# A step at a time: An investigation of preschoolers' simulations of narrative events during story comprehension

by

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## Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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# Abstract

A growing body of work suggests that narrative comprehension involves the simulation of the events and actions described in a narrative (e.g., Barsalou, 2008; Matlock, 2004). Preliterate children's ability to simulate a narrative character's movements is explored here in three studies. Children's simulations of a character's movements were found to be constrained by their expectation of the *duration* of the described activities (i.e., walking vs. driving) and by their expectations about the motivating influence of certain *psychological factors* (i.e., character being eager or not eager to get to a location). Using a novel methodology these findings reveal an ability among preliterate children to create impressively rich and dynamic mental representations of narrative events and address. The implications of the present investigation speak to the larger issue of how human minds comprehend narratives and represent narrative events.

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# Dedication

To my parents

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# Chapter 1: Introduction and Literature Review

The ability to create and comprehend stories is a remarkable feature of the human mind. As the following passage, written by the famous French writer Gustave Flaubert (1857, p. 96-97), so strikingly illustrates, reading a story affords us the privilege of experiencing the perspective of another person, place, or time.

> Without leaving your chair you stroll through imagined landscapes as if they were real, and your thoughts interweave with the story, lingering over details or leaping ahead with the plot. Your imagination confuses itself with the characters, and it seems as if it were your own heart beating inside their clothes.

And indeed, research indicates that during story comprehension, readers and listeners often behave as if they are embedded in the narrative situation, tracking and adopting a character's spatial, temporal, and psychological perspective (e.g., Black, Turner, & Bower, 1979; Bower & Morrow, 1990; Gernsbacher, Goldsmith, & Robertson, 1992; Gerrig, 1993; Morrow, Bower, & Greenspan, 1989; Özyürek & Trabasso, 1997; Tapiero, 2007; Trabasso & Suh, 1993; Zwaan, 1999a). But how is it that comprehenders, be they readers or listeners, track and adopt these perspectives? Findings suggest that, in addition to a representation of the surface structure of narratives (e.g., words, sentences), narrative comprehension also involves the creation of a mental representation of the situation, known as a situation model (e.g., Johnson-Laird, 1983; Kintsch, 1998; Zwaan & Radvansky, 1998). Situation models are quite detailed and contain information about the time, space, entities, intentionality, and causal relations of the events and actions described in a narrative (for review see Zwaan 1999a).

Recent findings suggest that situation models of narratives are also dynamic and rest on our ability to *mentally simulate* the events described in a narrative (e.g., Barsalou, 1999, 2008). Mental simulations, which have been described as "the reenactment of perceptual, motor, and introspective states acquired during interaction with the world, body, and mind" (Barsalou, 2008, p. 618), have revolutionized our understanding of not only narrative comprehension, but, more generally, language comprehension as well. With respect to language comprehension, it has also been proposed that "any transformation the referent undergoes should cause an analogous transformation in the simulation" (Stanfield & Zwaan, 2001, p. 153; Barsalou, 1999). And indeed, numerous studies demonstrate that adults routinely simulate the perceptual and motor information described in a text (e.g., Barsalou, 2008; Brunyé, Ditman, Mahoney, Augustyn, & Taylor, 2009; Fischer & Zwaan, 2008; Glenberg & Kaschak, 2002; Matlock, 2004; Pecher & Zwaan, 2005; Stanfield & Zwaan, 2001; Zwaan, 2004; Zwaan & Madden, 2005; Zwaan, Stanfield, & Yaxley, 2002). For example, in one study, readers took longer to read the sentence "Road 49 crosses the desert" when they were told earlier that the desert was 400 miles in diameter than when they were told the desert was only 30 miles in diameter (Matlock, 2004). These and similar types of findings, which will be reviewed in more detail in the pages to follow, suggest that language comprehension involves the simulation of the described situations and events.

Simulations have been observed at all levels of language comprehension including word, sentence, and narrative comprehension. Little, however, is known about the developmental nature of this ability, especially as it pertains to the comprehension of narratives. Considerably more research has explored the simulation of textual information in adults than in children, leaving us with a better understanding of these processes in adults. It is not yet clear whether children also simulate narrative events - and if so, when this ability develops. Consequently, the aim of the present investigation was to explore young children's ability to simulate narrative events. Specifically, the key question the studies in the present investigation seek to answer is whether young children simulate a narrative character's spatio-temporal perspective and specifically, a character's movements.

This chapter consists of an introduction to the study of narrative, followed by an introduction to the mental processes involved in narrative comprehension in both adults and children. Chapter 1 also provides a summary of the experiments reported in Chapters 2, 3, and 4. Finally, Chapter 5 summarizes the findings and integrates them into a framework for understanding the role of mental simulation in narrative comprehension. Chapter 5 also discusses some caveats and future directions.

## A Brief Introduction to the Study and History of Narrative

> …narrative is present in every age, in every place, in every society; it begins with the very history of mankind and there nowhere is nor has been a people without narrative… narrative is international, transhistorical, transcultural; it is simply there, like life itself. (Barthes, 1982, p. 251-2; also see Young & Saver, 2001)

As the above passage suggests, humans have been telling and listening to stories for quite some time. Scholars believe that humans began telling stories sometime between 30,000 and 100,000 years ago, during our hunting-and-gathering past. These estimates place the emergence of storytelling prior to the emergence of other forms of symbolic expression (e.g., cave paintings, figurines, and engravings found on bones and antlers) but after the emergence of language (i.e., before *Homo sapiens* began migrating out of Africa; Sugiyama, 2001a). These estimates indicate that the practice of storytelling pre-dates not only the advent of writing, but also of agriculture and permanent settlement.

Storytelling is an important and universal component of people's daily lives. Research indicates that narrative plays a critical role in many aspects of our social and cognitive functioning, influencing our social skills, attitudes, thoughts, memories, sense of self, and even our sense of time (Abbott, 2002; Dunbar, 1996; Hsu, 2008; Sugiyama, 2001a, 2001b). No special education is required to develop the ability to understand narratives and indeed all typically developing humans acquire the ability to create and comprehend stories. The universal presence of this remarkable trait has led some to rank it along with language as *the* distinctive human trait (Abbott, 2002).

## Defining Narrative

To study and explore a particular topic, one must of course define and set clear boundaries around the phenomenon of interest. Historically, the definition of the term narrative has been widely debated (e.g., for review see Abbott, 2002; Mar & Oatley, 2008; Zunshine, 2006). Attempts to categorically define narratives have been notoriously difficult, as many categorical statements have often been countered with exceptions (Mar & Oatley, 2008). Even a definition as clear-cut as Aristotle's (330 BCE/1987) - a story should consist of a beginning, a middle, and an end - has been undermined by Edgar Allen Poe's (1846/1967) story, *A Cask of Amontillado,* which consists mostly of an end, no beginning, and a condensed middle.

Most definitions of narrative have emphasized its structure.  The characterization of narrative as "the representation of an event or a series of events" is perhaps the simplest (Abbott, 2002, p. 12). The critical term in this definition is "event"- a description pertaining to an action. According to Abbott, without action, there is no story. For example, *The cow has fleas,* is considered a description, *The cow was bitten by a flea* is considered a story because it describes an event.

Although a one event description is enough to satisfy Abbott, other scholars have argued that one event is insufficient, and that at least two events are needed to constitute a narrative and that the events need to be casually linked (e.g., Barthes, 1982; Rimmon-Kenan, 1983). Bordwell and Thompson (2003) add the element of time to their definition of narrative, which they assert is "a chain of events in a cause-effect relationship occurring in time." Others argue that narratives must contain human agents, making the action of the narrative goal-oriented (e.g., Van Peer & Chatman, 2001), while Black and Bower (1980) assert that the essence of a story lies in its description of problems and characters' plans for solving them.

A definition of narrative as a description of causally linked events unfolding over time has been useful in examining the mental processes involved in the narrative comprehension. This is the definition that best captures the stories used in the present investigation of children's ability to simulate narrative events (see Appendices A, B, and C).

## Functions of Narrative

Much has been written about the general function of narrative and its importance to our species (e.g., Hogan, 2003; Sugiyama, 2001a, 2001b). The origin of the English term "narrative" is intriguing and may also shed light on some of the more general functions of narrative. The word "narrative" originates from the Sanskrit word "gna", a root word meaning "know", which was passed down to us through the Latin words "gnarus" ("knowing") and "narro" ("telling"; White, 1987). Consequently, the narrative scholar, Porter Abbott (2002), has argued that "narrative" is a "universal tool for knowing as well as telling, for absorbing knowledge as well as expressing it" (Abbott, 2002, p. 11). As the knowledge conveyed by a narrative is by no means static, Abbott

(2002) has also argued that a narrative is an "instrument that provokes active thinking" (p. 11). It is this "active thinking" component of narrative that makes it an especially interesting topic of study.

The universality of narrative content has led many researchers to speculate about narrative's general function (e.g., Hogan, 2003; Sugiyama, 2001a, 2001b). Interesting thematic similarities have been observed in a variety of stories found in a number of distinct cultures (Hogan, 2003). For example, many of the world's stories survey themes associated with the interactions of autonomous intentional agents (e.g., Palmer, 2004). One very familiar and often reoccurring theme explores the characteristics and implications associated with evil stepmothers. The Cinderella story features one especially memorable stepmother. Versions of this story have been found in such diverse cultures as ancient Egypt, ninth-century China, a number of Native South American cultures, and Europe (Gough, 1990; Sugiyama, 2001b). The universality of human relation themes has led some scholars to argue that listening and reading stories improves our social and social cognitive skills (Mar & Oatley, 2008; Zunshine, 2006).

However, not all popular stories deal exclusively with human relations suggesting that the notion of stories as a means of improving social skills is partial at best. Indeed, other scholars have argued that the function of stories is not just limited to the social realm but rather to the improvement of any skills that may increase our chances of survival (Sugiyama, 2001a, 2001b). And indeed, findings suggest that other commonly reoccurring narrative themes feature important aspects of peoples' environments such as cosmology, topography, animal and plant characteristics, birth and death, as well as animal and human behavior (Sugiyama, 2001b).

## The Psychology of Narrative Comprehension

How does the human mind comprehend stories? The following section explores and reviews what is known to date about the mental processes involved in the comprehension of narratives, and especially what is known about how human minds simulate the perspective of a person, place, or time in a narrative. This review is presented in three subsections: (a) Situation Models; (b) Children's Situation Models; (c) Embodiment and Narrative Comprehension.

### Situation Models

Contemporary models of narrative comprehension assert that comprehension consists of a number of different processes that occur in parallel as people read or listen to a story (Therriault & Rinck, 2007). According to these theories, comprehension involves at least three levels of representation: the surface structure, the textbase, and the situation model (Gernsbacher, 1990; Johnson-Laird, 1983; Kintsch, 1988, 1998; van Dijk & Kintsch, 1983; Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998). Each level of representation deals with a different aspect of text comprehension; however, all three are interconnected in memory. The surface structure is a representation of the exact form of a text including its wording and syntactic structure. The textbase is a representation of a text's meaning. The final level is referred to as a *situation or mental model* (van Dijk & Kintsch, 1983). It is the situation model level of representation that is the main focus of the present investigation.

Situation models are conceptualized as a representation of the situation described in the text, created when the reader or listener integrates textual information with their own world knowledge (e.g., Zwaan & Radvansky, 1998). The construction of a "coherent situation model is tantamount to the successful comprehension of a text" (Zwaan & Radvansky, 1998, p. 163). A situation model “sets the parameters of space and time that are going to pervade the activities during the whole story” (Rinck, 2008, p. 360). Situation models impact and influence the reader and listener, especially their inferences, interpretations, and evaluations of incoming statements of the story.

But, why study situation/mental models? I believe Bower and Morrow offer one very compelling explanation in their 1990 Science article:

> The principles readers use to explain and understand the actions of storybook characters are much the same as those they use to understand people's actions in everyday life. We build mental models that represent significant aspects of our physical and social world, and we manipulate elements of those models when we think, plan, and try to explain events of that world. The ability to construct and manipulate valid models of reality provides humans with our distinctive adaptive advantage; it must be considered one of the crowning achievements of the human intellect. (p. 247)

## A Brief History of the Study of Situation Models

Text-comprehension researchers have been exploring the nature and interaction of the mental processes involved in the creation of a coherent situation model for almost 30 years. However, compared to other aspects of comprehension, the study of situation models is actually a relative “latecomer” (Kintsch, 2007, p. xv). Researchers began exploring situation models in earnest during the 1980s. Prior to the 1980s, text comprehension researchers focused their efforts on examining readers’ representation of the linguistic input, such as the surface structure and semantic meaning of a text. This change in research focus was inspired by the publication of books by Johnson-Laird (1983) and van Dijk & Kintsch (1983). Motivated by developments in linguistics and philosophy, both works focused on the notion of language comprehension as more than just a representation of linguistic input. All three authors argued that the essence of language comprehension is to create a mental representation of the situation described by the linguistic input. Johnson-Laird (1983) used the term *mental models* to refer to these representations, whereas van Dijk and Kintsch (1983) used the term *situation models*. Today, the term *situation model* is more often used to refer to a mental representation of a text, whereas, the term *mental model* tends to refer to a variety of different cognitive processes including, but not limited to, the comprehension of textual information (e.g., mental model of a town's spatial layout; Kintsch, 2007).

The notion of language comprehension as a process of creating a mental representation of a described situation has had a profound impact on text comprehension research. As Zwaan and Radvansky (1998) have pointed out, the introduction of the concept of situation models has changed the main research question posed by text-comprehension researchers from "How do readers comprehend a text?" to the more focused "How do readers construct a coherent situation model?" Thus, rather than simply asking how comprehenders are influenced by the structure of the text itself, the alternative question focuses on how readers are influenced by the situation described in the text.

In the processes of uncovering the answer to this question, researchers have found that readers employ a variety of cognitive processes to construct a situation model of narratives. These include memory based processes (Gerrig & O'Brien, 2005; McKoon & Ratcliff, 1998) as well as conscious intentional and strategic processes (Graesser, Singer, & Trabasso, 1994; Kintsch & van Dijk, 1978; Lorch & van den Broek, 1997; also see Rapp & van den Broek, 2005; van den Broek, Rapp, & Kendeou, 2005). For example, readers' situation models of stories influence the types of inferences readers make about a story's spatial layout (Glenberg, Meyer, & Lindem, 1987), and a character's goal-based intentions (Trabasso & Wiley, 2005). Readers appear to monitor many different aspects of a narrative during comprehension (Zwaan & Radvansky, 1998). The study of how all these processes work together to create a situation model has spurred the creation of many different models of text comprehension (See Table 1 for a summary of models, pp. 20-22; also see Mar, 2004).

