in text. Across both experiments, a facilitating relation was observed where the presence of a time shift lessened the empirical effect of a goal shift. There was also evidence that a goal shift lessened the effect of a time shift, but this was only the case when both dimensions shifted within a single sentence. In comparison, regression analyses consistently provided evidence of a facilitating relation of time on the goal dimension, but not of goal on time, meaning that processing a goal shift was facilitated when preceded by a time shift, but not vice versa. In addition, the results are consistent with the idea that the dimensions are processed in parallel. Otherwise, additional shifts would have resulted in overall increased processing time, rather than the overall decreased processing time that was observed.

5.1 The Facilitating Effect

The facilitating relation observed indicates that comprehending a goal shift is facilitated when it is preceded by a time shift. As such, updating that began as a result of the preceding time shift caused the processing of the goal shift to have less of an impact on overall reading time. This does not mean that the processing of the goal shift is done
to a lesser extent, or that it has less of an impact on comprehension. People almost
certainly understand that the character’s goals have shifted. Instead, the facilitating
relation most likely occurs because it has become easier to update the goal dimension
once the updating of the time dimension had already begun. In other words, there is likely
a complete updating of the goal dimension, but it occurs faster than it would if it were in
isolation.

A facilitating relation may result from a reduction in the amount of processing
needed to process a second shift. Specifically, it is likely that some of the cognitive
processes involved in updating are redundant across dimensions, so that once these
processes have started for one dimension they will not need to be redone for the other.
These include processes involved in establishing a new situational framework, and
creating relations within the new framework as well as with past information.

To illustrate redundant processes across dimensions, first consider the processes
associated with a single dimensional shift. Specifically, consider comprehension when
presented with the following sentences where the second sentence contains a time shift:

“Bobby was playing at the beach. Several hours later he was tying his shoe.” The
temporal shift signifies that events are taking place at a new time (and possibly a new
spatial location). This will result in construction of a new spatial-temporal framework. To
represent the new state of events within this framework, a number of processes will
occur. The pronoun he will be linked with the protagonist Bobby from the initial
sentence, and will be maintained as an active token in the new model framework. Playing
will be removed from the actions carried out by Bobby in the current framework, while
the action of tying his shoe will become associated with Bobby.
Given that the event is taking place in a new time-frame, temporal connections will be established between the events taking place in the first and second sentences. This will indicate the order in which Bobby went to the beach and tied his shoes, and perhaps a general indication of the time separating the two events. In addition, the spatial framework of the new events will be established, with either the location remaining the same, given that a new location was not specified, or a new generic spatial framework being established if the information were to convey a period of time longer than one would remain in a given location (Garrod & Sanford, 1994). Note that because there may be an establishment of a new framework in both cases, it is likely that there is some overlap in processing.

Now consider the processes involved in comprehending a goal shift, taking note of similarities with a previous time shift. Consider the following sentences where the second sentence contains a goal shift only: “Bobby was playing at the beach. He decided to go home.” Some amount of time had to pass during which Bobby formed his goal. Therefore, the introduction of the new goal is open to the possibility that a time change has occurred, although it does not necessarily indicate the presence of a temporal shift.

Given that no indication of a change in location has taken place when a goal shift is introduced, the spatial location will likely remain the same. As in the time shift example, the pronoun he will be linked with the protagonist Bobby from the initial sentence, and will be maintained as an active token in the new model framework. Playing will also be removed from the actions carried out by Bobby in the current framework, while the goal of wanting to go home will become associated with Bobby. Finally, this
goal will be linked to previous information to establish causal connection (e.g., motivate why Bobby decided to go home).

An explicit goal shift in a text is not the only way that a goal shift can be conveyed. A change in temporal framework is also likely to signify a change in goals as the scenario changes. For example, suppose a narrative describes Bobby at the beach, and his goal is to build a sand castle. After five hours pass in the narrative, not only has the temporal framework changed, but it is very likely that Bobby’s goal of building a sand castle has changed as well. He might, for example, want to go home after playing for several hours. If the introduction of a new goal is compatible with the possibility that an event is taking place in a new time-frame, the temporal connections established between the events taking place in the first and second sentences could be exploited.

