Imagining story spaces: Young readers' ability to construct spatial representations of narrative

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Doctor of Philosophy

in

Psychology

Waterloo, Ontario, Canada, 2015

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. I understand that my thesis may be made electronically available to the public.

ABSTRACT

Narratives are ubiquitous in human experience. They are the bestsellers we read on the beach, the news stories we read online, and, most commonly, the anecdotes we hear from our friends and family. Narrative comprehension involves creating a situation model, a non-verbal representation of the situation described by a text or spoken language (Zwaan & Radvansky, 1998). Whether and when children are able to create these representations is an important question for developmental research. Across 4 studies and using varying methodologies, I investigated children's ability to mentally represent the spatial aspect of narratives – in particular, to construct spatial situation models – at an age when they are becoming independent readers (6 to 8 years). In Studies 1 and 2, I investigated children's and adults' ability to construct *physical* representations of narrative and non-narrative passages after listening. Both age groups constructed more accurate models from narratives than non-narrative passages. Performance on narrative and non-narrative versions of the task were associated with different cognitive and linguistic abilities, with performance on the narrative version significantly correlated with narrative comprehension, and performance on the non-narrative version significantly correlated with verbal working memory. In Study 3, I investigated 7- and 8-year-olds' ability to represent spatial information during narrative listening, as measured by their enactment of a character's movement. Children enacted significantly more explicitly stated movements than movements that had to be inferred. But importantly, the ability to infer movements was significantly predictive of narrative comprehension. In Study 4, I investigated 6- through 8-year-olds' *spontaneous* processing of spatial information during narrative listening using an inconsistency detection task. Children listened to a series of short stories, some of which contained inconsistencies in either the spatial or goal-based fabric of the narrative. Children showed delayed processing in response to inconsistencies of both types compared to narratives with no inconsistencies. Together, these studies suggest that children can and do represent narrative spatial information, and that this ability may be an important building block of the comprehension process. This work has implications for both theoretical and educational accounts of language comprehension.

Acknowledgements

In my 5 ½ years of graduate school, I have benefited from numerous discussions, courses, and brown bag seminars. This work is a product of these experiences. I am grateful to the many individuals who have helped me to think about and approach problems in new ways. My adviser, Daniela O'Neill, has been a kind and supportive mentor. Most importantly, she has taught me to integrate applied and theoretical research, and has always stressed the importance of ensuring our findings reach audiences who will benefit from them. My committee members, Ori Friedman and Katherine White, have been wonderful mentors throughout my years of graduate school. They have always been willing sources of advice and input. Mathieu Le Corre also provided much insight on my research over the years. My office-mate, Pierina Cheung, has been not only a great source of ideas and input, but also a very supportive friend.

This research would not be possible without the many children, parents, and schools in the community who participated. A heartfelt thank you all of them. Luxsiha Sribaskaran and Reba Nauth were incredibly helpful with data collection and coding.

I am grateful to the individuals who have made my time in Waterloo a memorable and fun chapter in my life. In particular, David, Randall, Crystal, Steph and Dave have joined me in much-needed breaks from research for murder mystery and Mardi Gras parties, festivals, and camping trips. Thank you also to my friends in the ultimate and Special Olympics communities.

Finally, I would like to thank my family, Mom, Dad, Jackie, and Val, who have always been supportive of my educational journey. Without my parents' support and encouragement, I would not be writing this today. I would like to thank my husband, Oliver Johnson, for believing in and encouraging me along the way.

Dedication

To my parents, who encouraged and supported both my love of fiction and my love of science throughout my schooling.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: GENERAL INTRODUCTION

Countless readers have stepped into the land of Narnia through the wardrobe door, journeyed to Hogwarts through Platform 9¾, and experienced 19th century high society in Meryton through the eyes of Elizabeth Bennet. The subjective experience of readers and listeners of narratives is often one of being transported into the narrative world, vicariously participating in the unravelling events (Gerrig, 1993). Individuals may “feel” the hot sand beneath their feet from the beach the story protagonist is walking along and experience true sadness over the death of an important character. To the experiencer, narrative - with the imagination, perspective-taking, and emotional engagement that it encourages and induces - may seem qualitatively different from non-narrative processing. Many authors, literary theorists, and cognitive scientists agree that the subjective experiences associated with narrative processing are quite different from those associated with processing other types of language, such as lists, descriptions, and expository works (e.g., Gardner, 1984; Gerrig, 1993; Gibson, 1980; Jahn, 2004).

Underlying the imaginative experience that many readers and listeners of narratives report is the construction of a rich, multi-dimensional representation that goes beyond the words offered on a page. During narrative processing, individuals create representations not only of the surface form (e.g., word order) and text-base (i.e., the propositional meanings of words and sentences), but also non-linguistic representations of the situation the text or spoken language is about (Johnson-Laird, 1983; van Dijk & Kintsch, 1983). In this sense, language can be seen as a set of processing instructions for the type of model the reader or listener should create (Gernsbacher, 1990; Givón, 1992; Zwaan & Radvansky, 1998). It is often the goal of storytellers, whether telling fictional or non-fictional tales, to create a representation in the mind of listeners that is similar to the representation held in their own minds.

These representations of the situations described by the text are known as *mental models* (Johnson-Laird, 1983), or, more commonly, *situation models* (van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). The situations described by sentences are retained in memory, rather than verbatim representations of the text or utterances (Bransford, Barclay, & Frank, 1972; Glenberg, Meyer, & Lindem, 1987; Jahn, 2004). Situation models are multidimensional representations that may include temporal, spatial, causal, person and object, and intentional information, and are created by combining the content of the text with prior knowledge (Johnson-Laird, 1983; Zwaan & Randvansky, 1998). Representations of characters engaging in actions that are situated in a particular space and time are viewed from a perspective point—a here-and-now point (Black, Turner, & Bower, 1979; Morrow, Greenspan, & Bower, 1987; Rall & Harris, 2000). Situation model representations are thought to be similar, though not identical, to representations created from perception and memory (e.g., Bower & Morrow, 1990; Morrow, 1994; Zwaan, Stanfield, & Yaxley, 2002).

My interest in the present studies was in children's ability to represent spatial information in narratives (spatial situation models). Information about space and setting abounds in many written and spoken narratives. This information may come about through the movements and perspectives of characters. For example, a character may look from his bedroom window upon a tree in the backyard, a small bungalow beyond his property, and a high-rise that partially obscures the view of rolling hills in the distance. Or, the information may be presented in descriptive form, divorced from the actions or perspectives of characters. For example, a description of the spatial relationship between the house, tree, bungalow, high-rise, and hills may be provided before we are introduced to the character who looks out his window upon the awakening town. The ability to represent this information may simply serve to enrich one's representation of the storyworld, but may also in some cases be crucial for comprehension (Jahn, 2004), as I will discuss below. Whether and to what extent children are able to represent spatial information in narrative is important to understand, especially as children begin reading narratives which may present ample spatial information in the absence of illustrations. Using three different methodologies, I investigated children's ability to construct physical representations of narrative spaces compared to non-narrative spaces (Studies 1 and 2), their ability to enact a character's movement as it relates to spatial constraints of the storyworld (Study 3), and their spontaneous monitoring of spatial information as determined by their ability to detect spatial inconsistencies (Study 4).

Before going further, it is important to lay out the conditions that must be met for a piece of writing to be described as narrative, as its precise meaning is debated. For the present studies, I also want to settle upon a definition because I will later contrast narrative language with non-narrative language. After outlining the meaning of narrative adopted for the present studies, I will present a brief overview of relevant theories of language comprehension. Next, I will cover adult research investigating situation models, followed by a more in depth discussion of *spatial* situation models. Finally, I turn to the newly emerging and growing body of research investigating children's situation models.

What is narrative?

Although debate exists over what it means for a piece of language to be a narrative, there is at least some consensus over the minimal conditions required for an utterance or series of utterances to be classified as a narrative. At the very least, there must be (1) two or more events with (2) some type of temporal ordering between them (Carroll, 2001; Labov, 1972; Lamarque, 2004; Wilson, 2003). Bordwell and Thompson (2012) however provide compelling examples to suggest that a cause-and-effect relationship between the events should be added to this definition (see also Graesser, Hauft-Smith, Cohen, & Pyles, 1980). According to these minimal definitions, "John threw the ball and Mary caught it" is considered a narrative, whereas "John threw the ball and Mary went to Venice" is not. Beyond these basic criteria, narratives differ greatly from one another in terms of their subject matter, truth value, real or imaginary content, and function (Lamarque, 2004).

In contrast to these minimal definitions of narrative, Bruner (1986) argues that narrative is about the dynamics of human intention, and Black and Bower (1980) suggest that narrative involves the outlining of problems and characters' plans to solve them. Mar and Oatley (2008) argue that, for literary narratives, at least, the content concerns itself mostly with intentional beings and their relationships, and often includes episodes of conflict.

Gerrig (1993) has argued that this latter category of definitions is of *good* narratives. For the purposes of research investigating situation models, it seems that a minimal definition of narrative is sufficient. However, one would likely need to offer listeners a narrative that looks more like those discussed by Bruner if one wanted them to construct a situation model that included several dimensions (i.e., time, space, causation, person and object, and intention).

The narratives used in the present set of experiments were several sentences long and included agents with intentions engaging in actions in a particular time and place, and thus should satisfy both minimal and richer definitions of narrative, even though they are far from being literary narratives. The key way I will distinguish narrative from non-narrative language is through the presence of: (1) connected events which occur at a specific point in time, and (2) intentional agents engaging in these events.

The process of language comprehension

As noted, representations of language exist at the word and text level, and at holistic, situation model levels. Although earlier research focused on individuals' representations of the text itself, the field moved toward an emphasis on individuals' elaborative representations of what the text is *about* after the publication of two ground-breaking works on language comprehension by Johnson-Laird (1983) and van Dijk & Kintsch (1983). Most theorists agree that the construction of a situation model is an elaborative process that involves combining information from the text (or spoken language) with information stored in memory. For example, Kintsch's *Construction-Integration Model* proposes that information encountered in text automatically activates relevant information stored in long-term memory (Kintsch, 1988). The activation and integration of relevant background information allows the individual to make inferences crucial to the comprehension process.

Gernsbacher's *Structure Building Framework* (Gernsbacher, 1990) introduced language comprehension as a structure building process involving multiple stages: (1) laying a foundation, the process of developing a representation of initial information in a passage, (2a) mapping incoming information when it is coherent with previous information or (2b) shifting to create a new substructure with incoming information is less coherent, and (3) suppression of contextually inappropriate information and enhancement of contextually appropriate information.

According to the *Constructionist Theory* of comprehension (Graesser, Singer, & Trabasso, 1994), individuals construct a number of inferences when building a situation model. During comprehension, individuals engage in a process of "search after meaning" in which they seek to obtain both local and global coherence in their representation by making inferences. Local coherence is the process of resolving information between sentences or clauses (e.g., reference resolution), whereas global coherence involves connecting information with background knowledge and overarching themes (e.g., inferring the reason behind a character's actions). While many other theories of language comprehension apply to genres of language broadly (e.g., exposition, description), this theory pertains mostly to narrative comprehension.

Zwaan and colleagues' *Event-Indexing Model* proposes that events are the building blocks of integrated situation models (Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998). To build the situation model, individuals index events along five dimensions: time, space, causation, person and object, and intention. Integration is made easier when an event shares several indices with the existing model. For example, it should be easier to build a situation model of an event involving the same character that was involved in the previous event than one involving a different character.

More recently, Zwaan (2004) has proposed the *Immersed Experiencer Framework*, inspired by theories of perceptual symbols systems – the idea that language comprehension is a process involving perceptual and motor representations, rather than amodal propositions (Barsalou, 1999). Zwaan (2004) proposes that comprehension is a multi-stage process involving (1) *activation* of widespread functional networks by words encountered in the text/utterance, (2) *construal* of the initially broad activation to only those networks that are relevant to yield a representation of a specific event, and (3) *integration* of the currently-activated networks into an integrated model. Using Zwaan's (2004) example, if one encounters the sentence "the ranger saw the eagle in the nest", the following processes would occur: (1) initial diffuse activation of function webs that are active when we actually perceive an eagle, which may include eagles in flight, (2) constraining of the broad activation to the event of seeing an eagle in a nest, which would include an eagle seated with wings tucked in, and (3) integration of the representation of the eagle in a nest with other information presented in the passage.

The discussion that follows focuses on multi-dimensional situation models, most similar to those outlined under the *Event-Indexing Model* (Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998).

A brief history of research on multi-dimensional situation models

If individuals create representations along the five dimensions of the situation model (i.e., time, space, causation, person and object, and intention), then one may expect discontinuities along any of these dimensions to result in a processing cost for the reader or listener, who must update the situation model to reflect the shift. During reading of short, naturalistic texts, adults showed increased reading times when there was a discontinuity along one of the dimensions (e.g., Event 2 occurred significantly later in time than Event 1; a new character was introduced) relative to sentences with no discontinuity (Zwaan, Magliano, & Graesser, 1995; Zwaan, Radvansky, Hilliard, & Curiel, 1998). Introducing an event in a new location (spatial discontinuity), however, only resulted in increased reading times when participants first memorized a map of the areas in the story, suggesting, perhaps, that individuals do not spontaneously represent spatial information in narratives. These findings have been qualified slightly by more recent and puzzling findings that, when given a longer and more coherent narrative, participants did not show increased reading times in response to discontinuities along dimensions and, in some cases, showed decreased reading times (McNerney, Goodwin, & Radvansky, 2011). Adults' reading times actually decreased when discontinuties along temporal and spatial dimensions occurred, a finding the authors suggest is due to increased text coherence relative to the shorter texts used in previous studies. In a more coherent text, shifts are likely easier to anticipate.

A second method of assessing discontinuity processing is through a post-reading verb-pairing task. For example, in one study participants were asked to group verbs that corresponded to events in a short narrative they had previously read into related pairs (Zwaan, Langston, & Graesser, 1995). They were more likely to group verbs that referred to events that happened along a continuous dimension (e.g., referring to the same character, happening in the same place) than verbs taken from breaks across dimensions. These results suggest that adults spontaneously monitor several types of information in narratives (e.g., time, causation) and construct situation model representations along these dimensions.

Although the situation model studies reviewed thus far have simultaneously investigated the processing of all five dimensions, the majority of studies have focused on a single dimension separate from the others. An in depth review of situation models constructed along the spatial dimension follows.

Spatial situation models

Common, subjective experience suggests that narrative processing is a feat of the imagination, often including visuospatial components (Fincher-Kiefer, 2001; Langston, Kramer, & Glenberg, 1998; Zwaan, 1999). The spatial dimension of the situation model is the dimension that is most often associated with these visuospatial representations (Jahn, 2004). Individuals commonly report vividly experiencing the world of the story, so much so that it is not unusual to hear complaints after the release of a film adapted from a book that the world as depicted by the film "looked" nothing like the world as described by the book. Yet, experimental evidence for visuospatial representations of space in narratives is currently mixed. There is no doubt that most individuals are *able to* form spatial representations of narratives, but whether they do so spontaneously is another matter (Jahn, 2004; Morrow, 1994; Zwaan & Radvansky, 1998). The spatial relations included in situation models may include "information such as the protagonist's present location, where the protagonist is moving, what the described locations look like, and where important objects and actors are located" (Rinck, Hähnel, Bower, & Glowalla, 1997, p. 622).

But there is debate over what exactly constitutes a spatial situation model. Most researchers would agree that it should include spatial relations among entities (Foos, 1980; Ehrlich & Johnson-Laird, 1982) and some distance information (Bower & Morrow, 1990; Glenberg et al., 1987). However, definitions of spatial situation models vary greatly, from requiring that individuals simply maintain and update the location of protagonists as described in the narrative, with no mention of spatial relations or distance between location (Levine and Klin, 2001; O'Brien & Albrecht, 1992), to requiring that they construct representations that include metric properties (Rinck, Hähnel, Bower, & Glowalla, 1997) and that are structurally isomorphic to the space they represent, assuming the space exists somewhere in the real world (Denis & Zimmer, 1992). These two definitions map roughly onto what Zwaan and Radvansky (1998) call *spatial framework information* (e.g., it happened in the library) and *spatial relational information* (e.g., the magazine rack is 5 metres to the right of the librarian's desk), respectively. Levine and Klin (2001) found that individuals represented spatial framework information, regardless of whether spatial information was elaborated (i.e., a description of the protagonist's location was provided) or was briefly stated. Undergraduates in their study were slower to recognize probes for a protagonist's previous location compared to the current location, even when controlling for temporal shifts that usually accompany location shifts, suggesting that adults maintain and update representations of characters' locations in narratives.

The amount of detail encoded in a spatial situation model depends on several factors, including the structure of the text or verbal description, the reader's prior knowledge, the reader's goals, the number of exposures to the text, and the reader's cognitive resources (Zwaan & van Oostendorp, 1994). Research on spatial representations during both narrative and non-narrative processing has demonstrated that descriptions or narratives that are determinate, continuous, and condensed are more likely to yield coherent spatial situation models than texts that are indeterminate, lacking in continuity, and distributed (Zwaan & van Oostendorp, 1993). Determinate texts support only one representational configuration of space, which is likely to be constructed by readers, compared to texts that support multiple possible configurations (Mani & Johnson-Laird, 1982). Determinacy is, however, more relevant to representations of real-world spaces acquired from non-narrative descriptions, where an accurate representation is more important (e.g., if one is planning to navigate the space). Continuous texts, in which each sentence refers back to spatially adjacent entities from the previous sentence, are more likely to yield accurate representations than discontinuous descriptions (Ehrlich & Johnson-Laird, 1982). Finally, texts that are condensed – where spatial information is not interspersed with large amounts of non-spatial information – are more likely to lead to spatial representations (Sanford & Garrod, 1981). These three criteria – determinacy, continuity, and condensation – are relevant to non-narrative spatial descriptions, but are often not features of narratives. Storytellers rarely intend to convey a determinate representation of space, and typically do not provide continuous or condensed spatial descriptions, aside from when providing an extended description of a scene in a narrative world.

Common ways of assessing spatial situation models

There are a number of ways of assessing individuals' construction of spatial situation models. Some of these measures provide evidence for their mere existence, while others provide information on their accuracy and level of detail.

Physical representations. Asking participants to generate a physical representation of a described space, such as a map or drawing, provides researchers with a picture of both the presence and the level of accuracy of individuals' spatial situation models (e.g., Foos, 1980; Taylor & Tversky, 1992; Uttal, Fisher, & Taylor, 2006). However, these measures do not provide concrete evidence for the *spontaneous* construction of spatial situation models.

Inference questions. Studies using inference questions as a dependent measure rely on the fact that an individual must create a spatial situation model in order to generate certain inferences about the unmentioned relationship between two entities (e.g., Zwaan & van Oostendorp, 1993; 1994). Under certain conditions, inference questions can provide evidence for the spontaneous construction of spatial situation models (e.g., when participants are given instructions to respond as quickly as possible), but do not provide the same level of detail about the representations as do physical representations. For example, participants in one study read a passage from a novel about a murder (Zwaan & van Oostendorp, 1994). A detailed description of the room in which the murder took place was provided. After reading the passage, participants were asked to verify several inference statements about the crime scene, such as, "*The table was between the window and the body*", when it had been stated in the passage that the table was near the window and the body was near the bed, though the spatial relation between the body and the table was never directly stated. Participants were more accurate at verifying inference statements when given explicit instructions to attend to space during reading.

Processing time. These measures, variously called processing time, reaction time, and verification time, involve having participants respond with a button press to verify an image, word, or sentence that may or may not be consistent with the relevant spatial situation model. The underlying idea is that, if participants have indeed constructed a spatial situation model, they should be faster to respond to stimuli that are consistent with their model than those that are inconsistent. As the most common measure of adults' spatial situation model construction, processing and reaction time dependent variables have provided compelling evidence for *spontaneous* situation model construction and use. For example, participants are faster to verify objects that they infer to be close in proximity to the protagonist at a given point in time than objects that are more at a distance (e.g., Glenberg et al, 1987; Morrow et al., 1987; Morrow, Bower, & Greenspan, 1989). Participants are also faster to respond to objects that are described in a passage as being in front of them than those that are behind, when searching through imagined environments (Franklin & Tversky, 1990).

Conditions that lead to spatial situation model construction

A set of distinct task conditions usually lead individuals to construct detailed spatial situations models during narrative comprehension. Adults reliably build spatial models (1) when explicitly instructed to do so, (2) when given a map of the narrative setting, and (3) when a spatial representation is causally relevant.

