DEVELOPMENT OF GIST PROCESSING SKILLS AND MEMORY IN CHILDREN AND YOUNG ADULTS: EFFECTS OF PRESENTATION TYPE IN A MODIFIED DRM PARADIGM

by

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ABSTRACT

DEVELOPMENT OF GIST PROCESSING SKILLS AND MEMORY IN CHILDREN AND YOUNG ADULTS: EFFECTS OF PRESENTATION TYPE IN A MODIFIED DRM PARADIGM

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To date, studies have separately tested the role of narrative context and source-monitoring in gist extraction. The present study expanded upon that body of work by examining those variables in combination. Specifically, I observed the effects of presentation type (list versus narrative) on children's ability to process gist at ages 5, 7, 9, and 11, as well as young adults age 18–30. Participants watched two puppets present either a list of words or a narrative with an embedded DRM list. Following presentation of the puppet show, participants were given a source memory test where they were asked to judge whether a given item was previously presented, and if so, which puppet said it. Additionally, researchers administered two standardized tests for IQ (WASI; Wechsler, 1999) and listening comprehension (WIAT; Wechsler, 2005).

Results obtained from a series of ANOVAs and corresponding post-hoc tests provided partial support for hypotheses, such that gist-based false memory occurs at a lower rate in younger children than older children and young adults. Contrary to hypotheses, younger children (5- and 7-year-olds) did not seem to benefit from the increased context of a narrative. Instead, they processed gist just as effectively when information was presented in a list. In support of hypotheses, 9-year-olds experienced the expected effect of presentation type, processing gist more effectively when information was presented in a narrative than in a list. Interestingly, analyses yielded the unexpected finding that young adults processed gist more effectively in lists than in narratives. Finally, in support of hypotheses, enhanced gist processing resulted in both a higher proportion of false but gist-consistent "old" recognition judgments and a higher proportion of gist-consistent source memory errors. Findings from the present study are discussed with respect to implications for future research on the development of gist processing and the role of narrative context in typical and atypical gist extraction.

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CHAPTER 1

INTRODUCTION

A large body of existing literature describes the general trajectory of memory development from childhood to adulthood (for review, see Bauer, Larkina, & Deocampo, 2011; Howe & Wilkinson, 2011; Raj & Bell, 2010; Schneider, 2011; Shing & Lindenberger, 2011). However, questions remain about nuanced changes occurring between early and late childhood in the ability to extract gist from simple or complex information sets. Many studies of gist development have used the extensively validated Deese-Roediger-McDermott paradigm (DRM; Deese, 1959; Roediger & McDermott, 1995; Stadler, Roediger, & McDermott, 1999). In the DRM paradigm, individuals are presented with list of related words. For example, individuals might be presented with *bed, rest, snooze, slumber, etc,* during an initial study phase. However, participants are not presented with the critical lure, *sleep*, which links the list of presented words together. Past research demonstrates that young adults falsely recognize and recall having been presented with such critical lures at rates equivalent to that of the actual studied items. Such high rates of false alarms to the thematic words that represent the underlying gist of the list is thought to provide a measure of gist processing.

Systematic modifications to this paradigm have revealed age-related differences in gist processing ability, with older children (i.e., 11 years old) better able to extract the general idea or theme of information sets than younger children (i.e., 5–9 years old) (for an extensive review, see Brainerd, Reyna, & Zember, 2011). Counterintuitively, older children and young adults actually falsely recognize the critical non-presented word from studied DRM lists at higher rates than younger children. In order to further extend the literature on gist development during childhood, this study addressed the impact of differences in gist and verbatim processing in various contextual settings. The present study was designed to test the specific influence of presentation format (narrative versus list) on memory for traditional DRM item types (critical lures, targets, and related distracters) and source monitoring. In order to support and extend existing literature on age-related changes in gist processing ability, the present sample of children and young adults all completed the same memory task. A careful examination of the relationship between age and the effect of presentation type addressed an area of DRM literature not previously studied.

1.1 Overview of Information Processing and Memory Development

Cognitive psychologists generally agree on a trajectory of information processing and memory development that begins with the acquisition of basic skills such as categorization and word-learning in early childhood and expands to refinement of higher-order skills such as gist processing and logical reasoning in late childhood and early adulthood (Goswami, 2011). However, researchers continue to probe nuanced differences in the onset and refinement of certain cognitive skills (i.e., gist processing), in an attempt to further delineate the known trajectory of cognitive development.

In the following sections, I will only address development from early childhood (3–7 years old), late childhood (8–11 years old), adolescence (12–17 years old), and early adulthood (18–30 years old), as the present study did not include infants, toddlers, or older adults. However, note that memory and information processing abilities remain dynamic and fluid across the lifespan, changing and developing in response to environmental and biological demands associated with aging.

1.1.1 Early Childhood

Cognition in early childhood develops in tandem with supporting brain areas like the prefrontal cortex and hippocampus. As a result, some higher-order functions such as logical reasoning, abstract thinking, and aspects of the explicit memory system develop later as the brain matures and forms neural connections to support a network of knowledge. Many basic cognitive skills that develop in early childhood are critical to later milestones, and so it is important to understand the sequence in which they are acquired and refined. Generally, increases in working memory efficiency, increases in the amount of information stored in long-term memory, and improved executive function characterize cognitive development in early childhood (Goswami, 2011). More specific cognitive abilities also develop during this period, for example, the ability to make connections between conceptual and perceptual elements of an event or object. This capacity to generalize from one instance of an event (i.e., processing the perceptual elements of a 5^{th} birthday party) to an overall schema for that type of event (i.e., processing conceptual elements of birthday parties in general) proves a useful skill for later problem solving and decision-making, where previous experience can inform a child's response to a related task.

Early studies of perceptual priming led to the conclusion that implicit memory is present from birth, and many researchers have failed to find age-related differences in perceptual priming task performance (Lloyd & Newcombe, 2009; Parkin, 1998; Reber, 1989). Historically, researchers have primarily tested implicit memory using perceptual priming but not conceptual priming tasks, and so questions remain about whether this ability is innate. Conceptual priming tasks allow researchers to tackle the issue of whether a child's knowledge network, which includes semantic relationships between concepts, influences implicit memory performance. If so, perhaps implicit memory is not so innate as previously thought. Presently, the literature on priming and implicit memory is still murky, and researchers continue to question whether implicit memory is innate or dependent on experience. Notably though, as Schneider (2011) and others suggest based on current neuroimaging data, it seems that the brain regions and networks underlying implicit memory are fully developed in infancy and early childhood.

With respect to explicit memory, young children seem to have basic temporal ordering and information processing and integration skills around 3 years old (Nelson, 1986; Nelson & Gruendel, 1981). In early work by Nelson's group, children's existing knowledge of a particular event influenced their memory for future, similar events, such that more prior knowledge led to improved memory performance. Nelson and colleagues determined that the facilitating effect of prior knowledge on memory indicated that children were able to form cohesive *scripts*, or general knowledge sets about elements of an event and their order, and organize episodic memories accordingly. The span of explicit long-term memory also seems to increase with age, as demonstrated in a number of early and recent studies (Bauer, 2006; 2009; Bauer, Wener, Dropik, & Wewerka, 2000; Fivush & Fromhoff, 1988; Rovier-Collier, 1997). Bauer and colleagues (2000) found that children around 1 year old are able to remember episodes and their elements in the correct temporal order for about 1 month, while children around 3 years old are able to remember for 6 months or longer. Fivush and Fromhoff (1988) found similar age-related memory trends in their earlier study of children 2–3 years old, all of who successfully recalled at least 1 event from 6 months prior to the interview. Young children also experience age-related increases in the ability to remember novel events, not just those associated with prior knowledge and scripts.

Increased efficiency of working memory may improve overall performance on cognitive tasks, specifically as children begin to use strategies and prior knowledge to guide encoding and retrieval. Generally, cognitive flexibility seems to increase from 2–5 years of age (e.g., DeLoache, 1995; Flavell, Green, & Flavell, 1986; Wellman, Cross, & Watson, 2001). Some researchers have also suggested that working memory capacity actually increases with age, with studies consistently demonstrating that children nearly double in memory span from 4–12 years of age (for a review, see Dempster, 1981; Gathercole, 1998). The recent work of Schneider, Knopf, and Sodian (2009) further reinforced this theory. Specifically, Schneider and colleagues (2009) conducted a longitudinal study and found that, as measured by performance on span tasks, children's and adolescents' memory capacity steadily increased from age 4 to 18. The same participants' memory span did not increase from age 18–23, but rather remained constant, suggesting that working memory capacity increases are limited to childhood and adolescence. This finding replicates earlier work (as reviewed by Dempster, 1981) that found memory span increases of approximately 1 unit every 2 years (i.e., 5-year-olds remember 4 items, 7-year-olds remember 5 items, 9-year-olds remember 6 items, etc.).

1.1.2 Late Childhood

One important cognitive skill that develops during late childhood is the ability to implement strategies in an attempt to increase memory performance. Older children more frequently employ a number of strategies including, but not limited to, rehearsal, meaning-based chunking, and use of mnemonics (Schneider, 2011). Older children are also better able to employ more than one strategy at a time, and researchers consistently find that use of multiple strategies tends to increase memory task performance (Schneider, Kron, Hünnerkopf, & Krajewski, 2004; Schneider, Kron-Sperl, & Hünnerkopf, 2009; Schneider, 2011).

However, these age-related trends in use of strategies do not necessarily mean that younger children are unable to learn or use strategies unintentionally or when instructed. In fact, young children in preschool and kindergarten can employ strategies when explicitly trained on a strategy and instructed to use it during a task (Carr & Schneider, 1991; Cox, Ornstein, Naus, Maxfield, & Zimler, 1989; Lange & Pierce, 1992; Schneider & Sodian, 1988). Their success in using these strategies, however, is not as consistent as older children and seems to depend largely on experience with using a strategy in a given situation (for a review, see Bjorklund, Dukes, & Brown, 2009). In sum, existing data suggest that late childhood is characterized by an important increase in frequency and efficiency of independent or intentional strategy use (Bjorklund, Dukes, & Brown, 2009; Flavell, Beach, & Chinsky, 1966; Schneider & Pressley, 1997; Pressley & Hilden, 2006).

This late childhood increase in strategy use can be expressed either consciously (i.e., intentional subvocalization) or unconsciously (i.e., meaning-based chunking, later referred to as gist processing). Although meaning-based chunking, or gist processing, often occurs unconsciously, children can also consciously attempt to categorize or chunk information using existing knowledge. Because children’s knowledge increases rapidly, further study is necessary to accurately gauge whether observed performance and strategy use are due primarily to increased strategy use and efficiency, or to broader knowledge networks supporting these strategies.

1.1.3 Adolescence and Early Adulthood

Memory development stabilizes in many ways during late childhood, adolescence, and early adulthood. However, some age-related differences are still evident in adolescence, specifically those related to metamemory and strategy use. Waters (1982) found age-related increases in performance on a recollection memory test for paired associates in a sample of 8^{th} and 10^{th} grade students. This increased performance was positively correlated with metamemory (i.e., knowledge of memory strategies) and increased appropriate strategy use. These results provide evidence in support of continuing development of cognitive processes supporting memory even into adolescence.

In contrast, Lucianna, Conklin, Hooper, and Yarger (2005) failed to find age-related differences in recognition memory from 11-17 years of age, but did find age-related increases in working memory for spatial tasks and tasks requiring organization of information. This finding is not in direct opposition to Waters' finding, but rather suggests that even if recognition memory has fully developed by adolescence, other underlying cognitive processes are still malleable and may influence performance on tasks requiring information organization (i.e., extracting global gist). Lucianna et al. (2005) point out that few studies exist to illuminate age-related changes in memory development in adolescence and early adulthood. They suggest that although two earlier studies indicate that cognitive skills are fully developed between age 12 and 20, their sample of adolescents and young adults demonstrated marked differences in some aspects of memory performance up to age 16 before stabilizing. This raises the question of whether all cognitive processes underlying information processing and memory are truly fully developed in adolescence. As Lucianna and others point out, further neuroimaging, neuropsychological, and behavioral studies are needed to shed light on the adolescent and early adulthood portion of the developmental trajectory. However, equivalent performance between adolescents (i.e., age 11 and older) and young adults on recognition memory tasks is well-documented by a number of studies examining age-related differences in performance on the DRM paradigm (for review, see Brainerd, Reyna, & Zember, 2011). In the present study, similarities between late childhood, adolescence, and adult performance on recognition memory, source monitoring, and gist processing tasks were of greatest interest.

In essence, current evidence suggests a steady age-related increase in memory span across early and middle childhood, which results in better overall performance on memory tasks. However, age-related increases in source monitoring ability and the tendency to employ strategies such as categorization and chunking continue throughout late childhood and early adolescence. These later developments influence individuals' tendency to rely more heavily on gist traces of memory as they age. Critical developmental shifts occur in the degree of reliance on gist around age 11, and these changes are discussed at length in subsequent sections.

1.2 Gist Processing

1.2.1 Fuzzy Trace Theory

Fuzzy Trace Theory (FTT; Brainerd & Reyna, 1990a) serves as a process model for encoding and retrieval of information. FTT presents two means of processing information, either on a global (gist) level, or a local (verbatim) level. This theory arose from a wide body of literature attempting to explain information processing from perspectives of logicism as seen in Piagetian theories of development (Frege, 1884; Inhelder & Piaget, 1958; Russel, 1903) and formalism as seen in information-processing theories of Broadbent (1958) and others (see also Hilbert, 1923; Shannon, 1988). Brainerd and Reyna (1990a) suggested that logicist and formalist theories of information processing did not allow for certain aspects of human cognition, namely, its flexibility and dependence on inference and heuristics. In an attempt to address these shortcomings, they proposed FTT and its 7 core components: (1) gist extraction, (2) fuzzy-to-verbatim continua, (3) fuzzy-processing preference, (4) reconstructive short-term memory, (5) output interference, (6) resource freedom, and (7) ontogenesis. These components separately and collectively facilitate interpretation and maintenance of information for later use. For the purpose of this study, the components having to do with "fuzzy" or gist-based traces of information are most relevant.

1.2.1.1 Gist Versus Verbatim Memory Traces

Even before proposing FTT, Brainerd and Reyna (1988, 1990b) investigated the concept of *reduction to essence*, or the idea that at encoding, individuals looking for patterns that characterize the to-be-remembered information as a whole (see also Brainerd & Kingma, 1984). This reduction to essence tendency is essentially a heuristic for processing complex information sets as a gestalt rather than individually memorizing each element in the set. This gestalt understanding of a set of information is the *fuzzy* end of the *fuzzy-to-verbatim continuum* described in FTT. Specifically, in the FTT framework, information can be stored as general, vague representations of the whole (fuzzy or gist traces) or as detailed, exact representations of a target (verbatim traces). According to Brainerd and colleagues, adults are biased toward using fuzzy traces of a memory during recollection tasks rather than verbatim traces. They suggest that this bias results from the fact that fuzzy traces are easier to retrieve, process, and alter, whereas verbatim races require greater effort. Fuzzy traces are also more resilient across time, as opposed to quickly-decaying verbatim traces, and therefore they persist in memory.

The original FTT model also proposes age-related changes in memory, such that children are more likely to use verbatim retrieval and adults are more likely to rely on fuzzy traces. This implies that the nature of gist extraction and application develops and varies across the lifespan. Brainerd and Reyna found support for their FTT model in subsequent research demonstrating functional differences between gist and verbatim representations in memory (Brainerd & Reyna, 1992; Reyna & Brainerd, 1991a, 1991b). Others have subsequently tested the gist versus verbatim memory distinction in a mathematical model, finding further support for FTT (Brainerd, Reyna, & Mojardin, 1999; Brainerd, Reyna, Wright, & Mojardin, 2003; Brainerd, Wright, Reyna, & Mojardin, 2001; Lampinen, Watkins, & Odegard, 2006; Odegard, Holliday, Brainerd, & Reyna, 2008).

FTT makes the core assumption that humans engage in *parallel distributed processing* (PDP; Ballard, Hinton, & Sejnowski, 1983; Estes, 1988) of information within a knowledge network. In a network model of information processing and memory, nodes represent verbatim traces of information stored exactly as presented (i.e., cat, dog, bird), and the pattern of connections among nodes make up the gist, or fuzzy traces, of information at the conceptual level (i.e., animals). Brainerd and Reyna (1990) suggest that humans engage in parallel processing during a memory search by relying on patterns of connections among nodes, which results in retrieval of gist-based representations of learned information rather than verbatim traces. The dissociation between gist and verbatim traces may arise from underlying structural differences in the brain areas supporting memory (Brainerd, Reyna, & Brandse, 1995; Dennis, Hongkeun, & Cabeza, 2008; Kintsch, Welsch, Schmalhofer, & Zimny, 1990; McDermott, 1996; Stäubli, Ivy, & Lynch, 1984; Toglia, Neuschatz, & Goodwin, 1999).

Both gist and verbatim memory traces carry advantages and disadvantages (Acredolo, 1995). Gist traces are quite robust and enduring compared to verbatim traces, and they are less vulnerable to interference. However, gist traces represent broad, conceptual representations of information compared to detailed, highly specific verbatim traces. Because of their broad scope, gist traces may aid retrieval by providing enough context to fill in missing information and produce a successful response. Brainerd and Reyna (1988; 1990a; 1990b) aptly point out that humans are biased toward the use of heuristics and schemata, and the tendency to use gist-based representations to compensate for decayed verbatim traces is a cognitive shortcut often used at retrieval.

In addition to filling in the blanks where missing verbatim information should have been, reliance on gist traces at retrieval also provides an efficient alternative to a time consuming search for the most detailed, precisely accurate verbatim trace (Malmberg & Shiffrin, 2005; Tun, Wingfeld, Rosen, & Blanchard, 1998). Gist traces may also be easier to access because connections between multiple nodes in a knowledge network typically equates to a broader span of available retrieval cues, whereas verbatim traces are constrained by encoding specificity and fine detail, making them difficult to access in the absence of a precisely matched retrieval cute (Brainerd & Reyna, 1990a; Tulving, 1983). Although there are benefits to gist-based encoding and retrieval, the tendency to rely on gist to fill gaps in verbatim memory makes a person vulnerable to gist-consistent intrusion errors.

The broad, flexible, modifiable pattern of associations between nodes that makes up a gist trace is easier to access at retrieval than a rigid, detailed verbatim trace, but simultaneously more prone to error. False but related information from a person's knowledge network may be mistakenly reconsolidated into an old memory because of reliance on gist (Brainerd & Reyna, 1988; Ceci & Bruck, 1993; Ceci, Toglia, & Ross, 1988; Hasher & Zacks, 1988; Loftus, Miller, & Burns, 1978; Marche & Howe, 1995; Titcomb & Reyna, 1995). Reconsolidation of new, incorrectly-activated information into an existing gist trace results in strong feelings of familiarity with the false information (Bransford & Franks, 1971; Lampinen, Meier, Arnal, & Leding, 2005). Although fundamentally different in their degree of vulnerability, duration, and ease of retrieval, gist and verbatim memory traces are both important for learning and information processing, and each uniquely contributes to a person's knowledge network.

1.2.2 Typical Development of Gist and Verbatim Memory

Information processing skills develop across childhood, and generally, older children have a greater capacity for verbatim details than younger children (Brainerd, Holliday, & Reyna, 2004; Ghetti & Angelini, 2008; Ghetti, Qin, & Goodman, 2002; Odegard, Jenkins, & Koen, 2010). In addition to age-related increases in the number of items children recall on a memory test, children experience age-related increases in reliance on gist until around age 11, when they mirror adult performance (Brainerd, Forrest, Karibian, & Reyna, 2006; Farrar & Goodman, 1992; Ghetti & Angelini, 2008; Odegard, Cooper, Lampinen, Reyna, & Brainerd, 2009; Reyna & Kiernan, 1994).

Age-related increases in reliance on gist affect the type of memory errors that children make in early versus late childhood. Younger children struggle to make conceptual connections across events (i.e., global gist processing), but are able to process the conceptual meaning of a single event (i.e., local gist processing) (Lampinen, Leding, Reed, & Odegard, 2006). This important distinction explains why young children are able to extract individual item meanings (i.e., local gist) from a list of category exemplars, but may still fail to make conceptual associations between the items (i.e., global gist) (Brainerd & Reyna, 2007). Specifically, Brainerd and Reyna (2007) tested 6-, 10- and 14-year-olds' recognition memory for presented and non-presented exemplars of studied categories. They found that after studying a list of category exemplars, older children falsely recognized more non-presented exemplars than younger children. When only one exemplar was presented at study, however, Brainerd and Reyna found equivalent performance across older and younger children. This result suggests that local gist processing skills are intact in early childhood, but global gist processing ability does not fully develop until late childhood.

1.2.2.1 Gist Processing in the Original DRM Paradigm

The present study employed the Deese-Roediger-McDermott paradigm, commonly used to assess false memories resulting from reliance on gist (DRM; Deese, 1959; Roediger & McDermott, 1995; Stadler, Roediger, & McDermott, 1999). The original paradigm involved sequential auditory presentation of 36 word lists, each made up of 15 word associates (i.e., bed, rest, snooze, slumber, etc.) of a *critical lure* or category word (i.e., sleep). Following presentation of each word list in the original paradigm, participants completed a 2-minute recall memory test in which they wrote down as many words as they could remember. At the end of the 36-list set, participants completed a recognition memory test designed to assess reliance on gist-based processing. This test contained critical lures, targets taken from position 1, 8, and 10 of the presented lists, and 36 unpresented words for a total of 108 items. Results from the original study suggested that adults encoded the gist of word lists at study, and they later relied on the gist at retrieval if verbatim traces of individual target words had degraded.