As can be seen, there are some redundant processes that may be shared when comprehending sentences containing multiple shifts. Most importantly, comprehending time and goal shifts both require the establishment of temporal connections between events. Once the establishment of these connections has been initiated by a time shift, it could greatly benefit the comprehension of a subsequent goal shift. A similar benefit, however, is not necessarily expected when a time shift is preceded by a goal shift. This is because the change in temporal connections indicated by the goal shift might not adequately reflect the change in time indicated by the subsequent time shift.

While it does take some time for a change in goal to occur, the extent of temporal updating signaled by a goal change might be much smaller (or larger) than what is conveyed by the temporal shift that follows. For example, consider the following sentences that contain a goal shift followed by a time shift: “Bobby decided to go home.”
Several hours had passed.” It is apparent from the first sentence that some amount of time has passed during which Bobby decided to go home. This time shift will initiate the process of establishing new temporal connections, but this may only represent a small change in time such as few minutes. When the second sentence is read, a new temporal framework must be established reflecting the passage of several hours. This will involve the establishment of more distant temporal connections, and it is unlikely that the temporal updating initiated by the first sentence will remain relevant due to causal connections and capable of exploitation that would result in faster processing.

In addition to redundant processes, some information must be processed that is unique to each dimension. For example, the introduction of a new goal requires changing the goal property associated with the entity. This is necessary when comprehending a goal shift, but is not involved in processing a time shift. Although this information is unique to each dimension, it may not add drastically to the amount of time needed to process two shifts relative to one. This is because the processing of information unique to each dimension may occur partially in parallel, given that distinct types of information are less likely to compete for processing resources than are those that are similar in nature. Parallel processing would decrease the amount of time needed to process multiple shifts.

To the extent that the facilitating relation reflects an overlap in dimension processing, shifts occurring within a single sentence should result in more evidence of a facilitating relation than shifts occurring across two sentences. This is because the end of a sentence is a site for model integration (e.g., Just & Carpenter, 1980). When shifts occur across two sentences, processes are wrapped up before moving on to the next
sentence. This lessens the extent of shared processing. This hypothesis is supported in the current study in that the facilitating effect was not as pronounced in the second experiment where shifts occurred across two sentences. Beta weights were significantly smaller in the second experiment ($t(122) = 5.85, p < .001$) indicating that a goal shift preceded by a time shift contributed to a greater reduction in reading times when the shifts occurred in a single sentence than when they occurred across two sentences.

The fact that a facilitating relation was obtained in the second experiment, however, suggests that model updating is not completed at the end of a sentence. Some processes appear to spill over, and at least some of these processes are ones that can be exploited to aid the updating of the second shift. This relationship provides additional support for the sharing of resources. The more that resources involved in processing dimensional shifts can be shared, the more that a benefit in comprehension is observed.

5.2 Nonsymmetrical Influence

The facilitating relation was observed for time, but most evidence did not support a facilitating effect of the goal dimension. As discussed previously, this is because a shift in time may be a more prominent indicator that a situation has changed. The better a dimension conveys a situational change, the more effectively it will initiate the updating process. Effective initiation of the updating process will allow for maximum sharing of time-consuming updating processes across dimensions, resulting in a facilitating relation.

Evidence shows that the time dimension is a very salient one. A change in time is often accompanied by several changes in a situation including the goals and emotions of a protagonist, and the setting where a situation takes place, which involves changes in location and entities. For example, a situation often changes between early morning and
afternoon, during which a protagonist might leave for work or school. Studies have shown that shifts in time impact overall comprehension (e.g., Zwaan et al., 1995; Zwaan et al., 1998), as well as the accessibility of surrounding information (Zwaan, 1996), suggesting that the time dimension effectively initiates the updating process.

While the goal dimension has also been shown to have an impact on comprehension, and is important to the causal structure of a narrative, it may not have as profound an effect on the surrounding information in a text as the time dimension. The goal dimension directly affects the state of the protagonist, but a change in the goals of the protagonist is not associated with changes in the overall setting/location of a situation to the same extent as changes in time.

The goal dimension aids in the causal understanding of the protagonist’s actions, but direct situational changes due to the protagonist’s actions do not always occur. For example, sometimes the actions taken to satisfy a goal are delayed, or a protagonist will change their goal based on newly encountered information. Therefore, changes in a protagonist’s goals are not as effective as time changes are in signaling that a situational change has occurred that requires updating.