Briefly, one of the most influential theories of text comprehension has been Kintsch and van Dijk's (1978) *Interactive Model of Comprehension,* which outlined the process of reading from word recognition through to the creation of a mental representation of a text's meaning. Kintsch (1988, 1998) extended this theory into another very influential model, the Construction-Integration Model, explored further in Table 1. Kintsch's models have served as a foundational point for many other theories of text comprehension. Theories of text comprehension have continued to evolve and in recent years have undergone considerable transformations.

Two of today's most prominent models, the *Event-Indexing Model* (Zwaan, et al., 1995) and the *Immersed Experiencer Framework* (Zwaan, 2004), were developed by Zwaan and colleagues. The Event-Indexing Model (Zwaan et al., 1995) drew attention to the different dimensions of narratives tracked by comprehenders, and how readers and listeners experience the perspective of another person, place, or time. This focus is closest to that of the present investigation. Consequently, the Event-Indexing Model is described in more detail below, while a description of the Immersed Experiencer Framework (Zwaan, 2004) can be found later in this chapter in the section entitled *Embodiment and Narrative Comprehension* (p. 36).

**Table 1: Models of Text Comprehension**

| Name of Model | Authors | Publication Year | General Overview of Model |
|---|---|---|---|
| | | | |
| An Interactive Model of Comprehension | Kintsch & van Dijk | 1978 | Text comprehension proceeds in cycles.<br><br>A few propositions are processed in every cycle and connected to existing ones.<br><br>Situation models are needed because they (1) integrate information across sentences, (2) explain similarities in comprehension performance across modalities, (3) account for domain expertise on comprehension, (4) explain translation, (5) explain how people learn about a domain from multiple sources. |
| | | | |
| Construction-Integration Model | Kintsch | 1988 | Focuses on importance of inferences in maintaining a coherent model.<br><br>During reading, readers construct a coherent network of explicit text propositions, thematic generalizations and coherence preserving inferences.<br><br>Incoming information is integrated into model. During integration, activation builds up in highly interconnected elements of the model. |
| | | | |
| Structure-Building Framework | Gernsbacher | 1990 | Focuses on the importance of building a coherent mental representation or "structure" of the information being comprehended<br><br>Readers: (1) build a foundation for representing new information, (2) map new information onto previously established related information, and (3) shift and create new foundations when incoming information is not coherent with previous structures. |

| Name of Model | Authors | Publication Year | General Overview of Model |
|---|---|---|---|
| | | | |
| Minimalist Model | McKoon & Radcliff | 1992 | Focuses on memory processes that support comprehension at the local level.<br><br>Memory-based and minimalist model.<br><br>Defers to constructionist theories model for comments on more global processing. |
| | | | |
| Capacity Constraint Reader Model | Just & Carpenter | 1992 | Shares general theoretical framework with Kintsch and van Dijk's model (1978), but focuses directly on the *processes* of comprehension *as they occur* (e.g., on-line reading processes).<br><br>Encouraged the use of eye-tracking methodologies. |
| | | | |
| Constructivist Framework | Graesser, Singer, & Trabasso | 1994 | Focuses on inferences need to create a coherent causal situation model.<br><br>Assumes that readers monitor coherence of model and routinely seek explanations for text outcomes.<br><br>Comprehension does not need proceed from lower to higher level of representation (e.g., surface form to situation model).<br><br>Causal situation models consist of interconnected networks of textual events. |
| | | | |
| Event Indexing Model | Zwaan, Langston, & Graesser | 1995 | Focuses on the multi-dimensional aspects of situation models. Claims that narrative events are split into five dimensions: time, space, causes, motivations, and person/object.<br><br>Focuses on how incoming information is processed and represented in the long-term memory.<br><br>Narrative events are represented in a network of nodes. The nodes are linked with each other through situational links according to the indexes they share. Claims that it is easier to integrate a new incoming event if it shares indexes with a previous event.<br><br>Very influential model. |

| Name of Model | Authors | Publication Year | General Overview of Model |
|---|---|---|---|
| | | | |
| Capacity-Constrained Construction-Integration Model | Goldman, Varma, & Coté | 1996 | Focuses on the ways in which readers' limited working memory capacity influences comprehension.<br><br>Uses computational architecture of the Capacity Constraint Reader Model (Just & Carpenter, 1992).<br><br>Comprehension occurs in cycles in which certain textual elements become more or less active in working memory. |
| | | | |
| Landscape Model | van den Brock, Risden, Fletcher, & Thurlow | 1996 | Focuses on the multi-dimensional aspects of situation models (like Zwaan et al., 1995).<br><br>Similar to Construction–Integration Model. Views reading as cyclical process, in which propositions fluctuated in activation from cycle to cycle.<br><br>Also, focuses on readers' goals and judgments of coherence of representation. |
| | | | |
| The Immersed Experiencer Framework | Zwaan | 2004 | Focuses on the notion that language comprehension involves action and perceptual representations and not amodal propositions.<br><br>Comprehension consists of three components: activation, construal, and integration. Activation works at the word level, construal at the clause level and integration at the discourse level. |

The Event-Indexing model revolutionized the study of narrative comprehension by focusing research efforts on the multidimensional aspects of situation models and how these different dimensions operate together during the construction and maintenance of a coherent situation model. Although today situation models are, by definition, considered multidimensional (Rinck, 2008), when developing the Event-Indexing model Zwaan and Radvansky (1998) argued that even though previous work (e.g., Trabasso & Magliano, 1996; Trabasso & Sperry, 1985; Trabasso & Suh, 1993; Trabasso & van den Broek, 1985) had established that causal relations play a critical role in the creation of a coherent situation model, the work overlooked compelling evidence that comprehenders also track other aspects of narrative events, such as time, space, and protagonists.

According to the Event-Indexing model, during comprehension clauses are parsed into events. These event representations are then integrated into the situation model and into long-term memory, resulting in a coherent situation model. As supported by years of subsequent research, five different dimensions of the events and actions described in a narrative are routinely tracked by comprehenders and incorporated into a situation model: (1) person/object, (2) motivation, (3) spatial, (4) temporal, and (5) causal aspects. For example, with respect to the person/object dimension, research indicates that readers make numerous inferences about characters' personal characteristics. When presented with the sentence, *The electrician examined the lighting fitting*, readers were slower to read the sentences, *She took out her screwdriver*, than the sentence, *He took out his screwdriver* (Carreiras, Garnham, Oakhill, & Cain, 1996). This finding suggests that readers are quick to make inferences about the gender of characters and that these inferences tend to be driven by stereotypes, such as that electricians are typically male. Furthermore, these different situation model dimensions are often inherently intertwined (e.g., Schmalhofer & Perfetti, 2007). For example, given that causes temporally precede effects, representations of the temporal and causal dimensions of narrative are often closely linked. Thus, rather than explicitly focusing on the role of perspective, the Event-Indexing Model revolutionized the study of narrative comprehension by focusing on how readers track and incorporate these five dimensions into their situation models. The results of the studies most pertinent to the present investigation are described in the following section.

## Perspective in Narrative

> If we are told in the early pages of a story that it is a rainy night, and if the descriptions have set us inside a drafty house, then we naturally inhabit that context. Having brought a setting to life in our imaginations, and having invested it with the tones and shadings that are uniquely our own, we sustain it… We work hard to establish the image, and then move our attention elsewhere; the image becomes part of the context through which we filter what we read. (Birkerts, 1994, p. 225-266 in Van Peer & Chatman, 2001)

The importance of perspective in narrative has been lauded and extensively studied by both cognitive and literary scholars alike. It has even been argued that the fundamental function of narrative is "not to report a chronological sequence of events, but to signal a perspective on events . ." (Gee, 1991, p. 20). Bruner (1986) has argued that narratives "must depend on forms of discourse that recruit the reader's imagination" such as *subjectification* which he defines as the "depiction of reality, not through an omniscient eye that views a timeless reality, but through the filter of the consciousness of the protagonists in the story . . ." (p. 25).

In narrative, perspective is associated with the "deictic centre" (Duchan, Bruder, & Hewitt, 1995) or the "here/now" point (Morrow, Greenspan, & Bower, 1987), which typically refers to the location of the observer (e.g., story's protagonist, narrator) at a current moment in a narrative.

Generally, it is believed that tracking and adopting a character's perspective enhances comprehension by allowing a reader to focus their limited attentional resources on the most salient aspect of a story, the character (e.g., Bower & Morrow, 1990; Zwaan & Radvansky, 1998). It has also been argued that perspective serves as a tool by which readers organize information presented in a text (MacWhinney, 2005; Zwaan, 2004).

Given that situation models are created from a particular perspective, usually the protagonist's, text-comprehension researchers have for some time been interested in how narrative perspectives influence the comprehension of narratives. And indeed, both readers' and listeners' ability to track and share narrative perspectives has been one of the most extensively investigated aspects of situation models, and narrative cognition more generally (e.g., Black et al., 1979; Bower & Morrow, 1990; Dijkstra, Zwaan, Graesser, & Magliano, 1995; Gernsbacher et al., 1992; Graesser et al., 1994; Morrow et al., 1989; Morrow et al., 1987; Özyürek & Trabasso, 1997; Tapiero, 2007; Trabasso & Suh, 1993; Van Peer & Chatman, 2001; Zwaan, 1999a, 1999b). Overall, studies indicate that adopting a narrative perspective influences comprehension and situation models in a number of ways. First, adopting a protagonist's perspective activates information about this character's thoughts, emotions, or goals, making this information more highly accessible. Second, switching perspectives may slow comprehension. Third, perspective-taking influences the reader's response to the narrative including the reader's causal and emotional inferences.

The following summary, which focuses on adult readers' abilities to track and adopt a narrative character's perspective, is presented in three subheadings: Psychological Perspective-taking, Spatial Perspective-taking, and Temporal Perspective-taking. The limited, emerging work on children's ability to adopt a narrative character's perspective is discussed in the following section entitled *Children's Situation Models*.

*Psychological Perspective-taking*

Narrators are viewed as telling a story from the perspective of the main character, and similarly readers are viewed as focusing attention on the protagonist, whose actions determine the "here and now" point (Bower & Morrow, 1990, p. 45) in the narrative. It has been argued that "one prerequisite of comprehension is that readers keep track of their knowledge of the story world (privileged knowledge) coupled with the various mental states of characters described in the story" (Therriault & Rinck, 2007, p. 232). And indeed, research indicates that readers' situation models of narratives include representations of characters' mental or psychological perspectives. The most commonly investigated aspects of a character's psychological perspective include emotions and goals (e.g., Dijkstra et al., 1995; de Vega, Diaz, & León, 1997; Gernsbacher et al., 1992; Kneepkens & Zwaan, 1994; Oatley, 1994; Zwaan, 1999a). In one frequently cited study of emotional perspective-taking during narrative comprehension, subjects read narratives about a character engaging in an emotionally significant activity (e.g., character steals money from a store where his best friend works and later learns that his friend had been fired; Gernsbacher et al., 1992). After reading each narrative, readers read aloud matching emotion words (e.g., shame) and mismatching ones (e.g., pride). Mismatching emotion words were read more slowly suggesting that readers track and adopt characters' psychological perspectives during comprehension, suggesting that readers' were actively drawing inferences about the characteristics of the characters during comprehension.

Research also indicates that readers keep track of the main character's goals (Lutz & Radvansky, 1997; Suh & Trabasso, 1993; Trabasso & Suh, 1993). For example, researchers have found that readers are faster to recognize goals that have not yet been accomplished by a protagonist than goals that have just been accomplished, presumably because unaccomplished goals are more active and relevant in the character's mind (Lutz & Radvansky, 1997; Trabasso & Suh, 1993). When readers were presented with a sentence such as *David is attempting to submit his chapter in a timely manner*, they stored and maintained in memory David's goal to submit the chapter until David was removed from the focus of the text or until the goal had been accomplished. Evidence suggests that objects relevant to main character's current goals remain highly accessible, while objects that are relevant to a completed goal become less accessible over time, and objects that are relevant to a postponed goal are inhibited almost immediately (Rinck & Bower, 2004).

### *Spatial Perspective-taking*

The most widely studied dimension of situation models has been the spatial dimension, which generally includes a mental map of the places, landmarks, and objects described in the narrative, as well as the locations and movements of the characters. Generally, research suggests that when people read a narrative, they focus on the spatial aspects of the main character's perspective and "move with" the character through the narrative setting, making locations closer to the protagonist more accessible (e.g., Bower & Morrow, 1990; Morrow et al., 1987; Rinck & Bower, 2004).

Several different approaches have been used to study spatial aspects of situation models. In one extensively used paradigm, participants first memorize the layout of a narrative setting, which often includes the location of different rooms and objects.  Participants are then presented with a story set in a location depicted on the map. Findings indicate that a narrative character's current location influences participants' judgment times about various locations and objects in the setting (Morrow et al., 1987). For example, objects that are closer to the protagonist are more active and more available for reference in readers' minds than objects that are further away from the protagonist (e.g., Glenberg et al., 1987; Morrow et al., 1987; Morrow et al, 1989; Rinck & Bower, 1995; Wilson, Rinck, McNamara, Bower, & Morrow, 1993).  A narrative character's movement throughout a story can be thought of as a shifting 'spot of light' moving over the corresponding parts of a reader's situation model (Bower & Morrow, 1990).

Research indicates that readers track different spatial aspects of characters' thoughts.  In one such study (Morrow et al., 1989), participants read short narratives about a character moving through a building. Throughout the story, critical sentences located a character in a particular location (physical location), while the character thought about a different location (mental locations). Subsequently, when presented with a probe word, readers were faster to identify words denoting an object located in the character's mental location rather than physical location, suggesting that readers were tracking the character's thoughts about different locations.

Finally, it should also be noted that, although the spatial dimension has been the most widely studied aspect of situation models, research indicates it is not the one most routinely tracked by readers. Studies of the dominance of particular situation model dimensions indicate that readers are most sensitive to the protagonist and time dimensions (Magliano, Miller, & Zwaan, 2001; Rich & Taylor, 2000; Rinck & Weber, 2003; Therriault, Rinck, & Zwaan, 2006; Zwaan, Magliano, & Graesser, 1995; Zwaan et al., 1995; Zwaan et al., 1998).