Brainerd, Reyna, and Zember (2011) recently reviewed variations of the DRM paradigm designed to test effects of modifying instruction sets, presentation style, and testing format, among other variables (also see Gallo, 2006; 2010 for review). Studies using modified versions of the paradigm consistently find that adults falsely recall and recognize critical lures as previously presented items, even though they were not presented at study (Gallo, Roediger, & McDermott, 2001; McCabe & Smith, 2002; Neuschatz, Payne, Lampinen, & Toglia, 2001; Neuschatz, Benoit, & Payne, 2003; Payne, Elie, Blackwell, & Neuschatz, 1996; Roediger & McDermott, 1995; Sugrue & Hayne, 2006; Watson, McDermott, & Balota, 2004). Each modification reveals that slight changes to the paradigm can shift memory performance in adults and children. Payne et al. (1996) manipulated the delay between study and test, and discovered that adult participants falsely recognized critical lures but not targets after the delay. Sugrue and Hayne (2006) further demonstrated that adults were more likely to falsely recall critical lures than children when presented with long (i.e., 14 word) as opposed to short (i.e., 7 words) lists. A number of researchers also found that warning adults to avoid falsely identifying associated but non-presented words can help to buffer against the effects of gist-based false recognition, but these buffering effects are not as strong for older adults (Gallo, Roediger, & McDermott, 2001; McCabe & Smith, 2002; Neuschatz, Benoit, & Payne, 2003; Neuschatz, Payne, Lampinen, & Toglia, 2001; Watson, McDermott, & Balota, 2004).

The original DRM paradigm was developed and normed with adult samples, but subsequent studies have adapted it for use in children and atypically developing populations. Older children (9–12 years old) are vulnerable to the influence of gist or fuzzy traces in memory retrieval, like their adult counterparts (Brainerd, Forrest, Karibian, & Reyna, 2006; Brainerd, Reyna, & Ceci, 2008; Brainerd, Reyna, & Zember, 2011; Odegard, Holliday, Brainerd, & Reyna, 2008; Reyna & Brainerd, 1995). Young children (5–8 years old) are less reliant on gist traces and better able to encode, preserve, and recall verbatim details of an information set (Brainerd, Reyna, & Ceci, 2008; Brainerd, Reyna, & Zember, 2011; Ghetti, Qin, & Goodman, 2002; Odegard, Holliday, Brainerd, & Reyna, 2008). Interestingly, 9 years of age seems an important milestone in the shift from reliance on verbatim traces to reliance on gist traces, as seen in a study by Lampinen, Leding, Reed, and Odegard (2006). In their study of younger children (around age 7), older children (around age 9), and adults, Lampinen and colleagues (2006) found that cuing participants to attend to themes in presented DRM lists increased gist-consistent false memory for older children but not for younger children or adults. This finding points to a critical shift in gist processing and reliance on fuzzy traces between early and late childhood.

The present study extended existing literature on the DRM paradigm by systematically examining the effect of presentation type across several age groups. Presentation of DRM information was either a list, as in the original DRM paradigm, or in a narrative. Narrative context should help younger children to organize information by making conceptual, meaning-based connections between story elements (i.e., DRM list words embedded in a story). However, this enriched context may not be needed for older children and young adults who already effectively process gist from basic information sets. While list versus narrative presentation manipulations have been done previously (e.g., Dewhurst, Pursglove, & Lewis, 2007; Howe & Wilkinson, 2011), a number of issues complicate these existing results, which demonstrated marginally significant effects of narrative context at best. Specifically, neither existing study compared a wide age range of children *and* young adults on the same paradigm, making it difficult to equate older children's performance with that of adults as expected.

Furthermore, the narratives constructed by Dewhurst et al. and used by Howe and Wilkinson did not consistently include DRM word associates in the correct order, and lists or narratives were read aloud by a researcher, rather than in a more engaging format that might better hold the attention of younger children. Finally, neither study directly measured source monitoring to assess the influence of gist processing on the reconstruction of contextual details. Later sections address the relationship between source monitoring and gist. The present study was designed with the goal of carefully examining the influence of presentation type and age across early, middle, and late childhood, as well as young adulthood, while addressing the methodological problems encountered by previous work in this area.

1.3 Source Monitoring

Like gist processing and general working memory span, source monitoring ability develops across early and late childhood (Foley & Johnson, 1985; Lindsay, Johnson, & Kwon, 1991; Parker, 1995; Powell & Thomson, 1996). Johnson, Hashtroudi, and Lindsay (1993) define source monitoring as the ability to identify and remember contextual information related to a memory or learning experience. Source monitoring is, therefore, often linked with the conceptual representation of an event or information set during encoding. As such, the ability to accurately identify the source of a memory may be influenced by the context or gist-based representation of the original event. In the case of false memories, false source memory can occur as a byproduct of gist processing, wherein a person misremembers a memory's broader context but not the specific details of the exact event.

Existing research on the development of source monitoring skills indicates that children 6 years or younger struggle to make accurate source judgments when sources were highly similar (Foley, Aman, & Gutch, 1987; Gopnik & Graf, 1988; Perner & Ruffman, 1995; Taylor, Esbensen, & Bennett, 1994; Wimmer, Hogrefe, & Perner, 1988). However, when sources for two events are quite distinctive, children as young as 4 are able to accurately—though not always consistently—make correct source judgments (Lindsay, Johnson, & Kwon, 1991). Regardless of source similarity, Lindsay et al. (1991) found age-related increases in accuracy of source judgments made by 4-year-olds, 6-year-olds, and adults. In a more recent study of recognition and source memory, Cycowicz, Friedman, Snodgrass, and Duff (2001) found further support for age-related increases in source monitoring ability in a sample of 7- to 9-year-old children and 18- to 24-year-old young adults. Interestingly, Cycowicz and colleagues found that children struggled significantly more with making accurate source judgments than with making accurate old versus new recognition judgments for items, indicating that development of source monitoring ability is an important cognitive milestone independent of general memory span or gist processing development. Like a number of cognitive abilities in childhood, source monitoring requires some support from the prefrontal cortex, which continues to develop throughout childhood (e.g., Rybash & Colilla, 1994; for a brief review see Drummey & Newcombe, 2002). Thus, underlying neural development likely contributes to the age-related differences in source monitoring ability seen in research.

Keeping these findings in mind, the present study included a measure of source monitoring for the purpose of measuring reliance on gist at retrieval. Johnson, Hashtroudi, and Lindsay (1993) present an extensive discussion of aspects of source monitoring framework that are outside the scope of this project, so it is important to note that the type of source monitoring assessed in this project is *external monitoring*, or "discriminating between externally derived sources" (p. 4). Because younger children tend to perform better on source monitoring tasks with highly distinctive sources, two different voices and two different puppets were used to present information. I expected that younger children would struggle more with making correct source judgments for targets than older children and young adults. On a related note, I also expected that younger children would make fewer gist-consistent source judgments for falsely remembered critical lures and related distracters, indicating that they failed to process source and encode it as part of the global gist representation of the information set.

1.3.1 Gist Processing and Reconstructive Memory

Memory for events is a largely reconstructive process. That is, when a person remembers an event, he or she attempts to retrieve individual details, context, source, and overall theme from memory, and uses those elements to reconstruct a representation of the event. If gist or verbatim traces have decayed or become tainted by interference from associated knowledge, the reconstructed memory of the event may be inaccurate. Gist-based false memories for elements of an event or the source of information are often a product of corrupted reconstruction. Failure to correctly link a memory to its original source can further jeopardize the integrity of the original memory by leaving it vulnerable to interference from previous experiences that might share contextual similarities. With respect to gist processing, over-reliance on fuzzy traces increases opportunities for interference from related experiences, largely because the scope of a gist trace is broad and may include connections to more information than what was actually experienced at the time of encoding.

Researchers consistently find age-related increases in reliance on gist. Essentially, this means that adults and older children are more likely to commit memory errors consistent with the gist of the event than younger children, who are more likely to report verbatim details. This tendency to depend upon gist traces in memory often results in errors that are consistent with associated information from the actual event or an event with a number of similarities, and older adults are particularly susceptible to gist-based interference at encoding and retrieval (Koutstaal & Schacter, 1997; Koutstaal, Schacter, Galluccio, & Stofer, 1999). Several researchers have also found that age-related increases in gist-consistent errors are often accompanied by high confidence ratings for the falsely-remembered information (Dodson & Krueger, 2006; Tun, Wingfield, Rosen, & Blanchard, 1998).

Unfortunately, children are not immune to gist-based interference in memory. In fact, older children are quite vulnerable to misinformation and false memories when there is a gist-based match between a lure and previously-experienced information (Odegard, Cooper, Lampinen, Reyna, & Brainerd, 2009; Odegard, Cooper, Holliday, & Ceci, 2010; Wright & Loftus, 1998). For instance, Odegard et al. (2009) asked 5- to 12-year-old children general or theme-specific questions about a themed birthday party that they attended. The birthday parties were SpongeBob or Harry Potter themed, and involved snacks, games, crafts, and stories that contained general (i.e., plain sugar cookies) and specific (i.e., "magic potion" drinks) elements. Older children (ages 7–9 and 10–12) relied more on gist at retrieval than younger children (ages 5–6), as evidenced by greater cued recall for theme-specific elements than general ones. Older children also made a higher proportion of within-theme source errors for theme-specific than general elements compared to their younger counterparts. Ackil and Zaragoza (1995) found a similar trend, with 1st graders making more source errors than 3rd and 5th graders, and all children making more errors than college students. In combination, these results indicate that source monitoring ability and reliance on gist traces during retrieval increase with age, with fundamental differences appearing between age 9 and 11.

1.4 Hypotheses

1.4.1 Hypothesis 1

Consistent with existing literature, I expected that participants would show age-related increases in gist processing ability. Specifically, I hypothesized that older children (11 years old) and adults (18–30) would have higher proportions of "old" recognition judgments than younger children (5, 7, and 9 years old) for critical lures that were consistent with the gist of a presented word list.

I further expected that younger children would experience enhanced gist processing for information presented in narrative format as compared to list format—because of its increased contex—while older children and adults would not experience enhanced performance. If enhanced gist processing exists for younger children in the narrative presentation condition, it should be evident in a higher proportion of "old" recognition judgments.

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Related Distracters, Critical Lures) x 5 (Age: 5, 7, 9, 11, 18–30) Analysis of Variance (ANOVA) with proportion of "old" recognition judgments as the dependent variable.

1.4.2 Hypothesis 2

I expected that older children (11 years old) and adults (18–30) would make a higher proportion of correct source memory judgments than younger children (5, 7, and 9 years old). This result would support current literature indicating general age-related increases in source memory.

I further expected that younger children would experience enhanced gist processing for information presented in narrative format as compared to list format—because of its increased context—while older children and adults would not experience enhanced performance. If enhanced gist processing exists for younger children in the narrative presentation condition, it should be evident in a higher proportion of correct and gist-consistent source judgments.

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Related Distracters, Critical Lures) x 5 (Age: 5, 7, 9, 11, 18–30) Analysis of Variance (ANOVA) with proportion of correct source judgments as the dependent variable.

1.4.3 Hypothesis 3

I expected that older children (11 years old) and adults (18–30) would make a higher conditional proportion of gist-consistent source judgments errors than younger children (5, 7, and 9 years old) for critical lures that were consistent with the gist of a presented list, conditionalized by the rate of items being recognized as old. In other words, if a participant previously identified a critical lure as “old” (for example, “Yes, I heard the word BREAD”), he or she should make a gist-consistent source judgment. If Mary the Monkey read the target list corresponding to the gist of the critical lure (i.e., bed, rest, snooze, slumber, etc.), the participant should falsely remember Mary as the source of the critical lure, *sleep*. Therefore, the proportion of correct and gist-consistent source judgments that a participant made should be based on the rate of old recognition judgments.

I further expected that younger children would experience enhanced gist processing for information presented in narrative format as opposed to list format, because of its increased context, while older children and adults would not experience enhanced performance. If enhanced gist processing exists for younger children in the narrative presentation condition, it should be evident in a higher proportion of correct and gist-consistent source judgments conditionalized by the rate of items being recognized as old.

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Related Distracters, Critical Lures) x 5 (Age: 5, 7, 9, 11, 18–30) Analysis of Variance (ANOVA) with proportion of correct and gist-consistent source judgments conditionalized by the rate of items being recognized as old as the dependent variable.

CHAPTER 2

METHOD

2.1 Participants

Participants (*N* = 120) included 96 typically-developing children within 1 month of ages 5 (M = 12, F = 12), 7 (M = 11, F = 13), 9 (M = 10, F = 14), and 11 (M = 10, F = 14), as well as 24 young adults (aged 18–30; M = 3, F = 21). Mean age in years and months for each age group are presented in Table 2.1, and frequencies for participant ethnicity and grade for each age group are presented in Table 2.2. Child recruitment took place through schools and organizations in Arlington, TX, and children received an age-appropriate book or prize as compensation. Young adults volunteered for the project through the UT Arlington Sona System psychology subject pool, and they received course credit as compensation for participation.

Table 2.1 Mean Participant Age in Years and Months by Age Group

Age Group		*M (SE)*	Min	Max
5-year-olds	Years	5.51 (0.04)	5.08	6.00
	Months	66.58 (0.66)	61.00	72.00
7-year-olds	Years	7.61 (0.04)	7.00	8.00
	Months	91.33 (0.72)	84.00	96.00
9-year-olds	Years	9.39 (0.04)	9.00	10.08
	Months	113.21 (0.79)	108.00	121.00
11-year-olds	Years	11.50 (0.10)	11.00	12.08
	Months	138.96 (0.93)	132.00	145.00
Young Adults	Years	19.42 (0.24)	18.08	23.92
	Months	233.04 (3.09)	217.00	287.00

Table 2.2 Participant Ethnicity and Grade Frequencies by Age Group

Age Group	Race				
	White/ Caucasian	Black/African -American	Hispanic	Asian	*Total*
5-year-olds	10 (42%)	9 (38%)	5 (21%)	0 (0%)	*24 (20%)*
7-year-olds	11 (46%)	4 (17%)	9 (38%)	0 (0%)	*24 (20%)*
9-year-olds	14 (58%)	4 (17%)	6 (25%)	0 (0%)	*24 (20%)*
11-year-olds	13 (54%)	3 (13%)	8 (33%)	0 (0%)	*24 (20%)*
Young Adults	12 (50%)	4 (17%)	5 (21%)	3 (13%)	*24 (20%)*
Total	*60 (50%)*	*24 (20%)*	*33 (28%)*	*3 (2%)*	*120 (100%)*

	Grade									
	K	1	2	3	4	5	6	13	14	15
5-year-olds	24	-	-	-	-	-	-	-	-	-
7-year-olds	-	13	11	-	-	-	-	-	-	-
9-year-olds	-	-	1	6	16	1	-	-	-	-
11-year-olds	-	-	-	-	1	7	16	-	-	-
Young Adults	-	-	-	-	-	-	-	11	9	4

2.2 Materials

2.2.1. Recognition Memory Test

2.2.1.1 Stimulus Materials

The 24 word lists used in the memory paradigm were selected from the original set of Deese-Roediger-McDermott (DRM) lists, and they are presented in Appendix A (for the complete set of lists originally developed and normed for the DRM paradigm, see Stadler, Roediger, & McDermott, 1999). This subset of 24 word lists included, among others, 7 of the 8 lists (*sleep, smell, lion, fruit, thief, music, cold*) used with children in a previous study by Dewhurst, Pursglove, and Lewis (2007). The subset of lists in the present study also included 7 of the 8 lists (*cold, lion, sleep, smell, bread, music, fruit*) used by Howe and Wilkinson (2011). Each list consisted of 15 words that related to a *critical lure*—or the theme word for the list—that was not presented at study. The 15 words were listed by strength of association to the critical lure, with the strongest associate listed first. Positions 14 and 15 in the list were designated as *related distracters*. Like the critical lure, the related distracters were not presented at study. However, they were presented at test to examine whether participants were vulnerable to gist-based errors in their memory for presented words. Positions 4, 7, and 10 in the list were designated as *targets*, and were presented at both study and test.

The 24 word lists were also integrated into narratives, some of which were adapted from Dewhurst, Pursglove, and Lewis (2007), and some of which were created for this study (see Appendix B for a complete list). Words were presented in the same order within the narratives as in the original lists, by strength of association, such that the strongest associate appeared first. In four cases (*music, needle, smell, soft*), narratives from the Dewhurst et al. (2007) study were re-written to preserve the original DRM list order.

For the study phase of the memory task, 2 puppets read the lists and narratives in a pre-recorded video. These were generic animal puppets—named Mary the Monkey and Franny the Frog—rather than well-known characters that child or adult participants might have previously experienced (puppets are depicted in Figure 2.1). This should eliminate the possible influence of differences in prior knowledge of the puppets on memory performance. Two females operated the puppets and provided voices for the videos. Videos were recorded and edited using iMovie and an external microphone, with a plain gray background behind both puppets. Puppets gave introductory instructions together, repeating instructions that the researcher read to the participant before starting the video (for protocols, see Appendix C).

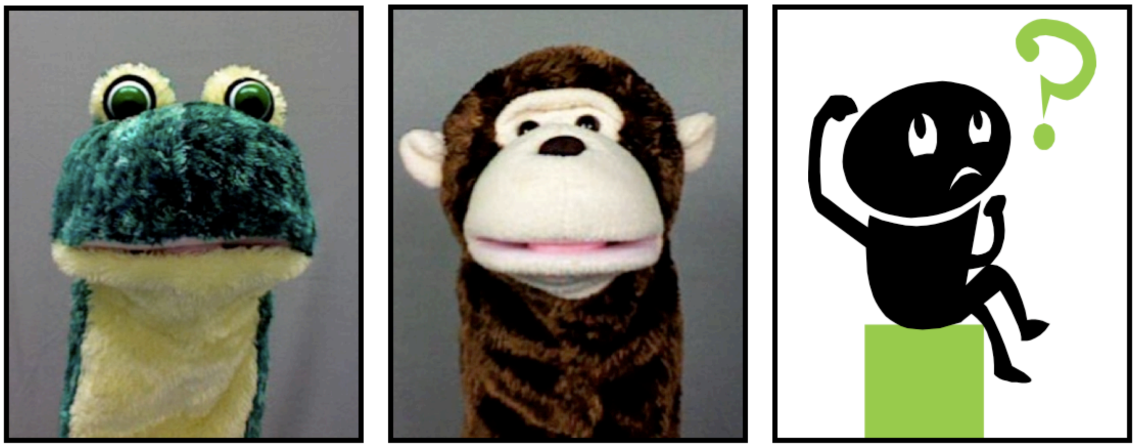

Figure 2.1 Franny the Frog, Mary the Monkey, and the
Figure Representing “I Don’t Know”

Word set presentation type (list vs. narrative) and source puppet (Mary the Monkey vs. Franny the Frog) were both manipulated within subjects, and materials were counterbalanced to ensure that participants received each combination of presentation type and puppet. The 24 word sets were split into 6 groups (A, A’, B, B’, C, and C’) using random assignment of 4 sets to each group. Counterbalancing procedures ensured that the 6 groups were evenly distributed across 12 orders of presentation, each consisting of 2 sessions (e.g., Order 1–Day 1 and Order 1–Day 2). Counterbalancing also allowed equal distribution of presentation type (list, story, or unpresented) across the 12 orders. Each order contained 4 presented groups of word sets (consisting of 4 sets each) for use as related critical lures, related distracters, and presented targets in the recognition memory test administered after the puppet show video ended. Each presentation order also contained 2 groups of word sets (consisting of 4 sets each) that were not presented at study but were used as unrelated critical lures, unrelated distracters, and unpresented targets at test. Finally, puppet presentation was counterbalanced across the 12 orders, such that Mary and Franny presented each set of words an equal number of times as a list and as a story to each participant in the videos presented during Session 1 and Session 2. Tables 2.3–2.5 present the previously described order assignments and counterbalancing procedures.