More specifically, goal changes might not be highly effective at indicating the extent to which other dimensions, such as the time dimension, have changed. As mentioned previously, a large change in a protagonist’s goal is not always accompanied by a large or small change in time. Therefore, a goal change might not be used as a reliable indicator of temporal updating. On the other hand, a large change in time is not necessarily accompanied by a goal shift. However, it may seem more likely to the reader, based on previous experience, that a time change is a reliable indicator that the situation
has changed, and that other aspects of the situation, such as character goals, have changed. This will result in updating of other dimensions including the goal dimension, which will benefit subsequent processing of a goal shift.

5.3 Previous Evidence of a Facilitating Effect

There have been other studies of the effects of multiple dimensions that have provided evidence of a facilitating effect, although none have examined the specific relation of time and goals. Rinck and Weber (2003) found support for a facilitating relation among the protagonist, location, and time dimensions. Once an initial shift was processed, readers were faster to process subsequent shifts. Specifically, they found that additional shifts did not cause as large of an increase in reading times as did an initial shift, suggesting that the initial shift had a facilitating effect on the other dimensions.

Despite the fact that they did not look at the goal dimension, their manipulation of the time dimension provides an important point of comparison to the current study. All of the shifts within their stories were constructed to take place within a single sentence. Of the three potentially shifting dimensions, the time dimension was always the first to shift. This resulted in a decrease of the effect of subsequent dimensional shifts, relative to what was expected if dimensions occurred in isolation. This study therefore provides corroborating evidence for a facilitating effect specific to the time dimension. Because the order of the shifts was not manipulated in their study it is not clear whether the other dimensions also had a facilitating effect.
5.4 Previous Evidence Inconsistent with Facilitating Effect

A facilitating relation has not been observed in all studies investigating dimensional relations. Specifically, previous studies using a correlational approach (Zwaan, Magliano, & Graesser, 1995; Zwaan, Radvansky, Hilliard, & Curiel, 1998) found that reading times increased as the number of shifts (along the time and causality dimensions) in the text increased, with the exception of the spatial dimension. The increase in reading times that they found, however, could be indicative of any of the three relations discussed here. The exact nature of the relation is unclear because there were no reading times for specific isolated shifts to compare to the multiple shifts. Although their results do not rule out a facilitating relation, they clearly differed from the present study in which reading times were actually faster with the addition of a second shift.

The only dimension present in all of the studies just mentioned is that of time. It is possible that the conclusions of the studies differ because the time dimension has a greater facilitating effect on the goal dimension than it does on the causal dimension. This is consistent with the idea that time and causality form more of the structure of situation models whereas goals are a component of them. It is also possible that the correlational nature of the studies of Zwaan and colleagues, which lack strong control over the dimensional shifts, did not provide proper control to allow for inferences about dimensional effects.

5.5 Broader Implications

The current study provides evidence that shifts along multiple dimensions can be updated very efficiently, particularly when a salient dimension such as that of time is the first one indicated as shifting. A salient dimensional shift initiates an updating process
that in turn aids any updating of additional dimensions. It is important to note that this account assumes that each dimensional shift is being comprehended and successfully processed by the reader. It is possible, however, that the simultaneous processing of shifts along multiple dimensions could overwhelm the cognitive system, and some updating may be unsuccessful. This could result in a decline in the ability to process the second shift, and would shorten reading times as additional time is not taken to update multiple dimensions (which is characteristic of the facilitating effect). This is very unlikely, however, given that readers seem to be able to keep track of many situational changes at once.

To make sure that the facilitating relation is not a result of processing declines, or that readers are for some reason ignoring one of the dimensions, a follow-up study could be performed. The specific purpose of the study would be to assess whether readers have actually updated the information along both dimensions. For example, this could be done by presenting readers with a probe word that was present in the story but occurred prior to a shift in time. Readers should be slower to recognize the probe word if the shift has been comprehended than if it has not (e.g., Zwaan, 1996). This can be determined by comparing response times to probe words that are followed by shifts to probes that are not. In addition to providing evidence of the extent to which each dimensional shift has been comprehended, this could also provide evidence regarding the saliency of each dimension.

Another extension to the current study would be to hold the size of the time and goal shifts constant. Although this was not varied in a systematic way in the current study, some shifts were larger than others (e.g., an hour later vs. several hours later)
which could have affected the relation. Along these lines, future studies could be done that specifically manipulate the extent of the time and goal shifts (e.g., long-term vs. short-term). It is possible that under these circumstances the size of a shift along the goal dimension may interact more with that of the time dimension. For example, a long-term but not a short-term goal shift may affect processing of the time dimension. Previous evidence, for example, has shown that a long time shift has more of an effect on the spatial dimension than a short shift (Rinck & Bower, 2000), so it is likely that the same relation would hold for time and goals.