Explicit instructions. When reading naturalistic texts (i.e., excerpts from a novel), adults who were given instructions to recall spatial information read more slowly and correctly answered more spatial inference questions than adults who were not given such instructions (Zwaan & van Oostendorp, 1993; 1994). Thus, it seems there is a speed-accuracy trade-off when it comes to processing and representing spatial information from texts, though there was no comparison condition in this study in which participants were told to attend to another dimension. Based on these findings, Zwaan and colleagues (Zwaan & Radvansky, 1998; Zwaan & van Oostendorp, 1993; 1994) concluded that individuals do not spontaneously construct spatial situation models during naturalistic reading.

Use of maps. Numerous studies over the past 25 years have demonstrated that, when given a map of the location in which a narrative takes place, participants will represent a character's movement through that space. In the original study using this paradigm, adult participants were given a map of a research centre with several rooms, each of which contained a set of objects (e.g., the lounge contained a TV, ping pong table, and refrigerator) (Morrow et al., 1987). They learned the layout of the building before reading a computerized narrative about events in the building. The narrative was interrupted at various points with the names of pairs of objects, and participants had to identify whether the object pairs belonged in the same room as one another or in different rooms. Crucially, the probes always appeared when the character moved from one room to another. The object pairs could belong in the room the character was coming from (the source), the room the character was in (the goal), an *unmentioned* room the character passed through (the path), or a room not involved in the movement (other). Response times to goal room objects were fastest, followed by path objects, source objects, and then other objects. The most intriguing finding is that participants were faster to identify objects in the path room than the source room. This suggests that they were mentally travelling through the unmentioned path room and that the character's departure from the source room rendered it less accessible. In a subsequent study, Morrow et al (1989) found that objects in locations the character was merely thinking of were more accessible than those in the character's physical location. Several studies have replicated Morrow and colleagues' (1987; 1989) findings using a map task (e.g., Zwaan et al., 1998; Zwaan & van Oostendorp, 1994, but see Wilson, Rinck, McNamara, Bower, & Morrow, 1993).

Causal relevance. The first demonstration that adults *spontaneously* build spatial situation models was in a now classic study by Bransford et al (1972). Participants listened to a series of sentences in the study phase, and then completed a sentence recognition task in which they encountered new and old sentences and had to verify whether they had heard them previously. For example, participants would hear the study phase sentence, *Two zebras graze next to a shrub and a lion trots toward it*. During the sentence recognition task, they would hear sentences that used (1) identical wording, (2) different wording, but an identical spatial situation model (*Two zebras graze next to a shrub and a lion trots toward them*), or (3) different wording and a different spatial situation model (*Two zebras graze next to a shrub and a lion trots beside it*). Participants were more likely to falsely recognize sentences with different wording and identical situation models than they were to recognize sentences with different wording and different situation models. This finding suggests that adults construct a spatial representation of the relation between the zebras, the shrub, and the lion from a single sentence. In a later study, Jahn (2004) manipulated the causal relevance of the sentences by making half of the sentences about predator-prey pairs, as in the example above, and half about neutral pairs (e.g., substituting an antelope for the lion). Jahn replicated the original Bransford et al (1972) findings only for those sentences that included predator-prey relations and were thus causally relevant. Using different dependent measures and longer stories, other researchers have also found that space and causation interact to promote spatial situation models under conditions of causal relevance (e.g., Sundermeier, van den Broek, & Zwaan, 2005).

Spatial representations of non-narratives

Outside the domain of narrative, evidence for detailed spatial representations is somewhat mixed. Denis and Cocude (1989; 1992) found that spatial representations derived from verbal descriptions of maps were similar to those derived from actual observation of the same maps. Participants either heard a description or viewed a map and then engaged in a mental scanning procedure, in which they would focus on one location before mentally travelling to another. Mental scanning times were predicted by distance on the map for participants in both conditions. Foos (1980) had participants draw a map of a town after hearing a description. They were accurate in their construction, though accuracy depended on the continuity of the description.

Perrig and Kintsch (1985) gave participants descriptions of a small town that were from either a route perspective (a perspective *within* the town) or a survey perspective (a perspective *above* the town), and then asked participants to write down everything they remembered from the text. They were then asked to confirm or reject a series of statements about the town, including verbatim sentences, paraphrased sentences, and true and false inference statements. Following this, participants were asked to draw a map of the town. Participants in both the route and survey conditions were poor at verifying inferences and drawing maps. Free recall was also low, though participants in the route condition were slightly better than those in the survey condition. From these findings, Perrig and Kintsch concluded that individuals exposed to survey and route descriptions of texts form representations of the textbase, rather than forming a situation model representation.

In a study similar to Perrig and Kintsch's, but using more coherent non-narrative texts, Taylor and Tversky (1992) found that accuracy was high on a map drawing task and on an inference verification task for participants in both route and survey conditions, though individuals in the survey condition outperformed those in the route condition on the map drawing task. Participants' success on inference questions led Taylor and Tversky (1992) to conclude that individuals do form spatial situation models of the environments described. These early studies, using a range of dependent measures, provide some evidence that individuals form spatial representations of non-narrative descriptions presented in both survey and route formats.

Narrative versus non-narrative spatial representations

There may be differences in the representations derived from narrative and non-narrative passages. Specifically, I think there is reason to suggest differences in features of the representation and in the processes used to build these representations.

In the case of narrative processing, it may be important to construct meaningful and potentially relevant representations of the space, without requiring directional detail such as A is north of B, or X is to the left of Y to be a part of the representation. For example, representing that a railway is located behind a character's house may be relevant for a number of reasons. The reader or listener who includes this information in the situation model may infer that the residents of the house would frequently be disturbed by the sound and rumbling of passing trains, or that letting a dog run out into the unfenced yard may be cause for concern. (Note that this point is similar to Jahn's (2004) argument for the importance of causal relevance in forming spatial relations.) Such a representation would be intermediate to spatial framework and spatial relational representations. Recall that spatial framework representations include the character's current location or setting (e.g., at school), but do not require the reader or listener to include wider characteristics of the setting, such as the presence of geographical features. On the other hand, spatial relational representations are more map-like and require the inclusion of directional and metric information, making them more relevant to representations of real world spaces that one may expect to navigate. A spatial representation of a non-narrative description may be more likely to include metric details (e.g., the train tracks are 50 metres from the house) and directional details (e.g., the house is on the east of the road). This level of detail in representation may be expected by the individual providing the description, though whether individuals are actually able to represent this level of detail is up for question. These proposed differences could result from different *motivations* on the part of the reader or listener (i.e., to situate the narrative events versus to represent space one expects to navigate) or from different cognitive processes engaged when one encounters a narrative versus a non-narrative.

The process of constructing a spatial representation from a narrative may also be fundamentally different than that from a description. In the former, one is following a character through space, whereas in the latter, one must conceive of the space from a character*less* perspective. Narratives are typically presented from a first-person (e.g., "*I* took the train to visit my cousin yesterday.") or third-person perspective (e.g., "*Arthur* rode his bike to the soccer game.") and invite the reader or listener to take the perspective of the individual about whom the narrative is presented. When reading a non-narrative, such as a set of directions (e.g., the hospital is at the end of the road, on the right), the passage does not offer the reader a perspective of an individual. Although spatial representations of non-narrative descriptions are often referred to as spatial situation models, this term is misleading, as there is no situation per se—no characters, actions, intention, or time. When spatial information is presented in the form of a narrative, the system that builds spatial situation models may be engaged, whereas one may have to rely on a different set of processes to represent non-narrative information (e.g., verbally encoding sentences).

Spatial situation models – Summary

The evidence for whether adults construct spatial situation models during language comprehension is somewhat mixed, and seems to depend on the dependent measures used, and the way in which spatial situation models are operationalized. Although most studies have found that adults construct spatial situation models during language comprehension, others have shown limitations in this ability and have called into question its spontaneity (i.e., Jahn, 2004; Perrig & Kintsch, 1985; Zwaan & van Oostendorp, 1993; 1994)

Children's situation models

Despite the extensive research on adults' spatial situation models (albeit with mixed findings), little research has investigated children's spatial situation models. Can children build spatial situation models during narrative comprehension? Do they do so spontaneously? Can they represent spatial framework (i.e., setting) and spatial relational (i.e., distance and metric) information? Given that stories for young readers often contain detailed information about space and setting (Lukens, 1986), it is important to know the extent to which children are able to process and represent this information. Consider the following passage from the classic children's novel, The Wind in the Willows by Kenneth Graeme:

> He shuffled on in front of them, carrying the light, and they followed him, nudging each other in an anticipating sort of way, down a long, gloomy, and, to tell the truth, decidedly shabby passage, into a sort of a central hall; out of which they could dimly see other long tunnel-like passages branching, passages mysterious and without apparent end. But there were doors in the hall as well--stout oaken comfortable-looking doors. One of these the Badger flung open, and at once they found themselves in all the glow and warmth of a large fire-lit kitchen. (1908, pp. 70-71).

In this passage, and throughout the novel, Graeme attempts to evoke a detailed image of the characters' surroundings. Is his intended readership (likely children aged 7 through 10) able to represent this information and create spatial situation models?

Although research on children's construction of situation models along other dimensions is also limited, some evidence seems to exist for children's representations of time (Pyykkönen & Järvikivi, 2012).), character (Rall & Harris, 2000), causation (Casteel, 1993), and intentions (Lynch & van den Broek, 2007; Wenner, 2004). In particular, it seems that children are quite adept at tracking characters' intentions and perspectives.

In one of the first studies to investigate children's situation models, Rall and Harris (2000) found that preschool children accurately recalled a deictic verb (e.g., come/go, bring/take) within a sentence when it was consistent with the main protagonist's perspective, but made substitution errors when the verb was inconsistent. If given the sentence, "Little Red Riding Hood was sitting in her bedroom when her mother *came/went* in and asked her to go to Grandmother's house," 3- and 4-year-old children were more likely to reproduce the sentence with *came* as the deictic verb, regardless of whether they actually heard *came* or *went*. These results suggest that children adopt the perspective of a protagonist and expect the ensuing events in a narrative to be presented in a way that is consistent with that perspective.

Preschoolers track not only characters' physical perspectives, but also their mental perspectives. Children heard a short story about a character who was in one location (e.g., in a barn with a cow), but was thinking about doing something in another location (e.g., feeding a cow in a field), and were shown accompanying models of each location, each with a cow in it (O'Neill & Shultis, 2007). After hearing the story, children were asked an ambiguous question: "Can you point to the cow?" Five-year-olds, but not three-year-olds pointed to the cow that was in the character's thoughts, rather than the cow that was in the same physical location. Thus, this finding suggests that children situate themselves in a character's mental perspective, even when it is different from the character's physical location.

Children also appear to simulate characters' movements during story listening. Preschoolers took longer to process a scenery description of a character's surroundings when she was walking somewhere compared to when she was being driven, and took longer to process a description of a series of preparatory activities when a character was dreading going somewhere compared to when he was eager to get there (Fecica & O'Neill, 2010). These findings suggest that children adopt characters' spatiotemporal perspectives and represent characters' movement through space, but do not necessarily tell us whether they also represent the spatial surroundings through which these characters are moving.

These findings demonstrate that, from an early age, children are inclined to track a character's thoughts and actions. If children represent the perspectives and actions of characters, is it also reasonable to expect that they represent the space or setting within which characters perceive and act? In line with this prediction about the interaction between setting, perspectives, and actions, Bruner (1986) has argued that "the inseparability of character, setting, and action must be deeply rooted in the nature of narrative thought. It is only with difficulty that we can conceive of each of them in isolation" (p. 39). In other words, it is potentially difficult to construct a situation model that lacks one of the major dimensions; a character who acts without goals, an occurrence without apparent cause, or an event devoid of setting. Some evidence exists to support this prediction. When given narratives that did not include character goals, 6- to 8-year-old children spontaneously imputed goals to make sense of the narrative (Lynch & van den Broek, 2007)[1]. In a study with adults investigating the interplay of space, time, and characters,

[1] The ability underlying children's performance in Lynch and van den Broek's study is likely much more fundamental. Imputing intentions is something that even infants have been shown to do, measured outside the context of complex narratives. See Scholl & Tremoulet (2000) for a review of the extensive literature demonstrating that infants and adults perceive causality and intention when shown displays of two-dimensional geometric shapes moving in certain patterns.

the accessibility of a character's prior location (e.g., the library) after arriving at a new location (e.g., the pub) was measured by response time to a probe (e.g., "Library") (Rapp & Taylor, 2004). The accessibility of the prior location was influenced by the distance between the two locations, which was not explicitly stated, and which participants had to infer from the duration of an activity the character carried out on his journey between the two locations (e.g., listening to *half a lecture* versus listening *to the introduction to a lecture* on a headset). Longer response times were found when the character had carried out a longer-duration activity on his journey. Therefore, perhaps we should not conceive of the dimensions of situation models as independent of one another, but, rather, as deeply intertwined.

Children's spatial situation models

The amount of detail in children's spatial situation models and the extent to which they are veridical representations of the space as described in the narrative is currently unknown. When given a physical model of a narrative setting before reading a narrative, as in the original Morrow et al (1987; 1989) studies described above, 9- to 16-year-old children were able to construct and maintain an accurate spatial situation model (Barnes, Raghubar, Faulkner, & Denton, 2014). After being familiarized with a physical model of a marketplace, children read a narrative about a character shopping in the market. The narrative was periodically interrupted with probes listing items that either were or were not in the stall that the character was currently visiting. Children were faster to respond to items in the character's present location, and to items that were located at unmentioned stalls that the character had to pass by in order to arrive at his destination versus the origin stall or other stalls not along the path. These findings suggest that children were relying not only on explicitly stated information in the text, but also on information that could be inferred based on the situation model they had constructed earlier from the physical model. What these findings are not able to tell us, however, is whether children are able to *construct* a spatial representation of a narrative world from hearing or reading alone, without the assistance of a physical model.

Outside the domain of narrative, Uttal et al (2006) compared 8- and 10-year-old children's and adults' ability to create representations of space from descriptions to representations from maps. Participants heard a description of a six-room building or saw a map of the same space and were then asked to assemble the space using six cards. Eight-year-old children who heard the description had difficulty with the task. Their situation models seemed to be tied to the sequential order in which locations were mentioned. Ten-year-olds' performance on the task was generally good and was intermediate to that of the 8-year-olds and adults. Only when given an outline of the spatial configuration prior to hearing the spatial description did 8-year-olds' performance improve to a level similar to that of the older children.

Although this study suggests that children have difficulty constructing spatial representations from language, when no visual information is available, it tells us little about how children may be able to create spatial situation models during narrative comprehension. Perhaps representations created during narrative processing are qualitatively different from representations created from descriptions, or perhaps this ability is similarly limited during narrative processing.

The Present Research

I designed this set of studies to discover what children's spatial situation models of narratives look like—the amount and type of detail they include, and how they may be different from spatial representations of non-narratives. Across these studies, I have operationalized children's spatial situation models in three different ways in order to paint a fuller picture of children's ability to represent space in stories, incorporating measures of both deliberate and spontaneous spatial situation model construction. Studies 1 and 2 were designed to measure children's competence at building spatial situation models from narratives under deliberate instruction, comparing this ability to the case of constructing spatial models from non-narratives. I gave children explicit instructions to imagine and build the space in the passages, which they had the opportunity to do after listening to their assigned passage. Study 3 was designed to investigate children's real-time processing of spatial information in narrative, by asking them to enact a story while listening to it. Finally, Study 4 was designed to investigate children's spontaneous, real-time processing of spatial information in narrative. In Study 4, I introduced children to a collection of passages, some of which contained inconsistencies in the spatial arrangement of the story world, and some of which included no such inconsistencies. I compared children's processing time of inconsistent sentences to consistent sentences. I also compared children's ability to track spatial inconsistencies to their ability to track inconsistencies in characters' motivations and actions, an aspect of narratives that children appear to track from an early age (Fecica & O'Neill, 2010; Lynch & van den Broek, 2007; O'Neill & Shultis, 2007).

CHAPTER TWO: ARE CHILDREN ABLE TO CONSTRUCT SPATIAL SITUATION MODELS OF NARRATIVE UNDER DELIBERATE INSTRUCTION?

Given that there has been no systematic investigation of children's ability to construct spatial situation models, I wanted to first investigate children's competence at constructing spatial situation models under conditions which have been shown to lead to adults' successful construction. Recall that three factors have been shown to promote the use of spatial situation models: providing maps (Barnes et al., 2014; Morrow et al., 1987; 1989), making space more causally relevant (Jahn, 2004), and the use of explicit instructions. However, readers and listeners of narratives are rarely provided with a map of the story setting in normal situations[2] and adding causal relevance would make a comparison between spatial representations of narratives and non-narratives unfeasible because non-narrative passages and texts do not typically include a causal dimension. Therefore, the use of explicit spatial instructions would be most suitable. My first question was whether, under explicit instructions to attend to the spatial dimension of a narrative or description, children are able to accurately represent this information.

Motivated by both previous research and theory, I compared children's ability to represent spatial information from a narrative versus a non-narrative description. Recall that children in a previous study had difficulty constructing models of a six-location described space (Uttal et al., 2006). Does performance differ when spatial information is offered in the form of a narrative? I suggested above that the processes underlying narrative versus non-narrative

[2] The exception to this is epic fantasy novels, in which one can often find a map of the "land" in which the story takes place on the inside cover. These maps typically present the narrative places on the scale of whole lands or kingdoms, at not at a scale that may be mostly readily incorporated into representations of single events or chains of events. It may take a character days of travel to arrive at one destination on the map from an adjacent location. Still, it is a question for future research whether the provision of these maps may help in the process of comprehension. Popular examples include J.R.R. Tolkein's Middle Earth, Ursula LeGuin's Eathsea, and George R.R. Martin's Seven Kingdoms.

processing may be fundamentally different, and the features of the representations derived from these two types of language may also be different.

Recall that there are three common ways in which adults' spatial situation models have been studied in the past: physical representations, inference questions, and processing time. I decided to use physical representation as a dependent measure in these studies, because they allow a comparison of spatial representations of narrative and non-narrative passages, and because I wanted to investigate the presence and level of accuracy of these representations before investigating spontaneous construction. Across Studies 1 and 2, I used a novel neighbourhood-building task which required participants to arrange model pieces (e.g., a house, a fire station) in a manner consistent with what they heard in the passage.

In Study 1, I compared 7-year-old children's and adults' abilities to construct spatial representations of narratives and non-narrative descriptions. Seven-year-olds were chosen because it is at this age that children begin regularly encountering texts that they must mentally construct, without the support of any visuals from pictures or illustrations (Ontario Ministry of Education, 2006). Many children begin reading short novels at this age and often hear stories read aloud in class.

I also investigated whether certain cognitive and linguistic abilities were related to children's spatial situation model construction, including comprehension, verbal ability, spatial ability, and working memory. If children process narrative and non-narrative passages in different ways, we may expect different abilities to be associated with performance on the spatial situation model task depending on which passage they hear.

Study 1: Children's ability to construct spatial situation models of narratives compared to descriptions

Method

Participants

Participants were 44 7-year-old children (*M* = 7.56 years, *SD* = 0.24, range = 7.17 to 8.0, months; 22 girls) and 44 adult undergraduate and graduate students (*M* = 23.3 years, *SD* = 3.0 years, range = 18 to 30, 28 females). All children were recruited through a laboratory database and were in Canadian second grade. Adults were recruited by word-of-mouth in a Psychology Department or through an undergraduate research participant pool, through which participants could receive half a study credit for their participation. Children and adults both participated in the spatial situation model task, but only children completed the additional measures. All data collected from participants was included in the following analyses, with the exception of data from 5 participants on the sentence span test, discussed in more detail below.

Spatial situation model (SSM) task

Participants were randomly assigned to one of two conditions: *narrative* (*N* = 22 children, 22 adults) or *description* (*N* = 22 children, 22 adults) and heard one of one of two corresponding passages about a character's neighbourhood, which were pre-recorded using Audacity 2.0 software (Audacity Developer Team, 2012). The passages are displayed in Appendix A. Participants in the *narrative* condition heard about a child who bakes cookies, leaves her house, and delivers them to four landmarks in the neighbourhood (a fire station, a vet's office, a library, and a toy store). In this passage, the relative position of the landmarks comes about through the character's movement through space; for example, the character is described as walking "over the bridge to the library that's across the river from her house." Participants in the description condition heard a description of the same five landmarks (house, fire station, vet's office, library, and toy store) without the presence of a character moving between them. In this passage, the relative position of the landmarks is explicitly stated; for example, the library is described as being "across the river from Molly's house, over the bridge". The passages in both conditions were designed to be as similar as possible, with the critical difference between the two being the presence of a goal-driven character moving through space and carrying out actions to achieve her goals. The narrative passage also included a three-sentence introduction that presented the character's motivations for visiting the landmarks in the neighbourhood. Female participants heard the narrative or description passage with a girl named Molly as the character, whereas male participants heard the same passages with a boy named Max.