Table 2.3 Random Assignment of 24 Word Lists to 6 Groups

A	A'	B	B'	C	C'
River	Shirt	Chair	Soft	Window	Smell
Needle	Music	Foot	Fruit	Mountain	Thief
Sweet	Lion	Slow	Car	High	Sleep
Bread	Spider	King	Cold	Cup	Pen

Table 2.4 Counterbalancing of 6 Groups Across 12 Orders of Presentation

	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12
List Presented	A	A	A	A	C	C	C	C	B	B	B	B
List Presented	A'	A'	A'	A'	C'	C'	C'	C'	B'	B'	B'	B'
Narr. Presented	B	B	B	B	A	A	A	A	C	C	C	C
Narr. Presented	B'	B'	B'	B'	A'	A'	A'	A'	C'	C'	C'	C'
Unpresented	C	C	C	C	B	B	B	B	A	A	A	A
Unpresented	C'	C'	C'	C'	B'	B'	B'	B'	A'	A'	A'	A'

Table 2.5 Puppet and Day Assignments Across 12 Orders of Presentation

	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12
List Presented	M1	F2	F1	M2	M1	F2	F1	M2	M1	F2	F1	M2
List Presented	F1	M2	M1	F2	F1	M2	M1	F2	F1	M2	M1	F2
Narr. Presented	M2	F1	F2	M1	M2	F1	F2	M1	M2	F1	F2	M1
Narr. Presented	F2	M1	M2	F1	F2	M1	M2	F1	F2	M1	M2	F1
Unpresented	1	2	1	2	1	2	1	2	1	2	1	2
Unpresented	2	1	2	1	2	1	2	1	2	1	2	1

Note: M = Mary, F = Franny; 1 = Day 1, 2 = Day 2

2.2.1.2 Test Materials

Following the study phase, participants completed a source memory test. For this test, researchers asked the participant to make recognition judgments (e.g., “Did you hear the word ‘sleep’?”) for a list of 72 words. If the participant indicated that a given word was presented at study (e.g., “Yes, I heard ‘sleep’.”), the researcher asked for a source judgment (e.g., “Who said ‘sleep’?”). Researchers instructed the participant to respond to each source judgment prompt by saying, “Franny,” “Mary,” or “I don’t know”. Acceptable variants of these response options included, but were not limited to: “frog,” “the green one,” and gestures to a puppet or the ‘I don’t know’ stick figure (see Figure 1 for images). The test list consisted of targets, related distracters, and critical lures from the 8 lists presented at study, and a set of targets, related distracters, and critical lures from 4 unpresented lists. Researchers used a coding sheet that included instructions and a section for recording participant responses to each word for both practice trials and the test phase of the paradigm (see Appendix D for a sample coding sheet).

2.2.2. Standardized Materials

2.2.2.1 Wechsler Abbreviated Scale of Intelligence (WASI)

The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) measures cognitive ability in 4 domains: vocabulary, block design, similarities, and matrix reasoning. The WASI is normed for ages 6 to 89, and all 4 subtests were used in the present study. The WASI full-scale IQ, calculated from scores on all 4 subtests, has an average reliability of .98 and a test-retest reliability of .92. For the present study, all participants were required to have WASI scores within normal range for their age group in order to be included in data analysis. Lower than normal scores might indicate a deficit in cognitive development that could impair task performance, since the memory task required a developmentally appropriate understanding of vocabulary words and relationships between concepts. However, all participants scored within normal range for their age groups, and therefore none were excluded from analysis on the basis of WASI scores. Mean WASI scores for the current sample are presented in Table 2.6.

Table 2.6 Mean Standardized Test Scores (WASI/WIAT) and Reliabilities by Age Group

Measure	Age Group *M(SE)*				
	5 Year Olds	7 Year Olds	9 Year Olds	11 Year Olds	Young Adults
WASI Raw Scores					
Vocabulary	18.38 (1.36)	27.33 (1.28)	38.42 (1.25)	44.25 (1.45)	58.17 (1.19)
Block Design	4.38 (0.53)	8.96 (1.28)	20.33 (2.69)	29.33 (2.97)	45.58 (2.67)
Similarities	11.54 (1.27)	19.29 (1.03)	26.96 (0.96)	29.63 (1.04)	35.71 (0.79)
Matrix Reasoning	6.46 (0.91)	16.67 (1.30)	23.08 (0.63)	23.63 (1.16)	27.71 (0.63)
WASI Std. Scores					
Verbal IQ	96.75 (3.12)	104.38 (2.80)	113.67 (2.80)	106.00 (2.69)	104.42 (1.83)
Performance IQ	119.71 (25.74)	101.50 (2.54)	107.25 (2.63)	102.96 (3.16)	102.83 (2.10)
Full 4-Scale IQ	94.29 (2.39)	103.42 (2.56)	112.04 (2.60)	104.96 (2.85)	104.54 (1.88)
Full 2-Scale IQ	94.71 (2.71)	104.83 (3.04)	111.79 (2.22)	105.04 (2.55)	106.38 (1.84)
WIAT Raw Scores					
Receptive Vocabulary	6.88 (0.47)	8.38 (0.47)	10.00 (0.36)	10.75 (0.34)	13.63 (0.32)
Sentence Comprehension	5.46 (0.36)	8.08 (0.31)	8.58 (0.21)	8.88 (0.22)	9.33 (0.17)
Expressive Vocabulary	2.25 (0.33)	4.46 (0.50)	7.88 (0.49)	8.71 (0.43)	12.33 (0.40)
Total	14.67 (0.94)	20.92 (1.00)	26.46 (0.74)	28.21 (0.73)	35.29 (0.75)
WIAT Std. Scores					
Age-Based Total	106.04 (2.74)	104.88 (2.85)	107.38 (2.32)	100.92 (2.32)	103.67 (2.64)
Grade-Based Total	104.00 (3.39)	108.38 (3.58)	106.33 (2.87)	101.42 (2.59)	95.17 (3.91)

2.2.2.2 Wechsler Individual Achievement Test (WIAT)

The Wechsler Individual Achievement Test–Second Edition (WIAT; Wechsler, 2005) measures reading, math, writing, and oral comprehension skills. The WIAT is normed for ages 4 to 89, and the entire battery consists of 9 subtests. For the present study, researchers administered only the Listening Comprehension subtest. This subtest has an average reliability of .81 and a test-retest reliability of .98 (averaged for groups 6–9, 10–12, and 13–19). For the present study, all participants were required to have WIAT scores within normal range for their age group in order to be included in data analysis. Lower than normal scores might indicate a deficit in listening comprehension skills that could have impaired performance on the memory task, since all task instructions and word lists at study and test required auditory processing and comprehension. However, all participants scored within normal range for their age groups, and therefore none were excluded from analysis on the basis of WIAT scores. Mean WIAT scores and reliabilities for the current sample are presented in Table 2.6.

2.3 Procedures

Researchers met with participants in 2 sessions, each lasting approximately 1 hour. Researchers obtained informed consent from young adults participants, or informed assent from minor participants and consent from a parent. Child participants were either accompanied by a parent or guardian for the first session, or had appropriate consent and assent documents signed by their parent prior to the appointment. The consent or assent/consent form signed by participants (and parents, when applicable) applied to both sessions, and a copy was sent home with participants for their records.

2.3.1 Session 1

In the first session, researchers administered the memory paradigm. The memory paradigm lasted approximately 30 minutes, including two brief practice trials. The researcher first introduced Mary the Monkey and Franny the Frog to the participant. The researcher asked the participant to point to Mary the Monkey, and then point to Franny the Frog, in order to ensure that he or she was able to correctly identify each puppet for later source judgments. The researcher then read instructions aloud and presented two practice videos and practice tests to ensure that the participant was familiar with the characters and understood the instructions.

During the practice trials, participants were presented with a video of the puppets giving instructions, followed by one puppet reading a short list of related words. For the first practice trial, Franny the Frog read a list of shape words (*circle, square, triangle, rectangle*). The first practice test included 3 of the 4 words presented in the video (*circle, square, triangle*) and 1 unrelated word (*toy*). The participant was asked to make old/new recognition judgments for each item (e.g., “Did you hear *circle*?”) along with source judgments for items they identified as presented in the puppet show (e.g., “Who said it?”). For each item, the researcher provided feedback (e.g., “That’s right, Franny said circle!” for a correct judgment or “Well, really it was Franny who said square” for an incorrect judgment) to help the participant understand the instructions. The second practice trial followed the same procedure, but this time with Mary the Monkey presenting a list of color words (*blue, green, pink, yellow*). Again, the practice test included 3 of the 4 words presented in the video (*blue, green, pink*) and 1 unrelated word (*book*). As before, participants were given feedback for each item response, to ensure that they understood the instructions. See Appendix C for coding sheets detailing verbal instructions for participants and sample feedback that researchers provided in response to correct or incorrect answers. An opportunity for questions was given before and after each practice test, so that the researcher could repeat or reword instructions if a participant was confused.

After successfully completing practice trials, the participant watched his or her randomly assigned order of video clips, presented with 5 seconds of a black screen in between each clip and lasting for approximately 6 minutes total. The researcher then repeated instructions for the memory test and asked the participant to make recognition and source judgments according to the format of the test materials outlined above. After participants finished the memory test, they were given the option of a 5-minute break, after which researchers administered the four subtests of the WASI.

2.3.2 Session 2

In the second session, researchers administered the memory paradigm for the second time. The memory task involved identical procedures to that of Session 1, but with a different set of words. Again, participants had the option of a 5-minute break before researchers went on to administer the Listening Comprehension section of the WIAT. After completing both sessions, participants were debriefed and compensated for their time. Young adults, recruited from the university subject pool, received 2.25 credits per session toward course requirements or extra credit options in the Sona System. Children chose an age-appropriate storybook or prize to take home as their compensation for participation.

CHAPTER 3

RESULTS

The following analyses test 3 hypotheses about the development of gist processing. The first hypothesis was that age-related increases in gist processing would be evident in higher proportions of "old" recognition judgments for critical lures than related distracters, and for targets than related distracters (i.e., CL = T > RD). The second hypothesis was that age-related increases in gist processing would be evident in higher proportions of correct and gist-consistent source judgments for CL than RD, and for T than RD (i.e., CL = T > RD). The third hypothesis was that age-related increases in gist processing would be evident in higher conditional proportions of correct and gist-consistent source judgments based on the rate of recognizing items as old. Across all hypotheses, younger children were expected to process gist more effectively from information in narrative format than list format. Results in line with predictions would indicate that participants successfully processed the gist of presented item groups, and experienced false memory for critical lures and a corresponding source as a result.

3.1 Data Management

Participant responses to the "Did you hear the word ___?" question on the recognition memory test were coded as 0 (no) or 1 (yes). Proportions of "yes" ("old") responses to total items were calculated separately for presented and unpresented CL, RD, and T item types.

"Old" recognition judgments to any item type other than T from presented word sets are technically incorrect. However, "old" recognition judgments to a CL or RD from a presented word set were also important, since activation of a gist trace could elicit false memory for items related to presented targets (i.e., CL, RD) despite not being presented during the puppet show . "Old" recognition judgments to T, CL, or RD items from unpresented word sets reflect false memory unrelated to the possible interference of gist traces, since no related items were presented during the study phase. Thus, mean proportions > 0.00 for presented CL or RD item types reflect falsely remembering gist-consistent information, and perfect memory for targets would result in a mean proportion of 1.00. Raw mean proportions of “old” recognition judgments to total number of test items were computed for each item type, age group, and presentation type. Raw mean proportions of “old” recognition judgments are presented in Table 3.1.

Table 3.1 Raw Mean Proportions of Items Recognized as Old by Item and Presentation Type

Item Type	Age Group *M(SE)*				
	5	7	9	11	YA
Narrative Presented					
Targets	0.47 (0.05)	0.47 (0.05)	0.61 (0.03)	0.66 (0.03)	0.67 (0.03)
Critical Lures	0.49 (0.06)	0.51 (0.04)	0.68 (0.05)	0.78 (0.04)	0.80 (0.03)
Related Distracters	0.31 (0.05)	0.24 (0.05)	0.21 (0.03)	0.30 (0.04)	0.27 (0.04)
Narrative Unpresented					
Targets	0.28 (0.06)	0.19 (0.06)	0.10 (0.03)	0.20 (0.04)	0.18 (0.05)
Critical Lures	0.29 (0.06)	0.19 (0.06)	0.13 (0.04)	0.20 (0.04)	0.24 (0.06)
Related Distracters	0.32 (0.07)	0.18 (0.06)	0.12 (0.03)	0.18 (0.04)	0.16 (0.05)
List Presented					
Targets	0.53 (0.05)	0.50 (0.04)	0.58 (0.03)	0.64 (0.03)	0.73 (0.03)
Critical Lures	0.52 (0.06)	0.53 (0.05)	0.54 (0.05)	0.74 (0.05)	0.77 (0.05)
Related Distracters	0.35 (0.05)	0.29 (0.06)	0.23 (0.03)	0.36 (0.03)	0.32 (0.05)
List Unpresented					
Targets	0.35 (0.06)	0.22 (0.05)	0.09 (0.02)	0.22 (0.05)	0.13 (0.04)
Critical Lures	0.33 (0.07)	0.30 (0.07)	0.18 (0.03)	0.26 (0.06)	0.21 (0.06)
Related Distracters	0.33 (0.06)	0.24 (0.05)	0.14 (0.03)	0.22 (0.04)	0.12 (0.04)

In an effort to correct for participant guessing on the memory test, raw proportions were adjusted using the A’ statistic, as recommended by Odegard et al. (2008) and Snodgrass and Corwin (1988) (see Appendix E for calculations). Snodgrass and Corwin propose a *two-high-threshold model* of recognition judgments, wherein a person’s hit rate equals “a certain proportion of true recognitions plus lucky guesses” (p. 38). These guesses are equivalent to the probability of correctly identifying an item as old when uncertain. In other words, a participant might guess “old” for an item when uncertain, and that judgment could be correct (a lucky guess) or incorrect (an unlucky guess). Because unpresented test items were never heard and were unrelated to items presented at study, participants should not identify them as “old”. The proportion of “old” recognition judgments for unpresented test items therefore represented a participant’s base rate of guessing and was subtracted from the total proportion of items judged as “old”. Proportions of A’ corrected “old” recognition judgments are presented in Table 3.2.

Table 3.2 A’ Corrected Mean Proportions of Items Recognized as Old by Item and Presentation Type

Item Type	Age Group *M(SE)*				
	5	7	9	11	YA
Narrative Presented					
Targets	0.66 (0.03)	0.75 (0.02)	0.84 (0.02)	0.82 (0.02)	0.83 (0.02)
Critical Lures	0.66 (0.03)	0.78 (0.03)	0.86 (0.02)	0.87 (0.02)	0.89 (0.01)
Related Distracters	0.53 (0.03)	0.57 (0.04)	0.63 (0.04)	0.61 (0.04)	0.60 (0.04)
List Presented					
Targets	0.67 (0.03)	0.73 (0.03)	0.76 (0.04)	0.76 (0.03)	0.86 (0.02)
Critical Lures	0.67 (0.03)	0.75 (0.02)	0.79 (0.03)	0.82 (0.03)	0.87 (0.03)
Related Distracters	0.50 (0.04)	0.57 (0.03)	0.61 (0.03)	0.62 (0.03)	0.68 (0.04)

After correcting for guessing at the level of “old” recognition judgments, source data was coded. Source judgments, or participant responses to the “Who said it?” question on the recognition memory test, were only solicited for items the participant identified as “old”. Source judgments for presented Ts were coded as correct, incorrect, or “I don’t know”. Source judgments for presented CL and RD were coded as gist-consistent (i.e., consistent with the source who presented a T from the same word set at study), gist-inconsistent (i.e., not consistent with the source of the presented T from the same word set), or “I don’t know”. Proportions were then calculated separately for each item type, for both narrative and list presentation (see Appendix E for calculations). Proportions are presented in Table 3.3.

Table 3.3 Mean Proportions of Correct and Gist-Consistent Source Judgments by Item and Presentation Type

Item Type	Age Group *M(SE)*				
	5	7	9	11	YA
Narrative Presented					
Targets	0.24 (0.03)	0.23 (0.03)	0.36 (0.03)	0.43 (0.03)	0.40 (0.03)
Critical Lures	0.27 (0.04)	0.29 (0.04)	0.42 (0.04)	0.47 (0.04)	0.50 (0.40)
Related Distracters	0.16 (0.03)	0.14 (0.03	0.12 (0.03)	0.17 (0.31)	0.16 (0.03)
List Presented					
Targets	0.27 (0.03)	0.27 (0.03)	0.34 (0.03)	0.42 (0.03)	0.57 (0.03)
Critical Lures	0.23 (0.05)	0.29 (0.05)	0.33 (0.05)	0.50 (0.05)	0.63 (0.05)
Related Distracters	0.19 (0.03)	0.15 (0.03)	0.16 (0.03)	0.21 (0.03)	0.26 (0.03)

To better understand participants’ use of gist to identify the source of a memory, I computed mean proportions of correct and gist-consistent source judgments conditionalized by the rate of correct and gist-consistent “old” recognition judgments. This conditional proportion was computed as the proportion of correct and gist-consistent source judgments divided by the proportion of “old” recognition judgments. In other words, this proportion identifies a participant’s rate of correctly (T) or gist-consistently (CL, RD) identifying the source associated with a particular word set, based on their rate of correctly or gist-consistently identifying a test item associated with a word set presented at study as "old".

Table 3.4 Mean Proportions of Conditional Source Judgments by Item and Presentation Type

Item Type	Age Group *M(SE)*				
	5	7	9	11	YA
Narrative Presented					
Targets	0.47 (0.04)	0.50 (0.04)	0.59 (0.04)	0.64 (0.04)	0.57 (0.04)
Critical Lures	0.53 (0.05)	0.54 (0.05)	0.63 (0.05)	0.60 (0.05)	0.61 (0.05)
Related Distracters	0.48 (0.08)	0.43 (0.08)	0.54 (0.08)	0.50 (0.08)	0.52 (0.08)
List Presented					
Targets	0.49 (0.04)	0.56 (0.04)	0.57 (0.04)	0.64 (0.04)	0.77 (0.04)
Critical Lures	0.38 (0.06)	0.57 (0.06)	0.57 (0.06)	0.67 (0.06)	0.76 (0.06)
Related Distracters	0.51 (0.06)	0.51 (0.06)	0.54 (0.06)	0.58 (0.06)	0.74 (0.06)

Data were checked for accuracy and screened for outliers. Data were also screened to ensure that they met assumptions of homogeneity of variance (Levene's test), equality of covariance matrices (Box's test), and sphericity (Mauchly's test). Results from these three tests are presented in subsequent sections and in Tables 3.5, 3.6, and 3.7.

3.2 Hypothesis Testing

Separate 2 (Presentation Type: List, Narrative) x 3 (Item Type: Critical Lure, Target, Related Distracter) x 5 (Age: 5, 7, 9, 11, Young Adults) repeated-measures analyses of variance (RMANOVAs) were conducted for proportion of "old" recognition judgments (using A' corrected proportions as described above) and for proportion of correct and gist-consistent source judgments. I included Researcher (N = 9) as a variable to confirm that the person administering the protocol did not significantly affect participants' responses, but since the main effect was nonsignificant in each model, I removed that variable in the models reported below.

3.2.1 Hypothesis 1

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Critical Lures, Related Distracters) x 5 (Age: 5, 7, 9, 11, Young Adult) RMANOVA, with Presentation Type and Item Type as within-subjects variables and Age as a between-subjects variable. The A' corrected proportion of "old" recognition judgments was the dependent variable in this analysis.

Several tests were conducted to determine whether the data met core assumptions of RMANOVA. Box's Test of Equality of Covariance Matrices was significant, indicating unequal variance-covariance matrices across groups (see Table 3.5). However, given the broad age range of the present sample and the rapid development occurring from ages 5–11 and from 11 to young adulthood, this result is not surprising. Further, since sample sizes are equal across all groups in the present study, the RMANOVA should be robust even in the event of a significant Box's M test (Field, 2009). Mauchly's test indicated that the data violated the assumption of sphericity for both Presentation Type and Item Type (see Table 3.5). This result is fairly common, and again, RMANOVA is typically robust even when the assumption of sphericity is violated, particularly if epsilon corrections are implemented to compensate for the violation (Field, 2009). To that end, I considered both Greenhouse-Geisser (Geisser & Greenhouse, 1958; Greenhouse & Geisser, 1959) and Huynh-Feldt (Huynh & Feldt, 1976) epsilon corrections, as both presented appropriate methods of accounting for the violated assumption. Given recommendations for using the Huynh-Feldt correction in cases where epsilon is greater than 0.75, degrees of freedom for univariate tests were adjusted according to this more liberal method of correction, as recommended in Huynh (1978) and Huynh and Feldt, (1976). Pairwise comparisons were used to probe significant effects and examine group differences between levels of each independent variable, using a Bonferroni correction in each instance to adjust for multiple comparisons.

Table 3.5 Tests of RMANOVA Assumptions of Equality of Covariance Matrices, Sphericity, and Equality of Error Variances for "Old" Recognition Judgments

Test Name	Test Statistics				
Box's Test of Equality of Covariance Matrices	*Box's M* = 173.35	*F*(84, 25266.81) = 1.83***			
Mauchly's Test of Sphericity	*Mauchly's W*	X^2	*df*	*G-G Epsilon*	*H-F Epsilon*
Presentation Type	1.00	.000***	0	1.00	1.00
Item Type	.93	8.90**	2	.93	.98
Presentation x Item	.98	2.44	2	.98	1.00
Levene's Test of Equality of Error Variances	*F*(4, 115)	Narratives		Lists	
Targets		3.10*		0.90	
Critical Lures		4.23**		0.69	
Related Distracters		1.13		0.75	

Note: * = significant at $p < .05$, ** = significant at $p < .01$, *** = significant at $p < .001$

Consistent with existing literature and predictions in the present study, multivariate tests revealed a significant main effect of Item Type, $F(2, 114) = 158.57$, $p < .001$, $\eta_p^2 = .75$, but contrary to predictions, no significant main effect existed for Presentation Type or Age. In addition, no significant interactions occurred among the three independent variables.