*Temporal Perspective-taking*

Time is a critical component of situation models and of special interest to the present investigation. As many readers already know, stories take place in time. Some, such as Abbott (2002), have even argued that the principal purpose and "fundamental gift" of narrative is to organize our species' understanding of time (p. 3). Similarly, Ricoeur has stated that narrative "is meaningful to the extent that it portrays the features of temporal existence" (see Abbott, 2002, p. 4). With respect to the role time plays in situation models and narrative comprehension, Zwaan and Radvansky (1998) have argued that "to achieve a proper understanding of the situation described by a text, the reader needs to know when the described events took place both relative to each other and relative to the time at which they were narrated" (p. 175). Time is also the most linguistically explicit aspect of situation models, with temporal morphemes and time adverbials (e.g., "a few seconds ago") specifying the temporal sequence of events described in a narrative (Zwaan & Singer, 2003).

Research indicates that readers' situation models of narrative include representations of the temporal aspects of a narrative. Generally speaking, evidence suggests that readers spontaneously track temporal information during comprehension (Zwaan & Radvansky, 1998). Using a probe-word recognition task, Zwaan (1996) found that events that happened to a character more recently were more accessible to readers than events that happened less recently. In his study, adult participants read a story presented on a computer screen, one sentence at a time. At various points in the story, a probe word was displayed on the screen and readers were asked to decide if that word had appeared in the story. Zwaan found that the time readers took to respond to the probe words was affect by the introduction of time shifts in the narrative. For instance, the word *enter* was less accessible (i.e., read more slowly) to readers after reading the sentence, *An hour ago, John entered the building*, than after reading the sentence, *A moment ago, John entered the building* (Zwaan, 1996). Just as in real life, events that happened more recently were more accessible to the reader than events that happened less recently. These findings suggest that readers are prone to interpret narrative time in the same terms typically used to interpret events in real life. In addition, the results of this study demonstrate that readers' situation models of narratives contain important temporal information.

Time, however, has also been the least investigated aspect of situation models. Therriault and Raney (2007) have recently acknowledged that, "although we are certainly making progress, there is still much that we do not understand about how readers process and represent time in discourse" (p.174). As they point out, part of the reason why time has received so little attention from cognitive psychologists may be due to the difficulty in defining time. With respect to narrative, time may refer to duration, simultaneity, order, temporal perspective, and socially constructed units of time. Identifying which aspects of time readers routinely process during reading comprehension is important if we are to better understand the complexities involved in reading (Therriault & Raney, 2007). Given that children's representation of, not just time, but specifically the *duration* of a narrative character's movement is the primary focus of the present studies, our current understanding of readers' representation of time and especially duration warrants a closer examination.

Duration, or "our ability to represent the relative time course of some events", is a fundamental aspect of temporal processing (Therriault & Raney, 2007, p. 174). Duration has received relatively little direct attention from text-comprehension researchers and has not been addressed at all in studies exploring children's situation models of narratives. Although few studies have focused exclusively on duration, the results of these studies provide some evidence that adult readers represent duration information during text-comprehension. Duration has been explored in combination with other aspects of situations (Rich & Taylor, 2000), such as characters' goals (Anderson, Garrod, & Sanford, 1983; Magliano & Schleich, 2000; Singer & Richards, 2005), as well as other aspects of time (Rinck, Hahnel, & Becker, 2001; Rinck, Gámez, Díaz, & de Vega, 2003). For example, Rinck et al. (2001) examined how readers process inconsistent temporal sequence information. An example of a temporally inconsistent passage used in Rinck et al.'s (2001) study includes the following (p. 79):

> Today, Markus and Claudia would finally meet again.
> Markus's train arrived in Dresden on time at 4:10 p.m., and Claudia's train arrived at 4:30 p.m.
> Markus was very excited when his train stopped at Dresden Central Station just as scheduled.
> He tried to think of what he should say when he met her.
> Many people were crowding around the platform.
> Claudia was already waiting for him when he got off the train with his huge bag.

Rinck et al. (2001) found that when presented with inconsistent temporal information (e.g., Claudia was waiting for Markus), readers' reading time increased compared to more consistent temporal information (e.g., Markus was waiting for Claudia). Reading time increased both when readers noticed and failed to notice the temporal inconsistencies. Rinck et al. (2001) argued that their findings demonstrate the readers track the temporal dimension of narratives during comprehension and situation model creation. Therriault and Raney (2007) extended Rinck et al.'s (2001) findings, demonstrating that readers attend to temporal information without the use of specific time terms and direct contradiction used by Rinck et al. (2001). Both findings demonstrate that readers notice explicitly and implicitly inconsistent event durations and that these inconsistencies affect comprehension.

Overall, the results of studies exploring adults' situation models of narrative indicate that situation models of narrative are rich in detail and specific to the various perspectives described in a narrative.

## Children's Narrative Comprehension and Situation Models

Several aspects of young children's narrative comprehension have been quite extensively studied (for reviews see Perfetti, Landi, & Oakhill, 2005; and also Lynch et al., 2008; Milosky & Skarakis-Doyle, 2007; Paris & Paris, 2003). The majority of these studies have explored children's inference-making and comprehension monitoring. Inferences are an important aspect of narrative comprehension and a critical component of situation models and as such, children's ability to make inferences is reviewed below in the subsection entitled *Narrative Comprehension and Inferences*. Children's ability to track and adopt a character's perspective, however, has received much less attention (Perfetti et al., 2005; Lynch et al., 2008). What is known about children's ability to track and adopt a character's perspective, especially as it pertains to the focus of the present investigation, is reviewed in the subsection entitled *Perspective-Taking during Narrative Comprehension*.

### Narrative Comprehension and Inferences

During comprehension, comprehenders need to make numerous inferences bridging their own relevant world knowledge with the information provided in a narrative (e.g., Graesser et al., 1994; Langston & Trabasso, 1998; Suh & Trabasso, 1993; Trabasso, Secco, & van den Broek, 1984; van den Broek, 1990; Zwaan et al., 1995). Relevant background knowledge may include an understanding of the how one event can be motivated, psychologically or physically induced by another event (Lynch et al., 2008; Trabasso, van den Broek, & Suh, 1989). A failure to make appropriate inferences results in an incoherent situation model, leading to well documented comprehension failures (e.g., Cain & Oakhill, 2007).

Evidence suggests that young children engage in some of the same inference-making processes as older children and adults. Children as young as 6 years of age regularly make appropriate inferences concerning a character's goal (Lynch & van den Broek, 2007). Both adult and child comprehenders remember events that have more causal connections (e.g., Goldman & Varnhagen, 1986; Trabasso & van den Broek, 1985; van den Broek, 1988; van den Broek, Lorch, & Thurlow, 1996). Even children as young as 4 and 6 years of age were more likely to recall events that had more causal connections than events with fewer causal connections after watching Sesame Street videos, suggesting that preschoolers are sensitive to the causal structure of stories (van den Broek et al., 1996). Preschoolers' correct answers to questions pertaining to short stories reveal an understanding of the causal structure of narratives, as do the simple, yet causally coherent, narratives children tell by 5 years of age (Lynch et al., 2008; Stein, 1988; Trabasso & Nickels, 1992). Generally, younger children are able to make the same inferences as older children, but they may not always do so spontaneously, and often require prompting (Casteel & Simpson, 1991). In summary, as evidenced by their ability to recall a narrative or answer basic questions, that preschoolers make important inferences, and track and encode causal connections to create at least rudimentary mental representations of a narrative.

## Perspective-Taking during Narrative Comprehension

Only three studies to date have explored the details of children's situation models, and they have done so by investigating whether young children track and adopt a narrative character's perspective (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler, Mitchell, & Currie, 2005). These studies have demonstrated that preschoolers' situation models of stories contain information about a character's spatial (Rall & Harris, 2000; Ziegler et al., 2005) and mental perspective (O'Neill & Shultis, 2007) by about 4 years of age. Rall and Harris (2000) were the first to demonstrate that children, like adults (e.g., Black et al., 1979; Morrow et al., 1987), adopt a protagonist's *spatial* perspective. They asked children to listen to stories describing the activities of well-known fairytale characters. Each story used deictic verbs of motion to describe the movements of secondary characters. These verbs were either consistent (e.g., came) or inconsistent (e.g., went) with the protagonist's spatial perspective. For example, children heard, "*Cinderella was sitting on the chair by the fireplace, dreaming about the ball. Then her fairy godmother* *<u>came (went)</u>* *into the cottage."* When Rall and Harris (2000) asked 3- and 4-year-olds to recall sentences from the stories, they found that, like adults, children's accuracy in recalling the targeted deictic verbs of motion suffered when the verb of motion was inconsistent with the protagonist's spatial perspective (e.g., went), rather than when the verb of motion was consistent with the protagonist's perspective (e.g., came). Like adults, children often made substitution errors, replacing an inconsistent motion verb with a consistent motion verb. These findings suggest that while listening to a story, preschoolers adopt a character's spatial perspective.

Using Rall and Harris' (2000) methodology, Ziegler et al. (2005) found that children not only adopt the spatial perspective of familiar and nice characters, but will also adopt the spatial perspective of unfamiliar, wicked, and even inanimate characters. More recently, O'Neill and Shultis (2007) demonstrated that 4- and 5-year-olds but not 3-year-olds also track and adopt a character's *mental* perspective. Preschoolers listened to several short stories, each describing a character thinking about engaging in an activity in a location (e.g., playroom) different from the protagonist's current location (e.g., kitchen). While listening to each story (e.g., *This is John's house. This is the kitchen. This is the playroom beside the kitchen. Right now, John is in the kitchen. He wants to eat a snack. He is thinking of eating at the table in the playroom because the table in the kitchen is dirty.*), children looked at two toy models of the locations described in the story.  Critically, both toy models contained an identical target object (e.g. the exact same table), located in the same location relative to the base of the model. After listening to each story, children were asked a test question containing an ambiguous referent (e.g., *Can you point to the table*?). O'Neill and Shultis (2007) hypothesized that if children could adopt a character's mental perspective and track the protagonist's thoughts to the table in the playroom, they would point to the table in the playroom model and not the table in the kitchen model, and indeed, they did. Four- and five-year-olds pointed to the target object in the protagonist's mental goal location (e.g., table in playroom) 81% and 88% of the time, respectively. In contrast, 3-year-olds pointed to the target object in the protagonist's mental location only 62% of the time. Thus to date, findings suggest that preschoolers' situation models of stories contain information about a character's spatial (Rall & Harris, 2000; Ziegler et al., 2005), and mental perspective (O'Neill & Shultis, 2007) by about 4 years of age.

As already revealed, findings indicate that adult readers track and a adopt a character's perspective during narrative comprehension, and that their situation models contain a wealth of information about narrative characters' perspectives (e.g., Black et al., 1979; Bower & Morrow, 1990; Bryant, Tversky, & Franklin, 1992; Gernsbacher et al., 1992; Morrow et al., 1989; Özyürek & Trabasso, 1997; Tapiero, 2007; Trabasso & Suh, 1993; Zwaan, 1999a). Although limited to the results of just three studies, findings also suggest that preschoolers' mental representations of stories contain substantial detail concerning a main character's spatial and mental perspective (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler et al., 2005).

## Embodiment and Narrative Comprehension

Many of the studies thus far reviewed pose a challenge to traditional, amodal accounts of situation models. This challenge has continued to gain support from a growing number of recent behavioural and neuropsychological studies, which have begun to shed light on the *embodied* nature of situation model. By demonstrating that situation models may indeed be modal (e.g., Zwaan, 2004) and not amodal as traditionally conceptualized (e.g., Kintsch & Van Dijk, 1978), these findings have revolutionized our understanding of narrative comprehension, and language comprehension more generally. This section will introduce both traditional and embodied arguments and summarize the key findings of both approaches.

### Traditional Approaches to Language Comprehension

The traditional view of language comprehension, also known as a propositional, symbolic, or amodal view (e.g., Fodor, 1983; Pylyshyn, 1984) was discussed, albeit briefly, in the section entitled *Situation Models* (e.g., Kintsch & Van Dijk's, 1978). The general assumption of traditional views of language comprehension is that,

> …the human mind is much like a bricklayer, or maybe a contractor, who puts together bricks to build structures. The malleable clay of perception is converted to the neat mental bricks we call words, and propositions, units of meaning, which can be used in a variety of structures. (Zwaan & Madden, 2005, p. 224)

Thus, according to traditional views of language comprehension, comprehension is based on the creation and manipulation of amodal, abstract, and arbitrary symbols (e.g. AAA symbols; Fodor, 2000; Newell, 1990). An *amodal* symbol or token (e.g., mental representation of coffee) is created when a percept (e.g., experience of drinking coffee) is stripped of sensory information, thus no longer bearing any systematic morphological relationship to the corresponding multimodal perceptual experience (e.g., actual act of drinking coffee). In addition, according to the traditional accounts of language comprehension words derive much of their meaning through their associations with other words (Louwerse & Jeuniaux, 2008). This approach is evident in many early and computational theories of situation model constructions (e.g., See Table 1, p. 20-22). Furthermore, the majority of publications supporting the amodal account of language are not empirical but rather "computational in nature" (Louwerse & Jeuniaux, 2008, p. 311).

Motivated by an accumulating amount of empirical evidence suggesting that mental representations are rooted in brain systems involved in perception (e.g., vision, audition), action (e.g., movement, proprioception), and introspection (e.g., mental states, affect), numerous arguments have been put forth challenging the traditional or amodal view of language comprehension (e.g., Barsalou, 1999, 2008; Gibbs, 2006; Glenberg & Robertson, 2000; Zwaan, 1999b, 2004). For example, Zwaan (1999b) has pointed out that the sheer number of propositions needed to mentally represent the essential characteristics of a narrative situation (e.g., character's perspective, spatial layout of story) would overwhelm adults' working memory and attention systems. Meanwhile, Barsalou (2008) had argued that amodal symbols were adopted as an explanation of many cognitive processes, not because of compelling empirical evidence, but "because they provided an elegant and powerful formalisms for representing knowledge, because they captured important intuitions about the symbolic character of cognition, and because they could be implemented in artificial intelligence" (p. 620).

## Review of Empirical Evidence Supporting an Embodied Approach to Language Comprehension

As mentioned earlier, a growing number of studies have challenged the traditional view of language comprehension. The general finding of these studies is that readers appear to mentally simulate the perceptual, motor, and affective content of narratives (e.g., Barsalou, 2008; Brunyé, et al., 2009; Fischer & Zwaan, 2008; Glenberg, 2007; Havas, Glenberg, & Rinck, 2007; Speer, Reynolds, Swallow, & Zacks, 2009; Zwaan, 2004). Research has also indicated that simulations are involved in all levels of language comprehension including word, sentence, and narrative comprehension (for review see Zwaan, 2004). The following section reviews three main avenues of research supporting this conclusion.