5.6 Conclusion

The current study demonstrated that a facilitating relation exists between the time and goal dimensions, where the presence of a time shift lessened the empirical effect of a subsequent goal shift. This facilitating relation most likely reflects the sharing of redundant cognitive processes that are initiated by the salient shift in temporal information. The differential effects of the time and goal dimensions suggests that there is no single relation that exists among all of the dimensions, and therefore it is important to investigate the specific relation of each dimension with another. Many of the dimensions appear inherently related (e.g., space and entities), but a limited amount of research has been done investigating these relations. A great deal of future research is needed to gain a complete understanding of the relations of the dimensions, and the present effort helps provide a foundation.
APPENDIX

Experimental Narratives used in Experiments

Narrative (1) below contains critical sentences used when multiple shifts occurred simultaneously within a single sentence (used in experiment 1) as well as those when multiple shifts occurred sequentially across two sentences (used in Experiment 2). The rest of the narratives only contain the critical sentences used in Experiment 1, but were simply divided into two sentences to make the materials for Experiment 2. The rest of the story remained the same.

1) Fred turned 16 and was getting his drivers license. The line at the license branch was almost out the door. Most of the people in line looked angry. Fred entered the line and tried to read a book.

Simultaneous shifts (Experiment 1)
None -- He began reading his book and looking up at the line to see if it was moving.
Time -- He began reading his book and eventually looked up after an hour had passed.
Goal -- He began reading but was distracted and decided that he should just go home.
T, G -- After he had stood in line for an hour he decided that he should just go home.
G, T -- He decided that he should just go home after he had stood in line for an hour.

Sequential shifts (Experiment 2)
None -- He began reading his book. He looked up to see if the line was moving.
Time -- He began reading his book. He looked up after an hour had passed.
Goal -- He began reading but was distracted. He decided that he should go home.
T, G -- He stood in line for an hour. Then he decided that he should go home. G, T --
He decided he should just go home. He had stood in line for an hour.

Only one person was at the desk. No wonder the line was so long.

2) Desmond had the day off work. He was going to the beach. He would lounge around and work on his tan. He spread out his towel and sat down.

None -- He was relaxed and ready to soak up the rays.
Time -- He was still lying in the sun a few hours later.
Goal -- He was relaxed but he wanted to rent a jet ski.
T, G -- A few hours later he wanted to rent a jet ski.
G, T -- He wanted to rent a jet ski a few hours later.

The beach was a good idea. He always had a good time.

3) Brad wanted to paint a picture to hang in his bedroom. He wasn’t much of an artist. He had another painting that he was going to copy. He got out his paint brushes.

None -- He put them in the paint and kept dragging his brush over the white canvas.
Time -- He was comparing his to the original later after he had finished painting.
Goal -- He put them in the paint but he decided that he should hang a photo instead.
T, G -- Later when he had finished he decided that he should hang a photo instead.
G, T -- He decided that he should hang a photo instead later when he had finished.

He couldn’t even copy a painting. He didn’t know it would be so difficult.

4) Two boys went on a hike in the woods. They had never been hiking by themselves. They wanted to camp overnight. They started on the trail.

None -- They had a good conversation on the trail as they walked along.
Time -- They were walking and joking with each other later that evening.
Goal -- The trail was boring so they decided to go home before it was dark.
T, G -- Later that evening they decided to get home before it turned dark.
G, T -- They decided to get home before it turned dark later that evening.

The bugs were biting. They would be more comfortable at home.

5) Katie was going to run a marathon. She was ready to start training. She was supposed to run ten miles a day. She went out for her first run.

None -- She ran in the park with the other runners.
Time -- She went out on her routine run the next day.
Goal -- She started but decided she wouldn’t run again.
T, G -- The next day she decided not to run anymore.
G, T -- She decided not to run anymore the next day.

She didn’t know how she would run an entire marathon. She was already sore.

6) Shelley was going to the doctor. She had a cold that wouldn’t go away. She made an appointment with a new doctor. She sat patiently in the waiting room.