Within-subjects univariate tests, with the Huynh-Feldt epsilon correction applied as described above, confirmed the same main effect of Item Type, $F(1.96, 224.88) = 216.29$, $p < .001$, $\eta_p^2 = .65$, $MSE = 2.97$. Post-hoc tests for the effects of Item Type revealed mean differences between Targets, Critical Lures, and Related Distracters. Specifically, participants' old recognition judgments were higher for CL ($M = 0.80$, $SE = 0.01$) > T ($M = 0.77$, $SE = 0.01$) > RD ($M = 0.59$, $SE = 0.01$). Between-subjects univariate tests revealed a main effect of Age, $F(4, 115) = 12.94$, $p < .001$, $\eta_p^2 = .31$ $MSE = 0.66$. Post-hoc tests for the effects of Age revealed mean differences between the 5-year-old group and all other age groups, with 5-year-olds having a lower mean proportion of old recognition judgments than 7, 9, 11, or young adults, and between 7-year-olds and young adults, with 7-year-olds having a lower mean proportion of old recognition judgments than young adults (see Table 3.2).

In an effort to better understand the main effects of item type and age group, I conducted a series of t-tests to determine group differences among each age group, item type, and presentation type. Mean proportions for each item type, presentation type, and age group are presented in Figure 3.1. A complex pattern of results emerged from the series of t-tests, and notably, the presence of several marginally-significant differences within cells may account for the nonsignificant 2- and 3-way interactions mentioned above.

For Ts presented in narrative format, young adult performance was equal to that of 11- and 9-year-olds, with no significant difference in mean proportions of "old" recognition judgments across the three groups *t*s(46) = 0.24, -0.53, -0.83, *p*s = 0.82, 0.60, 0.41. The proportions of older participants were, however, greater than those of 7-year-olds, *t*s(46) = 2.22, 2.19, 2.89, *p*s = 0.03, 0.03, 0.01, and all age groups' proportions exceeded those of 5-year-olds, *t*s(46) = 4.35, 4.43, 4.95, 2.60, *p*s < .001, .001, .001, .01. This pattern reflects a developmental trend of increased memory capacity for items as individuals mature cognitively, which has historically been demonstrated in a number of studies using the DRM paradigm. Although there was not a main effect of Presentation Type, it is interesting to note that for Ts presented in list format, proportions for the young adult group exceeded all other age groups *t*s(46) = 2.43, 2.02, 3.77, 5.48, *p*s < 0.02, 0.05, .001, .001, and children's proportions were not significantly different across ages 11, 9, and 7, *t*s(46) = 0.05, 0.82, 0.63, *p*s = 0.96, 0.42, 0.53. The 11-year-old and 9-year-old groups did have a higher proportion of "old" judgments than 5-year-olds, *t*s(46) = 2.21,1.79, *p*s = 0.03, 0.08, but 7-year-olds did not differ from 5-year-olds, *t*(46) = 1.54, *p* = 0.13.

Proportions of "old" recognition judgments for CLs and RDs in the narrative condition followed a pattern similar to that of Ts in the narrative condition. Specifically for CLs, young adults, 11-year-olds, and 9-year-olds were not significantly different, *t*s(46) = 0.90, 0.90, 0.05, *p*s = 0.37, 0.37, 0.96. Young adults had significantly higher proportions than 7 or 5-year-olds, *t*s(46) = 2.78, 6.10, *p*s < 0.01, .001, and 7-year-olds had marginally lower proportions than 11 or 9-year-olds, *t*s(46) = 2.01, 1.93, *p*s = 0.05, 0.06. In addition to young adults, all other age groups had significantly higher proportions than 5-year-olds, *t*s(46) = 5.01, 4.95, 2.56, *p*s < .001, .001, 0.01. With respect to CLs in the list condition, young adults did not differ from 11-year-olds, *t*(46) = 1.14, *p* < 0.26, and only marginally differed from 9-year-olds, *t*(46) = 1.93, *p* < 0.06. Although 11-year-olds, 9-year-olds, and 7-year-olds did not differ significantly, *t*s(46) = 0.81, 1.67, -0.65, *p*s < 0.43, 0.10, 0.40, young adults did have significantly higher proportions than 7-year-olds, *t*(46) = 2.79, *p* < 0.01. Again, all age groups had a higher proportion of "old" judgments for CLs than 5-year-olds, *t*s(46) =4.28, 3.38, 2.72, 2.07, *p*s < .001, 0.01, 0.01, 0.04.

For RDs in the narrative condition, young adults and 11, 9, and 7-year-olds were equal in their proportion of "old" recognition judgments, *t*s(46) = -0.03, -0.53, 0.59, -0.50, 0.61, 1.10, *p*s < 0.98, 0.60, 0.56, 0.62, 0.54, 0.28. The young adult, 11-year-old, and 7-year-old groups did not differ significantly from the 5-year-olds, *t*s(46) =1.69, 1.70, 0.97, *p*s = 0.10, 0.10, 0.34, but the 9-year-olds had significantly higher proportions than 5-year-olds, *t*(46) = 2.26, *p* = 0.03. In the list condition, again young adults, 11-year-olds, and 9-year-olds were equal in their proportion of "old" judgments, *t*s(46) = 1.07, 1.42, 0.25, *p*s < 0.29, 0.16, 0.81, and 11-year-olds, 9-year-olds, and 7-year-olds did not differ significantly, *t*s(46) = 0.25, 1.30, 1.18, *p*s < 0.81, 0.20, 0.25. As in the case of CLs in the list condition, young adults and 11- and 9-year-old children did have significantly higher proportions than 7- and 5-year-olds, *t*s(46) = 2.42, 3.47, 2.45, 2.44, *p*s < .001, 0.01, 0.02, 0.02, but 7- and 5-year-olds did not significantly differ, *t*(46) = 1.37, *p* < 0.18.

I also conducted a series of paired-samples t-tests to assess age differences in "old" recognition judgments by each presentation type (i.e., 5-year-olds' proportions of "old" recognition judgments in the list versus narrative condition), for each item type. Results indicated that 9-year-olds had higher proportions for critical lures in the narrative than in the list condition, *t*(23) = 2.42, *p* = .02, and young adults had marginally lower proportions for targets in the narrative than in the list condition, *t*(23) = -1.90, *p* = .07, but the other groups did not differ.

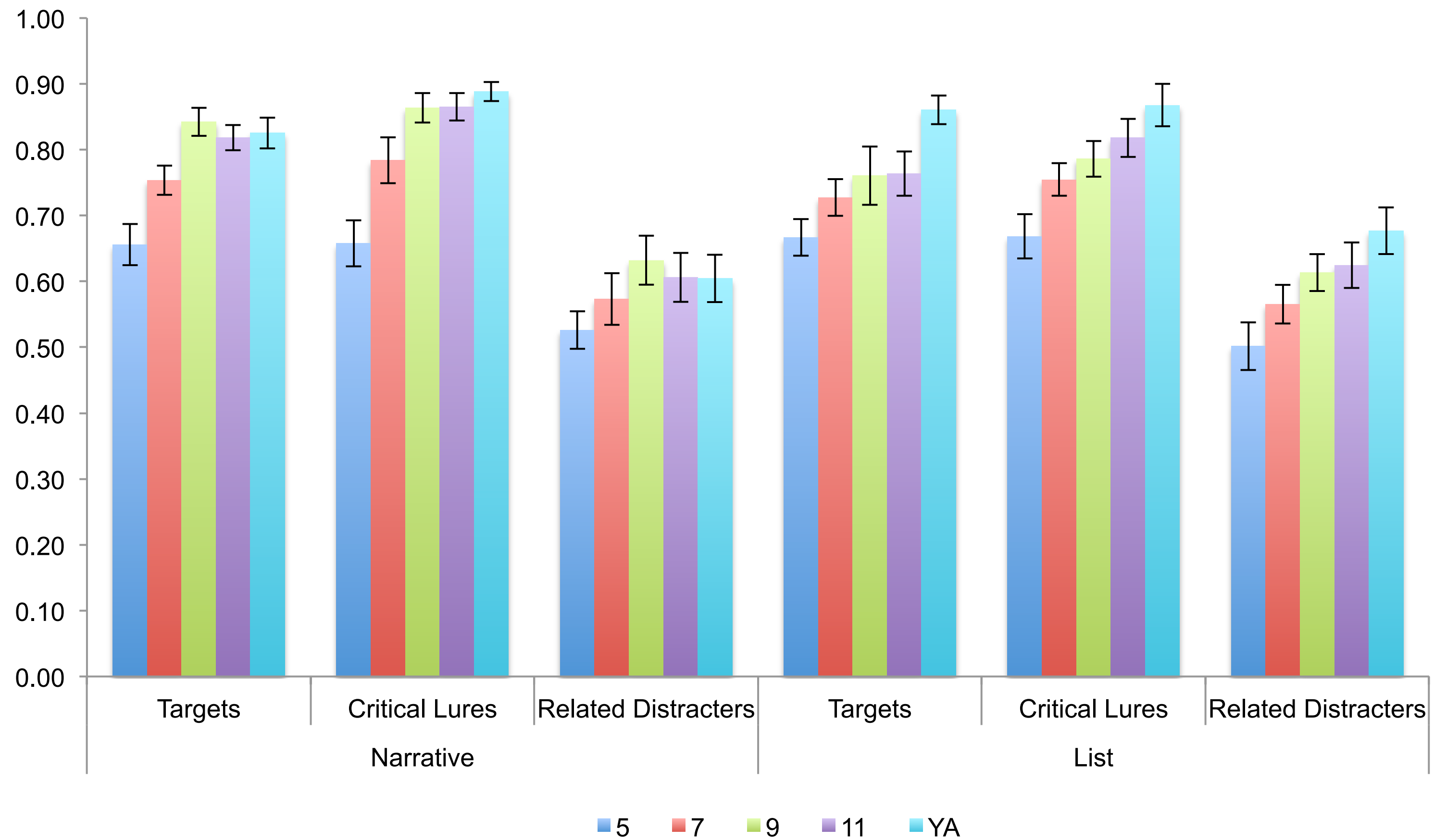

Figure 3.1 Mean Proprtions of "Old" Recognition Judgments by Item Type, Presentation Type, and Age

3.2.2 Hypothesis 2

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Related Distracters, Critical Lures) x 5 (Age: 5, 7, 9, 11, 18–30) RMANOVA with proportion of correct and gist-consistent source judgments as the dependent variable. Pairwise comparisons were used to probe significant effects and examine group differences between levels of each independent variable.

Several tests were conducted to determine whether the data met core assumptions of RMANOVA. Box's Test of Equality of Covariance Matrices was nonsignificant, but Mauchly's test indicated that the data violated the assumption of sphericity for Presentation Type, Item Type, and their interaction (see Table 3.6). Again, degrees of freedom for univariate tests were adjusted according to the more liberal Huynh-Feldt correction. Pairwise comparisons were used to probe significant effects and examine group differences between levels of each independent variable, using a Bonferroni adjustment for multiple comparisons.

Table 3.6 Tests of RMANOVA Assumptions of Equality of Covariance Matrices, Sphericity, and Equality of Error Variances for Source Judgments

Test Name	Test Statistics				
Box's Test of Equality of Covariance Matrices	*Box's M* = 119.93	*F*(84, 25266.81) = 1.27			
Mauchly's Test of Sphericity	*Mauchly's W*	X^2	*df*	*G-G Epsilon*	*H-F Epsilon*
Presentation Type	1.00	.000***	0	1.00	1.00
Item Type	.85	18.36***	2	.87	.91
Presentation x Item	.98	9.03**	2	.93	.98
Levene's Test of Equality of Error Variances	*F*(4, 115)	Narratives		Lists	
Targets		1.29		0.84	
Critical Lures		0.24		1.98	
Related Distracters		0.93		4.24**	

Note: * = significant at $p < .05$, ** = significant at $p < .01$, *** = significant at $p < .001$

Consistent with existing literature and predictions in the present study, multivariate tests revealed significant main effects of Presentation Type, $F(1, 115) = 4.46$, $p = 0.04$, $\eta_p^2 = .04$, and Item Type, $F(2, 114) = 164.07$, $p < .001$, $\eta_p^2 = .74$. In addition, significant interactions occurred for Presentation Type x Age Group, $F(4, 115) = 3.85$, $p < 0.01$, $\eta_p^2 = .12$, and Item Type x Age Group, $F(8, 230) = 6.11$, $p < .001$, $\eta_p^2 = .18$. However, interaction effects were not significant for Presentation Type x Item Type or for the 3-way interaction of Presentation Type x Item Type x Age Group.

Between-subjects univariate tests revealed a significant main effect of Age, $F(4, 115) = 11.24$, $p < .001$, $\eta_p^2 = .28$, $MSE = 0.09$. Post-hoc tests for the effects of Age, with Bonferroni corrections applied for multiple comparisons, revealed mean differences between several age groups. Specifically, differences occurred between the young adults and all other age groups except for 11-year-olds, with young adults having a higher mean proportion of correct and gist-consistent judgments than 9, 7, and 5-year-olds, and between 11-year-olds and 9 and 7-year-olds, with 11-year-olds having a higher mean proportion than 9 or 7-year-olds (see Table 3.3). All other age groups were equivalent in their proportions.

Within-subjects univariate tests, with the Huynh-Feldt epsilon correction applied as described above, confirmed the same main effects of Presentation Type, $F(1, 115) = 4.46$, $p = 0.04$, $\eta_p^2 = 0.04$, $MSE = 0.03$, and Item Type, $F(1.83, 210.11) = 189.15$, $p < .001$, $\eta_p^2 = .62$, $MSE = 0.02$. Post-hoc tests for the effect of Presentation Type revealed mean differences between Narrative and List presentation of information. Specifically, participants' correct and gist-consistent source judgments were higher in the List condition ($M = 0.32$, $SE = 0.01$) than the Narrative condition ($M = 0.29$, $SE = 0.01$). Post-hoc tests for the effects of Item Type revealed mean differences between Targets, Critical Lures, and Related Distracters. Specifically, participants' correct and gist-consistent source judgments were higher for CL ($M = 0.39$, $SE = 0.02$) > T ($M = 0.35$, $SE = 0.01$) > RD ($M = 0.17$, $SE = 0.01$). The interactions of Presentation Type x Age Group, $F(4, 115) = 3.85$, $p < 0.01$, $\eta_p^2 = .12$, $MSE = 0.03$, and Item

Type x Age Group, $F(7.31, 210.11) = 9.00$, $p < .001$, $\eta_p^2 = .12$, $MSE = 0.18$, were both significant (see Figures 3.2 and 3.3), but the interactions of Presentation Type x Item Type and Presentation Type x Item Type x Age Group were not significant.

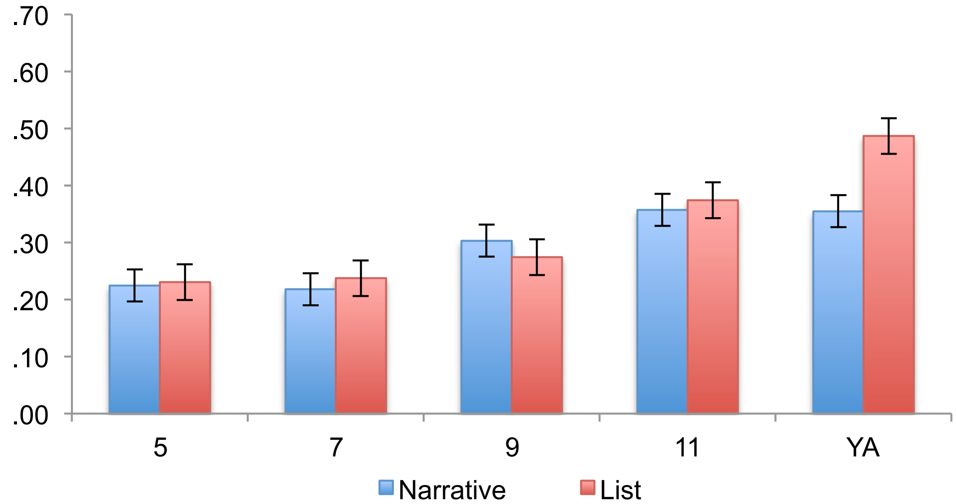

Figure 3.2 Interaction of Presentation Type and Age on Mean Proportion of Correct and Gist-Consistent Source Judgments

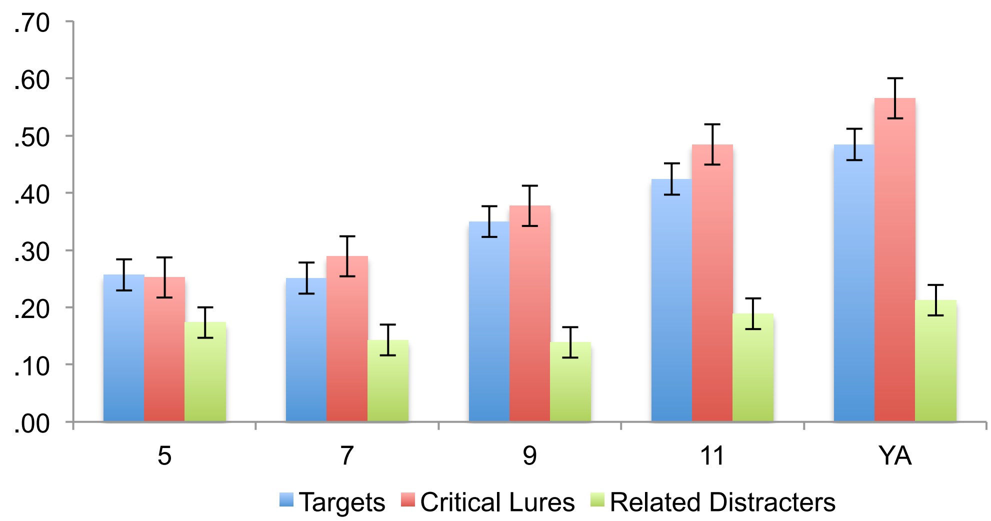

Figure 3.3 Interaction of Item Type and Age on Mean Proportion of Correct and Gist-Consistent Source Judgments

In an effort to better understand the significant main effects and 2-way interactions of Presentation Type x Age Group and Item Type x Age Group, I conducted a series of t-tests to determine group differences. Mean proportions for each item type, presentation type, and age group are presented in Figure 3.4. For Ts presented in narrative format, young adult performance was equal to that of 11- and 9-year-olds, with no significant difference in mean proportions of correct and gist-consistent source judgments across the three groups *t*s(46) = -0.67, 0.74, 1.46, *p*s = 0.50, 0.47, 0.15. The proportions of older participants were, however, greater than those of 7-year-olds, *t*s(46) = 3.84, 4.58, 3.40, all *p*s < .001. All age groups' proportions exceeded those of 5-year-olds, *t*s(46) = 3.15, 3.82, 2.69, *p*s < 0.01, .001, 0.01, with the exception of 7-year-olds, whose performance was equivalent to 5-year-olds, *t*(46) = -0.25, *p* = 0.08. As in the recognition data presented above, this pattern again reflects a general developmental trend of increased memory capacity. For Ts presented in list format, proportions for the young adult group exceeded all other age groups, *t*s(46) = 3.03, 4.99, 6.58, 5.74, *p*s < 0.01, .001, .001, .001, and children's proportions were not significantly different between ages 11 and 9, *t*s(46) = 1.73, 1.59, *p*s = 0.09, 0.12, again following the same pattern found in the recognition data above. The 11-year-old group did have a higher proportion of "old" judgments than 7 or 5-year-olds, *t*s(46) = 3.22, 2.79, *p*s < 0.01, 0.01, but 9, 7, and 5-year-olds did not significantly differ from one another, *t*s(46) = 1.59, 1.24, -0.01, *p*s = 0.12, 0.19, 0.99.

Proportions of correct and gist-consistent source judgments for CLs in the narrative condition followed a pattern similar to that of Ts in the narrative condition. Specifically, young adults, 11-year-olds, and 9-year-olds were not significantly different, *t*s(46) = 0.54, 1.39, 0.85, *p*s = 00.59, 0.17, 0.40. Young adults had significantly higher proportions than 7 or 5-year-olds, *t*s(46) = 3.64, 3.81, *p*s < .001, .001, and 7-year-olds had lower proportions than 11 or 9-year-olds, *t*s(46) = 3.18, 2.54, *p*s < .001, 0.01. In addition to young adults, 11- and 9-year-olds had significantly higher proportions than 5-year-olds, *t*s(46) = 3.37, 2.76, *p*s < 0.01, .001, but 7-year-olds did not significantly differ from 5-year-olds, *t*(46) = 0.29, *p* = 0.77. With respect to CLs in the list condition, young adults did not differ significantly from 11-year-olds, $t(46) = 1.76$, $p = 0.09$, but did differ from all other age groups, *t*s(46) = 4.35, 5.42, 5.40, *p*s < .001, 001, .001. Furthermore, 11-year-olds had significantly higher proportions than 9, 7, and 5-year-olds, *t*s(46) = 2.55, 3.51, 3.76, *p*s < 0.01, .001, .001. The 9-year-old group did not differ significantly from 7 or 5-year-olds, *t*s(46) = 0.79, 1.52, *p* = 0.44, 0.14, and the 7-year-olds had equivalent proportions with the 5-year-olds, $t(46) = 0.98$, $p = 0.33$.