Participants sat at a table with the laptop that presented the stories in front of them. They were able to click through the sentences of the story at their own pace.

Participants in the narrative condition were given the following instructions prior to hearing the passage: *"You're going to hear a story about a girl (boy) named Molly's (Max's) neighbourhood on this laptop. I would like you to imagine what her (his) neighbourhood looks like as you're listening to it, because I'm going to ask you to build a model of Molly's (Max's) neighbourhood later. You will listen to it twice before you build the model."*

Participants in the description condition were given the following instructions prior to hearing the passage: *"You're going to hear about a girl (boy) named Molly's (Max's) neighbourhood. I would like you to imagine what her (his) neighbourhood looks like as you're listening to it, because I'm going to ask you to build a model of Molly's (Max's) neighbourhood later. You will listen to it twice before you build the model."*

After having listened to the passage twice, participants in both conditions were asked, "Can you build Molly's (Max's) neighbourhood using these pieces?". The laptop was moved out of the way and participants were presented with a box with the following model pieces placed randomly within it: house, fire station, veterinarian's office, library, toy store, road, river, and bridge (see Figure 1). The model pieces were made for the study using various craft supplies. Participants were provided with labels for the pieces if they asked (e.g., "that's the library."), although the identity of most of the pieces was evident due to a sign on all but Max's/Molly's house. If children indicated that they forgot the location of a piece, they were told, "Try to remember what it said on the computer", and if they indicated further uncertainty, were told, "Put it wherever you think it goes best." When participants had placed all the pieces, they were asked, "Okay. Is everything where you want it to be?" If they rearranged pieces, they were asked the question again until they indicated they were finished. At this point, they were told, "Molly's (Max's) neighbourhood looks great. Shall we put the pieces away?"

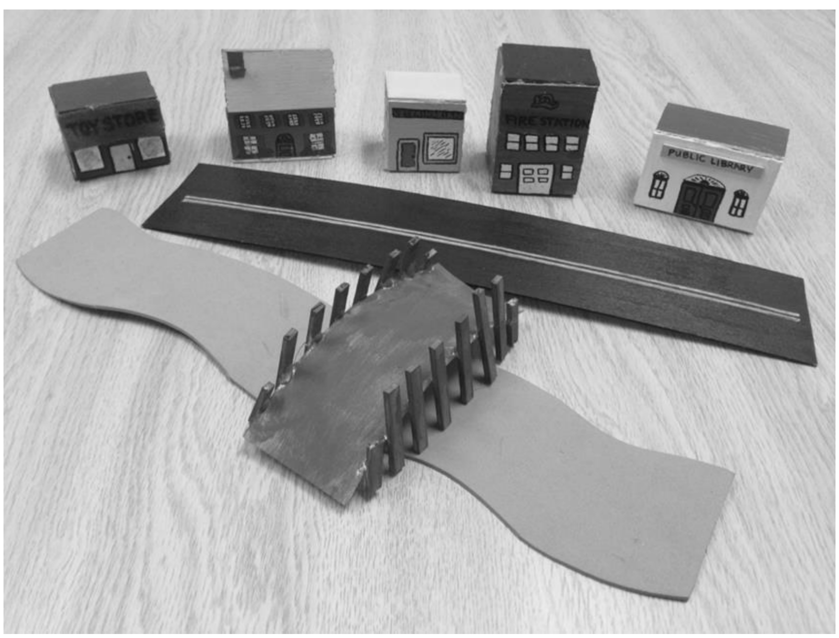

Figure 1. Model pieces used for the spatial situation model task in Studies 1 and 2.

Coding

Each session was video recorded for later analysis. When watching the video for each child, I noted the order in which the child placed the model pieces in *deliberate* positions (i.e., some children removed all the pieces from the box and placed them on the table, before placing them in the locations that represent the neighbourhood). I took a screen capture of their final placement of the pieces. Figure 2 presents an example of one such screen capture. The adults' participation was not video recorded, but a research assistant noted the order in which they placed the model pieces in deliberate positions, and took a photograph of their final placement of the pieces. Using the screen captures or photographs, I coded each participants' final model. An independent coder, blind to participant condition and the purpose of the study, also coded each participant's placement based upon the image provided. Coding considered only the meaningful relations between landmarks in the neighbourhood (i.e., metric and directional information was not considered). The following criteria were used for coding: house beside river, fire station beside house, vet's office across street from fire station, library across river from house, and toy store beside library. Participants received 1 point for each of the five landmarks that was correctly placed, and could therefore receive a score ranging from 0 to 5. For example, the child whose screen capture is displayed in Figure 2 received 1 point for the house beside the river, 1 point for the fire station beside the house, 1 point for the vet across the street from the fire station, and 1 point for the library across the river from the house, for a total of 4 points.

To calculate coding agreement, I compared the 440 coding decisions made by each coder (5 decisions for 88 participants). Coding agreement was excellent, with the two coders agreeing on 418 of 440 codes provided (95%, Cohen's $\kappa = .89$).

Figure 2. One child's final model of the neighbourhood described in the passage (Study 1). Labels were added for the reference of coders after the screen capture was taken. (L = library, H = Molly's/Max's house, F = fire station, T = toy store, V = vet's office.)

Additional Measures

Recall that only children and not adults completed the additional measures beyond the SSM task. This was due to the lack of clear, equivalent narrative comprehension, verbal working memory, and spatial ability measures for children and adults, and the fact that children were the primary population of interest.

Narrative comprehension

Two stories were chosen from the Neale Analysis of Reading Ability Test (NARA; Neale, 1997), a standardized tool designed to assess children's reading accuracy and comprehension between the ages of 6 and 12. The stories were selected because they included details about settings. Although the tool is designed to be a reading test, children listened to the stories because the remainder of the tasks in the study involved story listening. Due to well-documented dissociations between children's comprehension and decoding (i.e., word reading) abilities (cf. Oakhill, Cain, & Bryant, 2003), I decided to present all stories aurally. Because only a selection of the stories was used and standardized conditions were not followed, norms could not be calculated, and raw scores alone were used. After listening to each story on headphones, children were asked 8 comprehension questions from the NARA, which yielded a score out of 16 for each participant. The task takes approximately 8 minutes to complete.

Oral comprehension

The Oral Comprehension subtest from the Woodcock-Johnson Tests of Achievement (Woodcock, McGrew, & Mather, 2001), a measure of language comprehension that uses a cloze procedure, was also administered. In this task, participants listen to sentences and short passages of increasing difficulty and are asked to provide a word to complete the passage. Appropriate completion depends on having processed and comprehended the passage as a whole. In some cases, there may be multiple correct answers. The test is terminated when the participant provides six wrong answers across the whole test. The task takes approximately 10 minutes to complete.

Vocabulary (General language ability)

Children completed the Picture Vocabulary subtest from the Woodcock-Johnson Tests of Achievement (Woodcock et al., 2001), as a measure of general language ability. In this expressive vocabulary test, participants are asked to provide a label for pictures of increasing difficulty. The test is terminated when the participant provides six wrong labels across the whole test. The task takes approximately 5 minutes to complete.

Verbal working memory

A sentence span test, a test of verbal working memory, adapted from the widely-used reading span test (Daneman & Carpenter, 1980) by Swanson, Cochran, & Ewers (1989), was administered. In this task, participants are presented with two to five unrelated sentences on a screen and are asked to read them aloud. They are asked to remember the last word from each sentence. To ensure participants are paying attention to sentences as a whole and not just the final words, they are asked a factual comprehension question about one of the sentences before being cued to recall the words. Participants only receive credit for recalling words on sets for which they have answered the comprehension question correctly. Participants read two sets of two sentences, before proceeding to larger sets of sentences. The maximum score is 28. The task takes approximately 5 minutes to complete. Performance on reading span tests has been shown to be strongly related to reading comprehension in adults (Daneman & Merikle, 1996).

Spatial ability

A mental rotation test (Levine, Huttenlocher, Taylor, & Langrock, 1999) was included as a measure of children's spatial ability. On this test, children are shown a page that includes a picture of two pieces, as well as four pictures of whole shapes. They are asked to select the shape the two pieces would make if put together. See Figure 3 for a sample item. Items require mental translation and/or rotation of the pieces to arrive at the correct answer. Upon presentation of the first item, children are given the instruction, "Look at these pieces. And look at these pictures. Can you point to the picture the pieces make if you put them together?" They receive a total of 32 trials. The task takes approximately 8 minutes to complete. Denis (1996) found that adults' performance on mental rotation and visualization tests predicts performance on tasks requiring the construction of spatial representations from spatial descriptions. Whether spatial ability and performance on SSM narrative tasks is similarly related is currently unknown.

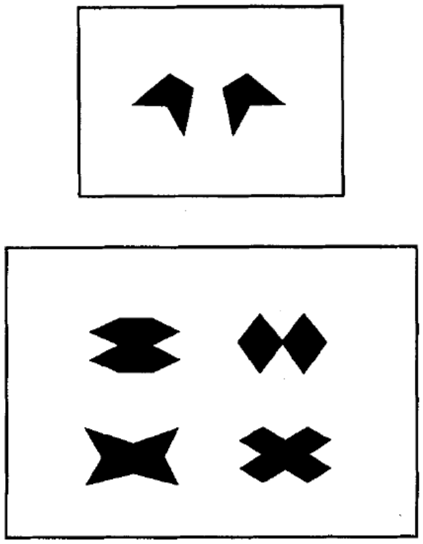

Figure 3. Sample item from the mental rotation task used in Study 1 (Levine et al., 1999). Children must select from the four pictures in the lower box which shape the two pieces in the upper box would make if put together.

Results

Spatial Situation Model (SSM) Task

There were no differences in performance between males and females for adults (p = .193) and children on the SSM task (p = .251), so the data for both genders were analyzed together. A 2 x 2 ANOVA with condition (description or narrative) and age group (children or adults) as between-subjects factors revealed that participants in the narrative condition (M = 3.75, SE = 1.24) performed significantly better than those in the description condition (M = 3.02, SE = 1.13), $F(1, 84) = 8.71$, p = .004, $\eta^2_{partial}$ = 0.09. Across both conditions of the SSM task, adults (M = 3.70, SE = 1.23) performed better than children (M = 3.09, SE = 1.17), $F(1, 84) = 6.67$, p = .012, $\eta^2_{partial}$ = 0.08. The age x condition interaction was not significant, p = .854. See Table 1 for condition and age means.

Table 1. *Mean score (SD) on the spatial situation model task in the two conditions by age group (Study 1). Scores collapsed across condition and age group are also shown.*

	Narrative	Description	Both conditions
7-year-olds	3.45 (1.14)	2.68 (1.09)	3.09 (1.17)
Adults	4.05 (1.29)	3.36 (1.09)	3.70 (1.23)
Both ages	3.75 (1.24)	3.02 (1.13)	3.39 (1.24)

Spatial situation model task performance and its correlates

Because I was interested in exploring whether different processes may underlie the construction of spatial representations depending on whether the information is presented in the form of a narrative or a description, I conducted correlation analyses to investigate whether children's performance on the two different conditions of the task was associated with performance on different measures[3]. Pearson correlation values are presented in Table 2. Children's performance in the narrative condition was uniquely correlated with their performance on the narrative comprehension measure. Performance in the description condition was uniquely correlated with performance on the verbal working memory measure. Both narrative and description performance were correlated with performance on the oral comprehension measure. All other correlations were non-significant.

[3] Regression analyses were not conducted, because the sample size was substantially smaller than recommended for this type of analysis (Green, 1991). Because the expected *R* is heavily influenced by sample size and number of predictors (Field, 2005), the expected *R* in this case for 5 predictors and 44 cases is 5/43 (k/n-1) = .11. Although this is a relatively small effect size according to Cohen's criteria (Cohen, 1992), it is substantially larger than would be expected from random data with a larger number of cases.

Table 2. *Correlations between spatial situation model task score and scores on other tasks, separated by condition (narrative vs. description) (Study 1). *p < .05, **p < .01.*

SSM Score	Narrative Comp.	Oral Comp.	Vocab (GLA)	Verbal WM (Sentence Span)	Spatial (Mental Rotation)
Narrative	.70**	.43*	.36	-.07	.006
Description	.30	.52*	.38	.54*	.02

Discussion

Both children and adults created more accurate models of the described neighbourhood when they heard about it in the form of a narrative versus a non-narrative description. Additionally, correlation analyses suggest that different cognitive processes may be related to performance on the narrative and description versions of the SSM task. Performance in the narrative condition was strongly correlated with narrative comprehension scores, whereas performance in the description condition was correlated with verbal working memory.

What is the reason for the advantage on the narrative task? It may be the case that the two types of passages were processed in fundamentally different ways; the narrative may have recruited systems that build situation models, whereas the description did not. However, there is also a possibility that the passages were processed in the same way, but participants simply found the narrative more interesting than the description, which maintained their attention and lead to greater success. Although the narrative and description versions were designed to be as similar as possible, the presence of a character in the narrative may have piqued participants' interest, without necessarily engaging a different set of cognitive processes than they engaged during description processing. The possibility that participants enjoyed the narrative passages more will be investigated in Study 2.

If the two types of passages were indeed processed in different ways, we can also consider to what extent these differences are automatic versus deliberate. Individuals may have different objectives when listening to a narrative compared to a descriptive passage. Perhaps when they encounter narratives, listeners have the objective of imagining and immersing themselves in the world, whereas when they encounter descriptions, they may have the objective of gathering information in a more propositional or list-like manner. Thus, differences in performance could be a result of more deliberate and conscious processes, rather than an automatic way in which the two types of passages are processed. This explanation for the differences being due to deliberate processing is less likely than one attributing the differences to automatic processing, because participants were given the same instructions across the two conditions. Participants were told before listening to the passage in each condition that they would have to build the neighbourhood, therefore their objectives should have been the same.

The correlations provide some compelling suggestions about the reason behind the narrative advantage. Of note is the fact that performance on the SSM task was correlated with verbal working memory in the description condition, but not in the narrative condition. There is a possibility that children in the description group held verbatim (or near-verbatim) representations of the sentences in memory, which would explain why children with stronger verbal working memory abilities had an edge on the task. The fact that narrative comprehension was significantly correlated with performance on the narrative version, but not the description version, could mean a few things. Children with strong narrative comprehension skills may have demonstrated such strength because they were better at constructing spatial (and other types of) situation models. That is, the ability to create detailed and accurate situation models might have scaffolded and bolstered children’s comprehension. Or, children may have required a certain level of competence in their comprehension abilities to be able to process the sentences they had heard, before they began constructing a situation model. If the latter explanation is the correct one, however, one might expect performance on the description version of the task to also be related to narrative comprehension, as both required integrating sentence-level information to create a coherent representation. A third possibility is that the children who performed well on both the narrative comprehension measure and the narrative SSM task may have just been those who enjoyed stories more.

Motivation for Study 2

Performance in Study 1 was better in the narrative condition than the description condition. There are three key ways in which the narrative and description versions in Study 1 differed. First, in the narrative, participants were presented with a character with specific goals (i.e., to deliver cookies) that motivated her to travel to the various landmarks. This may have given participants the opportunity to construct a multidimensional situation model that supported the construction of their spatial representation. Perhaps including goals, characters, and actions through space scaffolded the construction of a spatial representation that enabled listeners to create an event-based model of the story world.

Second, the narrative invited participants to take a perspective *within* the narrative, whereas the description may have encouraged participants to take more of a bird's eye view of the space. This distinction would be similar to that between route and survey perspectives, respectively. If participants are inclined to step into characters' shoes, as suggested by previous studies (e.g., Fecica & O'Neill, 2010; Morrow et al., 1987; 1989; O'Neill & Shultis, 2007; Rall & Harris, 2000), perhaps they take on something of a route perspective when processing a narrative. However, this explanation for the difference between the two conditions may be less likely, because previous studies have demonstrated that adults' spatial representations are essentially the same whether they are derived from survey or route descriptions (Perrig & Kintsch, 1985; Taylor & Tversky, 1992).

Third, the narrative version included temporal terms, such as "then" and "finally". Perhaps it was neither the opportunity to construct a multi-dimensional situational model nor the opportunity to take a perspective within space, but merely the temporal sequence imposed by a narrative that helped participants in the narrative condition to structure their representation.

In Study 2, I sought to investigate the observed difference in performance between the narrative and description conditions by controlling for additional differences, and to see whether the relationship between performance on the SSM task and the secondary measures would replicate.

Study 2: A further investigation of the narrative advantage observed in Study 1

In Study 1, we saw that children and adults had greater success on a task requiring them to build spatial representations when the represented space was presented in the form of a narrative, rather than a description. It is possible that this advantage was not due to the passage being a narrative, but to other features of the passage. The narrative passage differed from the description not only in the fact that it was a narrative, but also because it provided a perspective through space, and included temporal terms, such as “then” and “finally”. These features – a perspective through space and temporal terms – can be present in passages that are not narratives (e.g., route descriptions and procedural descriptions, respectively). In a second experiment, I manipulated the presence of a goal-driven character, the opportunity to take a perspective within the space, and the provision of temporal terms to shed light on the narrative advantage.

If the superior performance by participants on the narrative version of the task was not due to the presence of multidimensional building blocks that engage the system that builds situation models, then removing character, intention, and causation should not have a major impact on performance as long as the opportunity to situate oneself in the space and take a perspective is still intact. To investigate this possibility, I created a *route perspective*, which held constant the opportunity to situate oneself within the space, while eliminating all but the spatial and temporal dimensions of the passage. The route perspective could be interpreted as having a temporal component, although the utterances were not meant to describe a series of events unfolding over time, as they were in the original narrative condition. It is not possible to describe a route through space that does not include time (as it is impossible to move through space without passing time).

To investigate the possibility that superior performance on the narrative version was due solely to the presence of temporal terms that imposed a temporal order on the spatial information, I also created a *temporal description* version that was similar to the description condition in the first study, with the additional of temporal terms such as “then” and “finally”.

The narrative passage in Study 1 included a 3-sentence introduction, which also could have driven the observed narrative advantage by providing more context. In Study 2, I reduced the introduction to a single sentence stating the character’s goals, yielding a *stripped narrative* version.

I also asked the children and adults in Study 2 to rate their enjoyment of the passages in each condition to investigate the possibility that participants were more successful in the narrative condition simply because they found the passage more interesting. I did not expect that enjoyment would differ between the conditions.

Children in this study were given additional measures to further investigate the relationship between performance on the primary SSM task and abilities such as verbal working memory and comprehension, as in Study 1. Because 7-year-olds’ performance in Study 1 was not yet at adult level, slightly older children were included in this study. By age 8, children are expected to be able to read mostly independently in Ontario classrooms (Ontario Ministry of Education, 2006), and therefore may be significantly more skilled at building representations from verbal passages as a result of this additional practice.

Method

Participants

Participants were 39 7-year-old (*M* = 7.53 years, *SD* = 0.21, range = 7.0 to 7.83, 20 girls) and 39 8-year-old children (*M* = 8.42 years, *SD* = 0.31, range = 8.0 to 9.0, 19 girls) and 69 adult undergraduate students (*M* = 21.1, *SD* = 2.8 years, range = 17 to 32 years, 35 females). Data from two participants was excluded; one due to parental interference during the testing session, and the other because the child was only 6-years-old (which was not known at the time of recruitment) and required significant assistance to complete all tasks. All children were recruited through a laboratory database or through permission forms in their classroom and were in Canadian second or third grade. Children participated in the laboratory (*N* = 58) or in a quiet room in their school (*N* = 20). Adults were recruited through an undergraduate research participant pool, and could receive a study credit for their participation. Children and adults both participated in the spatial situation model task, but only children completed the additional measures.