None -- She watched TV and read a paper.
Time -- She was still waiting a while later.
Goal -- While waiting she decided to leave.
T, G -- A while later she decided to leave.
G, T -- She decided to leave a while later.
She had waited too long. She didn’t know why they bothered scheduling appointments.

7) Peggy was having trouble with her pants. They didn’t fit her anymore. She could only wear the ones with elastic waists. They were more forgiving of her late night desserts.

None -- She put on a pair of elastic waist pants and looked at herself in the mirror. 
Goal -- She had been putting it off but Peggy finally decided that she wanted to diet. 
Time -- She was still eating late night desserts and wearing tight pants a week later. 
T, G -- After another week of desserts Peggy finally decided that she wanted to diet. 
G, T -- Peggy finally decided that she wanted to diet after another week of desserts.

She really needed to lose some weight. She couldn’t afford to buy new pants.

8) Gary pumped gas for the young couple. They drove a new large Ford truck. Gary had never pumped so much gas into a single vehicle. When he finished, the couple left him a nice tip.

None -- As the car left Gary continued to work pumping gas and helping people with car troubles. 
Time -- Gary was still hard at work pumping gas and helping people with car troubles several hours later. 
Goal -- As that car left Gary wanted to pump gas for another large truck that drove to a nearby pump. 
T, G -- Several hours later Gary wanted to pump gas for another large truck that drove to a nearby pump. 
G, T -- Gary wanted to pump gas for another large truck that drove to a nearby pump several hours later.

Gary’s shift would end soon. He earned a good deal of money at this new job.

9) The old man searched up and down the rows for a new movie. He didn’t recognize any of the titles. Some of the covers were shocking to the man. One of the movies was about a woman that was actually a robot.

None -- The man just chose the next video that he saw on the shelf out of frustration. 
Time -- The man finally chose a comedy he had already seen after an hour of searching. 
Goal -- He was confused by the videos so he just wanted to find an old country western. 
T, G -- After an hour of searching, the man just wanted to find an old country western. 
G, T -- The man just wanted to find an old country western after an hour of searching.

He really liked movies. He was just afraid that he wouldn’t understand the new movies.

10) The doctor agreed to work a 24 hour shift. She saw her first patient of the evening. It was a young girl who had bumped her head. The doctor did some testing to make sure she was fine.
None -- The doctor looked at the test results right away and didn’t find anything wrong. Time -- When the doctor got the test results back later that night he saw nothing wrong. Goal -- The doctor looked at the test results right away and wanted to admit the girl. T, G -- When the results came back later that night the doctor wanted to admit the girl. G, T -- The doctor wanted to admit the girl when the results came back later that night.

The girl sat close to her mother. The hospital was very cold.

11) Stacey and Matt were at a party. Matt was pressuring Stacey to smoke a cigarette. Stacey had never done anything like that before. She told Matt that she didn’t want to.

None -- Even though Stacey didn’t smoke, Matt would not stop pressuring her. Time -- Even though Stacey didn’t smoke, Matt pressured her again a while later. Goal -- But everyone else was smoking so she decided that she wanted a cigarette. T, G -- After being at the party for a while she decided that she wanted a cigarette. G, T -- She decided that she wanted a cigarette after being at the party for a while.

The party stunk of smoke. It was starting to get crazy.

12) Ted and his son went fishing. They sat by the bank and threw in their worms. His son looked bored. Ted thought that he had a couple bites on his line, but it was tangled in weeds.

None -- Ted threw in his line again and looked at his son who was starting to sleep. Time -- Ted was trying but still hadn’t caught anything after several hours of fishing. Goal -- Ted wasn’t catching any fish and decided that he wanted to go swimming. T, G -- After several hours of fishing Ted decided that he wanted to go swimming. G, T -- Ted decided that he wanted to go swimming after several hours of fishing.

The water was calm. The boat stopped rocking back and forth.

13) Christie went into Verizon to get a new cell phone. The phone she had was too large and got bad reception. She knew that her plan covered new phones. Unfortunately it only covered certain phones.

None -- She started looking around and there was such a large selection to view. Time -- She was still looking around the store at phones after an hour had passed. Goal -- She started looking but decided that she wanted to keep her old phone. T, G -- After looking around for over an hour she wanted to keep her old phone. G, T -- She wanted to keep her old phone after looking around for over an hour.

She was told that her plan only covered certain phones. These were the cheapest in the store.

14) Tina was at the mall shopping for a jacket with friends. She heard that the Gap was having a big sale. She looked but most of the jackets were small or extra large.
Her skinny friend put several items on hold.