For RDs in the narrative condition, proportions of correct and gist-consistent source judgments were equal across all age groups, *t*s(46) = 0.13, 1.05, 1.24, 0.76, 0.34, 0.61, 0.06, 0.19, 0.90, -0.51, *p*s = 0.89, 0.30, 0.22, 0.45, 0.74, 0.54, 0.95, 0.85, 0.38, 0.61. In the case of RDs in the list condition, the only significant group differences occurred for young adults, who had higher proportions than 9 or 7-year-olds, *t*s(46) = 2.06, 2.05, *p*s < .05. All other groups did not differ significantly, *t*s(46) = 1.11, 1.48, 1.47, 0.14, 1.47, 0.62, -0.78, -0.85, *p*s = 0.27, 0.15, 0.15, 0.89, 0.15, 0.54, 0.44, 0.40. The lack of age differences in reporting a source for RDs is interesting because since gist traces are not cued as strongly for RDs as for CLs and Ts, any age-related differences in gist processing may not be evident for this item type.

I conducted a series of paired-samples t-tests to assess differences in proportion of correct and gist-consistent source judgments by presentation type within each age group, for each item type. Results indicated that, as previously found for “old” recognition judgments, 9-year-olds had higher proportions for critical lures in the narrative than in the list condition, $t(23) = 2.70$, $p = .01$. Interestingly, young adults had lower proportions for targets, critical lures, and related distracters in the narrative condition than in the list condition, *t*s(23) = -4.74, -2.37, -2.74, $p < .01$ and = .03, .01, respectively. All other group differences were nonsignificant.

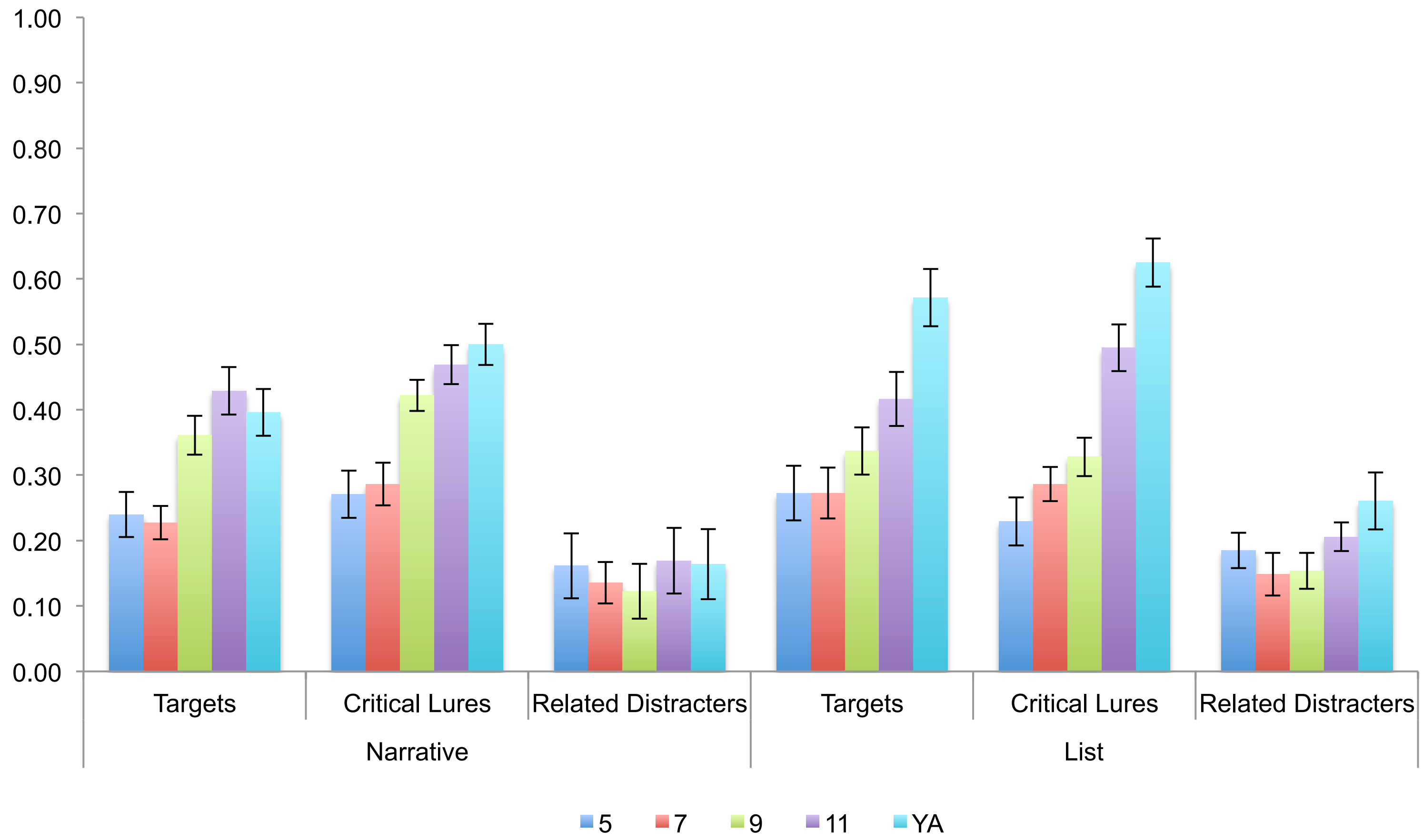

Figure 3.4 Mean Proportions of Source Judgments for Each Item Type, Presentation Type, and Age

3.2.3 Hypothesis 3

This hypothesis was tested using a 2 (Presentation Type: List, Narrative) x 3 (Item Type: Targets, Related Distracters, Critical Lures) x 5 (Age: 5, 7, 9, 11, 18–30) RMANOVA with proportion of correct and gist-consistent source judgments conditionalized by the rate of items being recognized as old as the dependent variable. Pairwise comparisons were used to probe significant effects and group differences.

I again tested the data for compliance with core assumptions of RMANOVA. Box's Test of Equality of Covariance Matrices was significant, indicating inequality of covariance matrices, and Mauchly's test indicated that the data violated the assumption of sphericity for Presentation Type, Item Type, and their interaction (see Table 3.7). Again, degrees of freedom for univariate tests were adjusted according to the more liberal Huynh-Feldt correction. Pairwise comparisons were used to probe significant effects and examine group differences between levels of each independent variable, using a Bonferroni adjustment for multiple comparisons.

Table 3.7 Tests of RMANOVA Assumptions of Equality of Covariance Matrices, Sphericity, and Equality of Error Variances for Source Judgments

Test Name	Test Statistics				
Box's Test of Equality of Covariance Matrices	*Box's M* = 127.29	*F*(84, 25266.81) = 1.34*			
Mauchly's Test of Sphericity	*Mauchly's W*	X^2	*df*	*G-G Epsilon*	*H-F Epsilon*
Presentation Type	1.00	.000***	0	1.00	1.00
Item Type	.79	26.94***	2	.83	.87
Presentation x Item	.90	911.82**	2	.91	.96
Levene's Test of Equality of Error Variances	*F*(4, 115)	Narratives		Lists	
Targets		0.46		0.99	
Critical Lures		1.51		1.91	
Related Distracters		0.33		2.43*	

Note: * = significant at $p < .05$, ** = significant at $p < .01$, *** = significant at $p < .001$

In partial support of existing literature and predictions in the present study, multivariate tests revealed marginally significant main effects of Presentation Type, $F(1, 115) = 3.60$, $p = 0.06$, $\eta_p^2 = .03$, and Item Type, $F(2, 114) = 2.74$, $p = 0.07$, $\eta_p^2 = .05$. There was a significant interaction of Presentation Type x Age Group, $F(4, 115) = 2.90$, $p = 0.03$, $\eta_p^2 = .09$. However, interaction effects were not significant for Item Type x Age Group, Presentation Type x Item Type, or the 3-way interaction of Presentation Type x Item Type x Age Group.

Between-subjects univariate tests revealed a significant main effect of Age, $F(4, 115) = 6.14$, $p < .001$, $\eta_p^2 = .18$, $MSE = 0.13$. Post-hoc tests for the effects of Age, with Bonferroni corrections applied for multiple comparisons, revealed mean differences between several age groups. Specifically, differences occurred between young adults and the 7- and 5-year-olds, with young adults having a higher mean proportion of correct and gist-consistent judgments. Young adults, 11-year-olds, and 9-year-olds did not significantly differ from one another, although 11-year-olds had significantly higher conditional proportions than 7- and 5-year-olds (see Table 3.4). All other age groups were equivalent in their proportions.

Within-subjects univariate tests, with the Huynh-Feldt epsilon correction applied as described above, confirmed a marginally significant main effect of Presentation Type, $F(1, 115) = 3.60$, $p = 0.06$, $\eta_p^2 = 0.03$, $MSE = 0.10$, and suggested a significant main effect of Item Type, $F(1.73, 199.13) = 3.76$, $p = 0.03$, $\eta_p^2 = .03$, $MSE = 0.06$. Post-hoc tests for the effect of Presentation Type revealed marginally significant mean differences between Narrative and List presentation of information. Specifically, participants' correct and gist-consistent source judgments were slightly higher in the List condition ($M = 0.59$, $SE = 0.02$) than the Narrative condition ($M = 0.54$, $SE = 0.02$). Post-hoc tests for the effects of Item Type did not indicate mean differences between Targets, Critical Lures, or Related Distracters. The interaction of Presentation Type x Age Group, $F(4, 115) = 2.90$, $p = 0.03$, $\eta_p^2 = .09$, $MSE = 0.10$, was significant (see Figure 3.5), but the interactions of Item Type x Age Group, Presentation Type x Item Type, and Presentation Type x Item Type x Age Group were not significant.

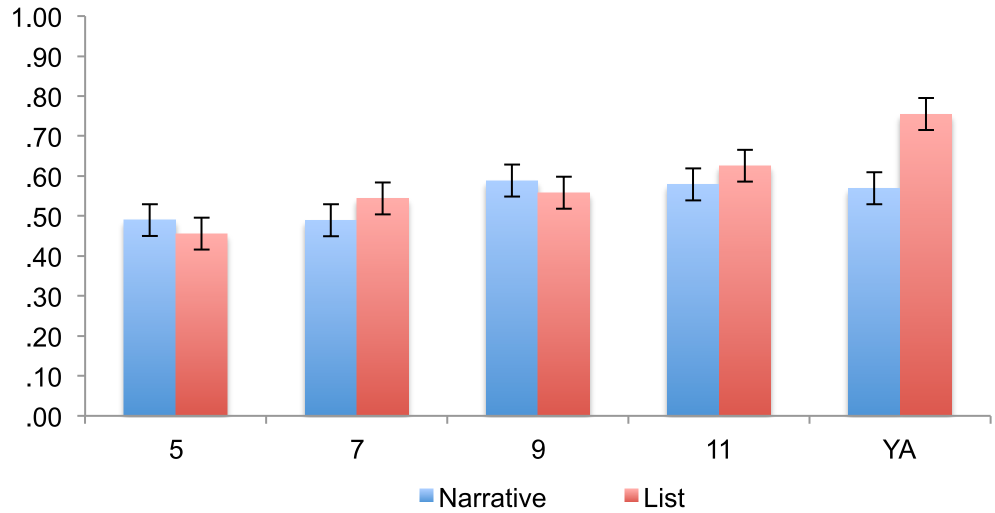

Figure 3.5 Interaction of Presentation Type and Age Group on Mean Proportion of Conditional Source Judgments

In an effort to better understand the significant main effects and 2-way interaction of Presentation Type x Age Group, I conducted a series of t-tests to determine group differences. Mean proportions for each item type, presentation type, and age group are presented in Figure 3.6. For Ts presented in narrative format, young adults had equivalent conditional proportions of source judgments to those of 11, 9, 7, and 5-year-olds, ts(46) = -1.13, -0.38, 1.14, 1.69, ps < 0.26, 0.71, 0.26, 0.10. However, for T's presented in list format, young adults had higher proportions than each of the other age groups, ts(46) = 2.76, 3.94, 4.74, 4.94, ps < 0.01, .001, .001,.001. Children in the 11, 9, and 7-year-old groups did not differ from one another, ts(46) = 1.21, 1.56, 0.20, ps = 0.23, 0.13, 0.84, and neither 9 nor 7-year-olds significantly differed from 5-year-olds, $t(46)$ = 1.30, 1.23, ps = 0.20, 0.23, but 11-year-olds did have a higher proportion than 5-year-olds, $t(46) = 2.43$, $p = 0.02$.

With regard to CLs presented in a narrative, no significant age group differences occurred, ts(46) = 0.26, -0.28, 0.46, 0.89, 1.26, 0.04, 1.06, 1.01, 1.36, 0.17, ps = 0.80, 0.78, 0.65, 0.38, 0.22, 0.35, 0.29, 0.32, 0.18, 0.87. However, when information was presented in a list, age groups differed somewhat in their conditional proportions. Specifically, while young adults did not differ from 11-year-olds in conditional proportions for critical lures presented in a list, $t(46) = 1.42$ $p = 0.16$, they did differ from every other age group, *t*s(46) =2.67, 2.56, 4.95, *p*s < 0.01, 0.01. .001. In addition, 5-year-olds had significantly lower proportions than 11, 9, or 7-year-olds, *t*s(46) = 3.67, 2.28, 2.24, *p*s = .001, .003, .003. Finally, for RDs in the narrative condition, no age group differences occurred *t*s(46) = -0.14, 0.18, 0.42, 0.69, 1.03, 0.91, 0.45, 0.22, 0.59, -0.42, *p*s = 0.89, 0.86, 0.68, 0.49, 0.31, 0.37, 0.66, 0.83, 0.56, 0.68. However, in the list condition, young adults had higher conditional proportions of source judgments than any other group, *t*s(46) = 2.00, 1.96, 2.36, 2.58, *p*s = 0.05, 0.06, 0.02, 0.01.

Again, I conducted a series of paired-samples t-tests to assess differences in the conditional proportion of correct and gist-consistent source judgments by presentation type within each age group, for each item type. Only young adults had significantly different proportions across the two conditions, with lower proportions for targets, critical lures, and related distracters in the narrative condition than in the list condition, *t*s(23) = -4.81, -3.14, -2.76, all *ps* ≤ .01, respectively. All other group differences were nonsignificant.

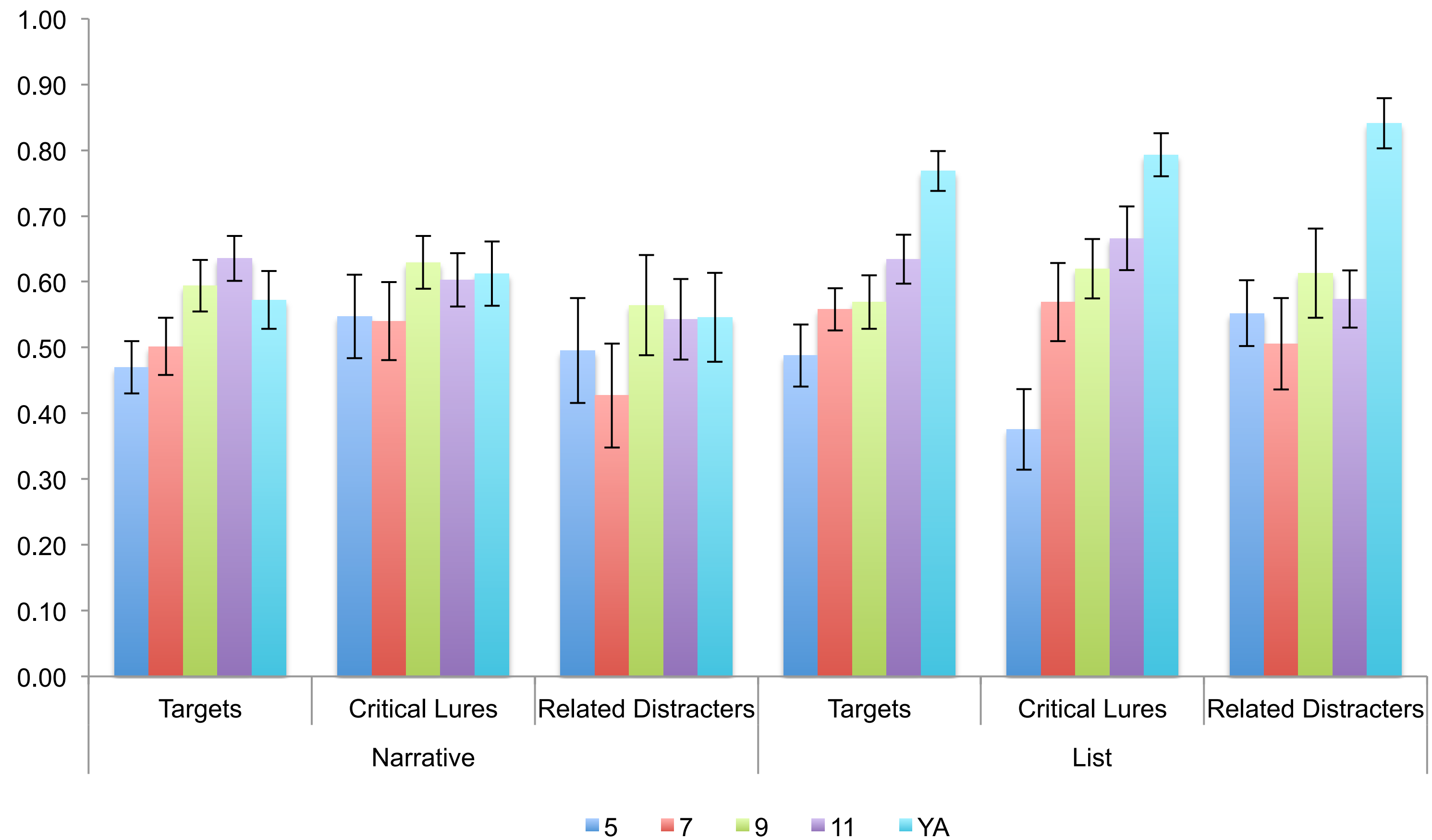

Figure 3.6 Mean Proportions of Conditional Source Judgments for Each Item Type, Presentation Type, and Age

<u>3.3 Supplemental Analyses</u>

I conducted supplemental analyses to aid interpretation of the hypothesis tests above, since results suggested a possible crossover interaction of age and presentation type, despite nonsignificance in the full model. These supplemental tests were driven by *a priori* predictions about the effects of narrative presentation for specific age groups, namely the difference between 5-year-olds and young adults, and between 9-year-olds and young adults. To that end, I conducted additional RMANOVAs identical to those described previously, with a model for 5-year-olds compared to young adults and a model for 9-year-olds compared to young adults. These analyses are intended to highlight and further probe differences in group means of specific theoretical interest, and all proportions used in the following supplemental tests are identical to those presented in Table 3.2, 3.3, and 3.4 and graphically represented in Figures 3.1, 3.4, and 3.6.

3.3.1 RMANOVA: 5-Year-Olds and Young Adults

For the model including only 5-year-olds and young adults, I applied a Hyunh-Feldt correction to address violations of the assumptions of RMANOVA, as described in earlier hypothesis testing. Several within-subjects univariate tests were significant, providing support for my hypotheses regarding proportion of “old” recognition judgments. There was a main effect of Item Type, $F(2, 1.93) = 93.07$, $p < .001$, $\eta_p^2 = .67$, $MSE = 1.13$, with CL significantly higher than RD but not different than T, and RD significantly lower than T, in full support of my predictions. The interaction of Item Type x Age Group was also significant, $F(2, 1.93) = 4.05$, $p = .02$, $\eta_p^2 = .08$, $MSE = 0.05$, with 5-year-olds’ proportions signifcantly lower than young adults’ proportions for each item type, and with CL significantly higher than RD but not different than T, and RD significantly lower than T within each age group. Finally, the interaction of Presentation Type x Item Type x Age Group was significant, $F(2, 2) = 3.12$, $p < .05$, $\eta_p^2 = .06$, $MSE = 0.03$. This effect was driven by differences in the young adult group, whose proportions were higher for RDs in the list condition than in the narrative condition, despite the fact that all other cell differences in presentation type for age and item type were nonsignificant. The between-subjects univariate test was also significant for the main effect of Age Group, $F(1, 46) = 30.58$, $p < .001$, $\eta_p^2 = .40$, $MSE = 0.07$, with young adults having significantly higher proportions than 5-year-olds, as expected.