Spatial situation model (SSM) task

Participants were randomly assigned to one of three passage types: *stripped narrative* (*N* = 12 7-year-olds, 14 8–year-olds, 23 adults), *route perspective* (*N* = 14 7-year-olds, 12 8–year-olds, 23 adults), or *temporal description* (N = 13 7-year-olds, 13 8–year-olds, 23 adults) and heard one of three corresponding passages about a character's neighbourhood, which were pre-recorded using Audacity 2.0.3 software (Audacity Developer Team, 2012). Unlike the narrative passage in Study 1, which had 3 introductory sentences, the stripped narrative passage included only one sentence of introduction stating the character's motivation for travelling around the neighbourhood (i.e., to deliver invitations). The route perspective included statements in the form one might give if telling someone how to navigate through the neighbourhood (e.g., "to get to the fire station, you walk over the bridge"). Note that the second person was used in this passage, in order to provide a perspective through space without introducing a character[4]. In previous

[4] In piloting, the stripped narrative condition was presented in the second person in order to make the conditions as equivalent as possible (e.g., "You are going to walk through your neighbourhood with your friend Molly to

research investigating individuals' processing of route perspectives, the second person has been used (Perrig & Kintsch, 1985; Taylor & Tversky, 1992). The temporal description described the relationship between the neighbourhood landmarks in the same order as in the other two passages, and was similar to the description passage in Study 1, with the addition of the temporal terms that appeared in the stripped narrative and route perspective passages. Each of the three passages can be found in Appendix B.

Within each passage type, participants could also hear one of two different paths through the neighbourhood. In Path I, the landmark order was the same as in the passages in Study 1. The character's house was mentioned first, followed by the landmark next door, then the landmark across the street, and finally the two landmarks over the river. In Path II, the character's house was mentioned first, followed by the two landmarks over the river, then the landmark next door to the character's house, and finally the landmark across the street. Path I followed a more intuitive route through the neighbourhood, so I expected performance might be better in this condition than in Path II. Half of the participants heard Path I and half heard Path II. I included two different paths in this study to allow a comparison of the order in which participants placed the landmarks in the neighbourhood across conditions (i.e., in order of mention, or otherwise), which may allow some insight into the manner in which individuals have constructed their representation (e.g., holistic versus fragmentary).

Finally, within each passage type, participants could also hear one of two different placements of the landmarks in the neighbourhood. In Version 1, for instance, the library was beside the house, whereas in Version 2, the toy store was beside the house. Both differed from

deliver invitations to your school's fun fair."), but the 4 children who participated expressed confusion over why they were in the story. I did a brief, informal analysis at a large bookstore of books for children in this age range, and found no books, aside from those of the "Choose Your Own Adventure" genre, that included second person perspectives.

the landmarks in Study 1. The arrangement of the landmarks was the same across both versions, relative to the location of the character's house (i.e., one landmark next door, one across the street, and two across the river). I included the alternate versions in this study to ensure there was not something especially memorable about the ordering and placement of landmarks in Study 1. I generated several different possible versions and then pseudo-randomly selected two that did not have any building locations in common with one another.

In summary, the between-subjects variables included: passage type (stripped narrative, route perspective, temporal description), path (i.e., order of mention), and version (i.e., placement of individual landmarks).

The instructions given and the remainder of the procedure were identical to the Study 1, with two exceptions. First, at the end of the task, participants were shown a modified Likert scale for children, depicting faces showing varying levels of enjoyment (Figure 4), and were asked,

> "Can you tell me how much you liked what you heard about Max's/Molly's neighbourhood on the computer? Did you think it was really great, good, OK, not very good, or really bad?"

Participants could provide their answer verbally or by pointing to the corresponding face.

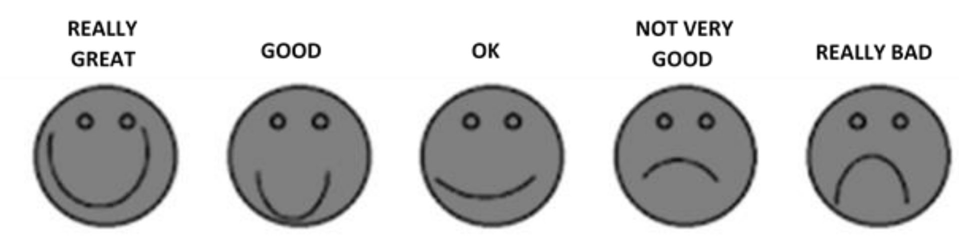

Figure 4. Modified Likert scale used in Study 2 to determine participants' subjective reports of enjoyment of the passages.

Second, to gain some insight into the subjective experience of narrative and non-narrative processing, adult[5] participants were asked the following question:

> "When you were listening to the passage, what strategy do you think you used to try to remember the neighbourhood? Did you try to visualize it, remember the sentences verbally, or did you do something else?"

The order of "visualize" and "remember the sentences verbally" in the question was counterbalanced across participants.

Coding

Coding was conducted as in Study 1. Participants could receive a score ranging from 0 to 5. To calculate coding agreement, I compared the 745 coding decisions made by each coder (5 decisions for 149 participants). Coding agreement was very good, with the two coders agreeing on 684 of 745 codes provided (92%, Cohen's $\kappa = .81$). Participants also received a code for the order in which they placed the landmarks. Excluding the placement of the road, river, and bridge, participants received an overall code of 1 if they placed the items in the order in which they were mentioned in the passage, and a code of 0 if they did not. Reliability coding was not conducted for order coding, because of the highly objective nature of the scoring.

Additional Measures

As in Study 1, only children completed the additional measures beyond the SSM task. Children completed the same measures as in Study 1, with the exception of the mental rotation

[5] Across different studies of narrative comprehension I have conducted in the past, I have asked children informally at the end of the testing session about their introspective experience with narrative processing, using questions such as, "how did you imagine it?" or "what did you do to try to remember it?" The majority of children expressed confusion over these types of questions, therefore I did not include questions about the subjective experience of passage processing to children in Study 2. Previous studies investigating children's metacognition of reading and language comprehension have generally included older children (e.g., Grade 4 and above), and those that have included younger children (e.g., Grade 2) have found that their awareness of comprehension strategies and processes was fairly limited (e.g., Brown, Pressley, van Meter, Schuder, 1996; Myers & Paris, 1978).

task. This was because correlations of close to 0 were found between performance on the mental rotation task and performance on both the narrative and description versions of the task in Study 1, and because it was one of the longer tasks to administer, making the testing session unduly long.

Results

Spatial Situation Model Task

There were no significant differences in performance between males and females for 7-year-olds (p = .878), 8-year-olds (p = .538) adults (p = .246) on the SSM task, so the data for both genders were analyzed. There was no significant difference between performance on Path I and Path II (p = .135) nor a significant path by condition interaction (p = .267). There also was no significant difference between participants' performance on Versions 1 and 2 of the SSM task (p = .616) nor a significant version by condition interaction (p = .954). When analyzed by age group, these main effects and interactions were also not significant. The data for both Paths and Versions were analyzed together. Path I and II will be considered separately when analyzing participants' ordering of placement.

A 3 x 3 ANOVA with condition (stripped narrative, route perspective, or temporal description) and age group (7-year-olds, 8-year-olds, or adults) as between-subjects factors revealed a marginally significant difference in participants' performance across the 3 conditions, $F(2, 138) = 2.52$, $p = .084$, $\eta^2_{partial} = .035$. There was a significant difference in performance across the 3 age groups, $F(2, 138) = 5.93$, $p = .003$, $\eta^2_{partial} = .079$. There was no significant condition by age interaction, p = .875. Although the main effect of condition was not significant, I was interested in looking at the difference between conditions, as this was the main question of interest in the present study. Participants in the stripped narrative condition performed significantly better than those in the temporal description condition (Tukey's HSD p = .032), though not significantly better than those in the route perspective condition (Tukey's HSD p = .118). The difference between participants' performance on the route perspective versus the temporal description (Tukey's HSD p = .550) was also not significant. Adults' performance was significantly better than that of 7-year-olds (Tukey's HSD p = .001), but, surprisingly, was not significantly better than 8-year-olds' performance (Tukey's HSD p = .257). Moreover, 7- and 8-year-olds' performance differed significantly from one another (Tukey's HSD p = .044). See Table 3 for condition and age means.

Table 3. *Mean score (SD) on the spatial situation model task in the three conditions by age group in Study 2. Scores collapsed across condition and age group are also shown.*

	Stripped Narrative	Route Perspective	Temporal Description	All conditions
7-year-olds	3.08 (1.19)	2.86 (1.35)	2.83 (1.34)	2.92 (1.27)
8-year-olds	3.85 (0.99)	3.33 (1.37)	3.29 (1.07)	3.49 (1.14)
Adults	4.22 (1.24)	3.74 (1.18)	3.35 (1.27)	3.77 (1.26)
All ages	3.82 (1.24)	3.39 (1.30)	3.20 (1.22)	3.47 (1.27)

Passage enjoyment ratings

Participants' responses to the question about how much they liked the passage they had heard were coded from 1 to 5, with 1 corresponding to "really bad" and 5 corresponding to "really great". Participants across the conditions showed equal enjoyment of the passages, with participants in the stripped narrative (M = 3.90, SD = 0.68), route perspective (M = 3.95, SD = 0.61), and temporal description conditions (M = 3.93, SD = 0.74) reporting, on average, that they thought the passage was "good", p = .916. Children of both ages (7-year-olds: M = 4.16, SD =

0.73; 8-year-olds: $M = 4.16$, $SD = 0.62$) gave significantly more positive ratings than adults ($M = 3.73$, $SD = 0.61$), $F(2, 116) = 6.21$, $p = .003$, $\eta^2_{partial} = 0.097$.

Ordering of placement

I conducted a three-way loglinear analysis, which allows for the comparison of more than two categorical variables. Examining the three categorical variables of interest, (1) condition (stripped narrative, route perspective, temporal description), (2) path (I or II), and (3) order (in order of mention or otherwise), revealed that none of the variables were related to one another. That is, the condition to which participants were assigned and the path they heard were not significantly associated with the order in which they pieced their neighbourhood model together.

Adults' recall strategy

Of those in the stripped narrative condition, the majority of adults reported using visualization to try to remember the passage, while relatively few reported using both visualization and verbalization or verbalization alone. Of those in the route perspective condition, the majority reported using visualization, some reported using both visualization and verbalization, and only 1 reported using verbalization. Those in the temporal description condition were more distributed across the three strategy types. See Figure 5 for the number of participants who reported using each recall strategy in each condition. The association between condition and recall strategy was not significant, χ^2 (4) = 5.62, $p = .233$.

However, when comparing scores of those who reported visualizing vs. verbalizing or doing a combination on the SSM task for each condition, there was a significant difference in the stripped narrative condition only, $F(1, 21) = 12.03$, $p = .003$. (Note that reports of verbalizing and both verbalizing and visualizing were combined for these analyses, due to the small number of participants in some conditions who reported verbalizing.) Adults in the stripped narrative condition who reported visualizing performed significantly better (M = 4.65, *SD* = 0.61) than those who reported verbalizing or using a combination of visualizing and verbalizing (M = 3.00, *SD* = 1.79). Note, however, that the vast majority of individuals in the stripped narrative condition reported visualizing, and there were therefore few participants in some of these comparisons.

When comparing scores between the three conditions for each recall strategy type, there was only a significant difference for those who reported visualizing, $F(1, 41) = 5.38$, $p = .008$, with visualizers performing significantly better in the stripped narrative condition than in both the route perspective (Tukey's HSD $p = .042$) and temporal description conditions (Tukey's HSD $p = .013$). The performance of visualizers in the route perspective and temporal description condition did not differ significantly (Tukey's HSD $p = .982$). There was no difference across conditions for those who reported verbalizing/both ($p = .377$). Figure 5 displays scores by condition and recall strategy.

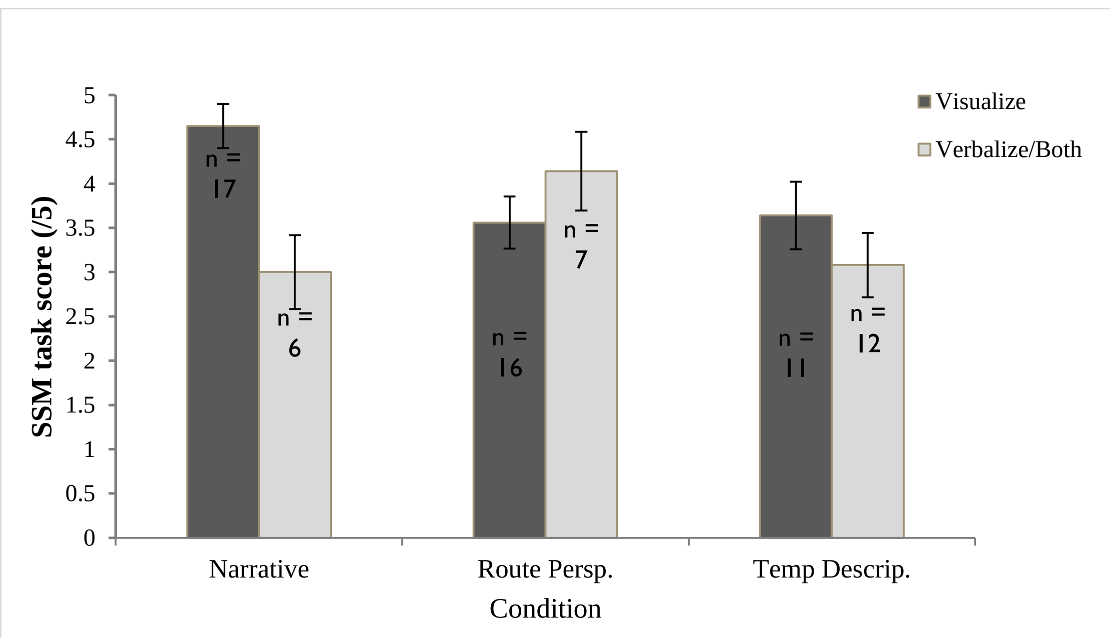

Figure 5. Adults' mean score on the spatial situation model task in the stripped narrative, route perspective, and temporal description conditions according to reported recall strategy (visualize or

verbalize/both) in Study 2. The number of participants in each condition that reported each recall type is displayed within the bars as *n* = X. Error bars display standard error of the mean.

Spatial situation model task performance and its correlates

I again conducted correlation analyses to investigate whether children's performance on the three different conditions of the task was associated with performance on different measures. Pearson correlation values for these correlation analyses are presented in Table 4. Children's performance in the stripped narrative condition was correlated with their performance on the narrative comprehension measure, replicating the result observed in Study 1. Performance in the route perspective condition was correlated with performance on the vocabulary measure, and performance in the temporal description condition was correlated with performance on the verbal working memory measure and the vocabulary measure. Note that in Study 1, participants' performance in both conditions was correlated with oral comprehension, which was not the case in this study. This was likely due to different distributions in performance on the task across the two samples (i.e., in Study 1, there was more of a normal distribution, whereas this distribution was more bimodal in Study 2; for this reason, both Pearson's *r* and Spearman's rho were conducted, but neither were significant).

Table 4. *Correlations between spatial situation model task score and scores on other tasks, separated by condition (stripped narrative vs. route perspective vs. temporal description) (Study 2). *p* < .05*

SSM Score	Narrative Comp.	Oral Comp.	Vocab (GLA)	Verbal WM
Stripped Narrative	.48*	.14	.33	.20
Route Perspective	.29	.26	.53*	.33
Temporal Description	.26	.08	.43*	.41*

Discussion

Study 2 replicated the finding from Study 1 that participants were significantly better at recalling spatial details from a simple narrative than from a description. The presence of temporal terms in the narrative did not appear to be driving this effect, as adding temporal terms to the description passage in Study 2 did not improve performance enough to make it comparable to performance on the narrative. Interestingly, participants' performance in the narrative condition, although better, was not significantly different from performance in the route perspective condition. Participants' performance in the route perspective condition was better than that of participants in the temporal condition, though this difference was not significant. Thus, presenting a perspective through space marginally increased participants' performance. Presenting the spatial information in the form of a true narrative improved performance further.

Differences in interest or enjoyment of the passages across conditions did not seem to be driving the differences in performance observed. I asked participants in Study 2 to rate how much they liked the passages they heard. Ratings of enjoyment were almost identical across the three conditions, suggesting that different levels of interest or enjoyment cannot explain the narrative advantage.

One key way in which the route perspective differed from the other conditions was in the subject of the passage. The route perspective presented a second-person perspective, whereas the narrative presented a third-person perspective, and the temporal description presented no perspective. A study with adults found that participants adopted an internal perspective of a scene during narrative comprehension when the pronouns *you* or *I* were used, but adopted an external perspective when *he* was used (Brunyé, Ditman, Mahoney, Augustyn, & Taylor, 2009). In light of this finding, it is especially interesting that both children's and adults' performance in the present study was marginally better when they heard the third person (i.e., Molly's or Max's perspective) in the narrative condition than when they heard the second person in the route perspective condition. The findings from the present study do not tell us whether participants adopted an internal perspective (i.e., imagining they were Molly moving through the town) or an external perspective (i.e., as an onlooker), but raise questions about why narrative processing was more effective than second-person route perspective processing for building the spatial representation.

As in Study 1, an interesting pattern of correlations between SSM task performance and performance on the cognitive and linguistic ability measures emerged. Performance in the narrative condition was correlated with narrative comprehension, whereas performance in the temporal description condition was correlated with verbal working memory. Beyond the patterns of significance observed, it is interesting to note that the patterns of correlations for the route perspective were much more similar to the temporal description than the narrative. This suggests that route perspective processing may have relied upon, or at least was associated with, more similar cognitive processes to description processing than narrative processing. Also of note is the pattern of correlations with the verbal working memory measure; the correlation with stripped narrative performance was small, the correlation with temporal description performance was relatively large, and the correlation with route perspective performance was intermediate to the two. This pattern suggests an increasing reliance on verbal processing from narrative to route perspective to temporal description.

The adults' reports of recall strategies are consonant with these conclusions. Adults in the narrative condition overwhelmingly reported visualizing. Visualizing was also reported frequently amongst those in the route perspective condition, but a quarter of participants also reported a combination of visualizing and verbalizing. Those in the temporal description condition reported visualizing about half of the time, verbalizing about 20% of the time, and a combination a third of the time. Analyses comparing performance on the spatial situation model task according to recall strategy and condition lend support to the notion that narrative and visualizing may be closely intertwined. Individuals who reported visualizing performed significantly better than those who reported verbalizing in the narrative condition only. Whether one used visual or verbal processing did not appear to matter for performance in the route perspective and temporal description conditions. Additionally, performance differed significantly across condition only for those who reported visualizing. These findings suggest both that narrative language seems to promote visualization and that visualization is a particularly good strategy for processing narratives, but is perhaps less well-suited to other types of language processing. Although introspection has its limitations, these results lend some support to the hypothesis that narrative processing is inherently different from non-social, non-narrative processing.

General Discussion – Studies 1 and 2

When they encountered the same spatial information in different passage types, children and adults in Study 1 constructed more accurate spatial models after they heard a narrative compared to a non-narrative description. In Study 2, even when a perspective through space was added to one condition (route perspective) and temporal terms to another (temporal description), performance was still superior in the narrative condition. Children's performance across the two studies in the narrative conditions was correlated with narrative comprehension, whereas performance in the description conditions was correlated with verbal working memory.

In order to succeed on the spatial situation model task used in Studies 1 and 2, participants needed to construct a representation of the incoming information, hold this representation in memory, and externally reconstruct it using the model pieces. Based upon the nature of the task, I cannot conclude with certainty that individuals were creating situation model-level representations on the task. They may instead have been holding verbatim or propositional representations in memory (i.e., van Dijk & Kintsch's surface form and text-base representations, respectively). If this were the case, however, there would be no reason to assume differences in performance on the task derived from narrative and non-narrative passages, nor any reason to assume differences in correlations with additional measures such as verbal working memory. Based on the observed differences between conditions, I think it is justified to conclude that children and adults in the narrative conditions were constructing situation model-level representations.

Visuospatial versus verbal processing

In the discussion for Study 2, I briefly discussed a finding on adults' adoption of internal versus external perspectives of a scene (Brunyé et al., 2009). The perspective an individual takes during language comprehension – internal or external – might have been the source of variation in performance across conditions in Studies 1 and 2. This explanation assumes, however, that individuals engaged visuospatial processing in both cases. Processing of narratives versus non-narratives may be more drastically different. Individuals may engage in visuospatial versus verbal processing, respectively, in the two cases. In a study with adults, when asked to hold a visuospatial memory load during narrative processing, situation model construction was disrupted, compared to participants who were asked to hold a verbal memory load (Fincher-Kiefer, 2001). This finding suggests that, even when processing narratives that do not have an explicit spatial component, individuals engaged visuospatial perceptual systems to represent the narratives.