None -- The salesperson put the items on the hold rack and said that they would be on hold for a week.
Time -- The salesperson put the items on hold and the girls were back to pick them up the next day.
Goal -- The salesperson put the items on hold and Tina decided that she wanted to apply for a job there.
T, G -- They picked up the items the next day and Tina decided that she wanted to apply for a job there.
G, T -- Tina wanted to apply for a job there when they picked up the items on hold the next day.

This was their favorite store. They had the best blue jeans.

15) Mike had packed up his car to drive to Miami. He hadn’t gone far when he realized that he had forgotten to tell his parents he was leaving. They would worry, but Mike couldn’t turn back now. He would call them later.

None -- He kept driving and listening to music while he looked out at the beautiful scenery.
Time -- He changed the cds in his player in the trunk after he had driven for several hours.
Goal -- He kept driving but he changed his mind and decided that he wanted to go home.
T, G -- After driving for several hours he decided that he should turn around and go home.
G, T -- He decided that he should turn around and go home after driving for several hours.

His parents would be angry with him. He was supposed to go to a reunion.

16) Paul took Suzie to Olive Garden. During dinner they didn’t have much to talk about. Paul tried to make a funny comment about the waiter. Suzie didn’t laugh or say much of anything.

None -- They kept eating but she didn’t laugh at any of Paul’s jokes.
Time -- She continued to be shy and quiet at the end of the night.
Goal -- They kept eating but Paul just wanted to take Suzie home.
T, G -- At the end of the night Paul just wanted to take Suzie home.
G, T -- Paul just wanted to take Suzie home at the end of the night.

This was his most awkward date. His other dates were only slightly awkward.
17) The Smith family went to a tree farm to buy a Christmas tree. It was tradition in their family to wait until Christmas Eve. Every tree they saw had something wrong with it. They were too tall or uneven.

None -- They continued looking around and making fun of all of the ugly trees.
Time -- They were still looking around for the perfect tree after an hour later.
Goal -- They continued looking around but they just wanted to buy a fake tree.
T, G -- After looking around for an hour they just wanted to buy a fake tree.
G, T -- They just wanted to buy a fake tree after looking around for an hour.

Going to a tree farm was tiring. Maybe this was why they waited until Christmas Eve.

18) Greg went to the mall to buy a Halloween costume. He wanted to be a pirate. He hoped he would look better than last year. He started looking through the racks.

None -- He looked at many costumes until he found one he wanted.
Time -- He was looking through the pirate costumes a while later.
Goal -- While searching he decided that he wanted to be a wizard.
T, G -- An hour later he decided that he wanted to be a wizard.
G, T -- He decided that he wanted to be a wizard an hour later.

Pirate costumes were very popular. Especially for younger boys.

19) Sam and Patty went for a bike ride. Sam had bought a new bike. Patty thought that he was trying to impress her. They started riding on the trail.

None -- Sam rode next to Patty who was trying hard to keep up with him.
Time -- They were still riding on the trail in the hot sun two hours later.
Goal -- They were hot and they wanted to leave the trail and get ice cream.
T, G -- After two hours they wanted to leave the trail and get ice cream.
G, T -- They wanted to leave the trail and get ice cream after two hours.

Sam did want to impress Patty. He thought she was cute.

20) Ben was going to redo his kitchen himself. The walls had ugly wallpaper. He was going to paint the walls cream. He started ripping off the wallpaper.

None -- The wallpaper was old and Ben had no trouble taking it down.
Time -- He was still hard at work painting the walls green the next day.
Goal -- It was hard so he decided to hire someone to paint it for him.
T, G -- The next day he decided to hire someone to paint it for him.
G, T -- He decided to hire someone to paint it for him the next day.

Ben wasn’t a big fan of manual labor. He had a job as a computer programmer.
21) Michelle went to the grocery store. She was buying ingredients to bake a cake. She never had baking supplies in her house. She went down the first aisle.

None -- She found the flour first and was looking around for the cake mix.
Time -- She had purchased most of her items after looking around a while.
Goal -- She noticed some good sales and decided to do all of her shopping.
T, G -- After looking around a while she decided to do all of her shopping.
G, T -- She decided to do all of her shopping after looking around a while.

Her friends would be very happy. Michelle was a good cook.