For the proportion of correct and gist-consistent source judgments, within-subjects univariate tests were significant for main effects of Presentation Type, $F(1, 1) = 8.85$, $p < .01$, $\eta_p^2 = .16$, $MSE = 0.34$, with proportions higher for lists than narratives, and Item Type, $F(2, 1.96) = 66.60$, $p < .001$, $\eta_p^2 = .59$, $MSE = 1.30$, with CL significantly higher than RD but not different from T, and RD significantly lower than T. The interactions of Presentation Type x Age Group, $F(1, 1) = 7.36$, $p < .01$, $\eta_p^2 = .14$, $MSE = 0.29$, and Item Type x Age Group, $F(2, 1.96) = 24.68$, $p < .001$, $\eta_p^2 = .35$, $MSE = 0.48$, were also significant. For the interaction of Presentation Type x Age Group, both young adults and 5-year-olds had higher proportions for lists than narratives, and young adults had higher proportions than 5-year-olds for both list and narrative presentation. For the interaction of Item Type x Age Group, young adults had significantly higher proportions than 5-year-olds for Ts and CLs, but not for RDs. Furthermore, 5-year-olds' proportions followed the predicted pattern of CL higher than RD but not different from T, and RD significantly lower than T, but young adults differed slightly, with CL higher than T, and T higher than RD.

For the conditional proportion of correct and gist-consistent source judgments, only two within-subjects univariate tests were significant. There was a main effect of Presentation Type, $F(1, 1) = 4.38$, $p = .04$, $\eta_p^2 = .09$, $MSE = 0.42$, with proportions higher for word sets presented in lists than narratives, and a significant interaction of Presentation Type x Age Group, $F(1, 1) = 9.20$, $p < .01$, $\eta_p^2 = .17$, $MSE = 0.88$, with 5-year-olds' proportions equal for lists and narratives, and young adults' proportions higher for lists than narratives. Young adults' proportions were significantly higher than 5-year-olds' for lists, but not for narratives. There was also a between-subjects main effect of Age Group, $F(1, 46) = 16.42$, $p < .001$, $\eta_p^2 = .26$, $MSE = 0.16$, with 5-year-olds' proportions significantly lower than those of young adults, as expected.

3.3.2 RMANOVA: 9-Year-Olds and Young Adults

For the model including only 9-year-olds and young adults, I applied a Hyunh-Feldt correction to address violations of the assumptions of RMANOVA, as described in earlier hypothesis testing. Several within-subjects univariate tests were significant, providing partial support for my hypotheses regarding proportion of "old" recognition judgments. There was a main effect of Item Type, $F(2, 2) = 87.30$, $p < .001$, $\eta_p^2 = .66$, $MSE = 1.37$, with CL significantly higher than RD but not different from T, and RD significantly lower than T, and a marginally significant interaction of Presentation Type x Item Type, $F(2, 1.99) = 2.73$, $p = .07$, $\eta_p^2 = .56$, $MSE = 0.04$, with CL > T > RD in the narrative presentation condition and CL = T > RD in the list presentation condition. Each item type was equal across the list and narrative conditions (i.e., narrative CL = list CL). There was also a significant interaction of Presentation Type x Age Group, $F(1, 1) = 4.96$, $p = .03$, $\eta_p^2 = .10$, $MSE = 0.14$, with proportions higher in the narrative than list condition for 9-year-olds, and proportions equal across presentation types for young adults. While 9-year-olds and young adults had equivalent proportions in the narrative condition, young adults had significantly higher proportions than 9-year-olds in the list condition. The between-subjects main effect of Age Group was nonsignificant, contrary to predictions and results of previous tests.

For the proportion of correct and gist-consistent source judgments, within-subjects univariate tests were significant for main effects of Presentation Type, $F(1, 1) = 5.80$, $p = .02$, $\eta_p^2 = .11$, $MSE = 0.47$, with proportions higher for information presented in lists than in narratives, and Item Type, $F(2, 1.83) = 2.59$, $p < .001$, $\eta_p^2 = .72$, $MSE = 2.59$, with proportions of CL higher than T and RD, and T higher than RD. The interaction of Presentation Type x Age Group was also significant, $F(1, 1) = 13.99$, $p = .001$, $\eta_p^2 = .23$, $MSE = 0.47$, with young adults' (but not 9-year-olds') proportions higher for lists than narratives, and 9-year-olds' proportions lower than young adults' proportions for lists but equivalent for narratives. The interaction of Item Type x Age Group was also significant, $F(2, 1.83) = 3.99$, $p = .03$, $\eta_p^2 = .08$, $MSE = 0.16$, with 9-year-olds' proportions lower than young adults' for all item types. While 9-year-olds followed the expected pattern of CL = T > RD, young adults did not, with CL > T > RD. The three-way interaction of Presentation Type x Item Type x Age Group was significant, $F(2, 2) = 3.52$, $p = .03$, $\eta_p^2 = .07$, $MSE = 0.04$, with 9-year-olds' proportions higher in the narrative than list condition for CLs, but not for RDs or Ts, and young adults' proportions higher in the list than narrative condition for all item types. Furthermore, 9-year-olds' proportions were lower than young adults' for Ts and RDs in the list condition, but not for any other combination of Item Type and Presentation Type. Finally, the between-subjects main effect of age group was significant, $F(1, 46) = 12.44$, $p = .001$, $\eta_p^2 = .21$, $MSE = 0.10$, with young adults having significantly higher proportions than 9-year-olds, as expected.

For the conditional proportion of correct and gist-consistent source judgments, only two within-subjects univariate tests were significant. There was a main effect of Presentation Type, $F(1, 1) = 4.94$, $p = .03$, $\eta_p^2 = .10$, $MSE = 0.44$, with proportions higher in the list condition than in the narrative condition. The interaction of Presentation Type x Age Group was also significant, $F(1, 1) = 9.63$, $p < .01$, $\eta_p^2 = .17$, $MSE = 0.85$, with young adults' (but not 9-year-olds') proportions higher for lists than for narratives, and 9-year-olds' proportions lower than young adults' in the list condition but equivalent in the narrative condition. Finally, the between-subjects main effect of Age Group was significant, $F(1, 46) = 4.09$, $p < .05$, $\eta_p^2 = .08$, $MSE = 0.14$, with 9-year-olds having lower proportions than young adults, as expected.

CHAPTER 4

DISCUSSION

Although a great deal of literature describes the typical trajectory of gist development, with particular emphasis on adult performance on false-memory tasks like the DRM paradigm, researchers have not yet clearly addressed the role of context in facilitating gist processing for younger children (for reviews, see Bauer, Larkina, & Deocampo, 2011; Brainerd, Reyna, & Zember, 2011; Howe & Wilkinson, 2011; Raj & Bell, 2010; Schneider, 2011; Shing & Lindenberger, 2011). To that end, I conducted a study of recognition memory, in an attempt to clarify any potential influence of narrative context on gist processing. I also aimed to expand existing knowledge of gist development by collecting data from a broad age range, specifically, from typically developing children age 5, 7, 9 and 11, as well as young adults. Previous studies of gist development have obtained data from participants within this age range, but few have tested both young adults and children of various wide-ranging ages using the same paradigm (Brainerd et al., 2011). Results partially supported my hypotheses, and results that were inconsistent with predictions present interesting implications for future work in this domain.

I generally expected to replicate previous results of studies employing the DRM paradigm, such that participants experienced false memory for critical lures at rates equivalent to their veridical memory for targets, and false memory for related distracters at slightly lower rates than memory for targets. I further expected that, in line with claims made by Howe and Wilkinson (2011) and Dewhurst, Pursglove, and Lewis (2007), providing an enriched context by embedding DRM word sets in a narrative would scaffold younger children's memory performance and allow them to process gist at more adult-like rates. Finally, I expected that when participants successfully processed gist, they would also encode the source (Mary or Franny) associated with the remembered word set as a component of the memory as a whole.

4.1 Summary of Specific Findings

4.1.1 Hypothesis 1

I predicted that participants would show age-related increases in gist processing ability, such that older children (11 years old) and adults (18–30) would have higher proportions of “old” recognition judgments than younger children (5, 7, and 9 years old) for critical lures that were consistent with the gist of a presented word list. I confirmed an anticipated main effect of Item Type, such that participants reported having previously heard critical lures and targets at higher rates than related distracters. However, results were slightly different than expected in that each of the 3 item types significantly differed in the proportion of “old” recognition judgments reported by participants. I expected the post-hoc tests to reveal proportions in a pattern of CL = T > RD, but in fact, results indicated that CL > T > RD.

Also in support of my hypothesis, a main effect of Age emerged, revealing that 5-year-olds reported significantly lower proportions of “old” recognition judgments than all other age groups. Interestingly, while their proportions were lower than those of young adults, 7-year-olds did not differ from 9 or 11-year-olds. This finding may indicate that the developmental tipping point for gist processing occurs earlier than originally thought, or that perhaps a more subtle change occurs across middle childhood rather than abruptly at age 9 (YA = 9 = 11, 9 = 11 = 7, YA > 7, all groups > 5, see Table 3.2). Despite nuanced age differences between the specific hypotheses and observed effects, these results generally support the prediction that age-related increases in gist processing would be evident in higher rates of “old” recognition judgments in older participant age groups.

The interaction of Item Type and Age was not significant in the full model. However, because of *a priori* predictions about subtle developmental differences, I examined the data more closely in a series of t-tests intended to detect differences among each age group, item type, and presentation type (see Figure 3.1). The results of these tests revealed a complex relationship between variables, further illuminating subtle differences between older and younger participants depending on the item type to which they were responding.

For both targets and critical lures in the narrative condition, young adults, 11-year-olds, and 9-year-olds were equivalent in their proportion of “old” recognition judgments, providing support for the hypothesis. These three older groups also had higher proportions than 7-year-olds, who had higher proportions than 5-year-olds (YA = 11 = 9 > 7 > 5). Critical lures presented in the list condition closely mirrored these findings as well, with young adults, 9-year-olds, and 11-year-olds being nearly equivalent in performance with the exception of only a marginally significant difference between 11- and 9-year-olds. Again, these three groups had higher proportions of “old” recognition judgments than 7-year-olds, who had higher proportions than 5-year-olds (YA ≈ 11 = 9 > 7 > 5). In essence, these results reflected the developmental trend that I predicted, with older participants (young adults, 9-year-olds, 11-year-olds) processing gist equivalently, and younger participants (7-year-olds, 5-year-olds) processing gist incrementally less for critical lures in both narrative and list conditions and for targets in the narrative condition.

For targets in the list condition and related distracters in the narrative and list conditions, a more complex pattern of age differences occurred. Specifically, young adults had significantly higher proportions of “old” recognition judgments for targets in the list condition than 11-year-olds, 9-year-olds, and 7-year-olds, whose performance was equivalent. The 7-year-olds were also equivalent to 5-year-olds, but 11- and 9-year-olds had significantly higher proportions than 5-year-olds, despite not differing significantly from 7-year-olds (YA > 11 = 9 > 5, 11 = 9 = 7, 7 = 5). These results suggest that perhaps developmental differences in memory begin to emerge between ages 7 and 9, rather than between age 9 and 11 as originally predicted.

Although the main effect of Presentation Type and the interactions of Presentation Type with Item Type and Age were nonsignificant in the full model, it is interesting to note here that the pattern of results across age groups was different for targets in the list condition than for targets in the narrative condition. This may indicate an issue of measurement insensitivity or insufficient power (although an *a priori* power analysis was conducted for the present study), and warrants further investigation in subsequent studies of context-based scaffolding of gist processing in children. However, because a similarly complex pattern emerged for related distracters in both the narrative and list conditions but not for critical lures in either condition, which theoretically require greater reliance on gist-based memory traces than related distracters or targets, this result may simply indicate a general developmental trend of increased memory capacity for items as individuals mature cognitively. This general increase in capacity has been demonstrated in a number of studies using the DRM paradigm, as well as in literature not specific to the development of gist processing (Brainerd, Holliday, & Reyna, 2004; Ghetti & Angelini, 2008; Ghetti, Qin, & Goodman, 2002; Goswami, 2011; Odegard, Jenkins, & Koen, 2010).

I also predicted that younger children would experience enhanced gist processing (i.e., higher proportions of “old” recognition judgments) for information presented in the enriched context of a narrative as opposed to a list, while older children and adults would not experience enhanced performance. However, neither multivariate nor univariate tests demonstrated a significant main effect of Presentation Type on proportion of “old” recognition judgments, contrary to my hypothesis. It is interesting to note that while previous studies reported an effect of Presentation Type, such that children reportedly experienced greater gist-based false memory when information was embedded in a narrative, these effects were only marginal and accompanied by very small effect sizes (e.g., Dewhurst, Pursglove, & Lewis, 2007; Howe & Wilkinson, 2011). Because the effect of Presentation Type was not found to be statistically significant in accordance with standard cutoffs (i.e., $p < .05$), questions remain about the interpretability of results found in these earlier studies. Thus, although I did not find the expected effect of Presentation Type as hypothesized, I did approximate the findings of existing literature.

4.1.2 Hypothesis 2

I expected age-related increases in source memory, such that older children (11 years old) and adults (18–30) would make a higher proportion of correct source memory judgments than younger children (5, 7, and 9 years old). Correct and gist-consistent source memory judgments on the modified DRM task should reflect participants' ability to successfully encode a source along with a verbatim and/or gist trace of a target item or category. Results supported my predictions, revealing significant main effects of Presentation Type, Item Type, and Age, as well as significant interaction effects of Age by Presentation Type and Age by Item Type. While effect sizes for the main effects of Item Type and Age were large, the small effect size of Presentation Type warrants further investigation in subsequent studies, in order to determine whether the observed effect of narrative context in the present study may be dampened by measurement insensitivity or whether it merely exerts a slight influence on overall gist processing and recognition memory performance compared to other factors.

Post-hoc tests for within-subjects main effects of Presentation Type and Item Type indicated that participants had higher proportions of correct and gist-consistent source judgments in the list condition than in the narrative condition, for critical lures than for targets, and for targets than for related distracters (CL > T > RD). Notably, mean proportions for critical lures and targets were 0.39 and 0.35, respectively, while the mean proportion for related distracters was 0.17. Although critical lures and targets did differ significantly, this pattern somewhat reflects my initial prediction that proportions for critical lures and targets would be equivalent and collectively greater than proportions for related distracters. Furthermore, post-hoc tests for the between-subjects main effect of age supported predicted mean differences between age groups, with young adults equivalent to 11-year-olds, and both groups having significantly higher proportions than 9-year-olds, 7-year-olds, or 5-year-olds, who were all equivalent (YA = 11 > 9 = 7= 5, see Table 3.3). The two-way interaction effects of Age with both Presentation Type and Item Type were also significant with small effect sizes, although the two-way interaction of Presentation Type by Item Type and the three-way interaction of Presentation Type, Item Type, and Age were nonsignificant.

To further examine significant interactions of Age with Presentation Type and Item Type, I again conducted a series of t-tests examining group differences (see Figure 3.4). These tests produced a virtually identical pattern of results for the proportion of correct and gist-consistent source judgments as found in the previously reported analysis conducted for the proportion of “old” recognition judgments. Specifically, for both targets and critical lures presented in the narrative condition, young adults, 11-year-olds, and 9-year-olds were equivalent in their proportions of correct and gist-consistent source judgments. These older groups collectively had higher proportions than the younger 7-year-olds and 5-year-olds, who were equivalent in their proportions (YA = 11 = 9 > 7 = 5). Since these results occur specifically for targets and critical lures in the narrative condition, they support my prediction that narrative context would scaffold the gist processing skills of 9-year-olds, making their performance on the task similar to that of young adults and 11-year-olds. For critical lures in the list condition, the 9-year-old group did not experience the same advantage in processing, such that young adults were equal in their proportions of correct and gist-consistent source judgments, but collectively greater than 9-year-olds, 7-year-olds, and 5-year-olds, who were all equal (YA = 11 > 9 = 7 = 5).

With respect to the proportion of correct and gist-consistent source judgments made for targets presented in the list condition and related distracters in both the list and narrative condition, results again revealed complex patterns of age differences similar to those found in analyses testing effects on proportion of “old” recognition judgments. For targets in the list condition, young adults had a higher proportion of correct and gist-consistent source judgments than 11-year-olds and 9-year-olds, who were equivalent. Although young adults and 11-year-olds had higher proportions than 7-year-olds or 5-year-olds, the 9-year-old, 7-year-old, and 5-year-old groups were equivalent (YA > 11 = 9, YA = 11 > 7 = 5, 9 = 7 = 5).

As in the recognition data presented above, this pattern may reflect a general developmental trend of increased memory capacity. For related distracters presented in the list condition, young adults and 11-year-olds were equivalent in their proportions, and although young adults had higher proportions than the other age groups, 11-year-olds, 9-year-olds, 7-year-olds, and 5-year-olds were all equivalent in their proportion of gist-consistent and correct source judgments (YA = 11, YA > 9 = 7 = 5, 11 = 9 = 7 = 5). Notably, there were not age differences between young adults, 11-year-olds, 9-year-olds, 7-year-olds, or 5-year-olds for related distracters in the narrative condition (YA = 11 = 9 = 7 = 5). The scarcity of age differences in reporting a gist-consistent source for related distracters is interesting. Since gist-based memory traces should not be cued as strongly for related distracters as for critical lures and targets, any age-related differences in gist processing ability may not be detectable via proportion of source judgments for related distracters.

Again, I predicted that younger children would experience enhanced gist processing (i.e., higher proportions of correct and gist-consistent source judgments) for information presented in the enriched context of a narrative as opposed to a list, while older children and adults would not experience enhanced performance. This hypothesis was theoretical in nature rather than based in existing literature, since neither Dewhurst et al. (2007) nor Howe and Wilkinson (2011) directly examined source monitoring ability in their earlier studies of gist processing development.

In support of my hypothesis, there was a significant interaction of Presentation Type and Age Group as mentioned above. However, closer examination of the t-tests used to probe group differences suggested that only young adults differed in their performance between presentation formats. Specifically, young adults experienced greater proportions of correct and gist-consistent source judgments for information presented in a list than in a story. This may be due to the fact that young adults have reached a developmental stage where they are able to process gist effectively without the added scaffolding of narrative context. Furthermore, the extra information presented in a story may result in distraction rather than support during the memory task.

4.1.3 Hypothesis 3

I expected that older children (11 years old) and adults (18–30) would make a higher conditional proportion of gist-consistent source judgments than younger children (5, 7, and 9 years old) for critical lures that were consistent with the gist of a presented list, conditionalized by the rate of items being recognized as old. That is, when a participant previously identified a critical lure as "old" (for example, "Yes, I heard the word *sleep*"), I expected that he or she would make a gist-consistent source judgment, identifying the source as the puppet who read target words associated with that critical lure. Results partially supported my hypotheses, revealing significant main effects of Item Type and Age Group, and a marginally significant main effect of Presentation Type. For the marginal main effect of Presentation Type, post-hoc tests revealed marginal mean differences between conditions, with list presentation resulting in marginally higher conditional proportions than narrative presentation. Although the main effect of Item Type was significant, post-hoc tests did not replicate findings from the previous two hypotheses, with conditional proportions of gist-consistent source judgments equal for critical lures, targets, and related distracters (CL = T = RD).

The significant main effect of Age Group provided support for my hypotheses, with mean differences generally in line with my predictions that older participants would have higher conditional proportions than younger participants. Specifically, young adults, 11-year-olds, and 9-year-olds were equivalent in their conditional proportions of gist-consistent source judgments, and 9-year-olds, 7-year-olds, and 5-year-olds did not differ significantly, but young adults and 11-year-olds collectively had higher proportions than 7 or 5-year-olds, who were equivalent. The two-way interactions were not significant for Item Type by Age or by Presentation Type, or for the three-way interaction of Presentation Type, Item Type, and Age Group.

In order to probe the significant interaction of Age and Presentation Type, I again conducted a series of t-tests examining group differences (see Figure 3.6). Inspection of mean differences for the conditional proportion of gist-consistent source judgments produced results somewhat like those reported for Hypotheses 1 and 2. Interestingly, for targets, critical lures, and related distracters presented in narratives, conditional proportions were equal across all age groups (YA = 11 = 9 = 7 = 5). That is, when information that was highly associated with a gist trace in memory was presented in the enriched context of narrative, participants across all age groups who judged an item as "old" also identified the correct or gist-consistent source that was associated with that information. For example, if Mary the Monkey presented targets including "Dough" from the word set associated with the critical lure "Bread", and a participant experienced gist-based false memory leading to an "old" judgment for the critical lure "Bread", he or she was also highly likely to identify Mary the Monkey the source of "Bread". This gist-consistent source judgment is likely the result of associative encoding between presented targets and the unpresented critical lure.

For items presented in the list condition, mean differences among age groups were somewhat more complex. Conditional proportions for targets were higher for young adults than for all other groups, and for 11-year-olds than for 5-year-olds, but proportions were equivalent between 11-year-olds, 9-year-olds, and 7-year-olds, and between 9-year-olds, 7-year-olds, and 5-year-olds (YA > 11 = 9 = 7, 9 = 7 = 5, 11 > 5). Critical lures presented in the list condition followed a similar pattern, with young adults having higher proportions than 11-year-olds, 9-year-olds, and 7-year-olds, which were equivalent (YA > 11 = 9 = 7 > 5). All age groups had higher proportions than 5-year-olds. Finally, for related distracters, young adults had a higher conditional proportion of correct and gist-consistent source judgments than 11-year-olds, 9-year-olds, 7-year-olds, and 5-year-olds, who were all equivalent (YA > 11 = 9 = 7 = 5). These results generally support the predicted age-related increases in gist processing, although further study is needed to fully understand the subtle differences in the pattern of results found for the narrative versus the list condition.