The findings of Fincher-Kiefer's study and the correlational findings in Studies 1 and 2 raise the intriguing possibility that narratives and non-narratives may be processed in fundamentally different ways. In particular, the fact that performance on the description conditions of the task was correlated with verbal working memory suggests that verbal memory may be recruited for description processing, but not narrative processing. It is a question for further research whether narrative processing may rely on visuospatial processing to construct a situation model, and whether description processing may rely on verbal processing. In future research, individuals in each of a narrative and description condition could be placed under visuospatial or verbal load. If performance is disrupted by visuospatial load in the narrative condition and by verbal load in the description condition, it would lend strong support to the hypothesis that narrative and non-narrative processing are qualitatively different.

A Note on Individual Differences

The tendency to process information visually or verbally seems to be an area of significant variation between individuals (Bergen, 2012). Where one person may report vividly visualizing a scenery description in a narrative, another may be more drawn in by witty banter between characters. These individuals are referred to as visualizers and verbalizers, respectively (Richardson, 1977). There was substantial individual variation on the SSM task used in Studies 1 and 2. On both conditions in Study 1 (narrative and description), scores ranged from 1 to 5. In Study 2, performance ranged from 1 to 5 in the stripped narrative and route perspective conditions, and from 0 to 5 in the temporal description condition. Future studies could employ a within-subjects design and correlate performance with performance on visuospatial and verbal memory tasks. It may be the case that verbalizers do better on the description version of the task if non-narrative language processing favours such an orientation. But, it could also be the case that even though non-narrative passage may encourage verbal processing, those who are able to impose a visuospatial perspective even when no perspective is offered are those who perform better, though subjective report from adult participants suggests that visualizing may not improve performance over verbalizing when given a non-narrative passage.

Developmental Differences

Although 7-year-olds' performance was significantly poorer than adults' on the SSM task, the 8-year-olds in Study 2 performed at levels comparable to the adults. While surprising, this finding suggests that important developments in children's spatial representations take place between the ages of 7 and 8 years. The increasing demands placed on children to read independently and without the support of visuals likely contributes to this difference.

A less interesting source of variation between children and adults may have been task motivation, which may have led to children's performance being overestimated relative to adults. As reflected in their passage ratings, children found the passages significantly more enjoyable than adults. This is not overly surprising, given than the passages were designed for children and featured a child protagonist. Moreover, children in the studies typically had their parents watching through a one-way mirror, which may have increased their motivation to perform well. Adults, on the other hand, often appeared somewhat disinterested in the task, and may have had little motivation to perform to their full ability.

Conclusion

Studies 1 and 2 provided insight into children's ability to represent spatial information from narrative, and demonstrated that they were more accurate at constructing spatial representations from narratives than from non-narrative descriptions. These findings lend support to the idea that a special mode of narrative thought exists distinctly from non-narrative thought (Bruner, 1986). Future research may investigate the extent to which narrative and non-narrative processing may rely on different cognitive abilities, and whether individual differences and preferences in visual versus verbal processing may lead to differences across conditions.

CHAPTER 3: DO CHILDREN SPONTANEOUSLY REPRESENT CHARACTERS' MOVEMENTS BASED ON THE SPATIAL CONSTRAINTS OF A NARRATIVE WORLD?

Space and setting are integral parts of narratives, often confining and determining the actions of story characters. Harry Potter and friends are forced to rush along an alternate route in order to arrive to class on time when their original path is interrupted by the moving stairs of the Hogwarts Grand Staircase. The winding tunnels of Goblin-town lead to Bilbo Baggin's separation from his group, his eventual discovery of the ring, and close run-ins with Gollum. Indeed, it seems that in some cases, it is difficult, if not impossible, to accurately represent a character's thoughts and actions without also representing the environment in which a story's events unravel.

Children in Studies 1 and 2 were reasonably accurate in their recall of the neighbourhood's landmarks, and had better recall for the neighbourhood landmarks when encountered in a narrative than in non-narrative descriptions. These studies, however, do not tell us about children's ability to construct spatial representations in real-time, during narrative processing, because spatial representations were collected *after* listening to the narrative.

In Studies 1 and 2 and in the study by Barnes et al (2014), in which children learned a model of a marketplace and then listened to a narrative taking place in the market, children's performance on the respective tasks was found to be related to their narrative comprehension abilities, suggesting that the ability to construct spatial representations of narratives may in some way enrich the situation model representations being built and support comprehension. However, like Studies 1 and 2, Barnes et al (2014) did not investigate children's ability to construct spatial representations in real-time, during narrative processing. In Barnes et al's (2014) study, children were presented with a physical model of the narrative world and thus did not have to construct it on their own based on the information presented in the narrative.

In the present study, I investigated whether children were able to represent the space in which a narrative's events are taking place *during* narrative processing. Using an enactment measure, in which children were given a small figurine of the story character and were asked to act out the story as it was narrated through computer speakers, I compared children's ability to enact instructed movements to their enactment of movements that must be inferred, based on the spatial constraints of the story space. Specifically, I was interested in whether children would make movements up or down imaginary stairs on key sentences. These movements were not critical for comprehension of the passage. Therefore, enactment reflected a tendency to spontaneously represent the spatial layout of the story world and the character's location within it. Because a large body of research suggests that children are adept at tracking a character's perspective from a relatively young age, outlined in the section, *Children's situation models* above, I hypothesized that if children track a character's perspective, then they may track that character's location within space as well. I was also interested in the extent to which children's performance on the enactment measure was predictive of their narrative comprehension, after controlling for other related abilities.

Study 3

Method

Participants

The study included 106 7- and 8-year-old children (*M* = 7.78, *SD* = 0.52, range = 6.92 to 9.00 years, 52 girls, 76 seven-year-olds, *M* = 7.51, *SD* = 0.22, 30 eight-year-olds, *M* = 8.50, *SD* = 0.37). Children were recruited through an existing laboratory database of families who were interested in participating in language development research studies, or through posters and flyers in the community about the specific study.

Character movement task

Stimuli

The story, *Jamie Gets Ready for Summer Camp*¸ was pre-recorded using Audacity 2.0.1 audio software (Audacity Developer Team, 2012) and was presented over computer speakers. The story describes the preparatory activities of a character, Jamie, as he or she gets ready for adventure camp. There were four critical sentences included in the story, two explicit (instructed) and two implicit (inferred), involving Jamie's movements up or down the stairs. A full transcript of the story can be found in Appendix C.

For the instructed movement sentences, Jamie's journey down (*Jamie went downstairs to look for some sunscreen*) or up the stairs (*Jamie went upstairs to his mom's room*) was explicitly stated. For the inferred movement sentences, Jamie's journey up (*He went to his mom's room to ask her if she knew where his backpack was*) or down the stairs (*Jamie picked up his backpack off the playroom floor*) could be inferred only by tracking the relation between Jamie's origin and destination, because it was not explicitly stated in the narration. A playroom was chosen, because of its lack of a canonical location, unlike kitchens or bedrooms. Note that children were not explicitly cued to enact these stair movements in the pre-task instructions, so any such movements were driven by the child's own comprehension and representation of the passage. I reasoned that if children were representing the space through which Jamie was moving, then they should have moved Jamie up or down the stairs if his destination location was on a different floor than his current location (e.g., if Jamie is in the playroom, which is downstairs, and goes to his mom's room, which is upstairs).

Procedure

Children were seated at a table with the experimenter. A space of approximately 2' x 3'on the table directly in front of the child was clear for the child to carry out the enactment of the story, as described below.

Children were given a small figurine of Jamie, with the gender of the character matched to that of the child. They were given the following instructions, *"This is Jamie. You're going to hear a story about Jamie getting ready for his/her very first day of summer camp. What I want you to do is just move Jamie around to act out the story like it's telling you about on the computer. Are you ready?"* The experimenter then clicked a mouse button to play the first sentence of the story. The experimenter clicked to present each subsequent sentence, which she did when the child had clearly finished enacting the previous sentence (by bringing the figurine to a rest for approximately 500ms). Children's entire enactment of the story was video recorded for later coding.

Coding

The video recordings of each child's enactment were coded for four critical movements, two instructed and two inferred, that involved the character moving up or down the stairs. Each child therefore received an instructed score of 0, 1 or 2, an inferred score of 0, 1, or 2, and an overall score of 0 to 4.

During the enactment phase for each of the four critical sentences (i.e., while the sentence was playing until the child's movement stopped and the next sentence began), children's movement of the figurine was coded for unambiguous stair movements. These movements involved, for upstairs movements, lifting the figurine up into the air off the table or slanting the figurine's front upward and tapping it on the table, and for downstairs movements, moving the figurine off the edge of the table to a lower finishing point or slanting the figurine's front downward and tapping it on the table. Recall that children were not explicitly cued to enact these stair movements.

One coder, blind to the purpose of the study, coded all 106 video recordings of children's enactment, while I coded 32 (30%) of the video recordings. Coding agreement was very good (89%, Cohen's $\kappa = .78$), with the two coders agreeing on 114 of the 128 coding decisions they both made (4 decisions for each of 32 participants). Both coders were blind to children's performance on the other measures, detailed below.

Additional measures

Children also completed tasks measuring their narrative comprehension, oral comprehension, general language ability, and verbal working memory, described in detail in the Method section for Study 1. Some of the children in the present study were also participants in Study 1 or 2, or completed additional narrative measures unrelated to the present study. The order of presentation of these tasks was counterbalanced, and no effects of task order were found, nor was there any difference between children who did versus did not participate in other narrative tasks.

Results

Character movement task

I compared 7- and 8-year-old children's enactment of the instructed and inferred movements of the story character during story processing, with age as a between-subjects factor (7- vs. 8-year-olds) and sentence type as a within-subjects factor (instructed vs. inferred sentences). The two age groups did not differ in their frequency of enactment of the character movements when collapsing across sentence type, $p = .622$. Recall that children could receive a score out of 2 for each sentence type (i.e., instructed versus inferred). There was a significant difference between the two sentences types, $F(1, 104) = 76.96$, $p < .001$, $\eta^2_{partial} = 0.43$, with children enacting, on average, more instructed sentence movements ($M = 1.37$, $SD = 0.76$) than inferred sentence movements ($M = 0.57$, $SD = 0.79$)[6]. The age x sentence type interaction was not significant, $p = .786$, indicating that both the younger and older children more frequently enacted the instructed movements than the inferred movements. For the instructed movements, there was no difference in the frequency with which children enacted the movement corresponding to the sentence, *"Jamie went downstairs to look for some sunscreen"* ($M = 0.71$, $SD = 0.46$) than the sentence *"Jamie went upstairs to his mom's room"* ($M = 0.66$, $SD = 0.48$), $p = .372$. For the inferred movements, children were marginally, though not significantly, more likely to enact the upstairs movement corresponding to the sentence, *"He went to his mom's room to ask her if she knew where his backpack was"* ($M = 0.32$, $SD = 0.47$) than the downstairs movement corresponding to the sentence, *"Jamie picked up his backpack off the playroom floor"* ($M = 0.25$, $SD = 0.43$), ($p = .073$).

Relation between character movement task performance and narrative comprehension

I was also interested in whether children's performance on the Character Movement task was predictive of their narrative comprehension abilities. To investigate this possibility, I conducted a hierarchical regression with age, oral comprehension, vocabulary (general language ability), and verbal working memory as predictors. This model (Model 1) was significantly predictive of children's narrative comprehension, $R^2_{adjusted} = .40$, $SE = 2.7$, $F(4,105) = 18.75$, $p <$

[6] Some children failed to enact the instructed movements, and may have done so because of a lack of motivation, a lack of understanding of the task instructions, or poor motor coordination. I conducted the same age x sentence-type ANOVA, treating the instructed movement sentences as screening trials, and excluding the children who did not enact either of these instructed movements. This resulted in the exclusion of 18 participants. Although the mean number of inferred movements increased ($M = 0.67$, $SD = 0.83$), the same pattern of results emerged. Thus, children were significantly more likely to enact instructed movements than inferred movements, even when excluding those children who did not enact the instructed movements.

.001. Oral comprehension and vocabulary, but not age and verbal working memory, were significant predictors. In the second step (Model 2), I included instructed and inferred movements from the character movement task. This model explained additional variance in narrative comprehension over and above the first model, $R^2_{adjusted} = .44$, $SE = 2.40$, $F(6,105) = 14.48$, $p < .001$, $R^2_{change} = .04$, $F_{change}(2, 99) = 3.84$, $p = .025$. Inferred movements were a significant predictor of narrative comprehension, whereas instructed movements were not. Table 5 presents B, SE, and β values for each variable in the two models.

Table 5. *Results of a hierarchical regression with narrative comprehension (adapted NARA) as the dependent measure (Study 3). Significant predictors are shown in bold text.*

	Variable	B	SE B	Β	*t*	*p*
Model 1	Age	0.85	0.49	0.14	1.73	.088
	Oral Comprehension	**0.35**	**0.08**	**0.40**	**4.20**	**<.001**
	Vocabulary Score	**0.33**	**0.11**	**0.27**	**3.07**	**.003**
	Working Memory	0.02	0.06	0.02	0.29	.777
Model 2	Age	0.89	0.48	0.14	1.85	.067
	Oral Comprehension	**0.35**	**0.08**	**0.40**	**4.31**	**<.001**
	Vocabulary Score	**0.30**	**0.11**	**0.25**	**2.81**	**.006**
	Working Memory	0.03	0.06	0.04	0.45	.657
	Instructed Movement	0.11	0.35	0.03	0.31	.760
	Inferred Movement	**0.78**	**0.33**	**0.19**	**2.35**	**.021**

Dependent variable: narrative comprehension (adapted NARA)

Discussion

Children's ability to track and represent a character's movements between an origin and destination location was tested in the present study. Children frequently enacted explicitly mentioned (instructed) movements between locations (e.g., Jamie went downstairs to look for some sunscreen). They less frequently enacted movements that required them to make an inference about the character's path based on prior information presented in the passage (e.g., He went to his mom's room to ask her if she knew where his backpack was). The ability to infer the character's movements was significantly predictive of children's narrative comprehension abilities, even when controlling for other relevant abilities.

Children's enactment of inferred movements

Enacting movements that were not explicitly stated, but had to be inferred, relied on representing the spatial layout of the story's setting (e.g., there is a playroom on the main floor of Jamie's house), as well as the character's current location within it (e.g., Jamie is in the playroom). More specifically, correct enactment of inferred movements meant that children were doing the following: (1) tracking the character's movements and by so doing, (2) building up a spatial representation of the storyworld on-line, and (3) using this spatial framework to continue to track the character's movement and location to allow for unmentioned movements to be made.

A lack of enactment of inferred movements could mean one of a few things. First, the child may have constructed a spatial representation of Jamie's house, but failed to represent the character's movement within it. Given that constructing the spatial representation initially relied upon tracking the character's movement, this possibility is unlikely. Second, the child may have represented the space and the character's movement, but failed to translate this into physical manipulation. Given that the movement of the figurine was quite simple and well within the motor repertoire of 7- and 8-year-olds, the failure to enact inferred movements seems unlikely to be due to a lack of translation from mental representation to physical manipulation, especially because the nature of the movement was the same for explicit and implicit sentences. A third possibility, which I think is more likely, is that the child enacted only on a sentence-by-sentence basis, constructing a piecemeal, rather than holistic representation of Jamie's house.

Because children in this study enacted inferred characters' movements only about 25% of the time, one might argue that children of this age (7 and 8 years) do not spontaneously represent characters' movements along unmentioned, but inferred paths. Recent research by Barnes et al (2014) suggests that, by the age of 9, children are able to infer character movements (although their study did not include children younger than 9). The children in their study responded faster to objects that were along a character's unmentioned path than to objects in other locations after they had memorized the story's setting using a physical model. Note that although the construction of spatial situation models in Barnes' study was not spontaneous, children's *application* of the model when representing unmentioned paths was. Unlike the children in Barnes et al's (2014) study, the children completing the character movement task did not have a physical model available to them. The character movement task was therefore more demanding, but also more representative of real-life scenarios, as children are not typically given a map or model of a story's setting. The paradigm used in the Barnes et al paper could be seen as similar, perhaps, to the situation of seeing a film adaptation of a book before reading the book. In both cases, one has the advantage of having some form of visuospatial representation of the world in which the story takes place, which may support comprehension when one begins reading or listening to a story.

The finding that children in this study did enact inferred movements about 25% of the time suggests that the ability to construct spatial representations that constrain and predict characters' movements is an emerging ability in 7- and 8-year-old children, but is important as it is related to comprehension, as discussed next.

The relationship between enactment and comprehension

Children's ability to infer the character's movements was significantly predictive of their narrative comprehension abilities. As I will argue later in this section, this is a finding that is both robust and generalizable. Because this finding is correlational, a number of different relationships could exist between the two variables to explain this finding.

It could be argued that some third variable underlies both performance in these spatial situation model tasks and in the general comprehension tasks. Perhaps the ability to make inferences, which is an integral aspect of the comprehension process (e.g., Cain, Oakhill, Barnes, & Bryant, 2001) and which was also required to correctly enact sentences like "He went to his mom's room to ask her if she knew where his backpack was" in the present study, is responsible for the observed correlation. However, for two reasons, I think this is likely not the case. First, one would not expect the ability to make inferred movements to account for additional variance in narrative comprehension beyond oral comprehension if it were also simply a measure of inferencing, because the oral comprehension measure also required inferences to be made to arrive at the correct answer. Second, the passage about Jamie was very simple and placed few additional representational demands on children aside from representing the story space and Jamie's location within it. Although the passage would meet most definitions of narrative, its lack of additional comprehension demands made it ideal to measure children's ability to track characters' locations in the absence of having to track multiple goals, mental states, and make inferences. If the child needed to wade through several additional comprehension puzzles in order to represent the spatial information, then we may expect general comprehension abilities to play more of a role. Because this was not the case, even a child with relatively poor comprehension abilities should have been able to follow and process the narrative.

I argue instead that the task testing children's ability to infer character movements was a measure of something other than comprehension or general inferencing abilities, such as the ability to visualize and draw *spatial* inferences. The ability to readily and accurately track characters' locations and movements may help to support comprehension and to construct a richer and more detailed representation of story worlds.

Note that tracking Jamie's location was not crucial for comprehension within the particular passage presented to children. As such, the character movement task may have *underestimated* children's propensity to construct spatial representations during narrative processing. However, tracking characters' movements and location may be crucial for comprehension in other narratives. Findings with adults suggest that they may only construct detailed spatial representations within narratives when doing so is causally relevant (Jahn, 2004), as discussed in the section *Conditions that lead to spatial situation model construction*. If a narrative had been provided to children in which space had more causal relevance, we might have observed more children carrying out the stair movements.

The findings of this study corroborate those of Barnes et al (2014), who used a different experimental paradigm, as well as a different standardized comprehension measure that relied upon a different processing medium (reading vs. listening). In this study, children's ability to infer a character's movement along an unmentioned path was predictive of their reading comprehension abilities. The ability to construct and update a dynamic spatial situation model, measured in the Barnes et al study and in the present study, therefore appears to be integral to the comprehension process. These findings raise the intriguing possibility that the opportunity (in Barnes' study) or ability (in the present study) to construct a spatial representation of the story world provided a framework for representing the events that took place within the story. Thus, it seems that this finding connecting spatial situation model construction and comprehension is robust and generalizable.

These findings further contribute to our understanding of children's narrative comprehension, by demonstrating that the ability to spontaneously construct a spatial representation of the narrative by tracking a character's location, based on information presented in the text alone, is predictive of comprehension abilities. Because the task requires only basic resources, it is possible that, after further validation and replication, it could be used in classrooms as a measure of one aspect of children's comprehension.

Limitations and future directions

There are a few limitations to the present study that are worth noting. First, the character movement task relied on only two enactment movements, which involved the character moving up and down the stairs. Future investigations may include a greater number and variety of movements. Still, it is notable that only two enactment movements significantly predicted children's narrative comprehension abilities. Second, it may have been the case that some of the children in the study were mentally representing the character's movement up and down the stairs, but were not physically manipulating the figurine in a way that reflected this. Future investigations may include other measures, such as reaction time or eye-tracking tasks, to investigate this possibility.

It would also be interesting to investigate in the future whether giving children a map, model, or image of a story's setting ahead of time supports comprehension. A training study with poor comprehenders found that providing children with a physical model of the setting, characters, and objects in a story that they could manipulate helped to bolster their comprehension (Glenberg, Gutierrez, Levin, Japuntich, & Kaschak, 2004). These findings, which support an embodied view of language processing, suggest that providing children who may not spontaneously visualize and mentally simulate aspects of narratives with external supports can help them to eventually mentally represent narratives in the same way.