First, comprehenders' eye and hand movements have been found to be consistent with perceiving or acting in the described situation (e.g., Glenberg & Kaschak, 2002; Spivey, Richardson, Tyler, & Young, 2000). Klatzky, Pellegrino, McCloskey, and Doherty (1989) found that the comprehension of verbally described actions is facilitated when participants are allowed to first form their hand into a shape appropriate for the action (e.g., fingers pinched together when reading about throwing a dart). In another study, adult participants were observed to direct their gaze to where they would look if they were actually examining the described scene (Spivey &

Geng, 2001). While looking at a blank screen, participants listened to stories about spatial scenes. When the story described an object or activity on a lower floor of the building, participants' eye movements lingered on the lower portion of the screen. As the actions of the story "moved" up in the building, so did the participants eye movement on the blank screen.

Second, word and sentence comprehension has been found to activate motor regions of the brain associated with the actions referred to by the word (e.g., Pulvermüller, 2001, 2005). For example, Tettamanit et al. (2005), found that simply reading an action sentence (e.g., the boy kicked the ball) activated brain region associated with the actual actions (e.g., premotor areas involved in the kicking of a ball). Hauk, Johnsrude, and Pulvermüller (2004) found similar results at the word comprehension level. In both studies, areas of activation in the premotor cortex were somatotopically organized. Sentences about hand actions activated brain areas associated with hand actions, whereas, sentences about mouth actions activated brain areas associated with mouth actions, and sentences about leg actions activated brain areas associated with leg actions. Research indicates that these activations are not simply the by-product of comprehension but rather an instrumental component of comprehension (Pulvermüller, Hauk, Nikolin, & Ilmoniemi, 2005). Similar results have been observed in a study using transcranial magnetic stimulation (TMS), where it was found that participants made faster lexical decisions in response to words denoting arm or leg actions when arm or leg areas in the left hemisphere received TMS (Pulvermüller, et al., 2005). TMS of arm area were also found to lead to faster responses to arm words and TMS of leg areas to faster responses to leg words.

Third, word and sentence comprehension has been found to involve the activation of visual representations of object shape and orientation. For example, readers routinely exhibit faster recognition and naming times when presented with pictures that match the implied perceptual orientation and shape of objects than when they mismatch (Zwaan, 2004; Stanfield & Zwaan, 2001; Zwaan et al., 2002). For example, Stanfield and Zwaan (2001) presented adult readers with sentences that implied a particular orientation of an object (e.g., “John put the pencil in the drawer”) followed by a picture of the object (e.g., picture of pencil). Participants were asked to verify that a pencil had been mentioned in the previous sentence. Verification times were faster when the pencil in the picture matched the orientation implied in the sentence (e.g., horizontal) than when it did not match (e.g., vertical). These types of findings suggest that adult readers construct sensorimotor simulations of the situations describe in the sentences. Other studies indicate that tasks that engage visuospatial processes disrupt the creation of coherent situation models, in comparison to tasks that engaged verbal memory (Fincher-Keifer, 2001; Fincher-Kiefer & D’Agostino, 2004). These findings suggest that the construction of situation models involves the simulation of the described situation.

## Embodied Theories of Language Comprehension

Empirical evidence challenging a traditional conceptualization of language comprehension has inspired several recent theories of embodied language comprehension including Glenberg and Robertson’s (1999) *Indexical Hypothesis* and Zwaan’s (2004) *Immersed Experiencer Framework*. However, it must be noted that embodied theories of language comprehension and cognition are not entirely new; as Barsalou (2008) points out, “nearly all prescientific views of the human mind going to back to ancient philosophers (e.g., Epicurus 341–270 B.C.E./1987) assumed that modal representations and imagery represent knowledge (Barsalou 1999, J. Prinz 2002), analogous to current simulation views" (p. 619). What is new, however, is the compelling amount of empirical evidence supporting an embodied account of cognition and language comprehension.

Generally, embodied theories of language comprehension "argue that language comprehension requires activation of our experiences with the world" (Louwerse & Jeuniaux, 2008, p. 309). Unlike traditional approaches to language comprehension, embodied approaches focus on the critical role mental simulations of textual information play in the representation of meaning (Barsalou, 2008). An embodied approach views language as a "sequence of stimuli that orchestrate the retrieval of experiential traces of people, places, objects, events, and actions" (Zwaan & Kaschak, 2009, p. 368). Experiential traces are created as one interacts with the world (e.g., drinks coffee). During these interactions, the brain captures states across the modalities (e.g., taste, smell), which are then integrated into a multimodal representation stored in memory. Multimodal representations can be reactivated at a later time (e.g., during thinking or reading about coffee) to create a simulation. In this way, simulations are "the re-enactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind" (Barsalou, 2008, p. 618).

Barsalou's (1999) Perceptual Symbols Systems Theory assumes that cognition and language comprehension are based on the activation and manipulation of perceptual symbols which are created during personal experiences. During an activity (e.g., drinking coffee), the brain records sensorimotor aspects of the experience. These combinations of the relevant neural states induced by the activity include multimodal information such as vision, hearing, touch, smell, taste, as well as proprioceptive, and kinaesthetic information. Only some aspects of the activity are recorded, suggesting that perceptual symbols are not simply recordings of an activity. Later perceptual symbols are collected into a frame, forming the basis of simulations, which afford representation and motor control. Essentially, according to the Perceptual Symbols Systems Theory, frames and simulations are abstractions that account for how experience becomes a memory and how related structures support inferences, categories, and concepts.

The Indexical Hypothesis (IH) centers on sentence comprehension. And like other embodied theories, IH proposes that an amodal account of language comprehension inadequately explains language comprehension. Instead, the IH focuses on the role of simulation and "asserts that the AAA symbols of language (i.e., words), become meaningful by simulating the content of sentences" (Glenberg, Gutierrez, Levin, Japuntich, & Kaschak, 2004, p. 425). Three processes are involved in the simulation of sentences: indexing, affordances, and meshing. First, words and phrases are mapped or indexed to objects in the environment or to perceptual symbols (Barsalou, 1999). This establishes the content of the language (e.g., what is being talked about). Second, affordances, or the ways in which one interacts with their environment, are derived from the objects (Gibson, 1979). Third, affordances are meshed to produce a coherent simulation. The syntax of a sentence provides instructions on how to mesh affordances by providing cues as to the general scene of the events being described into what amounts to a mental simulation (Kaschak & Glenberg, 2000).

Zwaan's (2004) Immersed Experiencer Framework (IEF) also highlights the role that simulation plays in comprehension. The IEF couples the idea that readers track multiple aspects of a narrative with the Perceptual Symbol Systems Theory (Barsalou, 1999). The main premise of IEF is that the comprehender is an immersed experiencer of the described situation and language is "a set of cues to the comprehender to construct an experiential (perception plus action) simulation of the described situation" and comprehension is "the vicarious experience of the described situation" (Zwaan, 2004, p.36). To further illustrate what is meant by "immersed experiencer", consider the following sentences (Zwaan, 2004, p. 36):

(1a) *The ranger saw the eagle in the sky.*

(1b) *The ranger saw the eagle in the nest.*

Although similar, the sentences convey very different images of an eagle. In sentence (1a) the eagle's wings are outstretched as it flies through the sky. In sentence (1b) the eagle's wings might be folded as it sits in its nest. In an amodal propositional representation (e.g., Kintsch & van Dijk, 1978) these sentences would appear as follows.

(2a) [[SAW[RANGER, EAGLE]], [IN[EAGLE, SKY]]]

(2b) [[SAW[RANGER, EAGLE]], [IN[EAGLE, NEST]]]

An amodal propositional approach does not account for the shape of the eagle, while the Immersed Experiencer Framework (IEF) proposes that words activate experiences with their referents. According to the IEF, sentence 1a should activate visual experiences of an eagle with outstretched wings in the sky. Zwaan et al. (2002) found that this was indeed the case. Readers were faster to identify a picture of an object as being mentioned in a sentence if the shape of the object matched the shape implied in the sentences. By highlighting the modal nature of situation model, embodied theories of language comprehension have had a profound impact on the study of narrative comprehension and have begun to offer a compelling account of how it is that readers share the perspective of a narrative place, person, and time.

## Simulation of Motion: Combining the Notion of Space, Time, and Embodied Language Comprehension

As already mentioned, research indicates that readers simulate the perceptual and motor information described in text (e.g., Barsalou, 2008; Brunyé et al., 2009; Fincher-Kiefer, 2001; Fischer & Zwaan, 2008; Glenberg & Kaschak, 2002; Lozano, Hard, & Tversky, 2008; Matlock, 2004; Pecher & Zwaan, 2005; Speer et al., 2009; Stanfield & Zwaan, 2001; Zwaan, 2004; Zwaan & Madden, 2005; Zwaan, et al., 2002). Recently, Zwaan and Madden (2005) have argued that simulations that occur during language comprehension necessarily include a spatio-temporal perspective of the described situation. As mentioned earlier, findings suggest that, while reading, readers focus their attention on characters' movements and that their situation models include spatial and temporal aspects of a narrative (e.g., Bower & Morrow, 1990; Morrow et al., 1989; Zwaan, 1999b). Recent findings also suggest that during comprehension readers are able to imagine scenes and simulate the motion described in a narrative (e.g., Matlock, 2004; Speer et al., 2009). For example, in one study, Zwaan, Madden, Yaxley, and Aveyard (2004) asked participants to listen to sentences describing the motion of an object (e.g., softball) and then judged whether two sequentially visually presented objects were the same (e.g., 2 pictures of softballs). On critical trials, subjects heard a sentence describing the ball as moving toward or away from the observer (e.g., “The pitcher hurled the softball to you”). Critically, the first picture of the ball was either slightly larger or smaller than the first picture, thus suggesting movement of the ball toward or away from the observer. Subjects were found to respond more quickly when the implied movement of the ball matched the movement described in the sentence. The results of other studies suggest that adult readers also infer distance (e.g., Black et al., 1979; Glenberg et al., 1987; Zwaan

& Radvansky, 1998), as well as object size and rate of travel (Morrow & Clark, 1988). These types of findings further demonstrate that language comprehension involves a dynamic and perceptual simulation of motion.

Additional evidence for a linguistically driven simulation of motion has also been observed in studies exploring an interesting type of implicit motion. Fictive motion is a type of figurative language that is pervasive across languages, and is typically used to describe physical space (Matlock, 2004).

(1a) *The road runs along the coast.*

(1b) *The trail goes from El Portal to Yosemite.*

Although both of these fictive motions sentences feature a motion verb (e.g., *run*, *go*), both sentences describe a stationary situation. Unlike the literal uses of motion verbs in sentences such as, "*John walks along the coast"* or the metaphorical, "*The meeting runs past midnight"*, fictive motion sentences communicate no change of state (Matlock, 2004). Many linguistic observations lend support to the idea that fictive motion involves simulation of motion or visual scanning. For example, in one study, readers took longer to read the sentence "Road 49 crosses the desert" when they were told earlier that the desert was 400 miles in diameter than when they were told the desert was only 30 miles in diameter (Matlock, 2004).

## Overall Summary

Research suggests that adults and even children as young as 3 and 4 years of age build rich detailed mental representations of a narrative and that in doing so vicariously experience that which they read.  These findings provide support for the notion that readers and listeners "leap into narrative worlds" while reading (Zwaan, 1999a), and explain how it is that "without leaving your chair you stroll through imagined landscapes as if they were real, and your thoughts interweave with the story…" (Flaubert, 1857).

## Present Investigation

The aim of the present investigation is to determine whether young children, like adults, also simulate narrative events and specifically *whether children simulate the speed of a narrative character's movements during story comprehension*? The studies in the present investigation are the first to directly explore this fascinating aspect of narrative cognition and mental simulation.

Important questions about the developmental aspects of the ability to simulate narrative events have yet to be explored. For example, it is not yet clear whether the ability to simulate narrative events is an early emerging ability, potentially evident in children before they learn to read. In this case, might this ability be evident as children listen to oral stories? Indeed, little is known about the narrative precursors of reading comprehension, and particularly children's comprehension of oral stories. It has been argued that studies of the antecedents of reading comprehension are very much needed if we are to gain a fuller understanding of how literacy and narrative comprehension skills develop (Lynch et al., 2008). More specifically, Skarakis-Doyle and Dempsey (2008) have argued that an exploration of preschool-aged children's mental representations of stories is merited, given that, "many of the foundational abilities that contribute to children's comprehension of stories emerge in their oral language comprehension in advance of their learning to read" (p. 131). Thus, while an investigation of young children's ability to simulate narrative events is warranted in its own right, exploring this particular aspect of young children's narrative comprehension will address a hitherto relatively unexplored aspect of narrative competence of potential importance to both narrative development and precursors to literacy.

A comprehensive model of narrative comprehension in children does not yet exist, but several aspects of young children's narrative comprehension have been quite extensively explored, including story structure understanding, inference making and comprehension monitoring (for reviews see Perfetti et al., 2005; Lynch et al., 2008). The study of young children's situation models is a more recent area of study, with only three studies to date exploring this aspect of children's narrative comprehension (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler et al., 2005). Some evidence from studies conducted with school-aged children who are poor readers has led to the suggestion that their comprehension difficulties may stem from problems building adequate situation models (Glenberg et al., 2004; Nation, 2007). Children's comprehension ability has also been studied from the vantage point of literacy development, with many studies concentrating on identifying critical components of reading ability and their developmental emergence (e.g., decoding, phonological processing, inference making). The ability to simulate narrative events has not been a focus of such studies.

The three studies to date exploring young children's situation models (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler et al., 2005) have demonstrated that preschoolers' situation models of stories contain information about a character's location and mental goals and that preschoolers adopt the spatial (Rall & Harris, 2000; Ziegler et al., 2005) and mental perspective of the main character (O'Neill & Shultis, 2007) by about 4 years of age. Although the work of Rall and Harris' (2000), Ziegler et al. (2005), and to some extent O'Neill and Shultis (2007), has demonstrated that preschoolers do indeed track a character's spatial perspective, none of these studies explored the more *dynamic* temporal component of a character's movements. Indeed, as stories are essentially series of events happening in space and time (Tversky, 2004; Wilson, 2003) and considering that it has been argued with respect to linguistic input that, "…a simulation should share certain 'physical' characteristics with its real world counterpart" (Stanfield & Zwaan, 2001, p. 153; Barsalou, 1999), it is important to consider whether children track and simulate the *spatial-temporal* aspects of narratives – for example, the duration of actions performed by a character.