Again, I predicted that younger children would experience enhanced gist processing (i.e., higher proportions of correct and gist-consistent source judgments conditionalized by the rate of “old” recognition judgments) for information presented in the enriched context of a narrative as opposed to a list, while older children and adults would not experience enhanced performance. As in the case of Hypothesis 2, results partially supported of my hypothesis, revealing a significant interaction of Presentation Type and Age Group. Again, only young adults differed in their performance between presentation formats, with greater proportions of conditional source judgments for information presented in a list than in a story. Possible explanations for this difference are similar to those presented for the same result in the previous section, namely that adults do not require additional context, and may in fact be distracted by additional information not directly linked to the to-be-remembered information.

4.2 Summary of Supplemental Findings

Supplemental analyses yielded interesting results and enhanced interpretability of the results of my primary hypothesis testing, specifically with respect to differences between 5-year-olds and young adults, and between 9-year-olds and young adults. I expected that 5-year-olds and 9-year olds would struggle to process gist in lists, and would benefit from the increased context of a narrative, while young adults would not require narrative context to scaffold gist processing. I further predicted that, specifically for 9-year-olds, the influence of context in the narrative presentation condition would bring proportions up to young adult levels. When all age groups were included in the full model used for primary hypothesis testing, my RMANOVA was nonsignificant. However, when only 2 age groups were included in the model (i.e., 5-year-olds and young adults or 9-year-olds and young adults), clear age-based differences in the influence of presentation type were evident for specific item types.

4.2.1 Comparing 5-Year-Olds and Young Adults

Given my *a priori* predictions about differences between 5-year-olds and young adults, I ran a reduced RMANOVA model with only these two age groups included, testing the influence of Presentation Type, Item Type, and Age Group on the proportion of "old" recognition judgments. Results confirmed my predictions, with a significant three-way interaction of Presentation Type, Item Type, and Age Group. The main effect of Item Type, the main effect of Age Group, and the interaction of Item Type and Age Group were also significant, as predicted, and followed expected trends of 5 year olds' proportions lower than young adults' for each item type, and CL = T > RD for both age groups. The significant three-way interaction is notable because critical differences occurred in the young adult group, rather than the 5-year-old group as expected. Specifically, young adults had higher proportions of "old" recognition judgments for RDs in the list condition than the narrative condition, but not for CLs or Ts. This finding is similar to results obtained in my primary hypothesis tests, and may be explained by the fact that RDs do not cue gist representations as strongly as CLs or Ts for a given word set, and therefore may not be as easily identified as relevant to the overall theme of the narrative at study. In other words, in the broad context of a narrative, RDs may be "lost in the shuffle" due to their low degree of association with the gist and accompanying CL and Ts. Conversely, RDs may be more noticeably related to Ts when these two item types are presented together in a list without additional unrelated information, and therefore may be more effectively encoded as part of the overall gist representation.

I ran a similar RMANOVA model for the proportion of correct and gist-consistent source judgments, which yielded significant main effects of Item Type and Presentation Type, but not Age Group. The interaction of Presentation Type and Age Group was significant, with both 5-year-olds and young adults having higher proportions for lists than narratives and young adults having higher proportions than 5-year-olds across both lists and narratives. The interaction of Item Type and Age Group was also significant, with young adults' proportions higher than 5-

year-olds' for Ts and CLs, but not RDs. Again, since RDs are not as strongly associated with the gist of a given word set, age-based differences in gist processing may not be apparent in performance on this specific item type. While 5-year-olds followed the predicted pattern of CL = T > RD, young adults followed a different pattern of CL > T > RD. This result may reflect a general tendency of young adults to rely more heavily on gist-based recognition (i.e., identifying the gist-consistent source for CLs) than recall (i.e., remembering the correct source for Ts) than 5-year-olds.

Finally, I ran a RMANOVA for the conditional proportion of correct and gist-consistent source judgments. There were significant main effects of Presentation Type, with proportions unexpectedly higher for lists than for narratives, and Age Group, with 5-year olds' proportions lower than young adults' proportions as predicted. There was also a significant interaction of presentation type and Age Group, with 5-year-olds' proportions equal for lists and narratives, but young adults' proportions higher for lists. Young adults' proportions were also significantly higher than 5-year-olds' for lists, but not for narratives, again reflecting the trend seen in earlier analyses.

4.2.2 Comparing 9-Year-Olds and Young Adults

Again, due to *a priori* predictions about key differences between 9-year-olds and young adults, I ran a reduced RMANOVA model with only these two age groups included, testing the influence of Presentation Type, Item Type, and Age Group on the proportion of "old" recognition judgments. The main effect of Item Type was significant, with proportions following the expected pattern of CL = T > RD. There was not a significant main effect of Age Group, perhaps due to cell differences found in the significant interaction of Presentation Type and Age Group. Specifically, young adults and 9-year-olds were equivalent in the narrative condition, but young adults' proportions were significantly higher than 9-year-olds' in the list condition. There was also a marginally significant interaction between Presentation Type and Item Type, with proportions following the expected pattern of CL = T > RD in the list condition, but an unexpected pattern of CL > T > RD in the narrative condition. In this instance, narrative context may have effectively enhanced gist processing for CLs, such that they were falsely remembered as “old” at even higher rates than Ts.

I also ran a reduced RMANOVA model for the proportion of correct and gist-consistent source judgments, which yielded main effects of Presentation Type, with proportions higher for lists than narratives, Item Type, with proportions following the expected pattern of CL = T > RD, and Age Group, with young adults having higher proportions than 9-year-olds. The interaction of Presentation Type and Age was significant, with young adults’ proportions again higher in the list condition than the narrative condition, and 9-year-olds’ proportions equivalent across presentation types. Proportions were equivalent between 9-year-olds and young adults in the narrative condition, but young adults’ proportions were significantly higher in the list condition. The interaction of Item Type and Age Group was also significant, with young adults’ proportions higher than 9-year-olds’ for all item types. While 9-year-olds followed the predicted pattern of CL = T > RD, young adults followed a different pattern of CL > T > RD. The results of these two interactions mimic previously presented findings from the reduced model including 5-year-olds and young adults.

The three-way interaction of Presentation Type, Item Type, and Age Group was also significant, with 9-year-olds’ proportions higher in the narrative than list condition for CLs, but not for RDs or Ts. This result supports my prediction regarding a scaffolding effect of narrative context, which seems to enhance 9-year-olds’ ability to process gist and increase their rate of gist-consistent false memories for source information associated with a given word set. Young adults’ proportions were higher in the list condition than in the narrative condition for all item types, again contrary to predictions as discussed previously. Interestingly, 9-year-olds’ proportions were lower than young adults’ proportions for Ts and RDs in the list condition, indicating that they had difficulty remembering the source of presented, moderately associated items and unpresented, loosely associated items (i.e., Ts and RDs), but successfully remembered the source for a broad, gist-based representation of the word set (i.e., CLs).

Finally, I ran a RMANOVA for the conditional proportion of correct and gist-consistent source judgments. There were main effects of Presentation Type, with proportions again higher in the list condition than the narrative condition, and Age Group, with 9-year-olds' proportions lower than young adults' proportions. The interaction of Presentation Type and Age Group was also significant, again reflecting the same pattern as presented previously. Specifically, young adults' proportions were again higher in the list condition than the narrative condition, and 9-year-olds' proportions equivalent across presentation types. Proportions were equivalent between 9-year-olds and young adults in the narrative condition, but young adults' proportions were significantly higher in the list condition. These findings are consistent with results of earlier analyses.

The results obtained in these supplemental analyses generally supported my predictions about key differences between 5-year-olds and young adults and between 9-year-olds and young adults. Additionally, they provide limited evidence for the prediction that narrative context enhances gist processing ability specifically for 9-year-olds. However, the tendency of adults to have higher rates of gist-based false memory in the list condition than the narrative condition was unexpected and requires further investigation.

4.3 General Discussion

A great deal of literature exists to describe general changes in memory across development, specifically broad shifts in working memory capacity and general reliance on gist, across the whole lifespan (for review, see Bauer, Larkina, & Deocampo, 2011; Brainerd, Reyna, & Zember, 2011; Goswami, 2011; Howe & Wilkinson, 2011; Raj & Bell, 2010; Schneider, 2011; Shing & Lindenberger, 2011). The present study was designed to address a need for greater specificity with respect to the study of nuanced changes in gist processing ability during the transition from childhood to adolescence to adulthood. Counterintuitively, older children and young adults falsely recognize CLs at higher rates than younger children, as demonstrated in the present study. Although existing studies have demonstrated age-related differences in false memory such that children's susceptibility to false memory gradually increases as a result of increased reliance on gist (i.e., Brainerd, Forrest, Karibian, & Reyna, 2006; Farrar & Goodman, 1992; Ghetti & Angelini, 2008; Odegard, Cooper, Lampinen, Reyna, & Brainerd, 2009; Reyna & Kiernan, 1994), the specific influence of context on the degree of reliance on gist traces remains insufficiently investigated. To extend the literature on gist development across childhood and into young adulthood, the present study investigated the potential impact of enriched context on differences in gist and verbatim processing across several age groups.

A large number of studies on gist processing development use the standard Deese-Roediger-McDermott paradigm (DRM; Deese, 1959; Roediger & McDermott, 1995; Stadler, Roediger, & McDermott, 1999) to assess gist-based false memory. The present study employed the same task in two conditions: one where information sets were presented in the original list format, and one where information sets were embedded into a narrative centered on a theme relating to the critical lure from that information set. Like earlier researchers (i.e., Dewhurst, Pursglove, & Lewis, 2007; Howe & Wilkinson, 2011), I attempted to determine the degree of influence that context has in children's ability to effectively encode and retrieve gist traces, and the degree to which they rely on gist representations in memory to complete a recognition memory task.

The present study contributed uniquely to the literature in several ways, specifically by (1) providing evidence that narrative context does not have the scaffolding effect predicted for young children, (2) including a source memory component in the recognition memory test to determine whether children effectively encode source as a part of gist-based contextual processing, (3) testing a broader range of age groups (5, 7, 9, 11, and young adults) on the same paradigm, (4) recruiting a socioeconomically and ethnically diverse sample, and (5) presenting materials in a more engaging format (i.e., a puppet show video) than previous studies, where researchers simply read stories aloud.

4.3.1 Assessing the Role of Presentation Format

Several research groups have attempted to address the role of enriched context and its potential role as a scaffold for children without fully developed gist-processing ability (i.e., Dewhurst, Pursglove, & Lewis, 2007; Howe & Wilkinson, 2011), but their results did not provide strong evidence for or against the use of narratives as a way of increasing awareness of or reliance on gist-based memory traces. Interestingly, my results largely replicate those of Howe and Wilkinson (2011) and Dewhurst et al. (2007), with results indicating only a marginal effect of presentation type (list vs. narrative). Specifically, Dewhurst et al. report an effect of study format such that recognition rates were higher for stories than lists, but the main effect of story format was not significant by traditional standards, with $p = .08$ in their sample. They go on to report an interaction between study format and age, with $p = .05$, with very low effect sizes. Howe and Wilkinson did not find an effect of study format (list vs. story) on recognition for targets, and reported nonsignificant increases in false memory for information presented in stories biased toward the critical lure. Howe's group did find decreased false memory for critical lures when study information was presented in stories biased away from the lure, but the effect was only significant for 7-year-olds ($p < .05$). While Howe and Dewhurst interpret their marginal effects as meaningful, attributing group differences to the scaffolding influence of narrative context on information processing and gist encoding, the results of the present study suggest a slightly different account. Since there was not a significant effect of presentation type by traditional standards ($p < .05$), it seems that neither children nor young adults benefitted substantially from narrative presentation of materials. Instead, both children and young adults performed remarkably well on the recognition memory task, with children as young as 7 equaling older children's and young adults' performance in some instances. When considered in light of the weak effects demonstrated in earlier studies, the present results seem to suggest that embedding information in a narrative neither helps nor hurts children's performance on gist-based memory tasks. The exception to this conclusion was only evident in supplementary analyses, where 9-year-olds' proportions of gist-consistent source judgments for CLs were higher in the narrative than the list condition. However, given the small effect size of the three-way interaction of Presentation Type, Item Type, and Age Group that produced this result, and the lack of additional support in other analyses, this finding should be interpreted conservatively.

Interestingly, the present study presents a slightly more complicated picture for young adults, who had higher rates of correct and gist-consistent source judgments for the list condition versus the narrative condition. At the outset of the project, I predicted that young adults would not benefit from either condition over the other, but would instead perform equivalently across both presentation types. However, this unexpected result warrants further investigation in future studies, as it suggests that adults may be impaired in their ability to correctly use gist traces to guide memory if context is too enriched. Perhaps the extra information presented in a narrative acts as a distracter, drawing adults' focus away from the most relevant information. Perhaps it is more difficult to effectively extract the gist of embedded information sets while engaging in a secondary task of following a narrative structure, due to increased cognitive load. Both possible explanations have interesting implications for adults attempting to engage in effective gist and verbatim encoding when learning new information, and the question warrants further investigation.

4.3.2 The Role of Source as a Context for Presented Information

As demonstrated in a number of existing studies, source monitoring ability increases across childhood, with older children having greater ability to remember the source of presented information (Foley & Johnson, 1985; Lindsay, Johnson, & Kwon, 1991; Parker, 1995; Powell & Thomson, 1996). Results in the present study supported my prediction that older children and young adults would have higher rates of correct source judgments (for targets) than younger children, because of developmental changes in the ability to monitor source (i.e., Lindsay, Johnson, & Kwon, 1991). I also found support for my prediction that older children and young adults would have higher rates of gist-consistent source judgments (for critical lures and related distracters) than younger children, indicating that they failed to encode the source as a component of the global gist representation for the information presented.

A general age-related increase occurred across all item types and presentation types, such that participants had incrementally higher rates of correct and gist-consistent source judgments in each higher age group. Although groups did not differ individually in some instances (i.e., 5-year-olds equivalent to 7-year-olds), Figure 3.3 offers a graphical representation of the interaction between item type and age group that clarifies the gradual increase in proportions observed for targets and critical lures. Interestingly, no age differences existed in proportions observed for related distracters, perhaps because they do not cue gist traces as strongly as the other two item types. Overall, results of the present study reflect findings of the previous studies mentioned above with respect to age-related increases in source monitoring ability. Additionally, these findings demonstrate a separate contribution of gist-based processing to source identification in the case of targets and critical lures.

4.3.3 A True Developmental Shift in Gist Processing?

The previously described result is in contrast to many earlier studies of gist development in children, which generally found that children younger than age 11 had a lower proportion of correct and gist-consistent recognition or recollection memory judgments than older children and young adults. However, a key study by Brainerd and Reyna (2007) raises the question of local versus global gist processing, and whether differences in the complexity of information sets may influence more subtle age-related increases in performance on these types of tasks. In line with results of the present study, Brainerd and Reyna found that 6 year olds differed in performance from 10 and 14 year olds. However, like many of the studies of gist development presented in this discussion, Brainerd and Reyna's participant groups were twice as far apart in age (4 years) than those in the present study (2 years). By recruiting child participants differing in age between groups by no more than 26 months (i.e., 2 years ± 1 month), I hoped to determine more precisely (1) whether a significant developmental shift occurs in gist processing and, if a clear shift is evident, (2) where specifically in childhood it occurs (i.e., early, middle, late). Since few studies to date have used the same paradigm for both child and adult participants, I also hoped to determine whether age-related differences reported in previous studies might have resulted from variability in measurement and task difficulty.

Across all item types and presentation types, a general developmental trend emerged, wherein proportions of “old” recognition judgments were higher as age group increased. However, young adults, 11-year-olds, and 9-year-olds were generally equivalent in their rates of recognition across most item types, which supports the hypothesis that memory processes may function differently in older children and adults than in younger children (i.e., 7 and 5-year-olds). Although I originally hypothesized developmental differences to emerge between ages 9 and 11, results of the present study indicate that a shift in reliance on gist-based memory traces may occur earlier, specifically between ages 7 and 9.

4.3.4 Additional Considerations

The present study had two additional strengths when compared with existing literature. Specifically, I successfully recruited and tested a highly diverse sample, both socioeconomically and ethnically. Participants were recruited from public schools, community centers, local businesses serving families, religious groups, and a charter school in Arlington, TX. All participants were from the Dallas–Fort Worth metroplex, but some lived as far as 50 miles away from the UT Arlington campus. Parents of some participants did not have access to transportation or childcare, and to increase participation in this underrepresented, low-resource group, researchers scheduled sessions at schools or local libraries near their homes. The diversity of the present sample, as well as the fact that results were consistent across multiple testing environments, both contribute to the ecological validity of these findings.

Furthermore, materials for the recognition memory test were presented in a highly engaging format at study (i.e., puppet show), particularly when compared with procedures traditionally used in studies of gist development. In many existing studies, researchers simply read stories aloud to participants off of a script. For children as young as 5 years old, this study format may not engage full attention, preventing effective encoding independent of the specific question of gist processing. While adult performance should not suffer in a child-friendly task, children's performance is likely to suffer if task demands are at adult levels, requiring a great deal of attention and self-regulation. Therefore, it seems most appropriate to tailor task difficulty and level of engagement to younger participants. By presenting materials using friendly, colorful puppets in a video format, I attempted to mirror the type of educational programming that young children might encounter in daily life (e.g., television programs like Sesame Street). In doing so, I hoped to create a more child-friendly and ecologically-valid task than those used in previous studies.

4.4 Implications and Future Directions

The development of gist processing is important to broader skills that emerge in childhood, such as the ability to develop schema for events and generalize learning across multiple contexts. Gist processing also contributes to children's ability to use cognitive resources more efficiently, although sometimes at the cost of accuracy. Studies of child and adult performance on tasks related to the DRM paradigm address one aspect of gist processing development. However, in addition to research at this fine level of detail (i.e., memory for individual items), study is also needed at the level of broad gist processing (i.e., processing emotional information from a complex social context). Studies of gist processing across multiple domains, in addition to investigations of both local and global gist processing development in childhood, may illuminate important developmental milestones that impact general learning. Discovery or refinement of such milestones would serve to inform professionals working in applied domains such as education administration and acquisition or use of eyewitness testimony.

Specifically, future research in this domain must clarify whether age-related differences in recognition memory performance truly suggest greater reliance on gist traces with age, or simply reflect age-related increases in working memory capacity. A number of studies attempted to address these mechanisms separately, as described in earlier sections. However, future studies of gist processing using the DRM paradigm should also include a simple working memory task that allows assessment of capacity independent of gist processing ability (e.g., digit span). This would enable researchers to statistically covary the effects of this heavily age-influenced variable, accounting for their influence on overall results from such experiments and enhancing interpretability of the effects of gist processing ability over and above general working memory development.

Due to the diversity of the sample and the engaging nature of the study materials, the present study may not be directly comparable to existing studies of gist development and narrative context. However, results obtained in the present study may hold greater ecological validity than those obtained from previous work using less diverse samples with broader age ranges and less engaging tasks. It is critical, therefore, for future studies to address these issues by directly assessing the influence of attention (e.g., Otgaar, Peters, & Howe, 2012) and participant engagement in the task. To that end, I plan to conduct a follow-up study manipulating degree of engagement by comparing 2 conditions: (1) low-engagement, where researchers read lists or stories aloud from scripts, and (2) high-engagement, where lists or stories are presented in the puppet show videos used in the present study. This follow-up investigation should clarify potential influences of highly engaging, multimedia presentation format on children's ability to attend to relevant information in their attempt to extract and encode global gist.

In addition to studies of typical development, future research should also begin to translate reliable methods of gist processing assessment, such as the DRM paradigm, to atypical development (i.e., Autism Spectrum Disorders; ASD). Evidence from the typical development literature can be used to inform understanding of specific deficits or compensatory mechanisms in atypical development. ASD is characterized by difficulty processing gist, often described in the disorder-specific literature as Weak Central Coherence (Happé & Frith, 2006), and therefore presents an opportunity for researchers to make informative cross-population comparisons using these well-established paradigms. Particularly in light of the growing popularity of narrative-based therapeutic approaches (e.g., Social Stories; Gray & Garand, 1993), a deeper understanding of the influence of narrative context on gist processing in ASD might aid in predicting treatment response to these types of interventions.