Together, my findings, along with those of Glenberg et al (2004), raise the possibility that those children who can spontaneously construct representations may be better comprehenders because of it. Those children who spontaneously inferred characters' movements up and down the stairs in the present study were better comprehenders.

CHAPTER 4: ARE CHILDREN ABLE TO DETECT SPATIAL INCONSISTENCIES DURING NARRATIVE PROCESSING?

Study 4

Ellen enjoyed her walk to work each morning. The journey to work took her through a quiet park with a stream running through it. On the other end of the park, she had to climb a steep hill to get to her office building overlooking the park. One particular morning, she was running late for an important meeting. Even though she was never late for work, she knew her boss didn't tolerate lateness. She walked as quickly as she could through the park. When she got through the park, she rushed down the hill toward the building. She made it in just as the meeting was beginning, and could feel her boss's unimpressed stare as she sat down, but didn't dare make eye contact.

When reading the passage above, you likely engaged in a number of different processes. You may have imagined the park with the stream, and the hill that separates it from the office building. You may have felt a sense of urgency as Ellen rushed to get to work before the start of her meeting, and may have imagined her rushing through the park. When you got to the sentence that described Ellen rushing down the hill, this comprehension process may have become less seamless. You may have paused to think about how the action of Ellen rushing down the hill fit with your existing model of the story world. You may have scanned a few sentences back to see if you had been mistaken, or if there was something amiss in the passage.

Stumbling over part of a written passage and thinking, "that didn't make sense" is a familiar experience to most readers. This experience may occur when one has misread or incorrectly parsed an aspect of the text. Underlying such a reaction is the process of comprehension monitoring.

Comprehension monitoring is a metacognitive process that involves evaluating one's ongoing understanding of the content of written or spoken discourse (e.g., Cain, Oakhill, & Bryant, 2004; Skarakis-Doyle, 2002; Wagoner, 1983) and is typically studied by measuring individuals' ability to detect errors in passages. Measures of comprehension monitoring have included verbal and non-verbal expressions of error detection (Skarakis-Doyle, 2002), answers to comprehension questions (Markman, 1979; Zinar, 2000), and processing times following inconsistent versus consistent sentences (van der Schoot, Reijntjes, & van Lieshout, 2012).

How does this error-detection process occur? As individuals encounter new information in a passage, they are thought to engage in situation model *updating*, which involves integrating new information into the existing situation model (e.g., Zwaan & Radvansky, 1998). If individuals truly construct non-verbal representations of the situation described by text or spoken language, then they should have difficulty processing information that conflicts with information presented earlier in a passage, even after the earlier information is gone from working memory.

The Inconsistency Detection Task

The inconsistency detection task (IDT) has been used in several studies with adults to investigate their comprehension monitoring of various situation model dimensions. In the first study to use this task (O'Brien & Albrecht, 1992), participants read a manipulation sentence that established a character's location (e.g., *As Kim stood inside/outside the health club, she felt a little sluggish.*), which was followed by filler sentences, and then a critical sentence which was either consistent or inconsistent with the location manipulation sentence (e.g., *She decided to go outside and stretch her legs a little.*). Note that this sentence is consistent with the earlier statement that Kim was standing *inside* the health club, but inconsistent with the version stating that Kim was standing *outside* the health club. Participants were slower to read the critical sentence (i.e., *She decided to go outside and stretch her legs a little*) if they had read "*Kim stood outside the health club...*" than if they had read "*Kim stood inside the health club…*" earlier. Crucially, the critical sentence was the exact same sentence across conditions. What differed was the location manipulation sentence.

The IDT has been used to investigate other aspects of adults' situation model construction and updating, including tracking characters' goal-related behaviour and the relation between character traits and actions (Albrecht & O'Brien, 1993; Huitema, Dopkins, Klin, & Myers, 1993; O'Brien, Rizella, Albrecht, & Halleran, 1998; Long & Chong, 2001). As readers, we generally expect characters to behave in ways that are consistent with their beliefs, values, and goals. Participants in one study were slower to respond to a sentence about a character ordering a cheeseburger and fries if it was stated earlier in the passage that she was a health nut and strict vegetarian, than if it was stated that she loved eating junk food and did not worry about nutrition (Albrecht & O'Brien, 1993).

Although most individuals show the pattern of slower reading times in response to inconsistent versus consistent sentences, those with poor comprehension abilities do not. In studies with both adults (Long & Chong, 2001) and children (van der Schoot et al., 2012), poor comprehenders did not show the same response delays associated with the processing of inconsistent information, indicating that they do not detect these inconsistencies. Poor comprehenders in these studies seemed to be capable of holding sentence-level representations of narratives in working memory, as evidenced by their ability to detect inconsistencies in adjacent sentences. When inconsistent sentences were separated by additional prose, poor comprehenders failed to detect inconsistencies, presumably because they failed to construct a situation model-level representation of the text (van der Schoot et al., 2012). In other words, van der Schoot and colleagues would argue that poor comprehenders never get to the stage of stumbling as Ellen rushes down the hill to work, because the uphill climb to her office was not part of their model in the first place. Of course, failing to explicitly notice the inconsistency in Ellen's passage at the beginning of this chapter does not imply one is a poor comprehender. Individuals may implicitly recognize inconsistencies (as reflected in their processing times) that may not reach explicit awareness.

The IDT is an ideal measure to address the question of whether children construct situation models *during* narrative processing, because it enables the use of multiple dependent variables that get at both implicit and explicit processing of inconsistencies. Few studies have explored the relationship between implicit and explicit processing, and the relationship between implicit inconsistency detection and higher level comprehension, aside from those mentioned above.

Outline of experiment

To investigate whether children truly incorporate spatial information into the situation models of narratives that they construct during narrative processing, I used the inconsistency detection task (IDT). To my knowledge, only one previous study has used the IDT with children (van der Schoot et al., 2012). The children in van der Schoot et al's (2012) study were 10 to 12 years old, and participated in a reading version of the task. The present study is the first to extend this paradigm to younger children (6-, 7-, and 8-year-olds) and to use a listening version of the task. I will refer to this version of the task as the Inconsistency Detection Task – Listening (IDT-L).

I decided to include 6-year-old children in the present study based on 7- and 8-year-old children's performance in Studies 1, 2, and 3. Given that 8-year-olds' performance in Study 2 was adult-like and was significantly better than that of 7-year-olds, it seemed appropriate to include a slightly younger age group. Unlike the previous 3 studies, the present study did not require children to externally demonstrate their representation (i.e., through model building or enactment), and instead relied upon a processing time measure of implicit processing of narrative spatial information. Studies 1 through 3 seem to have captured children's spatial situation model representations at a time when they are undergoing significant development, but it is unknown whether children will have more or less difficulty with a task requiring spontaneous and implicit processing. The spatial situation model task used in Studies 1 and 2 may have underestimated children's ability to represent narrative spatial information due to the memory demands placed on participants. On the other hand, the task may have overestimated this ability because participants were explicitly instructed to recall space.

Because it was uncertain at the time of study design whether children spontaneously incorporate spatial information into their situation model, I was interested in comparing children's ability to detect inconsistencies in the spatial dimension to inconsistencies along a dimension children are well-known to track from a young age: goal-directed behaviour. Both in the real world and in the realm of narratives, children are able to monitor, impute, and infer individuals' goals, desires, and preferences from a young age (e.g., Fecica & O'Neill, 2010; Hamlin, Newman, & Wynn, 2009; O'Neill & Shultis, 2007; Repacholi & Gopnik, 1997; Woodward, 1998). If children did not show a difference in listening times between inconsistent and consistent sentences about space, it would be difficult to conclude whether children were not incorporating space into their situation model, or whether the IDT-L is simply an inappropriate paradigm for children this young. Because we can be reasonably certain that children of the age in this study track goals and motivations, their performance on stories with inconsistencies versus consistencies in characters' goals and actions served to validate the IDT-L as a measure, and to offer a point of comparison for performance on the spatial stories.

As such, the present study had the following objectives: to validate a listening time version of the IDT-L with younger children (6-, 7-, and 8-year-olds), to investigate children's ability to represent spatial information in narratives, and to compare their ability to represent spatial information versus protagonists' goals.

Method

Participants

The study included 29 6-year-olds (*M* = 6.50, *SD* = 0.29 years, 14 girls), 30 7-year-olds (*M* = 7.44 years, *SD* = 0.27, 15 girls), and 30 8-eight year-olds (*M* = 8.43, *SD* = 0.31 years, 16 girls). Data was excluded from a 6-year-old who was not fluent in English, a 7-year-old who had Autism and related learning delays, and an 8-year-old who was talking throughout the task and had several extreme reaction times. Data was unavailable for 3 additional children because the E-Prime program crashed before the end of the task. Children were recruited through a laboratory database or through information letters in their classrooms.

Inconsistency Detection Task – Listening (IDT-L): Design

I developed a set of 18 9-sentence narratives for use in the IDT-L. These narratives all followed the structure outline in Table 7. In creating these narratives, I incorporated, wherever possible, examples from the literature that have been used in studies of adults' situation model construction. The space narratives were based upon findings about adults' representations of the spatial relationship between a character and object (Glenberg et al., 1987; spatial foregrounding, Zwaan & Radvansky, 1998), spatial-temporal interaction (Rapp & Taylor, 2004) and character location relative to a destination (O'Brien & Albrecht, 1992). The goal narratives were based upon findings on adults' and children's ability to track characters' goal-related behaviour (Albrecht & O'Brien, 1993; Lynch & van den Broek, 2007; van den Broek, Lynch, Naslund, Ievers-Landis, & Verduin, 2003), desires and preferences (Albrecht & O'Brien, 1993), and eagerness for an activity (Fecica & O'Neill, 2010). There were two versions of each narrative: one inconsistent and one consistent. The only sentence that differed between the two versions was a manipulation sentence, which set up the critical sentence to be either consistent or inconsistent with it later in the story. The critical sentence, on which processing times were of most interest, was identical across the two versions. Examples of 3 space narratives and 3 goal narratives can be found in Appendix D.

Children listened to a total of 18 stories and heard either the inconsistent or consistent version of each story. Of these 18 stories, 14 were experimental and 4 were filler stories. Filler stories contained no inconsistencies and did not focus on spatial or goal information (e.g., a story about a child performing in a school music concert). These were included to ensure there were more consistent stories than inconsistent stories, so children would not begin to expect inconsistencies as they progressed through the task. Children heard the stories in one of 4 different pre-determined orders. Order was not fully randomized, because I wanted to ensure that children did not hear two inconsistent stories in a row, or two stories of the same dimension (space or goal) in a row. For each order, the stories were placed into two blocks to allow for a short break. Each block comprised 9 stories. Across both blocks, each child heard 7 consistent (4 space, 3 goal), 7 inconsistent (4 space, 3 goal), and 4 filler stories.

To ensure that the inconsistent and consistent stories were judged as intended, 8 adults judged the consistency of half of the stories (either the consistent or inconsistent version of each). Using written versions of the stories, they were asked to circle whether each story was inconsistent or consistent, and were asked to briefly describe any inconsistencies they had identified. All but one of the inconsistent stories were identified as such. I revised this story and 2 adult judges further judged it as consistent/inconsistent. Some adults also identified points of confusion in stories that were not intended (e.g., a boy of an unspecified age bikes by himself to his aunt's house), and minor modifications to the stories were made to remove these areas of potential confusion.

The stories were recorded, one sentence at a time, using Audacity 2.0.3 software (Audacity Developer Team, 2012) by a female experimenter. For the inconsistent and consistent pairs of each story, as noted above, the only sentence that differed was the manipulation sentence. All sentences were recorded in a neutral, but engaging tone to maintain children's interest. The stories were presented using E-Prime 2.0 software (Schneider, Eschmann, & Zuccolotto, 2002) on a Lenovo ThinkPad E540 computer. The E-Prime program recorded children's *processing time* (PT) as the duration in milliseconds between the end of a sentence and the child's click of either the left or right mouse button.

Inconsistency Detection Task – Listening: Procedure

Children were given the following instructions at the beginning of the task: "For this activity, you're going to listen to a bunch of short stories about different boys and girls who are around your age. All I want you to do is listen carefully, and then I'll ask you <u>one</u> question at the end of each story. Some of these stories might have things about them that are a little mixed up or confusing. If there's anything that you find confusing, you can tell me at <u>the end</u> of the story. Now, are you ready to hear the stories? You will click through them one sentence at a time. When you're finished listening to one sentence and ready to hear the next one, you can just click the mouse button. You can click to start the first story whenever you're ready. "

Each story began with the title of the story presented in black text on a white background. The title of each story was the name of the main character (e.g., “Sam”, “Stephanie”). A white screen was displayed as children clicked through the 9 sentences of each story. At the end of the story, “The End” was displayed on the screen.

While the “The End” screen was displayed, I asked the child a comprehension question that referred to the manipulation information. In the case of the example in Table 6, the question was, “Where was Katie’s school?” The questions were identical across the inconsistent and consistent versions of each story, but the correct answer differed (e.g., “at the bottom of the hill” vs “at the top of the hill”, respectively). I recorded children’s answers to the comprehension questions on a scoring sheet and marked them for accuracy at a later point in time. While the “The End” screen was displayed for each story, some children explained inconsistencies they had noticed, as outlined in the task instructions. I did not explicitly ask at the end of each story whether they had noticed anything confusing, as this may have led children to expect they were supposed to find “confusing” aspects in each story. I noted any inconsistencies that children spontaneously mentioned on the scoring sheet. At the end of both the first and second block of 9 stories, I asked children, “how have you liked the stories (so far)?” and “were any of the stories mixed up or confusing?” Again, I noted any inconsistencies mentioned.

Other Tasks

Children also completed the same two stories as children in Studies 1-3 from the Neale Analysis of Reading Ability Test (NARA; Neale, 1997), and the Picture Vocabulary subtest from the Woodcock-Johnson Tests of Achievement (Woodcock et al., 2001). The details of both measures are outlined in the Method section for Study 1.

Table 6. *An example of a spatially inconsistent/consistent story.*

Sentence Type	Example: *Katie*
Intro 1	Katie was getting ready for the first day of school.
Intro 2	She packed her lunch in her new lunch bag and put it in her new backpack.
Intro 3	She was going to walk to school by herself.
Manipulation	*Katie's house was at the bottom of a big hill. Her school was at the top of the hill.* (Consistent) / *Katie's house was at the top of a big hill. Her school was at the bottom of the hill.* (Inconsistent)
Filler 1	She was starting Grade 3.
Filler 2	She couldn't wait to see all of her friends and find out who her teacher would be.
Filler 3	She said goodbye to her mom and dad.
Critical	**Katie started walking up the hill to get to school.**
Conclusion	She made some new friends at school.

Results

Processing time

Before analyzing differences in processing time (PT) across conditions, I first conducted an outlier analysis, excluding any PTs that were 4 standard deviations above or below each participants' mean (as in Fecica & O'Neill, 2010). This resulted in the exclusion of 253 of the total 14094 non-critical PTs across all participants (1.8% of trials). This also resulted in the exclusion of 12 critical PTs for inconsistent stories and 3 critical PTs for consistent stories of the total 1246 critical PTs recorded across all participants (1.2% of critical trials).

There was no significant difference between the 4 story orders in children's PTs, p = .859, so all orders were analyzed together in the following analyses. There was no significant difference between the two genders in children's PTs (p = .197 to .928), so gender was not considered as a variable in subsequent analyses.

To determine whether children's PTs differed on the *critical* sentences depending on consistency, story type, and age, I conducted a 2 x 2 x 3 repeated-measures ANOVA with consistency (inconsistent or consistent) and story type (space or goal) as within-subjects factors, and age (6-, 7-, and 8-year-olds) as a between-subjects factor. Children had significantly slower PTs for inconsistent stories than for consistent stories, $F(1, 86) = 5.71$, $p = .019$, $\eta^2_{partial} = 0.062$. The difference in PTs for the two story types (space stories and goal stories) was marginally significant ($p = .068$), as children took slightly longer to process space stories than goal stories. There was a significant difference in the PTs of the three age groups, $F(2, 86) = 12.24$, $p < .001$, $\eta^2_{partial} = 0.222$. Eight-year-olds had significantly faster PTs than both 7-year-olds (Tukey's HSD $p = .009$) and 6-year-olds (Tukey's HSD $p < .001$). The 6-year-olds and 7-year-olds did not differ significantly from one another in their PTs (Tukey's HSD $p = .151$). None of the interactions were significant, p = .600 to .988. Table 7 displays the mean PTs for each of the critical sentence types by age group. The Inc-Con measure is a calculation of children's average processing times on inconsistent sentences minus their processing time on consistent sentences. For all age groups across both story types (space and goal), children were slower at processing critical sentences for inconsistent stories than consistent ones, with one exception. Six-year-olds showed essentially equal processing times on inconsistent goal stories and consistent goal stories. Figures 6, 7, and 8 display the mean processing times on critical sentences for consistent and inconsistent space and goal story types for 6-, 7-, and 8-year-olds, respectively.

I conducted an additional 2 x 2 x 3 repeated-measures ANOVA with processing time on the manipulation sentence as the dependent measure. There was no effect of consistency (p =

.318), type (p = .325), nor any significant interactions (p = .321 to .800). As with the other analyses, there was a significant main effect of age, $F(2, 86) = 7.41$, $p = .001$, $\eta^2_{partial} = 0.15$.

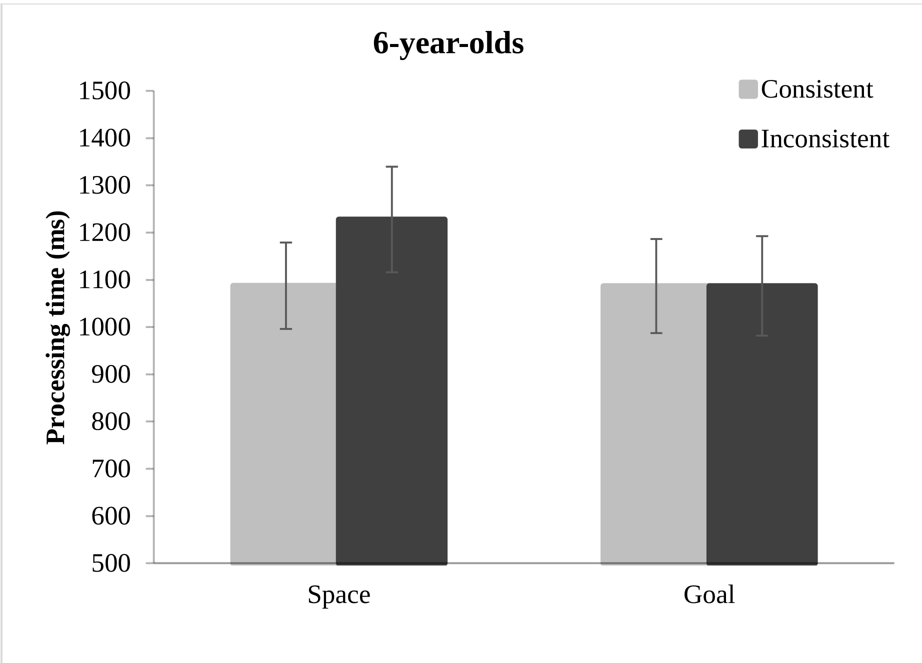

Figure 6. Six-year-olds' mean processing time on critical sentences for consistent and inconsistent space and goal story types in Study 4. Error bars display standard error of the mean.

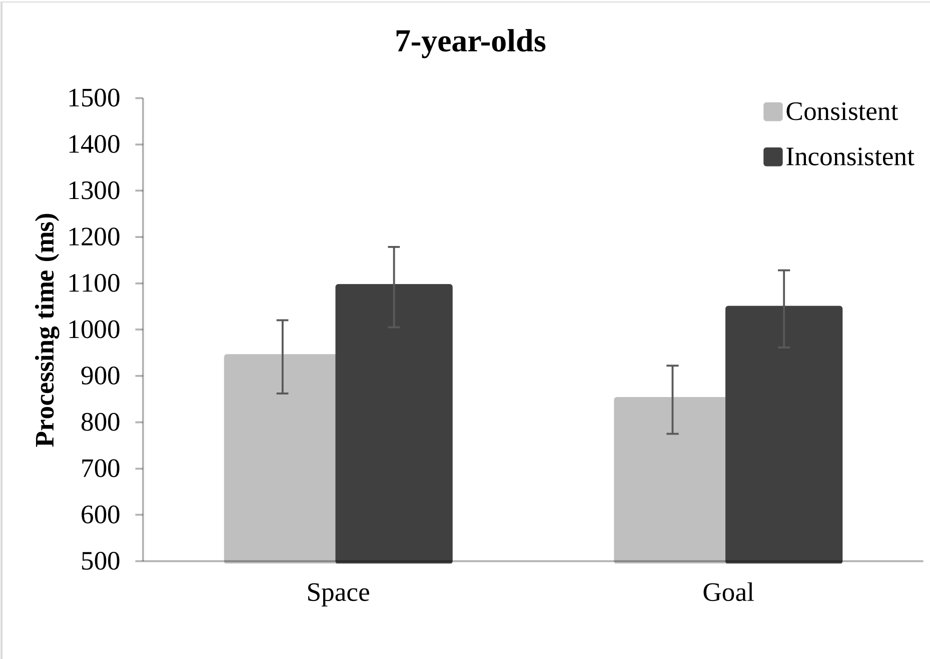

Figure 7. Seven-year-olds' mean processing time on critical sentences for consistent and inconsistent space and goal story types in Study 4. Error bars display standard error of the mean.