Three new studies were designed to explore the spatial-temporal aspects of young children's situation models of narratives by investigating whether and how children's expectations about the duration of certain activities (e.g., walking vs. driving) influences their simulation of narrative action. Research suggests that adult readers' expectations exert influence over a variety of narrative comprehension processes including simulations (e.g., Anderson et al., 1983; Rapp, Klug, & Taylor, 2006; Rapp & Taylor, 2004; Zwaan, 1994). For example, Rapp et al. (2006) explored the influence of readers' expectations on the well established finding that readers track a character's movements and take longer to identify objects that are located further from a character's current location than objects that are located near the character (Morrow et al., 1987; Morrow et al., 1989;). Rapp et al. (2006) found that when the events of a story did not clearly specify how a character moved from one location to another, and several alternative paths were available, readers no longer appeared to process text in a manner consistent with this spatial distance effect. The authors argue that expectations, which are often based on personal experiences, enable readers to anticipate how a narrative will unfold. And, in this case, the alternative paths made prediction of a character's path impossible, thus leading to the elimination of the spatial distance effect. Such findings highlight the importance of taking into consideration readers' expectations when investigating narrative comprehension and simulations of narrative events.

Because previous studies suggest that the ability to create detailed mental representations of narratives begins to emerge in preschoolers (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler et al., 2005), the following three studies of children's ability to simulate a character's movement focused on 3- to 5-year-olds. Study 1 explored whether young children's expectations about the duration of particular physical activities (i.e., walking vs. driving) would influence their simulations of the speed of a character's movements. Study 2 explored whether children's expectations about the influence of certain motivating psychological factors (i.e., eagerness to get to a particular location) might also influence children's simulations of the speed of a character's actions. Study 3 explored the combined effect of children's expectations about the duration of particular physical activities, specifically walking and driving, with the motivating effect of eagerness.

# Chapter 2: Study 1

## Introduction

Study 1 explored whether young children's expectations about the duration of particular physical activities (i.e., walking vs. driving) would influence their simulations of the speed of a character's movements. To answer this question, the speed of a character's movement from one location to another was manipulated in a story describing a character engaging in two ordinary motor activities familiar to young children: namely, walking and driving. It was reasoned that if children's simulations of a character's movements are constrained by their expectations and personal experiences of the duration of these two activities, then a character that is walking should have more time to view scenes along the way than a character that is driving. And, in keeping with previously observed reading-time methodologies used to study narrative comprehension in adults (Matlock, 2004), a corresponding prediction would be that readers (or listeners) would demonstrate longer reading times (or processing times) to process the events observed by a character described as walking as opposed to driving.

To test this prediction in young children, a self-paced reading task typically used to investigate narrative comprehension processes in adults was modified for use with preliterate children (e.g., Zwaan & Singer, 2003). In the adult version of the task, readers read a sentence displayed on a computer screen and press a computer key to be presented with the next sentence in the text, thus providing researchers with an estimate of the amount of time readers take to process each sentence. Because most 3- and 4-year-olds cannot read, the children in the present study listened to a pre-recorded story presented via computer speakers. The story was presented one sentence at a time and the children pressed a computer mouse button to hear each new sentence of the story, yielding a measure the amount of time each child took to listen to each sentence of the story (*processing time or PT*). No other study has utilized this type of methodology to investigate young children's story comprehension processes.

The story described a small child, Jamie, visiting an elderly relative, aunt Alice (see Appendix A). In one part of the story, Jamie was described as *walking* to aunt Alice's house, and in another part of the story as being *driven* to aunt Alice's house (i.e., Jamie's mother said, "You know what Jamie? This time, let's walk/drive to aunt Alice's."). Along the way to aunt Alice's house, Jamie was described as viewing a series of four different events (e.g., dogs in a park, some children playing baseball). Children heard a different, but similar, set of four events for each of the two manipulations of the character's movement (drive/walk). It was predicted that, if preschoolers simulate a character's movement while listening to a story, then they should proceed through the description of the four events Jamie sees along the way to aunt Alice's house more quickly (i.e., faster PT) when Jamie is being driven past them as opposed to walking past them. That is, it was reasoned that if children's simulations of a character's movements and experiences are influenced by their expectations of the duration of these movements - for example, it takes less time to reach a particular location when one is riding in a car as opposed to walking – then these expectations should be reflected in a predictable manner in the relative duration of children's processing times (PT).

# Method

## Participants

The participants were 48 native speakers of English with no reported history of speech or hearing difficulties: 24 younger preschoolers (12 boys and 12 girls, mean age = 47 months, range = 40 to 53), 24 older preschoolers (12 boys and 12 girls, mean age = 59 months, range = 55 to 65) drawn from a university child laboratory database. An additional 7 children were tested but excluded from the dataset because of fussiness (n =3) or unwillingness to listen to the story (n = 4).

## Procedure and Materials

Children were seated at a small table beside an experimenter. Two different tasks were administered to each child. Each child first received the story listening task, followed by four subtests of a standardized measure of language development (*Clinical Evaluation of Language Fundamentals – Preschool*, Second Edition (CELF-P2); Wiig, Secord, & Semel, 2004).

### Story listening task

The main focus of the study was children's performance on the story listening task. Each child listened to 2 pre-recorded stories (1 practice and 1 experimental story) presented via computer speakers. The stories were recorded one sentence at a time using Audacity recording software (2007) by an adult female research assistant not otherwise affiliated with the study. Children heard one sentence of the story at a time and pressed a mouse button to hear the next sentence of the story. The time from the end of each sentence to the child's next button press (i.e., processing time or PTs) was measured and logged by a Vault PC Series computer. Both story presentation and processing time data collection were controlled by E-prime software (Schneider, 1998).

At the start of each session, a drawing depicting Jamie, a friendly looking preschool child (a boy for male participants and a girl for female participants), was placed in front of the children. Children were introduced to the story listening procedure by listening to a 15-sentence practice story. Children were encouraged to listen carefully to the story by being told that they would later be asked four questions about the story and would receive a sticker for every correct answer.

The experimental story described Jamie visiting aunt Alice's house and contained two manipulations of the character's movement. The story consisted of seven components (Appendix A). Component 1 introduced the setting of the story. The first manipulation of the character's movement occurred in Component 2. Children heard Jamie's mom say "You know what Jamie? This time, let's walk/drive to aunt Alice's". In Component 3, immediately following this movement manipulation, children heard a 4-sentence long description of the scenery Jamie saw along the way to the aunt's house (e.g., kids playing baseball, birds flying around someone's yard). Component 4 described Jamie's adventures at aunt Alice's house, return home, as well as the reason for returning to aunt Alice's house (i.e., forgotten cell phone). Component 5 contained a reverse manipulation of the character's movement to aunt Alice's house. In Component 6, children heard a 4-sentence long description of the scenery Jamie saw along the way back to aunt Alice's house similar to that of Component 3. Component 7 concluded the story. To assess children's ability to simulate a character's movements, children's PTs , collected during the descriptions of the scenery Jamie saw along the way to aunt Alice's house (i.e., Component 3 and 6), in the walk condition were compared to the corresponding set of PTs in the drive condition. Each child heard the story once. The presentation order of components 2 and 5 (movement manipulation) and 3 and 6 (descriptions of scenery) were fully counterbalanced across children. Following the story, children were asked four story comprehension questions: Who did Jamie visit?/What did Jamie do at aunt Alice's?/How did Jamie get there the first/second time? Children received one point for every correct answer.

### Language measures

Because children's linguistic abilities have been linked to story comprehension in young children (e.g., Cain, Oakhill, & Bryant, 2004; Cain & Oakhill, 2007), a standardized measure of language development was administered: CELF-P2 (Wiig et al., 2004). Children were administered the three core language subtests (Sentence Structure, Word Structure, and Expressive Vocabulary) of the CELF-P2 as well as the Recalling Sentences in Context (RSC) supplementary subtest which evaluates a child's ability to repeat sentences presented in the context of a story without changing the wording of the sentence. The CELF-P2 was selected because it can be administered fairly quickly to young children and is commonly used to provide a broad overview of children's general language ability.

## Results and Discussion

Thirty-six out of 46 children[1] answered at least three of the four story comprehension questions correctly, suggesting that overall the children had complied with instructions and listened carefully to the story[2]. The data analysis focused on a comparison of the mean of the four PTs collected, for each child, during the 4-sentence description of the scenery Jamie saw along the way to aunt Alice's house in the *walk* portion of the story with the mean of the four PTs collected during the 4-sentence description of scenery in the *drive* portion of the story (i.e., Story components 3 and 6; 8 PTs in total). As is standard procedure in studies utilizing reading time methodology, an outlier analysis was performed on children's processing times. A conservative approach was adopted and any PTs that were four standard deviations from each participant's condition mean were removed, resulting in the exclusion of 2.2% of the total data. Participants' mean PTs were then submitted to a Speed of Movement (walk vs. drive) x Age (younger vs. older preschoolers) x Sex (girl vs. boy) x Story Order (walk /drive vs. drive/walk) repeated measures mixed model ANOVA with age, sex, and story order as the between-subjects variables and Speed of Movement as the within-subjects factor. The analysis revealed no significant main effects of age, $F(1, 40) = 2.3$, $MSE = 606454$, $p = .14$, $\eta^2 = .06$, sex, $F(1, 40) = .43$, $MSE = 606454$, $p = .52$, $\eta^2 = .01$, or story order, $F(1, 40) = .48$, $MSE = 606454$, $p = .5$, $\eta^2 = .01$; and none of these variables interacted with Speed of Movement, all *p*s > .1.

The ANOVA revealed a main effect of Speed of Movement condition, $F(1, 40) = 9.7$, $MSE = 173075$, $p = .003$, $\eta^2 = .2$. As predicted, children's mean PTs were significantly faster when Jamie was driven ($M = 796$ ms, SE= 61 ms) versus when Jamie walked to aunt Alice's house ($M = 1064$ ms, SE = 111 ms), resulting in a mean difference of 268 ms between conditions. Children's mean PTs were faster on all 4 scenery sentences (i.e., Story Components 3 and 6) in the drive condition than in the walk condition. Table 2, on page 47, provides the results of more detailed sentence by sentence paired-samples t-test analyses of the speed of movement effect.

Moreover, this speed of movement effect was highly specific and confined only to the sentences in Components 3 and 6 pertaining to the description of the scenery the character Jamie observed along the way to aunt Alice's house. That is, it was not observed for the movement manipulation sentence that immediately preceded the scenery description, even though the movement word 'walk' or 'drive' was explicitly stated (i.e., "You know what Jamie? This time, let's *walk/drive* to aunt Alice's"; Components 2 and 5), $t(47) = .17$, $p = .87$, $M_{\text{Walk}} = 1373$ ms, $M_{\text{Drive}} = 1402$ ms. It was also not observed for each of the two sentences immediately following each of the two key scenery description components (i.e., Sentence 11 or 30, $t(47) = .88$, $p = .39$, $M_{\text{Walk}}$ (i.e., following walk condition scenery sentences) = 1070 ms, $M_{\text{Drive}}$ (i.e., following drive condition scenery sentences) = 1209 ms; or Sentence 12 or 31, $t(47) = .58$, $p = .56$, $M_{\text{Walk}}$ Condition = 1292 ms, $M_{\text{Drive}}$ = 1144 ms. In addition, no significant effect of speed of movement was found for the full remaining portions of the story (i.e., Components 4 and 7), $t(47) = 1.4$, $p = .18$, $M_{\text{Walk}}$ = 1265 ms, $M_{\text{Drive}}$ = 1380 ms. That is the speed of movement effect was confined only to the focal Components 3 and 6.

**Table 2**

Children's PTs in Study 1, collected during the four scenery sentences [a] presented to children in the Walk and Drive conditions (N= 48).

| | Processing Times (ms) | | | |
|---|---|---|---|---|
| | Condition | | | |
| Scenery Sentences | Walk | Drive | Difference (SE) | *p*-value |
| 1 | 1083 | 911 | 172 (126) | .18 |
| 2 | 1274 | 1001 | 273 (124) | .03 |
| 3 | 975 | 543 | 432 (170) | .01 |
| 4 | 922 | 727 | 195 (102) | .06 |

a. See Appendix A, Example of Study 1 Story, Components 3 & 6 (Sentences 7-10 and 26-29).

With respect to the children's CELF-P2 scores, correlation analyses did not reveal a significant relation between children's performance on the story listening task (as assessed by processing time difference scores between the walk and drive condition) and children's performance on any of the CELF-P2 subtests (all *p*s > .1).

In interpreting the results of this study, the reader is reminded that the scenery description sentences were counterbalanced across the walk/drive condition and across participants, thus any differences with regard to the content of the scenery descriptions or presentation order cannot account for the results. Overall, these findings support the hypothesis that children simulate a character's movement during story comprehension and that these simulations are influenced by their knowledge and expectations of the duration of certain motor activities, such as walking and driving.

# Chapter 3: Study 2

Study 2 was designed to further explore the manner in which children's expectations and general world knowledge influence their simulations of the duration of a character's movements. Older preschoolers' sophisticated understanding of other people's mental states is well documented (e.g., Perner, 1991; Wellman, 2002) and previous studies have revealed that 4-year-olds track and adopt a character's mental goal perspective (O'Neill & Shultis, 2007). Study 2 explored the impact of a far more sophisticated type of expectation on children's simulations of the speed of a character's movements, namely, the *motivating influence of certain psychological states such as eagerness* was explored.

To illustrate what is meant by eagerness, consider the following passage from *The Secret Garden* (Hodgson Burnett, 1909/1993). The main character, Mary, has just introduced Dickon to the secret garden and Dickon has discovered that, despite appearances, some of the plants in the garden may still be alive:

> "…this here's a new bit", and he touched a shoot that looked greenish-brown instead of hard, dry grey. Mary touched it herself in an eager, reverent way. "That one?" she said "is that one quite alive – quite?" Dickon curved his wide smiling mouth. "It's as wick as you or me," he said; and Mary remembered that Martha had told her that "wick" meant "alive" or "lively." "I'm glad it's wick!" she cried out in her whisper. "I want them all to be wick. Let us go around the garden and count how many wick ones there are." She quite panted with eagerness, and Dickon was as eager as she was. They went from tree to tree and from bush to bush. Dickon carried his knife in his hands and showed her things she thought wonderful. (p. 106)

The above passage does not explicitly state how quickly Mary and Dickon moved about the garden, however, the use of the words "eager" and "eagerness" may easily lead an experienced reader to imagine Mary and Dickon moving fairly quickly from plant to plant inspecting each for signs of life. But how would a more inexperienced story listener, such as preschooler, comprehend a similar passage? Would young children's simulations of the character's movements reflect a character's eagerness?