22) Two friends were going to workout after school. They were very out of shape. They wanted to begin exercising regularly. They walked into the gym.

None -- They went around the track but couldn’t go as fast as the other runners.
Time -- They were tired but proud of themselves at the end of their workout.
Goal -- They started exercising but then decided to go back to their old ways.
T, G -- At the end of their workout they decided to go back to their old ways.
G, T -- They decided to go back to their old ways at the end of their workout.

They should have never stopped exercising. They use to be athletes.

23) Margie was growing a garden. She was upset because worms had eaten her cabbage. She bought some poison to kill them. She went to spray it over the vegetables.

None -- She whistled while she sprayed the vegetables.
Time -- She was almost done with the job a while later.
Goal -- She began but then decided not to use the poison.
T, G -- A while later she decided not to use the poison.
G, T -- She decided not to use the poison a while later.

She thought the poison might make the food bad to eat. She wasn’t sure.

24) Robert was going to learn how to play the piano. He was the guitar player in his band. The band needed piano and nobody else knew how to play. He went to his first lesson.

None -- Robert sat down and watched his teacher place her hands over the piano.
Time -- Robert was writing down tips from his teacher when the lesson was over.
Goal -- Robert sat and began to play but wanted someone else to learn the piano.
T, G -- When the lesson was over Robert wanted someone else to learn the piano.
G, T -- Robert wanted someone else to learn the piano when the lesson was over.

Playing the piano was more difficult than he thought. The guitar seemed so easy.

25) Billy was going on his first plane ride. He was excited. His parents sat him next to the window.
Billy looked out as the plane started flying.

None -- The view was amazing and Billy couldn’t stop looking.
Time -- Billy clutched onto his backpack when the plane landed.
Goal -- The view looked great and he wanted to become a pilot.
T, G -- When the plane landed Billy wanted to become a pilot.
G, T -- Billy wanted to become a pilot when the plane landed.

Flying was really fun. He didn’t know why adults thought it was boring.

26) Ken’s family went to the park for a picnic. His parents liked to sit by the lake and eat lunch. Ken liked to go swimming after he ate. He went into the water.

None -- The water was colder than usual but he swam for warmth.
Time -- He was swimming and flipping underwater an hour later.
Goal -- The water was colder than usual and he wanted to go home.
T, G -- An hour later his stomach ached and he wanted to go home.
G, T -- His stomach ached and he wanted to go home an hour later.

His parents were right. It wasn’t good to swim just after eating.

27) Amanda’s computer had a virus. It kept freezing every time she turned it on. She had a friend who was going to help her fix it. He started reformatting the hard drive.

None -- He was busy and she watched him so she could learn.
Time -- Amanda was still at her computer working later that day.
Goal -- He was busy but she wanted to take it to the manufacturer.
T, G -- Later that day she wanted to take it to the manufacturer.
G, T -- She wanted to take it to the manufacturer later that day.

She didn’t know what her friend had done. He hit buttons very quickly.

28) Neil went to the store to buy a new television. The family television was outdated. He wanted something more modern. He started looking around.

None -- The store had so many televisions and workers.
Time -- He was still looking for a great set a while later.
Goal -- He saw some but decided not to buy a television.
T, G -- A while later he decided not to buy a television.
G, T -- He decided not to buy a television a while later.

He was overwhelmed. He didn’t know how to choose without his family.

29) The photographer agreed to take pictures for a fashion ad. He had decided to start a new line of work. He had always been a wedding photographer. He took out his camera to get set up before the fashion model arrived.
None -- He was always well prepared and wanted to be ready for anything that might happen.
None -- He was relieved to be finished while taking down his equipment at the end of the shoot.
Goal -- As he set up he decided that he should go back to taking photographs at weddings.
T, G -- When the photo session had ended the photographer decided to go back to weddings.
G, T -- The photographer decided to go back to weddings when the photo session had ended.

Weddings were usually chaotic. He had grown accustomed to the chaos.

30) Ron went to the store to rent a tux for the prom. He wanted something a little different. He didn't want to look like every other guy there. He started looking around the store.

None -- He looked at a few tuxes before finding the one he wanted.
Time -- He was looking through the tuxes an hour later.
Goal -- While looking he decided to go with a traditional tux.
T, G -- An hour later he decided to go with a traditional tux.
G, T -- He decided to go with a traditional tux an hour later.

He could see why everyone wore the same one. All the others looked very strange.
WORK CITED