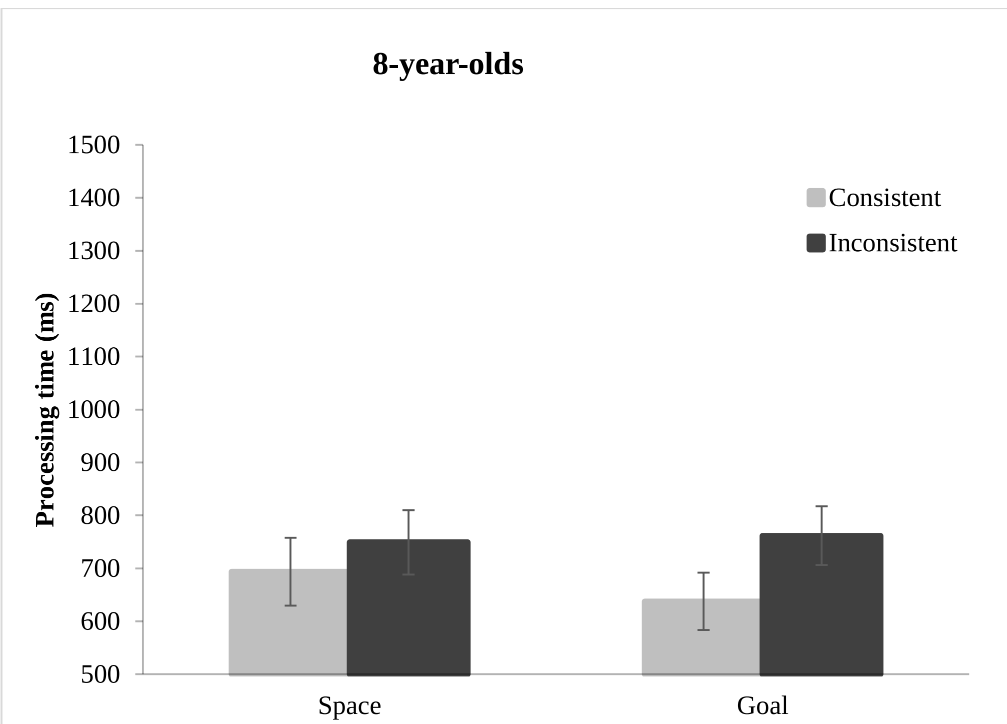

Figure 8. Eight-year-olds' mean processing time on critical sentences for consistent and inconsistent space and goal story types in Study 4. Error bars display standard error of the mean.

Table 7. *Mean processing times (SD) in ms for 6-, 7-, and 8-year-olds in Study 4. Inc = Inconsistent stories, Con = Consistent stories, Inc-Con = difference in PTs between Inconsistent and Consistent stories*

Age Group	Inc	Con	Inc-Con	Space Inc	Space Con	Space Inc-Con	Goal Inc	Goal Con	Goal Inc-Con
6-year-olds	1161.92 (530.15)	1087.16 (415.51)	74.76	1227.58 (601.44)	1087.59 (491.96)	139.99	1087.13 (568.20)	1086.76 (535.58)	0.37
7-year-olds	1007.69 (385.96)	901.79 (360.80)	105.90	1014.27 (474.05)	941.19 (434.77)	73.08	989.84 (456.09)	848.48 (403.11)	141.36
8-year-olds	676.50 (263.88)	657.22 (298.75)	19.28	705.25 (333.24)	693.58 (350.42)	11.67	667.00 (302.23)	610.14 (296.13)	56.86

Comprehension questions

To determine whether children's answers to the comprehension questions (proportion correct) differed depending of consistency, story type (space or goal), and age, I conducted a 2 x 2 x 3 repeated-measures ANOVA with consistency (inconsistent or consistent) and story type (space or goal) as within-subjects factors, and age (6-, 7-, and 8-year-olds) as a between-subjects factor. Recall that the comprehension questions referred to the information in the manipulation sentence. As would be expected, children answered a significantly higher proportion of questions correctly for consistent than for inconsistent stories, $F(1, 86) = 54.52$, $p < .001$, $\eta^2_{partial} = 0.39$. Children answered a greater proportion of questions correctly for space stories than for goal stories, though this difference did not quite reach significance, $F(1, 86) = 3.74$, $p = .057$, $\eta^2_{partial} = .042$. The three age groups did not differ from one another in the proportion of questions answered correctly, $p = .295$. None of the interactions were significant, $p = .213$ to $.995$. Table 8 displays the mean proportion correct for comprehension questions by age group.

Table 8. *Mean proportion of comprehension questions answered correctly (SD) for 6-, 7-, and 8-year-olds in Study 4.*

Age Group	Inc	Con	Space Inc	Space Con	Goal Inc	Goal Con	Total
6-year-olds	.69	.85	.67	.81	.70	.90	.77
	(.16)	(.16)	(.23)	(.23)	(.24)	(.20)	(.12)
7-year-olds	.74	.88	.73	.84	.76	.92	.81
	(.17)	(.14)	(.23)	(.17)	(.25)	(.17)	(.12)
8-year-olds	.76	.89	.76	.87	.76	.91	.82
	(.20)	(.16)	(.21)	(.19)	(.28)	(.21)	(.15)

Explicit mentions of inconsistencies

Children's explicit mentions of inconsistencies were infrequent overall, with children mentioning, on average, fewer than 1 inconsistency (*M* = 0.83, *SD* = 1.18). For example, a child said, "That was confusing because Mary went to buy a ball and then she bought a video game instead". Children mentioned a greater proportion of inconsistencies in characters' goals and actions (*M* = .13, *SD* = .26) than inconsistencies in space (*M* = .08, *SD* = .15), though this difference did not reach significance, $F(1, 86) = 3.44$, $p = .067$, $\eta^2_{partial} = .038$. There was no difference between the age groups in their explicit mention of inconsistencies, $p = .687$, nor was there an interaction between story type (space or goal) and age, $p = .266$.

Relationship between measures

There were few significant correlations between the three types of dependent measures. Children's overall Inconsistent-Consistent PT difference and the Inc-Con PT difference for the two types of stories (space and goal) were not significantly correlated with their responses to comprehension questions, nor their explicit mentions of inconsistencies. As could be expected, correlations within measures were highly significantly correlated (e.g., the correlation between answers to space and goal comprehension questions).

Relationship with NARA comprehension score

Children's performance on the NARA measure of narrative comprehension was not significantly correlated with their Inconsistent-Consistent PT difference overall nor on the two types of stories (space and goal), $p = .503$ to .818. NARA performance also was not correlated with children's explicit mention of inconsistencies overall nor on the two types of stories, $p = .280$ to .306. It was, however, significantly correlated with all scores for the comprehension questions. Correlations and significance values are presented in Table 9.

Table 9. *Correlations between score on the NARA comprehension measure and children's responses to comprehension questions in the IDT.*

	Total Correct	Space Inc	Space Con	Goal Inc	Goal Con
NARA	.47**	.31*	.29*	.28*	.35*

*p < .05, *p < .001

Discussion

Children's processing times were slower when they encountered a sentence that was inconsistent with an earlier aspect of a narrative than when they encountered a sentence that was consistent. These findings held for two types of inconsistencies: (1) when a character engaged in an action that violated the spatial layout of the narrative (e.g., one character grabs onto the hand of another character who is on a different floor in a house) and (2) when a character engaged in an action that was inconsistent with his or her earlier goal (e.g., a character picks flowers for his friend and delivers them to his aunt). Importantly, the actual sentences that children showed processing time differences on were identical across conditions. What differed were the earlier manipulation sentences, which the critical sentence either conflicted with or agreed with. These results provide compelling evidence that children spontaneously track spatial and goal-related information in narrative, and construct situation models that incorporate these types of information.

The present study was the first, to my knowledge, to specifically investigate children's ability to detect *spatial* inconsistencies in narrative. I expected that children would be more adept at detecting inconsistencies in characters' goals and actions than inconsistencies in space. This prediction was not borne out, suggesting that children are just as likely to incorporate the spatial relationship between a character and some other entity into their situation model as they are to incorporate a character's goal. This is especially interesting given the fact that motivational information in the stories likely placed fewer processing demands on the listener than spatial information. Detecting inconsistencies in spatial aspects of a narrative required children to represent the relationship between two entities (i.e., between a character and an object, between two characters, or between a character and a location) and a character's later action, whereas detecting inconsistencies in motivational aspects of a narrative required children to represent only a character's goal and its agreement with to the character's later action.

The results strongly suggest that children hold situation model-level representations in their minds during narrative processing. There remains the possibility that children could hold text-base (sentence-level) representations instead. However, this seems highly unlikely. If children hold text-base representations, but do not create higher-level representations of what the narrative is *about*, then the process of detecting an inconsistency would go something like this: the child must hold in working memory each sentence she encounters when clicking through the narrative. This may not be a verbatim representation, but would be a verbal representation of what was stated sentence-by-sentence. The child would then have to evaluate the consistency between each sentence she encounters and each preceding sentence. This would be quite an arduous process and would almost certainly take longer than 966.58 milliseconds—children's average processing time across all sentences. Instead, a more likely explanation is that children construct holistic, situation model-level representations that are non-verbal in nature.

It is worth noting that all three age groups showed the pattern of slower processing times on inconsistent critical sentences than consistent critical sentences, with one exception. Six-year-olds actually showed equal processing times for goal-related stories. Previous studies have demonstrated that preschoolers are capable of tracking characters' goals and motivations (e.g., Fecica & O'Neill, 2010; O'Neill & Shultis, 2007), so it is unlikely that 6-year-olds in the present study were unable to represent characters' goals and consider actions in light of these goals. A possibility is that the youngest age group was just more likely to accept that characters may change their goals or be forced to act in ways that are inconsistent with their goals. Although motivational information may be the "glue" that holds a narrative together (Bower & Rinck, 1998, p. 112) and may be more central to narrative processing than processing along other dimensions (for a summary, see Zwaan & Radvansky, 1998), inconsistencies along the spatial dimensions are typically *impossible*, whereas inconsistencies along the motivational dimension are more likely to be merely *improbable*.

The inconsistency detection task as a measure of comprehension

The results of the present study suggest that, like adults (Albrecht & O'Brien, 1993; Huitema et al., 1993; O'Brien et al., 1998; Long & Chong, 2001) and older children (van der Schoot et al., 2012), 6- through 8-year-old children are able to detect inconsistencies in narratives they encounter. This study also suggests that the inconsistency detection task is appropriate for use with younger children than have participated in previous studies.

Unlike some previous studies, no relationship was found between performance on the IDT task and children's comprehension. Two studies that compared good and poor comprehenders' performance on the IDT found that good comprehenders showed a delay in processing time in response to inconsistent sentences that were separated from the sentence they violated by filler sentences, whereas poor comprehenders did not (Long & Chong, 2001; van der Schoot et al., 2012). The participants in these studies were categorized as good or poor comprehenders based on their performance on standardized measures of reading comprehension[7]. The comprehension

[7] The previous studies mentioned have conducted their analyses using high and low comprehension groups. I conducted a comparable analysis with the data from the present study by dichotomizing narrative comprehension,

measure used in the present study (i.e., The NARA) was adapted from a standardized reading comprehension test. Six-year-olds in the present study had significant difficulty on the measure and often failed to grasp basic details of the chosen narratives. Based on the findings of previous studies using the IDT, it is possible that the particular comprehension measure used was accountable for this result. The NARA requires children to answer literal and inferential comprehension questions, and perhaps taps a different facet of comprehension than was tested by the IDT-L in the present study. The IDT measures comprehension at an implicit level, whereas the NARA measures comprehension at the explicit level. I will discuss the relationship between implicit and explicit processing in more detail below.

Relationship between measures

The finding that children's processing time differences between inconsistent and consistent sentences (i.e., Inc-Con PT) was not correlated with their answers to comprehension questions or explicit mentions of inconsistencies suggests that future investigations to explore the relationship between implicit and explicit processing of spatial and motivational dimensions of narratives are necessary.

It is important to consider some features of the comprehension questions that may have led to the lack of observed correlations. It may have been the case that children had different pragmatic interpretations of the comprehension questions. Although the comprehension questions were all designed to address the content in the manipulation sentence, this may not have consistently been the interpretation. In the inconsistent version of one story, for example, it is stated that a character "was going to the mall to buy her cousin a soccer ball." The character then buys herself a video game. Children were asked after the story what the character went to

yielding a high and low comprehension group, and entering this as a variable into an ANOVA. There was no difference between the high and low comprehension group on their Inc-Con processing time difference.

the mall to buy. Children may have reasoned that the experimenter was referring to information at different stages in the narrative. Some may have interpreted this question as referring not to the character's initial motivational state in the manipulation sentence, but to the character's purchasing action.

Another possibility is that children who showed a processing time delay in response to inconsistent sentences were using the extra time to reconcile the information with their existing situation model, which may have led to one of two outcomes: (1) disregarding earlier information, assuming it was erroneous or that they had made a mistake in earlier processing, or (2) disregarding incoming information, because it did not fit with the existing model. This may have led to some children answering that the character went to buy a video game, and to others answering that she went to buy a soccer ball after encountering the inconsistency.

The lack of correlation between children's explicit mentions of inconsistencies and their processing time delays in response to inconsistent sentences suggest a potential dissociation between implicit and explicit processing of inconsistencies. Children who stumbled when they reached an inconsistency may not have explicitly recognized the comprehension difficulties they were having. Children's metacognition related to language and reading comprehension seems to be an emerging ability in children of this age. Although children are able to explicitly detect obvious violations in familiar stories from a young age (Skarakis-Doyle, 2002), more advanced metacognition about the comprehension process is likely not achieved until later in elementary school (e.g., Myers & Paris, 1978).

Because the IDT has not previously been used with children of the age of those in the present study, and because the inconsistencies were perhaps more subtle than those used in violation studies with younger children in previous studies (e.g., Markman, 1977; 1979;

Skarakis-Doyle, 2002), the relationship between implicit and explicit monitoring of inconsistencies remains a question for future research.

Are spatial representations character-centred?

The results of the present study suggest that children are able to represent spatial information in narratives from the perspective of a protagonist. All spatial inconsistencies came about through the spatial relationship between a protagonist and some other entity (i.e., an object, another character, or a location). Future studies may investigate children's spontaneous spatial representations that are divorced from the perspective of a character. Consider the following passage:

The Wilson family's house sat empty. Inside the front entrance was a small statue at the bottom of a curved staircase. Everything was perfectly tidy, with the exception of a basketball, left by one of the children at the bottom of the stairs. There was no one checking in on the house while they were vacationing in Aruba, and the dog was staying in a kennel. Suddenly, a rumble caused the whole house to shake. This wasn't the first time the city had been struck by a small earthquake. The basketball bounced down the stairs and knocked the delicate statue over, breaking it into several pieces.

Processing this passage – an object-centred narrative – about the Wilson family's house, and noting the inconsistency, involves tracking the position and movement of an inanimate object (i.e., a basketball). One could also present a passage that involves no movement at all, and include a sentence that spatially contradicts an earlier sentence. Consider the following passage:

Main Street featured many popular attractions. On one side of the street, a small movie theatre sat next to a café. On the other side of the street were a florist's shop and a bookstore.

The street had lanes for cars, buses, and bicycles, and many residents visited the city centre each day. Between the movie theatre and the florist's shop was a skating rink.

Passages such as these could be used in the IDT to investigate whether having an object-centred narrative passage or a non-narrative passage influences the ability to detect spatial inconsistencies. Based on the findings from Studies 1 and 2 of this dissertation, we may expect less of a discrepancy in inconsistent and consistent processing times for non-narrative passages, as individuals may represent non-narrative information differently.

Conclusion

The present study is the first, to my knowledge, to demonstrate that children spontaneously incorporate spatial information into their representations of narratives. Although their attention was not specifically directed to the spatial aspect of the narratives, as it was in Studies 1 and 2, children showed processing time delays when they encountered sentences in passages that were spatially inconsistent with earlier information. Future work may investigate younger children's situation model construction, and may make use of the IDT-L to study children's ability to represent other dimensions of narratives, such as temporal information.

CHAPTER 5: GENERAL DISCUSSION

My focus in the set of studies in this dissertation was on children's ability to construct representations of spatial information in narrative – also termed spatial situation models.

I chose to focus on the abilities of children who are at an age when they are becoming independent readers, and must learn to process texts with little to no visual input. The extent to which individuals construct visuospatial situation models likely depends upon the amount of environmental support provided across situations (Zwaan, 2014). When visual input is provided during narrative comprehension – perhaps when watching a film, reading a picture book, or flipping through a graphic novel – fewer demands are placed on the child to construct a visuospatial situation model. When the child is required to represent abstract text in the absence of visual input, however, visuospatial situation model construction is likely required for comprehension.

Across four studies, I investigated children's deliberate and spontaneous construction of spatial situation models, and operationalized this ability in three different ways. Studies 1 and 2 demonstrated that children were reasonably accurate at constructing spatial representations of narratives, and that this ability was adult-like by the age of 8 years. Moreover, children and adults were more accurate at recalling and reconstructing spatial information from narratives than they were at recalling the same information from descriptions (e.g., the library is across the street from Molly's house), and slightly more accurate than they were at recalling information from route perspectives (e.g., you go across the street to get to the library from Molly's house). However, the spatial situation model task in Studies 1 and 2 used explicit instructions to construct spatial representations and relied on participants' recall of spatial information after listening to the passage. Thus, it likely did not provide an entirely accurate picture of children's and adults' spontaneous construction of spatial situation models. On the one hand, it may have overestimated this ability because participants were explicitly primed to consider space. On the other hand, the memory demands placed on participants may have underestimated this ability.

In Study 3, I attempted to measure children's spontaneous spatial representations on an enactment task (i.e., the character movement task) in which they were not given any explicit instructions to attend to space. This study also included enough participants to reliably be able to look at the predictive relationship using multiple regression between spatial situation model construction and other abilities, such as comprehension. Children were significantly more likely to enact instructed spatial movements than movements that must be inferred. They enacted inferred movements about 25% of the time. Interestingly, however, the inferences underlying these movements were entirely optional. They were not critical for comprehension of the passage, and reflected a tendency to spontaneously represent the spatial layout of the story world and the character's location within it. The tendency to enact these inferred movements was significantly predictive of children's narrative comprehension abilities. Study 3 presented the most compelling evidence for a relationship between children's spatial situation model construction and their comprehension. The character movement task could be used in a classroom or assessment setting as an indicator of children's comprehension, which I discuss further in the *Implications* section below.

In Study 4, I was again interested in investigating children's spontaneous representations of spatial information in narrative, but with a more sensitive task than the character movement task. Using an inconsistency detection task-listening (IDT-L), similar to the IDT used frequently with adults, I found that 6- through 8-year-old children were able to detect inconsistencies in spatial information presented in narratives, and that this ability was comparable to their ability to detect inconsistencies in characters' goals and actions. This study provided intriguing evidence that children can and do represent spatial information in narrative, as they showed delayed processing time when they encountered spatial inconsistencies compared to consistencies. As with the character movement task in Study 3, I did not direct children's attention to the spatial dimension of the narratives. Any spatial inconsistencies they detected were therefore due to their spontaneous processing of narrative spatial information in real time.

What do these studies tell us?