To answer these questions, two new stories describing Jamie getting ready for an activity (e.g., going to the dentist or the ice cream store) were created. Jamie's eagerness was manipulated by including a sentence in each story describing Jamie as thinking that an activity she was getting ready for was either "really great" (i.e., *eager* condition) or "really horrible" (i.e., *not eager* condition). Just as in the excerpt presented above, it was hypothesized that a state of eagerness should result in a character moving more quickly (e.g., getting ready faster) than a state of non-eagerness, resulting in a character moving more slowly. Thus, the prediction with regard to processing times was that children's PTs should be faster when the character is progressing through the "getting ready" actions while thinking the activity he/she is getting ready for is "really great" as opposed to "really horrible."

## Method

### Participants

The participants were 48 native speakers of English with no reported history of speech or hearing difficulties: 24 4-year-olds (12 boys and 12 girls, mean age = 52 months, range = 47 to 59), 24 5-year-olds (12 boys and 12 girls, mean age = 66 months, range = 61 to 71) drawn from a university child laboratory database. An additional 7 children were tested but excluded from the dataset because of fussiness or unwillingness to listen to both of the stories.

## Procedure and Materials

Children were seated at a small table beside the experimenter. All children were administered the story listening task, followed by the CELF-P2's (Wiig et al., 2004) three core language subtests (Sentence Structure, Word Structure, and Expressive Vocabulary) as well as the Recalling Sentences in Context (RSC) supplementary subtest. In addition, parents were asked to describe and rate their child's feelings about going to the ice cream store/dentist using a 5-point scale (i.e., 1 = child REALLY does not like going and 5 = child REALLY likes going to ice cream store/dentist). Children were asked to simply indicate, by replying yes or no, whether they liked going to either location. This information was important in demonstrating that, even if the child's perspective differed from the character's perspective, children's simulation would reflect the character's perspective rather than their own.

### Story-listening task

The story-listening task used in this study was essentially the same as the one used in Study 1. However, unlike Study 1, children in Study 2 listened to *two* different stories. Each story described the activities of a young child, Jamie, as she/he got ready to, and eventually engaged in, an activity (i.e., going to the ice cream store/dentist). Just as in Study 1, prior to the presentation of the stories, children were shown a laminated 11 x 8 inch drawing depicting Jamie, a friendly looking preschool boy for the boys and girl for the girls. The picture remained on the desk throughout the story listening task.

Each story consisted of four components (see Appendix B for an example story). Following the story introduction (Component 1), the character's eagerness was manipulated (Component 2). In the *eager* condition, children heard that "Jamie thought that going to the ice cream store/dentist was really great". In the *not eager* condition, children heard that "Jamie thought that going to the ice cream store/dentist was really horrible." Immediately following the eagerness manipulation, children heard a 6-sentence long description of Jamie's preparatory activities (i.e., changing clothes or cleaning up; Component 3). After the preparatory activities, children heard about Jamie's adventures at the ice cream store/dentist (Component 4). To assess children's ability to simulate the duration of a character's movement, children's PTs collected during Jamie's preparatory activities (i.e., Component 3) in the eager condition were compared to the corresponding set of PTs from the not eager condition.

The activity (i.e., going to the ice cream store/dentist), the character's eagerness (i.e. eager/not eager), the two preparatory activities (i.e., changing clothes/cleaning up), and the presentation order of the stories (i.e., dentist story first/dentist second) were counterbalanced across children. Each child listened to one story about Jamie going to the ice cream store and one story about Jamie going to the dentist, each with a different eagerness manipulation and set of preparatory activities.

As in Study 1, to ensure that children were actively listening to the stories, the experimenter told the children that at the end of each story they would be asked some questions about the story and would receive a sticker for every correct answer. In an effort not to draw children's attention to the character's eagerness, children were not questioned about the character's thoughts about each activity. The three questions asked at the end of the *ice cream* story included: Where did Jamie go in that story?; What did Jamie eat when he/she got there? What kind of toppings did Jamie get on his/her ice cream? The three question asked at the end of the *dentist* story included: Where did Jamie go in that story?; Why did Jamie go to the dentist?;  What happened to Jamie's tooth? Children scored one point for every correct answer.

## Results and Discussion

Forty-four of 46 children answered at least five of the six questions correctly, suggesting that overall the children had complied with instructions and listened carefully to the story. The data analysis focused on a comparison of the six PTs for each child during each of the character's preparatory activity sentences (Story Component 3) in both the eager condition and the not eager condition. Processing times that were four standard deviations from each participant's condition mean were considered outliers and eliminated from further analyses, resulting in the exclusion of 4% of the total data.

Participants' mean PTs were then submitted to a Eagerness (eager vs. not eager) x Age (4- vs. 5-year olds) x Sex (male vs. female) x Story Order (eager/not eager vs. not eager/eager) x Story Version (eager to go to dentist/not eager to go to ice cream store vs. eager to go to ice cream store/not eager to go to dentist) repeated measures mixed model ANOVA with age, sex, story order, and story version as the between-subjects variables and Eagerness as the within-subjects variable.  The ANOVA did not reveal a main effect of age, $F(1, 32) = .7$, $MSE = 234363$, $p = .41$, $\eta^2 = .02$, sex, $F(1, 32) = .001$, $MSE = 234363$, $p = .98$, $\eta^2 = .00$, story order, $F(1, 32) = 2.1$, $MSE = 234363$, $p = .16$, $\eta^2 = .06$, or story version, $F(1, 32) = 1$, $MSE = 234363$, $p = .32$, $\eta^2 = .03$; and none of these variables interacted with Eagerness, all $p$s > .15.

The ANOVA revealed a main effect of eagerness, $F(1, 32) = 23.4$, $MSE = 69318$, $p < .001$, $\eta^2 = .42$. Children's PTs were significantly faster when the character was described as thinking that the activity was "really great" (i.e., eager condition; $M = 676$ ms, $SE = 49$ ms), than when the character was described as thinking that the activity was "really horrible" (i.e., not eager condition; $M = 941$ ms, $SE = 58$ ms), resulting in a mean difference of 265 ms between conditions. Children's mean PTs were faster on all six sentences of Component 3 in the eager condition than in the not eager condition. Table 3 provides the results of more detailed sentence by sentence paired-samples t-test analyses of the eagerness effect.

**Table 3**

Children's PTs in Study 2, collected during the six preparatory sentences [a.] presented to children in the Not Eager and Eager conditions (N= 48).

| | Processing Times (ms) | | | |
|---|---|---|---|---|
| | Condition | | | |
| Preparatory Sentences | Not Eager | Eager | Difference (SE) | p-value |
| 1 | 1427 | 933 | 494 (108) | $p < .001$ |
| 2 | 832 | 557 | 275 (83) | $p = .002$ |
| 3 | 678 | 530 | 148 (76) | $p = .06$ |
| 4 | 852 | 640 | 212 (115) | $p = .07$ |
| 5 | 850 | 678 | 172 (86) | $p = .05$ |
| 6 | 1008 | 717 | 292 (111) | $p = .01$ |

a. See Appendix B, Example of Study 2 Story, Components 3 (Sentences 6-11).

Moreover, the main effect of eagerness was highly specific and confined only to the sentences pertaining to the character's preparatory activities (Component 3). That is, it was not observed for the eagerness manipulation sentence that immediately preceded the preparatory activities, even though the word 'horrible' or 'great' was explicitly stated (i.e., "Jamie thought that going to the ice cream store was really great/horrible"), $t(47) = 1.6$, $p = .15$, $M_{\text{Eager}} = 897$ ms, $M_{\text{Not Eager}} = 1030$ ms. It was also not observed for each of the two sentences immediately following the preparatory activity sentences (Sentence 12: $t(47) = 1.1$, $p = .27$ ($M_{\text{Eager}} = 758$ ms, $M_{\text{Not Eager}} = 889$ ms); Sentence 13, $t(47) = .05$, $p = .96$ ($M_{\text{Eager}} = 872$ ms, $M_{\text{Not Eager}} = 866$ ms). Nor was it observed for Component 1, $t(47) = .56$, $p = .58$ ($M_{\text{Eager}}$ Condition = 1132 ms, $M_{\text{Not Eager}} = 1190$ ms) or Component 4, $t(47) = .18$, $p = .86$ ($M_{\text{Eager}} = 1055$ ms, $M_{\text{Not Eager}} = 1067$ ms).

With respect to the children's CELF-P2 scores, correlation analyses revealed a significant relation between children's performance on the story listening task (as assessed by processing time difference scores between the eager and not eager condition) and children's performance on the CELF-P2 Recalling Sentences in Context (RSC) supplementary subtest, $r(47) = .37$, $p < .015$. None of the other CELF's language subtest scores (sentence structure, word structure, and expressive vocabulary subtest scores) correlated significantly with children's performance on the story listening task (all *p*s > .25). The nature of the relation between children's RSC scores and their performance on the story listening task is not yet clear and warrants further study.

The results of the parent and child questionnaire do not suggest children's own feelings about the two activities (i.e., going to ice cream store/dentist) influenced their ability to simulate the character's actions. Overall, parents rated their children's feelings about the dentist as positive (mean = 3.8 out of 5), and their feelings about the ice cream stores as significantly more positive (mean= 4.8 out of 5), $t(45) = .6.9$, $p < .001$  All of the children said that they liked going to the ice cream store. All but nine of the 48 children also said that they liked going to the dentist. Thus, in almost all cases when the character was described as thinking the activity was "really horrible," the character's perspective differed from that of the child participant's perspective. Nevertheless, a significant effect of eagerness in the hypothesized direction was observed. Additionally, correlation analyses did not reveal a significant relation between children's performance on the story listening task (as assessed by processing time difference scores between the eager and not eager condition) and parent ratings' of their child's feelings about going to the dentist, $r(47) = .17$, $p = .27$, and going to an ice cream store, $r(47) = .16$, $p = .28$.

Overall, the results of this study suggest that children's expectations about the influence of certain motivating psychological factors (i.e., eagerness to get to a particular location) might also influence children's simulations of the speed of a character's actions. Children's processing times were faster for sentences describing a child character "getting ready" (e.g., getting dressed) for an activity that he/she thinks is "really great" as opposed to "really horrible." Furthermore, children's own feelings about the activities the character was getting ready for did not seem to influence children's processing times. That is children's processing time were consistent with the character's perspective, even when their own perspective toward each activity differed from that of the character (e.g., child listener liked going to the ice cream store but story character thinks that going to the ice cream store is "really horrible").

# Chapter 4: Study 3

The results of Studies 1 and 2 demonstrate that preliterate children construct rich mental representations of the events described in a narrative. Specifically, the results of these two studies demonstrate that children simulate the speed of a character's movements and actions during story comprehension and that these simulations are constrained by certain physical and psychological factors that can influence the duration of these movements and actions. In Study 1, children's PTs were slower for scenery descriptions of what a character saw along the way to a relative's house when the character was described as walking as opposed to driving. These results suggest that children simulate a character's movements during story comprehension and that these simulations share certain 'physical' characteristics of these real-world movements (Stanfield & Zwaan, 2001, p. 153; see Barsalou, 1999). Using an entirely new set of stories, the results of Study 2 demonstrated that children's simulations of the speed of a character's movements are also constrained by the impact of a psychological factor, such as a character's eagerness to engage in an activity. Children progressed faster through a set of sentences describing the character's subsequent preparatory activities when the character was described as thinking the activity he/she was preparing for was "really great" as opposed to "really horrible". The results of Study 2 indicate that by 4 years of age children monitor the motivating influence of certain psychological states such as eagerness on a character's subsequent actions.

Study 3 was designed to further explore children's situation models by focusing on the manner in which children's expectations and spatial-temporal and psychological knowledge might combine to influence their simulations of a character's movements. That is, to put the predictions and findings from Study 1 and 2 to an even stronger test, Study 3 examined how the effect of the spatial-temporal movement variables (i.e., walking and driving) observed in Study 1 might be moderated by the psychological variable of eagerness investigated in Study 2. More specifically, among children in the Walk Condition (N = 16), the prediction was that a character's described state of eagerness (eager, not eager) would exert an influence on children's PTs, given that the speed of walking is under a person's control. Among children assigned to the Drive Condition (N = 16), however, the prediction was the opposite: namely, that a character's described state of eagerness (eager, not eager) would not exert an influence on children's PTs, given that the speed of being driven is not under a passenger's control. That is, it was reasoned that when a character does control the speed of his/her movement, then the character's eagerness should influence children's PTs but when the speed of movement is not under a character's control, then the character's eagerness should not influence children's PTs.

## Method

### Participants

The participants were 32 4-year-old native speakers of English with no reported history of speech or hearing difficulties, drawn from a university child laboratory database: 16 boys and 16 girls, (mean age = 55 months, range 48 to 61 months). Sixteen were randomly assigned to the Walk condition (mean age = 55 months, range 48 to 61 months). Sixteen others were randomly assigned to the Drive condition (mean age = 55 months, range 48 to 61 months). An additional 4 children were tested but excluded from the dataset due to inattentiveness.

### Procedure and Materials

The Walk condition explored the influence of the character's eagerness when the character walked to his/her aunt's house, while the Drive condition explored the influence of eagerness when the character was driven to his/her aunt's house. The story listening task used in this study was identical to that of Study 1, with the exception of the inclusion of two sentences used in Study 2 to describe the character's eagerness (i.e., "Jamie thought that going to aunt Alice's was really great/horrible."). This sentence was presented right after the movement manipulation sentence ("You know what Jamie? This time, let's walk/drive to aunt Alice's"). All other components of the story and procedure remained the same (Appendix C).

Each child heard the story once. As in Study 1, the presentation order of Story Components 3 and 7 (eagerness manipulation) and 4 and 8 (descriptions of scenery) were fully counterbalanced across children. As in Study 1, following the story, children were asked several story comprehension questions: two questions from Study 1 (Who did Jamie visit; What did Jamie do at aunt Alice's?) and two additional questions, (Did Jamie want to go his/her aunt's house the first/second time?). Children received one point for every correct answer. Following the story listening task, children were administered the CELF-P2's (Wiig et al., 2004) core language subtests (Sentence Structure, Word Structure, and Expressive Vocabulary) as well as the Recalling Sentences in Context (RSC) supplementary subtest.

## Results

Twenty-three of 30 children answered at least three of the four story questions correctly, suggesting that overall children had complied with instructions and listened carefully to the story. The data analysis focused on a comparison of the four PTs collected, for each child, during the 4-sentence description of scenery Jamie saw along the way to aunt Alice's house in the *eager* portion of the story with the four PTs collected for during the 4-sentence description of scenery in the *not eager* portion of the story (i.e., Story components 4 and 8; 8 PTs in total). Processing times that were four standard deviations from each participant's condition mean were considered outliers and eliminated from further analyses, resulting in the exclusion of 2.2% of the total data.

Participants' mean PTs were then submitted to an Eagerness (eager vs. not eager) x Speed of Movement (walk vs. drive) x Story Order (eager/not eager vs. not eager/eager) x Sex (male vs. female) repeated measures mixed model ANOVA with speed of movement, story order, and sex as the between-subjects factors and eagerness as the within-subjects factor. The ANOVA did not reveal a main effect of story order, $F(1, 24) = .4$, $MSE = 335269$, $p = .53$, $\eta^2 = .02$; sex, $F(1, 24) = 2.3$, $MSE = 335269$, $p = .14$, $\eta^2 = .09$; or speed of movement, $F(1, 24) = .72$, $MSE = 335269$, $p = .4$, $\eta^2 = .03$. The ANOVA did reveal a main effect of eagerness, $F(1, 24) = 4.6$, $MSE = 156494$, $p = .042$, $\eta^2 = .15$. Children's PT's were significantly faster in the eager condition (M = 838 ms, SE = 98 ms) than in the not eager condition (M = 1049 ms, SE = 76 ms). Critically, however, the analysis revealed a significant eagerness by speed of movement interaction, $F(1, 24) = 5.5$, $MSE = 156494$, $p = .032$, $\eta^2 = .14$. As predicted, the effect of eagerness was only observed in the walk condition and not in the drive condition. The details of this interaction are explored below for the walk and drive condition separately.

As found in Study 1 and 2, correlation analyses did not reveal a significant relation between children's performance on the story listening task (as assessed by processing time difference scores between the not eager and eager condition) and children's performance on any of the language subtests of the CELF-P2 in the Walk Condition (all $p$'s > .2) or in Drive Condition (all $p$'s > .3). Children's core language scores also did not differ significantly across the two speed of movement conditions, $t(27) = 1.4$, $p = .27$.

### Walk Condition

Twelve out of 15 children answered at least three of the four story comprehension questions correctly, suggesting that overall children had complied with instructions and listened carefully to the story. The ANOVA did not reveal a main effect of story order, $F(1, 12) = 3.2$, $MSE = 198419$, $p = .10$, $\eta^2 = .2$; or sex, $F(1, 12) = .1$, $MSE = 198419$, $p = .75$, $\eta^2 = .009$. None of these variables interacted with Eagerness, all *p*s > .1. Children's PT's were significantly faster in the eager condition (M = 663ms, SE = 57 ms) than in the not eager condition (M = 1102 ms, SE = 146 ms), resulting in a main effect of eagerness, $F(1, 12) = 13.2$, $MSE = 112999$, $p = .003$, $\eta^2 = .52$. Children's mean PTs were faster on all 4 scenery sentences (i.e., Components 4 and 8) in the eager condition than in the not eager condition. Table 4 provides the results of more detailed sentence-by-sentence paired-samples t-test analyses of the effect of eagerness.

Moreover, this effect of eagerness was highly specific and confined only to the sentences in Components 4 and 8 pertaining to the description of the scenery Jamie observed along the way to aunt Alice's house. That is, it was not observed for the eagerness manipulation sentence that immediately preceded the scenery description, even though the words 'great' or 'horrible' were explicitly stated (i.e., "Jamie thought that going to visit aunt Alice's was really *great/horrible*."; Components 3 & 7), $t(15) = .25$, $p = .8$ ($M_{\text{Not Eager}} = 1221$ ms, $M_{\text{Eager}} = 1326$ ms). It was also not observed on either of the two sentences immediately following each of the two key scenery description components (i.e., Sentence 12 or 32, $t(15) = 1.1$, $p = .27$, $M_{\text{Not Eager}} = 1550$ ms, $M_{\text{Eager}} = 1021$ ms; or Sentence 13 or 33, $t(15) = .98$, $p = .34$, $M_{\text{Not Eager}} = 1180$ ms, $M_{\text{Eager}} = 937$ ms. In addition, no significant eagerness effect was found for the remaining Components 5 and 9, $t(15) = 1.4$, $p = .19$, $M_{\text{Not Eager}} = 1463$ ms, $M_{\text{Eager}} = 1285$ ms.

**Table 4**

Children's PTs in Study 3's Walk condition, collected during the four scenery sentences [a] presented to children in the Not Eager and Eager conditions (N= 16).

| | Processing Times (ms) | | | |
|---|---|---|---|---|
| | Condition | | | |
| Scenery Sentences | Not Eager | Eager | Difference (SE) | *p*- value |
| 1 | 1186 | 620 | 566 (221) | $p = .02$ |
| 2 | 1399 | 880 | 519 (270) | $p = .07$ |
| 3 | 875 | 484 | 390 (142) | $p = .02$ |
| 4 | 947 | 666 | 282 (191) | $p = .16$ |

a. See Appendix C, Example of Study 3 Story, Components 4 & 8 (Sentences 8-11 and 28-31).

## Drive Condition

Eleven of the 15 children answered at least three of the four story questions correctly, suggesting that overall children had complied with instructions and listened carefully to the story. As in the walk condition, the ANOVA did not reveal a main effect of story order, $F(1, 12) = 3.7$, $MSE = 472118$, $p = .08$, $\eta^2 = .24$, or sex, $F(1, 12) = 4.1$, $MSE = 472118$, $p = .07$, $\eta^2 = .26$; and none of these variables interacted with Eagerness, all *p*s > .4.

Unlike the results of the walk condition, children's PTs were not significantly faster in the eager condition (M = 1013 ms, SE = 195 ms) than in the not eager condition (M = 996 ms, SE = 142 ms), $F(1, 12) = .015$, $MSE = 199988$, $p = .90$, $\eta^2 = .001$[3]. Table 5 provides the results of more detailed sentence-by-sentence paired-samples t-test analyses of the eagerness effect. Children's mean PTs on the 4 scenery sentences (i.e., Components 4 and 8) revealed no consistent pattern of being faster or slower.

**Table 5**

Children's PTs in Study 3's Drive condition, collected during the four scenery sentences [a.] presented to children in the Not Eager and Eager conditions (N= 16).

| | Processing Times (ms) | | | |
|---|---|---|---|---|
| | Condition | | | |
| Scenery Sentences | Not Eager | Eager | Difference (SE) | *p*- value |
| 1 | 858 | 736 | 122 (166) | $p = .47$ |
| 2 | 1354 | 1347 | -7 (215) | $p = .97$ |
| 3 | 915 | 884 | 31 (274) | $p = .91$ |
| 4 | 859 | 1084 | -225 (308) | $p = .33$ |

a. See Appendix C, Example of Study 3 Story, Components 4 & 8 (Sentences 8-11 and 28-31).

In addition, as in the previous studies, an effect of eagerness was not observed for the eagerness manipulation sentence that preceded the scenery description, $t(15) = .44$, $p = .67$ ($M_{\text{Not Eager}} = 1163$ ms, $M_{\text{Eager}} = 1298$ ms). It was also not observed on either of the two sentences immediately following each of the two key scenery description components (i.e., Sentence 12 or 32, $t(15) = .17$, $p = .87$, $M_{\text{Not Eager}} =$ 1076 ms, $M_{\text{Eager}} = 1120$ ms,; or Sentence 13 or 33, $t(15) = 1.5$, $p = .15$, $M_{\text{Not Eager}} = 850$ ms, $M_{\text{Eager}} =$ 1217 ms. In addition, no significant eagerness effect was found for the remaining Components 5 and 9, $t(15) = .85$, $p = .41$, $M_{\text{Not Eager}} = 1117$ ms, $M_{\text{Eager}} = 1238$ ms.

## Discussion

Overall the results of Study 3 suggest that children's simulations of character speed of movement are also constrained by the impact of a psychological factor, such as eagerness. Children PTs were faster when the character was described as eager, as opposed to not eager, to get to his/her aunt's house, but only when the speed of the character's movement was under his/her control; namely, when walking but not when being driven. Furthermore, in interpreting the results of Study 3, the reader is reminded that the scenery descriptions were counterbalanced across children, thus any differences with regard to their content and presentation order cannot account for the results. Overall, these findings support the hypothesis that children simulate a character's movement during story comprehension and that these simulations are constrained by their knowledge and expectations of the motivating influence of certain psychological states, specifically in this case, eagerness[4].

# Chapter 5

# General Discussion, Implications, Caveats, and Future Directions

## General Discussion

Children are exposed to a variety of narratives throughout childhood. As the following opening passage of Marcel Proust's essay *On Reading* (1905) so beautifully depicts, stories and books are an experience:

> There are perhaps no days of our childhood we lived so fully as those we believe we left without having lived them, those we spent with a favorite book.

And indeed, research indicates that, in many ways, readers and listeners experience that which they read. Over thirty years of research exploring the mental processes involved in the comprehension of narratives, although mostly in adults, (e.g., Johnson-Laird, 1983; Kintsch, 1998; Zwaan, 1999; Zwaan & Radvansky, 1998; Zwaan et al., 1995), has revealed that, during comprehension, readers and listeners construct detailed multidimensional representations of the situations and events described in a narrative. And a growing body of research investigating the dynamic and embodied nature of these mental representations has demonstrated that comprehension involves the mental simulation of the described events and actions (e.g., Barsalou, 2008; Matlock, 2004). The present investigation joins a small set of recent studies exploring this fascinating aspect of children's narrative development.

My studies have revealed that preliterate children's simulations of a character's movements are influenced by their expectations of the *duration* of the described activities and by their expectations about the motivating influence of certain *psychological factors*. Study 1 demonstrated that while listening to a story, children simulate a character's movements and that these simulations are influenced by children's expectations about the duration of certain activities such as walking and driving. Children's processing times were slower for scenery descriptions of what the character saw along the way to a relative's house when the character was described as walking as opposed to driving. Study 2 demonstrated for the first time that preschoolers' simulations of character actions are constrained by the motivating influence of certain psychological states such as eagerness. When the character in the story was described as thinking an upcoming activity (e.g., going to ice cream store or dentist) was "really great," children's processing times were faster for sentences describing the character getting ready for this activity than when the character was described as thinking the upcoming activity was "really horrible". Furthermore, the results of Study 2 indicate that preliterate children simulated a character's actions even when their own perspective toward each activity differed from the character's perspective (e.g., child listener liked going to the ice cream store but story character thinks that going to the ice cream store is "really horrible"). Finally, Study 3 extended the findings of Study 1 and 2 by demonstrating that children's simulations of a character's speed of movement are also influenced by the impact of a psychological factor - eagerness. Children progressed through a description of the scenery and events a narrative character observed along the way to his/her aunt's house faster when the character was described as eager, as opposed to not eager, to get there, but only when the speed of the character's movement was under his/her control; namely, when walking but not when being driven.

## Caveats

Although the results of the three studies presented here suggest that children simulate narrative events while listening to a story, the story listening task is not sufficiently sensitive to determine precisely what is happening during sentence processing. For instance, if children are listening to a sentence describing a character's movements (e.g., "On the way to aunt Alice's, they saw some dogs in a park") and they simulate what the character sees along the way, it is unclear how exactly the simulation is "sped up" in the drive condition as opposed to the walk condition. Does 'faster' in this case mean that they view the scene in less detail than children in the walk condition? Or might there exist individual differences the way in which children "view" the scene that the story listening task cannot pick up? A more visually based task might be better suited to teasing apart these alternatives and revealing a more detailed picture of what is happening during children's simulations of a character's movement. For example as implemented in adult research, children could be probed with different visual material to see which corresponds to their simulation (e.g., a blurrier picture of scene when moving quickly vs. slowly).

It is also unclear what is happening moment-to-moment while children construct a situation model of Jamie's activities. For instance, how do space and time contribute to children's simulations of the character's movements? Do they contribute equally or, as suggested by Zwaan and Radvansky (1998), does temporal information, which in this case might entail children's expectations about the duration of certain activities, play a more robust role in the construction of a situation model? These questions stress the need for more studies exploring this fascinating aspect of children's narrative comprehension and highlight the fact that the present investigation and previous studies are in many ways only first steps in the study of children's simulations of a narrative character's experiences.

Finally, it must also be noted that the issue of whether language comprehension, in general, is fundamentally embodied or symbolic is complicated and hundreds of years old. The studies comprising the present investigation were not designed to test between these two accounts of language comprehension, but rather to explore preliterate children's situation models within a narrative context and the role that simulations may play in children's comprehension of narratives. More specifically, they explored what kind of information may be represented in children's situation models (i.e., a character's spatio-temporal perspective). I believe the results of these studies lend themselves to a more embodied interpretation rather than a strictly traditional account of comprehension.

## Theoretical Implications

The present investigation makes a number of novel theoretical contributions to the study of narrative comprehension and narrative development in young children with respect to narrative comprehension, simulation, and our understanding of the function of narratives. These contributions will be discussed in turn.

### Development of Narrative Comprehension

The results of the present investigation extend the findings of previous studies of preliterate children's situation models and narrative comprehension in three main ways (O'Neill & Shultis, 2007; Rall & Harris, 2000; Ziegler et al., 2005). First, the present investigation is the first to explore the systematic capacity of preschool-aged children to track the *spatial-temporal* aspect of a character's experience. Second, the present investigation extends previous findings by highlighting the *dynamic* nature of children's narrative comprehension by exploring children's ability to simulate a character's perspective as it unfolds over time. Third, by examining the interplay between children's expectations of the influence of physical and psychological constraints on a character's movements, Studies 2 and 3 shed light on the impressive intricacies of children's simulations of narrative events. Indeed, the results of these studies speak to arguments that narrative comprehension is an intricate skill that entails the integration of a large amount of information, including the ability to make inferences about information not explicitly stated in the text and the "understanding of abstract concepts such as characters' underlying motivations" (Lynch et al., 2008, p. 350).

The results of the present investigation also enrich our understanding of the early aspects of the development of narrative comprehension. Although it has been argued that "many of the foundational abilities that contribute to children's comprehension of stories emerge in their oral language comprehension in advance of their learning to read", the antecedents of reading comprehension, and particularly children's comprehension of oral stories, have been overlooked in studies of young children's developing literacy skills (Skarakis-Doyle & Dempsey, 2008, p. 131). As a result, it has also been argued that studies of these precursory narrative comprehension abilities are very much needed if we are to gain a fuller understanding of how literacy and narrative comprehension skills develop (Lynch et al., 2008). The results of the present investigation offer insight into one possible precursory aspect of narrative comprehension, namely the simulation of narrative events and suggest that children, like, adults may also "leap into narrative worlds" (Zwaan, 1999b).

## Simulation

As mentioned earlier, simulation offers a compelling account of how it is that reading a story affords us the privilege of experiencing the perspective of another person, place, or time. If, as speculated, the simulation of narrative events is central to the comprehension of narratives, then one would expect to find evidence of this ability in young children and prior to the emergence of reading ability.  Discovering any indication that preliterate children simulate narrative events during comprehension would support an argument that simulation is indeed a fundamental component of comprehension and a possible important antecedent to reading comprehension.