Together, I believe the studies in this dissertation permit the following conclusions. Children spontaneously represent spatial information when processing narratives (Studies 3 and 4). This spatial information is likely represented in the form of a visuospatial situation model, rather than verbally, as verbal processing would have placed excessive processing demands on the child (Study 4). Children use the spatial information offered in narratives to make inferences about how it confines and determines characters' movements and actions (Study 3). Children incorporate spatial information into their representations of narratives as readily as they incorporate information about characters' goals – or perhaps even more so (Study 4). Children's and adults' spatial representations derived from narratives are more accurate than their representations derived from descriptions (Study 1), but are statistically similar to their representations derived from non-narrative route perspectives (Study 2).

How detailed are children's narrative spatial representations?

In the Introduction section, *Spatial situation models*, I discussed the debate over the what qualifies as a spatial situation models. At one extreme, some researchers argue that individuals need only represent a character's current location – *spatial framework representations* (e.g., Jack is outside the movie theatre). At the opposite extreme, other researchers believe individuals need to represent detailed metric and directional information for their representation to qualify as a spatial situation model – *spatial relational representations* (e.g., the movie theatre is on the north side of the street and is to the right of the bank). The results from the four studies I conducted speak to something in between. In Studies 1 and 2, although participants had to represent several different locations, the relation between these locations was not determinate (i.e., the river could have been to the right or the left of the house), and therefore did not require the same level of detail and precision as spatial relational representations. In Study 3, participants had to represent the relative upstairs/downstairs relationship between the character's current location and a destination. In Study 4, participants had to represent the spatial relationship between different entities, including character and location (e.g., Katie is at the bottom of the hill, her school is at the top of the hill), character and character (e.g., William is in the basement and his sister is in the attic), character and object (e.g., Emma is inside, the basketball is in the driveway), and space and time (e.g., Marcus's grandparents live 5 blocks away, which is not a far enough drive to read a whole chapter book).

Because adults in previous studies had difficulty constructing spatial relational representations, I did not attempt to test this level of detail in children. Adults in Zwaan & van Oostendorp's studies (1993; 1994) constructed *spatial relational representations* of a room in which a murder took place only when instructed to do so, and indeed it seemed this was quite an effortful process. The processing demands placed on participants in these studies were substantial. In one excerpt, participants were presented with no less than 13 entities that they could conceivably attempt to integrate into their spatial situation model. Zwaan and van Oostendorp (1994) state, "it is interesting to note that our subjects were systematically more accurate and faster in judging nonspatial inferences (dealing with character traits, goals, and actions) than spatial inferences" (p. 110). This is unsurprising given that they were presented with many more spatial information units. It seems likely that individuals would have as much difficulty processing non-spatial information if they were provided with the same number of relational information units (e.g., 16 different characters' goals).

What I found was that children were reasonably accurate at recalling the spatial relationship between 5 buildings (Studies 1 and 2), and 5 locations within a house (Study 3), and were able to spontaneously track the spatial relationship between two or more entities in an online task (Study 4). Clearly, children can and do construct much more detailed representations than spatial framework representations. It is unlikely, however, that they represent narrative spaces to the level of detail required for spatial framework representations. For now, it seems reasonable to conclude that children are capable of representing narrative spatial information to a level of detail that is intermediate to spatial relational and framework representations.

Future directions

I have discussed future directions for potential follow-up studies in the discussion sections for the individual studies. There are two overarching questions that pertain to this dissertation as a whole that I believe are important topics for future investigation.

(1) What is the nature of narrative processing? How are narrative and non-narrative processing alike or different?

Given narrative's many forms, complexity, and pervasiveness in human experience, it is unlikely that there is a simple answer to this question. A wealth of studies with adults have focused on the rich and automatic process of situation model construction, but relatively few have investigated this ability in development. The cognitive and neural processes that subserve narrative comprehension are likely numerous, and involve a combination of embodied perceptual and motor systems and speech processing systems (Chow, Mar, Xu, Liu, Wagage, & Braun, 2014).

The results of Studies 1 and 2 suggest differences between narrative and non-narrative processing. At present, it is unknown whether these differences are due to different underlying language comprehension processes. The difference between narrative and non-narrative (or paradigmatic) thought was first proposed by Bruner (1986). It is worth noting that the distinction drawn by Bruner, and the distinction I think the results of this dissertation hint at, are between narrative processing and *non-social*, non-narrative processing (see also Keen, 2007; Mar & Oatley, 2008; Mar, Oatley, Hirsh, dela Paz, & Peterson, 2006; Zunshine, 2006; Oatley, 1999). There is no evidence that I am aware of to suggest that narrative processing is different from event processing involving social beings in the real world. And why should it be? Is there a compelling reason why the cognitive processes involved in sitting on a park bench, watching a quarrel unfold between two individuals should really be any different from sitting on the same park bench, reading about a quarrel between two individuals? Instead, what I am referring to by the term “non-narrative” is descriptive or expository language.

To investigate whether narrative and non-narrative language comprehension involve different cognitive processes, future studies may make use of methods that place participants under different types of cognitive load, as outlined in the Discussion for Studies 1 and 2. Other studies may make use of imaging to investigate whether different brain regions are involved in narrative versus non-narrative language processing.

If narrative and non-narrative processing are indeed different from one another, future studies may also investigate narrative as a tool for learning in different domains. In spite of narrative’s prevalence across cultures and throughout history, a relatively small set of past studies have studied the power of narrative as a tool for learning. A classic study using the narrative chaining mnemonic found vastly superior recall of a list of nouns when participants were instructed to construct a story around the list of words compared to participants who were given the same amount of time and told to rehearse the words (Bower & Clark, 1969). Another study found that adult undergraduates recalled more components of narrative than expository texts (Graesser et al., 1980). As with the results of Study 2 of this dissertation, Graesser et al (1980) did not find that ratings of interestingness were related to narrativity nor to recall. These studies suggest that narrative involves a privileged type of processing, and may be particularly well-suited for certain learning and memory tasks.

(2) Why do individuals consume narratives?

Individuals may pick up a book simply to be entertained. Although the role of narrative as entertainment cannot and should not be denied, narratives may be told and heard, written and read for many other reasons. Specifically, narrative seems to be a good candidate for social simulation, lesson learning, and information learning.

Social simulation. Spoken narratives have existed as a part of daily human life across history in all cultures, long predating the written word (Brown, 1991; Sugiyama, 2001). How do we explain the ubiquity of narratives and storytelling? Given that narratives are usually centred on intentional agents (i.e., humans or anthropomorphized animals), it has been suggested that experience in narrative worlds – social simulation – confers benefits in real world social settings (Gottschall, 2012; Mar & Oatley, 2008; Zunshine, 2006). Indeed, exposure to fiction is correlated with mentalizing abilities in both adults (Mar, Oatley, Hirsh, dela Paz, & Peterson, 2006) and children (Mar, Tackett, & Moore, 2010).

Lesson learning. Turning to the perspective of the storyteller, however, narratives are not typically told for the express purpose of providing social simulation, but are often intended to convey information and lessons (Rubin, 1995) and to elicit certain behaviours in audiences (Sugiyama, 1996). Narratives can be used to warn the audience of local predators, to illustrate what becomes of cheaters and liars, or to emphasize the importance of hard work and reciprocity. Given the striking overlap between themes in folklore and domains of information that are relevant to human survival, including social relationships, animal behaviour, geography, and weather, narratives may have helped individuals deal with survival challenges (Sugiyama, 2001).

Information learning. As I mentioned in the previous section, narrative has been shown to be a useful tool for remembering lists (Bower & Clark, 1969). But it is worth highlighting the potential role of narrative as a vehicle for learning information about the world. Of course, the learning potential of narrative depends on the type of information that is presented in a given narrative. If a story was told entirely in a fantastical world, the reader would be unlikely to extract any information about the real world from it (though they may gain social simulation or lesson learning). Participants' performance in Studies 1 and 2 suggests that narrative could be an effective tool for learning spatial information.

Outside the lab, anthropologists have found that in cultures or tribes where the ability to navigate space is relevant to one's survival, narratives often include detailed spatial information. The narratives told by foraging peoples such as Greenland Eskimo place great emphasis on "the lay of the land, travel routes, or orienteering-knowledge critical to undertaking extended hunting, trading, or visiting trips, which are an important part of forager life" (Sugiyama, 2001, p. 243). Australian Aboriginal Dreamtime myths often describe ancestors' long journeys through the Outback, because knowledge of how to navigate and adapt to the harsh and barren land is often critical for survival (Sugiyama, 2001). Although individuals from foraging tribes may include spatial information in their narratives because their thinking is more spatially-oriented than non-foragers, it may be the case that storytellers include this information so listeners can build a spatial representation that they then apply to real world navigation.

(3) What is the relationship between spatial situation model construction and higher-level comprehension? Does one support the other?

Studies 1 through 3 suggest a relationship between spatial situation model construction and narrative comprehension. The correlational nature of these analyses does not allow firm conclusions to be made about the direction of this effect. It follows theoretically, however, that the construction of spatial situation models should scaffold the comprehension process, providing a framework within which the events of the narrative unfold, rather than the other way around.

Previous studies have found mixed results in terms of whether situation model training improves comprehension, with some finding that it can boost the comprehension skills of young children (Berenhaus, Oakhill, & Rusted, in press; Glenberg, Goldberg, & Zhu, 2011; Joffe, Cain, & Maric, 2007; Oakhill & Patel, 1991), and others finding null effects (de Koning & van der Schoot, 2013).

Future studies could train children in spatial situation model construction, or provide the child with a visual of the story world prior to hearing or reading a narrative, and measure whether this training or exposure boosts their comprehension in other areas, such as making cause-effect inferences, judging characters' mental states, or resolving anaphora.

(4) Other questions

Other studies may also investigate the extent and limits of spatial situation model construction in children younger than those included in the present studies and with more naturalistic narratives rather than tightly-controlled experimental texts.

Implications

The potential implications of this work are both theoretical and educational. On the theoretical side, the results of the present studies raise intriguing questions about the nature of language processing. They suggest that narrative and non-narrative processes may have different cognitive underpinnings, which may be visuospatial versus verbal, or even embodied versus propositional. The findings also suggest that spatial situation model construction is an important building block of comprehension. Just as Shakespeare's Globe Theatre was constructed to stage his many comedies, tragedies, and histories, spatial situation model construction may be important for providing a stage for the narratives that play out in the mind during comprehension.

If situation models are indeed the building blocks of comprehension, then their assessment and fostering are of importance educationally. Many current models of narrative comprehension are, first and foremost, descriptive, and do not provide an account of the underlying reasons for comprehension difficulties (e.g., Hruby & Goswami, 2011; Lonigan & Shanahan, 2010). In studies that have looked at children with comprehension difficulties, several underlying abilities have been pointed to as the culprit, including inferencing abilities (Cain et al., 2001; Cain & Oakhill, 1999), vocabulary, and working memory (Cain et al, 2004), among others.

The growing body of studies investigating situation model construction in development could eventually yield a battery to assess the underlying reasons for children's comprehension difficulties. Where one child may have difficulty constructing spatial representations, another may have trouble tracking characters' goals. Measures such as the character movement task in Study 3 could easily be used in a classroom setting for teachers to get a glimpse at one aspect of learners' underlying comprehension abilities. This task is short, easy to administer, and would not seem test-like to the child, especially for struggling learners who may have had to undergo rigorous standardized testing.

Conclusion

The experience of narrative processing is often described as "stepping into the world of the story" or "getting lost in a book". Given conflicting findings in previous studies with adults, this immersive experience was perhaps best thought of as being reserved for only the most vivid of narratives, told by our favourite storytellers. I found, across four studies using short and rather bland narratives, that children can and do include details of story spaces in their representations. Using three different measures, children aged 6 to 8 years showed slightly different levels of success across the four studies, and also showed significant individual variation. Combined, the four studies tell a tale of rich and automatic processing of spatial information that shows substantial development during the years that typically developing children are becoming independent readers.

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APPENDIX A: STUDY 1 PASSAGES

Passages used in Study 1 for the spatial situation model task.

Narrative Passage	Description Passage
It's "Share with Your Community" Day, so Molly and her mom are spending Saturday morning baking cookies for their neighbours.	
When they are finished baking, Molly fills small tins with cookies. She puts the cookies in her wagon.	
Molly is going to walk through her neighbourhood to deliver cookies to all the people who are working today.	
Molly lives on Oak Street. There's a river with a bridge over it that runs beside Molly's house.	Molly's house is on Oak Street. There's a river with a bridge over it that runs beside Molly's house.
Next door to Molly's house on the other side is the fire station. Molly leaves her house and walks there.	Next door to Molly's house on the other side is the fire station.
From the fire station, Molly then goes across the street to the vet's office.	The vet's office is across the street from the fire station.
Then, Molly walks over the bridge to the library that's across the river from her house.	The library is across the river from Molly's house, over the bridge.
Finally, Molly walks to the toy store beside the library.	The toy store is beside the library.
Molly has delivered all the cookies. She's really happy that she helped to brighten everyone's day.	

APPENDIX B: STUDY 2 PASSAGES

Passages used in Study 2 for the spatial situation model task. All three passage conditions are shown, as well as two of the four combinations of path (I or II) and version (1 or 2).

Spatial Situation Model passages: Path I, Version 2, Female Version

Stripped Narrative	Route Perspective	Temporal Description
Molly is going to walk through her neighbourhood to deliver invitations to her school's fun fair.		
Molly lives on Oak Street. There's a river with a bridge over it that runs behind Molly's house.	Molly lives on Oak Street. There's a river that runs behind Molly's house with a bridge over it.	Molly lives on Oak Street. There's a river that runs behind Molly's house with a bridge over it.
Next door to Molly's house is the toy store. She leaves her house and walks there.	Next door to Molly's house is the toy store. You leave her house to get there.	Next door to Molly's house is the toy store.
From the toy store, she then goes across the street to the library.	From the toy store, you then go across the street to get to the library.	From the toy store, the library is across the street.
Then, from the library, she walks over the bridge to the fire station that's across the river from her house.	Then, from the library, you walk over the bridge to get to the fire station that's across the river from Molly's house.	Then, from the library, the fire station is over the bridge across the river from Molly's house.
Finally, she walks to the vet's office beside the fire station.	Finally, you walk to the vet's office beside the fire station.	Finally, the vet's office is beside the fire station.
She has delivered all the invitations.		

Spatial Situation Model passages: Path II, Version 1, Male Version

Stripped Narrative	Route Perspective	Temporal Description
Max is going to walk through his neighbourhood to deliver invitations to his school's fun fair.		
Max lives on Oak Street. There's a river with a bridge over it that runs behind Max's house.	Max lives on Oak Street. There's a river with a bridge over it that runs behind Max's house.	Max lives on Oak Street. There's a river with a bridge over it that runs behind Max's house.
From Max's house, he walks over the bridge to the toy store that's across the river.	From Max's house, you walk over the bridge to get to the toy store that's across the river.	From Max's house, the toy store is across the river.
From the toy store, he then walks to the fire station that is next door.	From the toy store, you then walk to get to the fire station that is next door.	From the toy store, the fire station is next door.
Then, from the fire station he walks over the bridge to the library that's next door to his house.	Then, from the fire station, you walk over the bridge to get to the library that's next door to Max's house.	Then, from the fire station, the library is over the bridge next door to Max's house.
Finally, he goes across the street to the vet's office from the library.	Finally, you go across the street to get to the vet's office from the library.	Finally, the vet's office is across the street from the library.
He has delivered all the invitations.		

APPENDIX C: STUDY 3 PASSAGE

Passage used in Study 3 for the character movement task.

Jamie Goes to Summer Camp

1. Jamie woke up one morning and was really excited to start his first day of adventure camp.
2. It was time to get ready.
3. In his bedroom, Jamie changed into a pair of shorts and a blue t-shirt.
4. He put on his socks and thought, “I can’t wait for summer camp!”
5. Jamie went into his mom’s room to say “good morning”.
6. Then, Jamie walked into the bathroom.
7. He brushed his teeth and washed his face.
8. **Jamie went downstairs to look for some sunscreen.** (Instructed movement)
9. He looked in the kitchen.
10. He looked in the playroom.
11. And he looked in the living room.
12. There it was, on the coffee table.
13. Jamie just needed to pack his backpack for camp now.
14. **He went to his mom’s room to ask her if she knew where his backpack was.** (Inferred movement)
15. His mom was sitting on her bed reading.
16. “Your backpack is in the playroom, Jamie,” said mom.
17. **Jamie picked up his backpack off the playroom floor.** (Inferred movement)
18. He was almost ready for camp!
19. Jamie still needed to get his lunch and some water.
20. Jamie went into the kitchen.

21. He took his lunch and a water bottle out of the fridge and put them in his backpack.
22. Jamie went to the front door.
23. “Almost ready” Jamie thought.
24. He strapped on his backpack and put his green hat on.
25. **Jamie went upstairs to his mom’s room.** (Instructed movement)
26. “I’m ready to go, Mom!” Jamie said.
27. Jamie set off with his mom for his very first day of summer camp.

Note: critical sentences are in bold.

APPENDIX D: STUDY 4 STORIES

Example stories used in Study 4 for the inconsistency detection task.

Space (Spatial-Temporal Relationship): Marcus

Intro 1	Marcus's family was going to visit his grandparents.
Intro 2	Marcus packed some books in his bag.
Intro 3	Marcus and his family got in the car.
Manipulation	*Grandma and Grandpa lived five hours away.* (Consistent) / *Grandma and Grandpa lived five minutes away.* (Inconsistent)
Filler 1	Marcus sat in the backseat next to his brother, Jack.
Filler 2	His brother was bringing a painting he made with him.
Filler 3	Marcus opened up his new chapter book to the first page.
Critical	**He read the whole book on the drive.**
Conclusion	Grandma and Grandpa were happy to see them.

Space (Primary Character & Secondary Character): William

Intro 1	William was playing with his sister, Jane.
Intro 2	They were looking for their cat, Dusty.
Intro 3	William decided to look in the basement.
Manipulation	*Jane also went to look in the basement.* (Consistent) / *While Jane went to look in the attic.* (Inconsistent)
Filler 1	There was a thunderstorm outside.
Filler 2	Dusty was afraid of thunderstorms.
Filler 3	There was a big crash of thunder.
Critical	**William grabbed onto Jane's hand.**
Conclusion	Dusty came out from his hiding spot.

Space (Character & Object): Sam

Intro 1	Sam arrived at his school's cross country meet.
Intro 2	He saw kids from a lot of other schools there.
Intro 3	He was excited for the race.
Manipulation	*He took off his jacket and left it on the bus.* (Inconsistent) / *He put on his jacket and got off the bus.* (Consistent)
Filler 1	When it was his turn to race, he stepped up to the starting line.
Filler 2	Throughout the race, he was close to the front of the pack.
Filler 3	Sam crossed the finish line.
Critical	**As he walked over to his teacher, Sam took his jacket off.**
Conclusion	His teacher gave him a high five.

Goal (Desire): Casey

Intro 1	One morning, Casey woke up and looked out her window.
Intro 2	It was a bright and sunny day.
Intro 3	It was Saturday, so she could do whatever she wanted.
Manipulation	*She decided that she really wanted to read her book outside this morning.* (Consistent) / *She decided that she really wanted to play jump rope outside this morning.* (Inconsistent)
Filler 1	Casey's mom said she had to have breakfast first.
Filler 2	She had breakfast and then went upstairs to get dressed.
Filler 3	She was ready to start with her day.
Critical	**She went outside and opened up her book.**
Conclusion	She stayed outside until lunch time.

Goal (Intention): Mary

Intro 1	Mary's cousin birthday party was in just a few hours.
Intro 2	The party was at her aunt's and uncle's house.
Intro 3	First, Mary and her mom were going to the mall.
Manipulation	*Mary decided she was going to buy a video game for herself.* (Consistent) / *Mary decided she was going to buy a soccer ball for her cousin.* (Inconsistent)
Filler 1	They got to the mall.
Filler 2	Mary's mom chatted to a friend at the store's entrance while Mary went in.
Filler 3	She was going to use her own allowance money.
Critical	**She bought herself a video game.**
Conclusion	Mary and her mom headed home to get ready for the party.

Goal (Motivation): Stephanie

Intro 1	Stephanie's mom came to wake her up.
Intro 2	She reminded Stephanie that they were going skating.
Intro 3	Stephanie got out of bed.
Manipulation	*Stephanie thought that skating was really horrible.* (Consistent) / *Stephanie thought that skating was really great.* (Inconsistent)
Filler 1	Stephanie's mom gave her some breakfast.
Filler 2	Her mom said, "Can you go get dressed, Stephanie?"
Filler 3	"We're leaving as soon as you're ready."
Critical	**Stephanie changed into her outfit for skating as slowly as possible.**
Conclusion	They left for the rink.