The results of the present investigation suggest that children as young as three years of age do indeed simulate narrative events, and specifically a narrative character's movements through space and time. These findings therefore suggest that the simulation of narrative events may be a fundamental and critical component of narrative comprehension.

The present investigation also extends our understanding of mental simulation of narrative events by contributing to our understanding of the role that listeners' expectations play in their simulations. Scholars have argued that expectations enable readers to anticipate how a narrative will unfold (Rapp et al., 2006). Although research suggests that adult readers' expectations exert an influence over a variety of narrative comprehension processes including simulations (e.g., Anderson et al., 1983; Rapp et al., 2006; Rapp & Taylor, 2004; Zwaan, 1994), little is known about how children's expectations might influence their simulations of narrative events. The results of the present investigation suggest that children's expectations about the duration of certain activities (e.g., walking vs. driving) influence their simulations of a narrative character's movements.

In Study 1 children's simulations of a character's movements were influenced by their expectations about the duration of particular physical activities (i.e., walking vs. driving). In Studies 2 and 3, children's simulations of a character's movements were also influenced by children's expectations about the influence of certain motivating psychological factors (i.e., eagerness to get to a particular location). These findings lend support to the argument that simulations "…share certain 'physical' characteristics with its real world counterpart" (Stanfield & Zwaan, 2001, p. 153) and that "any transformation the referent undergoes should cause an analogous transformation in the simulation" (Stanfield & Zwaan, 2001, p. 153; Barsalou, 1999). The results of the present investigation demonstrate that children's simulations of a character's movements did indeed reflect real world characteristics and underwent analogous transformations (e.g., processing times increased when the character was driven as opposed to walked to his aunt's house).

The results of the present investigation also contribute to our understanding of how movement is represented in narratives. As any movement always entails the passing of time, tracking a character's movement requires a representation of both space and time. The present investigation is the first to explore children's mental representations of the combined influence of these two dimensions. Given that adults judge distances between moving entities and landmarks as greater when the moving entity is believed to be moving quickly than when the entity is believed to be moving slowly (e.g., Morrow & Clark, 1988), it may not seem surprising that children take longer to mentally "move" from one place to another when the character is described as walking as opposed to being driven. However, what makes the results of the present investigation especially interesting is that the key sentences (i.e., movement manipulations sentences, as well as the scenery and preparatory sentences) did not *explicitly* communicate the speed of a character's movement. These findings lend support to other studies, albeit with adults, suggesting that mental simulation of motion is not limited to *explicit* descriptions of motion but rather generalizes to *implicit* types of descriptions of motion such as, for instance, those expressed in fictive or figurative thought and language (Matlock, 2004). The results of the three studies comprising the presented investigation suggest that even preliterate children are capable of inferring the implied speed of a character's movements.

## Function of Narrative

Scholars believe that storytelling and narratives emerged in the Pleistocene. Such an early emergence suggests that narrative is sufficiently old to be considered a product of natural selection. Thus, on a final, albeit very speculative note, it may be worthwhile to revisit the issue of narrative function and specifically of the value of narratives, and the particular benefits that stories and storytelling confer on our species.

Many scholars agree that narratives and narrative cognition are an important aspect of our daily functioning. The cognitive literary theorist Mark Turner (2001) argues that narrative organizes the whole of human experience, including life stories of the past as well as life stories as they unfold. To psychologist Jerome Bruner, narrative represents one of the most fundamental means by which we come to understand the world. As Bruner (1990, p. 97) states, "our capacity to render experience in terms of narrative is not just child's play, but an instrument for making meaning that dominates much of life in culture."

Several other scholars have argued that the importance and benefit of stories is that they function as a form of simulation (Oatley, 1999; Mar & Oatley, 2008; Sugiyama, 2001a, 2001b).

Sugiyama has argued that “narrative may be characterized as a simulation of experience – a set of representations of the human physical, social, and mental environment – from which conclusions about the real world may be drawn” (Sugiyama, 2001a, p. 224). More recently, Mar and Oatley (2008) have also stressed the notion that narratives function as a form of simulation, although he primarily focuses on the social function of such simulations. If stories are a means by which we experience and simulate important aspects of our daily lives, the question then becomes: how does the brain enable narratives to serve this very important function?

The important role that simulations of narrative events play in comprehension has continued to gain support from a growing number of studies demonstrating that simulations are an integral part of narrative comprehension. Many of these studies were discussed in the introduction to the present investigation but, briefly, research suggests that during comprehension adults build a rich detailed mental representation of a narrative and that in doing so vicariously experience that which they read. This claim is supported by numerous behavioural and neuroimaging findings demonstrating that readers mentally simulate a story’s perceptual and motoric elements (e.g., Brunyé et al., 2009; Fischer & Zwaan, 2008; Glenberg, 2007). Findings that adults simulate narrative events offer an explanation of how the brain enables narratives to function as a virtual reality that enables humans to acquire and practice useful knowledge and skills without undertaking the risks of first-hand experience.

## Methodological Contributions and Future Directions

The processing time methodology developed to carry out the present investigation offers an alternative to methodologies requiring children to verbally produce narratives or answer comprehension questions. Investigating children's story comprehension using a response-time based approach may prove especially useful in the study of individual differences and especially in those observed in children with specific reading difficulties.

Specific reading difficulties are estimated to occur among 10% of typically developing 7- to 10-year-old children (e.g., Nation, 2007; Nation & Snowling, 1997; Stothard & Hulme, 1992; Yuill & Oakhill, 1991). These children have been classified as poor comprehenders, meaning that, despite age appropriate general language ability and decoding skills, they experience problems comprehending written and oral language. Because of their proficient general language ability, these children are seldom encountered in clinical settings, and for that reason their struggles are often overlooked (Nation, 2007).

Although several types of cognitive deficits have been investigated to account for specific reading comprehension difficulties (see Cain & Oakhill, 2007 or Nation, 2007 for review), these efforts have generally served to rule out plausible explanations (e.g., working memory deficits, inference making). Thus to date, precursors of specific reading comprehension difficulties remain elusive, as do remedies for comprehension problems (Nation, 2007). Indeed, experts in the field of reading comprehension have stressed that "long-term longitudinal studies are needed if we are to understand better the precursors to, and consequences of, 'specific' difficulties with reading comprehension" (Nation, 2007, p. 265).

One possible cognitive contributor to specific reading comprehension difficulties may be children's ability to create detailed situation models of narratives. Recent findings from studies conducted with school-aged children who are poor readers have led to the suggestion that their comprehension difficulties may stem from problems building adequate situation models (Glenberg, et al., 2004; Nation, 2005). Consequently, an investigation of this potential precursor of specific reading comprehension difficulty is very much warranted. The story listening task used in the present investigation may offer a unique and less taxing means of investigating these types of comprehension difficulties in young children. From a theoretical perspective, an exploration of the ability to construct coherent situation models of narratives in children who are struggling to comprehend has the potential to advance scientific understanding in numerous domains, including narrative development and developmental cognition. From a practical and potential policy perspective, research on the relation between early story comprehension difficulties and later reading performance has implications for the further understanding of basic reading comprehension processes within an everyday context.

## Conclusion

The results of the three studies that make up the present investigation highlight the importance of considering, and further investigating, the development and role of mental simulation in narrative comprehension in young children. In particular, although it has been argued that narrative comprehension is a critical component of, and precursor to, the acquisition of reading ability, recent reviews have highlighted the need for studies directed at children’s comprehension, rather than production, of narratives, especially among typically developing children (Lynch et al., 2008). By exploring one possible precursor of comprehension in young children, the present investigation addresses this need. Furthermore, the results of the present investigation offer new insights into the development and sophistication of narrative comprehension in preliterate children. The finding that such sophisticated ability exists long before children are even able to read is indeed very exciting.

## Footnotes

[1] Equipment failure (n = 4) and an unwillingness to answer the questions (n = 2) resulted in the absence of this data for a total of 6 children over all 3 studies.

[2]Additional analyses, conducted for each of the three studies with a sample that included only the children who answered all of the story comprehension questions correctly, yielded no differences with respect to the significance of results of all analyses and thus the results reported here are include the full sample of children for all three studies.

[3]The reader may note that overall mean PTs are longer in the eager condition in Study 3's drive condition than Study 3's walk condition, and in turn question the coherence of these findings with respect to Study 1. The reader should recall that the data from Study 3's walk and drive condition are from two different groups of children. Just as in adult studies assessing reading times, our hypotheses are not about *absolute* values of processing times that would hold across different groups of children, but rather about *relative* differences observed for different conditions presented *within* subjects.

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## **Appendix A:** Example of a Story used in Study 1

Component 1: Introduction

1. Jamie was at home playing in the playroom downstairs when her mom called to her and said,
2. “Jamie. It’s almost time to go.”
3. “As soon as you’re finished playing, we’re going to visit aunt Alice.”
4. “Ok, mom” said Jamie.
5. Jamie tidied up her toys and went upstairs to put on her shoes.

Component 2: 1st Movement Manipulation

6. “You know what Jamie? This time, let’s *walk* to aunt Alice’s”.

Component 3: Description of Scenery

7. On the way to aunt Alice’s, they saw some dogs in a park;
8. And some kids playing baseball;
9. And squirrels running around someone’s yard;
10. And even some kids sliding on a slide.

Component 4: Visit

11. Aunt Alice lived all alone and sometimes needed help with the housework.
12. When they got to aunt Alice’s, they helped her plant flowers in the backyard.
13. Jamie had a great time planting all the flowers.
14. When they were all done, aunt Alice brought out some lemonade and sandwiches and afterwards Jamie had a Popsicle.
15. But just when they were getting ready to go home, they heard a noise.
16. “It sounds like a meow!” said Jamie.
17. “Oh no! I think the neighbour’s kitty is stuck in my tree” aunt Alice said.
18. “Let’s get it down” all three of them said, and Jamie’s mom went to get a ladder.
19. Then Jamie’s mom climbed up the ladder and grabbed the scared kitty.
20. Then they played with the kitty a bit, but soon it was time to go home.
21. Then Jamie and her mom went home.

22. But when they got home, Jamie’s mom realized that she forgot something at aunt Alice’s.
23. “Sorry, Jamie, but we have to go out again. I forgot my cell phone at aunt Alice’s” said Jamie’s mom.
24. Jamie tidied up her toys and put on her shoes.

Component 5: 2nd Movement Manipulation

25. “You know what Jamie? This time, let’s *drive* to aunt Alice’s”.

Component 6: Description of Scenery

26. On the way to aunt Alice’s, they saw some ducks in the park;
27. And some kids playing soccer;
28. And birds flying around in someone’s yard;
29. And even some kids swinging on a swing.

Component 7: Conclusion

30. When they got to aunt Alice’s, she was already waiting for them with the phone.
31. Then Jamie and her mom went home to make dinner.

## **Appendix B:** Example of a Story used in Study 2

Component 1: Story Introduction

1. Jamie was at home playing when her mom called to her and said.
2. "Jamie, it's time to get ready."
3. "As soon as you're finished changing your clothes/cleaning up the mess you made in the backyard we're going to the ice cream store/dentist"
4. "Ok, mom" said Jamie.

Component 2: Eagerness Manipulation

5. Jamie thought that going to the ice cream store/dentist was really great/really horrible!

Component 3: Preparatory Activities

Changing clothes sequence of preparatory activities:

6. Jamie walked over to her dresser.
7. She put on her cool green t-shirt.
8. Jamie put on her socks.
9. She pulled on her favourite jeans.
10. And finally, Jamie put on her bright red sweatshirt.
11. Now Jamie was all ready to go.

or

Cleaning up mess in backyard sequence of preparatory activities:

6. Jamie went outside.
7. She picked up the blocks.
8. Jamie put the blocks in the bucket.
9. She picked up her ball.
10. And finally, Jamie walked back in.
11. Now Jamie was all ready to go.

Component 4: Adventure

12. “Jamie, it’s time to go” said Jamie’s mom.
13. Jamie and her mom drove to the ice cream store/dentist’s office.

14-30. Another 16 sentences describing Jamie’s activities at the ice cream store/dentist.

## **Appendix C**: Example of a Story used in Study 3

Component 1: Introduction

1. Jamie was at home playing in the playroom downstairs when her mom called to her and said,
2. "Jamie. It's almost time to go."
3. "As soon as you're finished playing, we're going to visit aunt Alice."
4. "Ok, mom" said Jamie.
5. Jamie tidied up her toys and went upstairs to put on her shoes.

Component 2: 1st Movement Manipulation

6. "You know what Jamie? This time, let's *walk* to aunt Alice's."

Component 3: 1st Eagerness Manipulation

7. "Jamie thought that going to visit aunt Alice's was really *great*."

Component 4: Description of Scenery

8. On the way to aunt Alice's, they saw some dogs in a park;
9. And some kids playing baseball;
10. And squirrels running around someone's yard;
11. And even some kids sliding on a slide.

Component 5: Visit

12. Aunt Alice lived all alone and sometimes needed help with the housework.
13. When they got to aunt Alice's, they helped her plant flowers in the backyard.
14. Jamie had a great time planting all the flowers.
15. When they were all done, aunt Alice brought out some lemonade and sandwiches and afterwards Jamie had a Popsicle.
16. But just when they were getting ready to go home, they heard a noise.
17. "It sounds like a meow!" said Jamie.
18. "Oh no! I think the neighbour's kitty is stuck in my tree" aunt Alice said.

19. "Let's get it down" all three of them said, and Jamie's mom went to get a ladder.
20. Then Jamie's mom climbed up the ladder and grabbed the scared kitty.
21. Then they played with the kitty a bit, but soon it was time to go home.
22. Then Jamie and her mom went home.
23. But when they got home, Jamie's mom realized that she forgot something at aunt Alice's.
24. "Sorry, Jamie but we have to go out again. I forgot my cell phone at aunt Alice's" said Jamie's mom.
25. Jamie tidied up her toys and put on her shoes.

Component 6: 2nd Movement Manipulation

26. "You know what Jamie? This time, let's *walk* to Aunt Alice's".

Component 7: 2nd Eagerness Manipulation

27. "Jamie thought that going to visit aunt Alice's was really *horrible*."

Component 8: Description of Scenery

28. On the way to aunt Alice's, they saw some ducks in the park;
29. And some kids playing soccer;
30. And birds flying around in someone's yard;
31. And even some kids swinging on a swing.

Component 7: Conclusion

32. When they got to aunt Alice's, she was already waiting for them with the phone.
33. Then Jamie and her mom went home to make dinner.