APPENDIX A

WORD LISTS

BREAD
Butter
Food
Eat
Sandwich
Rye
Jam
Milk
Flour
Jelly
Dough
Crust
Slice
Wine
Loaf
Toast

COLD
Hot
Snow
Warm
Winter
Ice
Wet
Frigid
Chilly
Heat
Weather
Freeze
Air
Shiver
Arctic
Frost

FRUIT
Apple
Vegetable
Orange
Kiwi
Citrus
Ripe
Pear
Banana
Berry
Cherry
Basket
Juice
Salad
Bowl
Cocktail

LION
Tiger
Circus
Jungle
Tamer
Den
Cub
Africa
Mane
Cage
Feline
Roar
Fierce
Bears
Hunt
Pride

CAR
Truck
Bus
Train
Automobile
Vehicle
Drive
Jeep
Ford
Race
Keys
Garage
Highway
Sedan
Van
Taxi

CUP
Mug
Saucer
Tea
Measuring
Coaster
Lid
Handle
Coffee
Straw
Goblet
Soup
Stein
Drink
Plastic
Sip

HIGH
Low
Clouds
Up
Tall
Tower
Jump
Above
Building
Noon
Cliff
Sky
Over
Airplane
Dive
Elevate

MOUNTAIN
Hill
Valley
Climb
Summit
Top
Molehill
Peak
Plain
Glacier
Goat
Bike
Climber
Range
Steep
Ski

CHAIR
Table
Sit
Legs
Seat
Couch
Desk
Recliner
Sofa
Wood
Cushion
Swivel
Stool
Sitting
Rocking
Bench

FOOT
Shoe
Hand
Toe
Kick
Sandals
Soccer
Yard
Walk
Ankle
Arm
Boot
Inch
Sock
Knee
Mouth

KING
Queen
England
Crown
Prince
George
Dictator
Palace
Throne
Chess
Rule
Subjects
Monarch
Royal
Leader
Reign

MUSIC
Note
Sound
Piano
Sing
Radio
Band
Melody
Horn
Concert
Instrument
Symphony
Jazz
Orchestra
Art
Rhythm

NEEDLE
Thread
Pin
Eye
Sewing
Sharp
Point
Prick
Thimble
Haystack
Thorn
Hurt
Injection
Syringe
Cloth
Knitting

SHIRT
Blouse
Sleeves
Pants
Tie
Button
Shorts
Iron
Polo
Collar
Vest
Pocket
Jersey
Belt
Linen
Cuffs

SMELL
Nose
Breathe
Sniff
Aroma
Hear
See
Nostril
Whiff
Scent
Reek
Stench
Fragrance
Perfume
Salts
Rose

SWEET
Sour
Candy
Sugar
Bitter
Good
Taste
Tooth
Nice
Honey
Soda
Chocolate
Heart
Cake
Tart
Pie

PEN
Pencil
Write
Fountain
Leak
Quill
Felt
Bic
Scribble
Crayon
Cross
Tip
Marker
Red
Cap
Letter

SLEEP
Bed
Rest
Awake
Tired
Dream
Wake
Snooze
Blanket
Doze
Slumber
Snore
Nap
Peace
Yawn
Drowsy

SOFT
Hard
Light
Pillow
Plush
Loud
Cotton
Fur
Touch
Fluffy
Feather
Furry
Downy
Kitten
Skin
Tender

THIEF
Steal
Robber
Crook
Burglar
Money
Cop
Bad
Rob
Jail
Gun
Villain
Crime
Bank
Bandit
Criminal

RIVER
Water
Stream
Lake
Mississippi
Boat
Tide
Swim
Flow
Run
Barge
Creek
Brook
Fish
Bridge
Winding

SLOW
Fast
Lethargic
Stop
Listless
Snail
Cautious
Delay
Traffic
Turtle
Hesitant
Speed
Quick
Sluggish
Wait
Molasses

SPIDER
Web
Insect
Bug
Fright
Fly
Arachnid
Crawl
Tarantula
Poison
Bite
Creepy
Animal
Ugly
Feelers
Small

WINDOW
Door
Glass
Pane
Shade
Ledge
Sill
House
Open
Curtain
Frame
View
Breeze
Sash
Screen
Shutter

APPENDIX B

NARRATIVES

BREAD – *targets: sandwich, milk, dough; related distracters: loaf, toast*

Katie's mom bought fresh butter at the store, along with some other food. Katie was ready to eat lunch, so she decided to make a sandwich on rye with jam. Katie liked to mix the milk and flour for her mom, and she helped make jelly too. Katie's mom made dough from scratch, so it had a nice crust on every slice. Mom and Dad had a glass of red wine with lunch, and Katie had grape juice.

CAR – *targets: automobile, Jeep, keys; related distracters: van, taxi*

Adam drives a truck, so his little brother Sam does not have to take the bus to school. The train tracks are on the way to school, with a special bridge where an automobile can cross. Adam's vehicle was easy to drive, unlike their dad's Jeep. Adam decided to enter his Ford in a race one day without permission. His parents found out, so they took away Adam's keys and locked the garage. The race was on the dangerous highway against a man in a blue sedan.

CHAIR – *targets: seat, recliner, cusion; related distracters: rocking, bench*

When Molly does her homework, the table is her favorite place to sit because the legs are tall. Molly's feet barely touch the floor when she is on the seat. Molly's room has a couch and a desk, but she likes to be around her family when she is studying. Her mom likes the recliner and her dad likes the sofa where he can put his feet up on the wood table and lean back on a soft cushion. Molly's sister likes to swivel around on the kitchen stool instead of sitting still.

COLD – *targets: winter, frigid, weather; related distracters: arctic, frost*

It was hot inside Seth's house but outside he could see snow. He didn't want to leave his warm house. It was the middle of winter and ice covered the wet ground. Seth stepped out into the frigid air. Seth didn't like going out when it was chilly, he liked the heat much better. He was sure that in this weather he would freeze as the air made him shiver.

CUP – *targets: measuring, handle, goblet; related distracters: plastic, sip*

Anna reached into the cabinet for her favorite mug and saucer for tea. Her mother was measuring water for the kettle, so Anna handed her a coaster and a lid. Anna was not supposed to touch the handle of the kettle because it was very hot. Sometimes, Anna's mother made coffee instead. Anna liked the little straw used to stir it. There was a big green goblet of soup on the table for Anna's mother, and a stein for root beer, which was Anna's second favorite drink.

FOOT – *targets: kick, yard, arm; related distracters: knee, mouth*

Mark's shoe was broken, so he had to carry it in his hand. He stubbed his toe trying to kick a ball while wearing sandals. Mark learned that these are not the best for playing soccer in the school yard. It was a long walk back home, and his ankle was starting to hurt. He waved his arm at his mom as she drove by in her van. Her boot was on the brake, so she pushed it in an inch and stopped the car so Mark could get in. When he got home, Mark put on a sock.

FRUIT – *targets: kiwi, pear, cherry; related distracters: bowl, cocktail*

Sally was shopping with her dad. They had already picked up lots of apples and vegetables. Sally didn't like them. She decided to pick all the things she liked. First, she picked up an orange and a kiwi. Her dad had told her that they were citrus. Sally chose a ripe pear and a banana, then a berry and a cherry and put them in the basket. Her dad said that one of everything would be enough to make some juice and a salad.

HIGH – *targets: tall, above, cliff; related distracters: dive, elevate*

Jane thought the low clouds looked stormy. She climbed up the stairs of the tall tower at the pool, and took a big jump into the water. As she looked above her and saw raindrops, she thought it was time to go into the building even though it was only noon. The poolhouse sat on the edge of a cliff where Jane could see the sky and look over the edge at the valley below. As she watched an airplane fly by, Jane wished the storm would end so she could go outside.

KING – *targets: prince, palace, rule; related distracters: leader, reign*

Jill likes to pretend she is the Queen of England, so she wears a crown that she got at the toy store. Her brother Tommy pretends to be a prince named George, who is a dictator trying to overthrow the palace and take the throne from his sister, like in a game of chess. Jill likes to rule the land and care for her subjects. She is a caring and kind monarch from a royal family.

LION – *targets: tamer, Africa, feline; related distracters: hunt, pride*

Brad knew that the tiger didn't belong in a circus. They belonged in the jungle. They don't need a tamer to look after them. Brad also knew that they lived in a den with their cubs in Africa. Brad thought of another animal with a mane he had seen in the cage – a big feline that roars. Brad's teacher says they are fierce like bears.

MOUNTAIN – *targets: summit, peak, goat; related distracters: steep, ski*

Kim lives on a hill next to a valley. It is a long climb up to the summit, or the top, of her very own molehill. From the peak you can see the whole plain that was created by a glacier many years ago. Kim has a pet goat and she likes to ride her bike on the trails and wave at the climbers. She has lived on this range her whole life.

MUSIC – *targets: sing, melody, instrument; related distracters: art, rhythm*

Jack played a note and listened to the sound that came from the piano. He began to sing along. Jack had been listening to the radio when he heard the brass band. Jack could play a melody on the horn, and he hoped that one day he would play in a concert or maybe play an instrument in a famous symphony. Jack also wanted to play jazz with an orchestra.

NEEDLE – *targets: sewing, prick, thorn; related distracters: cloth, knitting*

Joey was helping his mom untangle some thread so that she could use a pin to put it through the eye on her sewing machine. She told him to be careful, because the sharp point could prick his finger. That is why Joey's mom wears a thimble painted to look like a haystack. Joey's mom says just like a thorn, it can hurt like getting an injection with a syringe.

PEN – *targets: leak, Bic, Cross; related distracters: cap, letter*

Mary's dad used a pencil when he taught her how to write. He said the fountain kind of writing utensil can leak like an old quill, and the felt-tipped Bic was only good to scribble with like a crayon. His favorite kind of writing utensil was called Cross, and it had a tip like a marker. Mary asked if she could use the red one.

RIVER – *targets: Mississippi, swim, barge; related distracters: bridge, winding*

When Andy was young, he played in the water at the stream near his house. It ran into a lake in Mississippi. Andy's parents had a boat that they took out when the tide was high, and he liked to jump in and swim with the flow of the current. Andy used to run along the banks trying to keep up with a passing barge. He loved to watch a creek or a brook rushing by, and his dad liked to fish.

SHIRT – *targets: tie, iron, vest; related distracters: linen, cuffs*

Crystal liked to look through her mom and dad's closet. Crystal's mom had a beautiful blue blouse with lace sleeves. Crystal's dad had many pairs of pants. He also had a special tie that Crystal gave him as a gift. Crystal's mom had to mend the button on his shorts and help him iron out the wrinkles in his polo with the stiff collar. Sometimes, Crystal's dad wore a vest with a pocket to work, but he liked to wear a sports jersey on the weekends with jeans and his leather belt.

SLEEP – *targets: tired, snooze, nap; related distracters: drowsy, yawn*

Lauren lay in bed. She needed to rest but she was still awake even though she was so tired. Finally she nodded off and began to dream. She did not want to wake up. She began to snooze and wrapped her blanket tightly around her. Lauren quickly fell from a doze to a deep slumber and began to snore heavily. Lauren lay there quietly and was able to nap in peace.

SLOW – *targets: listless, delay, hesitant; related distracters: wait, molasses*

Today, Chris was not very fast in gym class. He felt lethargic and wanted to stop running because he was so listless. Chris explained to his teachers that he felt like a snail that day, so he was very cautious crossing the street, which caused a delay in traffic that made him late to school. Like a turtle, Chris was hesitant to play with kids running at full speed and playing a quick game at recess. He felt sluggish and decided to sit on the sidelines instead.

SMELL – *targets: aroma, nostrils, reek; related distracters: salts, rose*

Max held his nose so that he couldn't breathe. He didn't even want to sniff because of the aroma. He could still hear and see but he had covered his nostrils so that the whiff did not affect him. He tried to think of a nice scent to help him forget about the reek and disgusting stench. He thought of the sweet fragrance of perfume to help him forget.

SOFT – *targets: plush, fur, feather; related distracters: skin, tender*

It was hard for Grace to turn on the light because her pillow was so plush and comfortable. Grace could hear her loud alarm clock through the cotton blanket, and she felt fur and a gentle touch like a fluffy little feather against her face. It was her downy new kitten saying hello with a furry kiss.

SPIDER – *targets: fright, crawl, bite; related distracters: feelers, small*

Jacob's sister was watching a movie where things got caught in a giant web built by an insect. A bug in the room made Jacob jump with fright when he saw it fly toward him. The movie was about an arachnid that liked to crawl on people, called a tarantula. It could poison them with just one bite! Jacob thought it was a really creepy animal that was very ugly.

SWEET – *targets: bitter, tooth, chocolate; related distracters: tart, pie*

Sarah liked sour candy as long as it had some sugar on it. Sometimes, Sarah accidentally got something bitter, and it was not a good taste. Sarah's dentist said she would have a tooth ache if she ate too many nice things like honey, soda, and chocolate. Her mother did not have the heart to take it all away on Sarah's birthday, so she made Sarah a delicious cake.

THIEF – *targets: burglar, bad, gun; related distracters: bandit, criminal*

Maya knew it was wrong to steal. She had read a story once about a robber. The crook was a burglar who was caught stealing money by a cop. It was very bad to rob. So, the man went to jail and they took away his gun. People said he was a real villain because it was a crime to hold up a bank.

WINDOW – *targets: shade, house, frame; related distracters: screen, shutters*

Matt and Adam looked through a door made with four glass panes. The shade was not drawn, so they could peek over the ledge of the sill and see the house next door. The neighbors had open curtains, and through the frame Matt and Adam had a nice view of their living room. A sudden breeze caught the sash and slammed it shut with a loud bang.

APPENDIX C

CHILD AND ADULT PROTOCOLS

“Narrative Processing in Children and Young Adults”

Procedures Manual for Administration to Children

Materials*: (record forms, coding sheets, and assent documents should be in the participant's folder, but extras are available in the black file cabinet in LS 596).*

Session 1 – WASI materials – 1 record form, manual, block set *(white shelves in 596)*
Session 2 – WIAT materials – 1 record form, Stimulus Book 2 *(white shelves in 596)*

2 copies of the "Assent" form *(black file cabinet in 595)*

Laptop *(white shelves in 596)*

Coding sheets *(black file cabinet in 596)*

2 pencils and 2 pens *(wooden file cabinet in 596)*

Clipboard *(white shelves in 596)*

Stopwatch *(on top of the black file cabinet in 596)*

Setup:

Place all materials on the large table in LS 594, or an empty table at the testing site.

On the participant's side of the table, place the following items:

1. 1 pen
2. Consent documents

On the researcher's side of the table, place the following items:

1. WASI (Session 1) or WIAT (Session 2) materials and clipboard
2. Laptop and charger
3. Coding sheet and scoring template
4. Stopwatch
5. Remaining pen and pencils

Turn the laptop on at least 15 min. prior to the participant's scheduled appointment time.

Check in the project folder on the server, check the log filed named "Order Assignments" for stimulus presentation order. Verify that you have the correct coding sheet.

Open and minimize the corresponding study files (in Quicktime) and write the filename (i.e., O1_D1) at the top of the coding sheet, then set the laptop off to the side for later.

★ NOTE ★

For administration of the WIAT, the participant sits caddy-corner (90° angle) to the researcher.

For administration of the WASI, the participant sits directly across from the researcher.

Introduction and Consent:

When the participant arrives, say:

> *Hi! My name is ______________! What's your name?* (give participant time to respond…) *It's nice to meet you _____________! Are you having a good day?*

Spend a moment casually speaking with the participant until they seem comfortable. Then say:

> *Okay, I want to tell you what we are going to do today. We want to learn about memory. We want to know about how kids like you remember things. So we are going to ask kids to remember things for us. Some kids are going to be young, and some kids are going to be old. During this study you are going to watch puppet shows. Then, you will remember some words and answer some questions. We want to find out if older kids remember more. We also want to find out if kids remember more from stories or lists.*
>
> *It will take you about 3 hours to do everything. You will see me 2 times. Each time you see me will last about 1 ½ hours. The first time you see me, you will watch puppet shows, and remember words. Then, you will make patterns with blocks, and tell me what different words mean. Then, you will tell me how some things are the same, and pick out pictures that go together. The second time you see me, you will watch some more puppet shows and remember different words. You will also answer questions about pictures and sentences.*
>
> *We hope you will have fun doing this study. You might have fun watching the puppets, playing with blocks, and hearing stories. Also, you will help scientists learn about how memory works. At the end, you will get to choose a storybook to take home with you! This study isn't dangerous, and it will not hurt you. You can quit any time you want to, and nobody will be upset or mad at you. Your mom or dad can also call and tell us if you want to quit.*
>
> *About 150 kids and grown-ups will be part of this study. We keep all of your answers secret, and we don't tell anyone that you did the study. Me and a few other grown-ups I work with are the only ones who can look at your answers, but they won't know who you are. We keep everything locked up nice and safe.* (At this time, explain confidentiality procedures in more detail to mom/dad according to the language on the assent form.)
>
> *Do you have any questions?* (If they have questions, answer them as best you can…if not, continue.) *Great! So since you are under 18 years old, we have to have your permission* ***and*** *your mom/dad's permission. So you will both sign this paper we have been reading together. If you want to do this study, go ahead and sign here on both copies…one is for you to keep and one is for me* (indicate the correct line, and give them plenty of time to read the document and talk with mom/dad if necessary.)

When the participant signs, take the lab copy and give them their copy to take home. Say:

> *Okay, now it is time to begin. Mom/Dad, would you mind waiting in the next room? We should be finished in about an hour, but we'll take a break in the middle to come say hi.*

If the parent does not object, escort them to a separate room and make sure they are settled in. **Do not leave a child alone in the testing room**; allow them to come with you to see where mom/dad is going to be. Return with the child to the testing room to begin the study.

Session 1 Administration:

Begin by thanking the participant again for their time, and then maximize the Practice 1 video.

Administer the **Memory Task** test. Record the participant's answers on the coding sheets. Before starting the video say:

> *Okay, it is time to get started, are you ready? Now I am going to show you a video of two puppets named Mary the Monkey and Franny the Frog. This is Mary* (present picture card #1) *and this is Franny* (present picture card #2). *Can you point to Mary? That's right, this is Mary, and this is Franny* (again indicate the appropriate pictures). *These puppets will read you a list of words or a story, and I want you to try to remember all of the words you hear. You may not remember them all, but try to remember as many as you can. Do you have any questions? Okay, let's do one for practice. Remember, this puppet is Franny, and this puppet is Mary.*

Start the Practice1 video and use the coding sheet to go through the 2 Practice and 1 test trial.

When Memory Task administration is complete, say:

> *Okay, that part is finished. Let's take a 5-minute break so that you can get a drink, stretch your legs, or use the restroom.* (Escort him/her to the parent and give them 5 minutes to chat or relax before returning to the testing room.)

At the end of the break, say: *Okay, it is time to get started, are you ready?*

Take out the WASI materials. Begin reading the introductory text on **page 53 of the WASI Manual**, and administer all sections using the EXACT instructions written in the manual. Record participant answers on the response form, and be careful to not let the participant see your notes or read your facial reactions to their answers.

When the participant is finished with all practice/test trials, say:

> *Okay, you're finished, that's all for today. Thank you so much for your help! Let's pick a day for you to come back for the second session, and then you will be free to go.*

Work with the participant to set up Session 2, and then escort them out of the testing area, thanking them again for their time.

Post-Session Tasks:
After each session, it is important to make sure the lab is reset to its original condition, all materials are in their original location, and data is safely stored. Make sure the following things are done before leaving the lab for the day:

1. Remove any trash from the administration room and straighten/push in chairs if needed. Close the Quicktime video files. Shut down the laptop and place it back in the bag.

2. Score the participant's WASI form and memory task coding sheet.
3. File the participant's assent form alphabetically in the folder labeled "Signed Consent/Assent Forms". Put the participant folder back in the file cabinet. Double-check that the file cabinet is locked! Turn off the lights, and close/lock LS 595.
4. Place WASI materials, scoring template, clipboard, and pens/pencils back in their proper place in LS 596. Turn off the lights, and close/lock LS 596.

Session 2 Administration:

Begin by thanking the participant for coming in, and re-introduce yourself. Remind them that the consent forms they signed last time are for this session as well, and ask if they have any questions before beginning. If they do not have questions, say:

> *Okay Mom/Dad, just like last time, I'm going to ask you to wait in the other room. This will take about an hour, but we will take a break in the middle to come say hi.*

Escort the parent to a separate room and make sure they are settled in. **Do not leave a child alone in the testing room**; allow them to come with you to see where mom/dad is going to be. Return with the child to the testing room to begin the study.

Administer the **Memory Task** test. Record the participant's answers on the coding sheets. Before starting the video say:

> *Okay, it is time to get started, are you ready? Now I am going to show you a video of two puppets named Mary the Monkey and Franny the Frog. This is Mary* (present picture card #1) *and this is Franny* (present picture card #2). *Can you point to Mary? That's right, this is Mary, and this is Franny* (again indicate the appropriate pictures). *These puppets will read you a list of words or a story, and I want you to try to remember all of the words you hear. You may not remember them all, but try to remember as many as you can. Do you have any questions? Okay, let's do one for practice. Remember, this puppet is Franny, and this puppet is Mary.*

Start the Practice1 video and use the coding sheet to go through the 2 Practice and 1 test trial.

When Memory Task administration is complete, say:

> *Okay, that part is finished. Let's take a 5-minute break so that you can get a drink, stretch your legs, or use the restroom.* (Escort him/her to the parent and give them 5 minutes to chat or relax before returning to the testing room.)

At the end of the break, say: *Okay, it is time to get started, are you ready?*

Administer the **Listening Comprehension** subtest from **WIAT Stimulus Booklet 2.** Record participant answers on the response form, and be careful to not give any positive/negative feedback. When the WIAT is complete, say:

When the participant is finished with all practice/test trials, say:

> *Okay, you're finished! Let's go get your mom/dad, and then I will tell you both why we are doing this study.*

Debriefing:

Debriefing is a very important part of the research process. It is important that the participant (and his/her guardian, if under 18) understand the procedures and the purpose of the study. It is our responsibility to make sure they do not have any remaining questions or concerns when they leave the lab, and that they are comfortable with everything that went on during their session(s). When the participant has finished Session 2, offer him/her the opportunity to take a water/restroom break before beginning the debriefing process.

When the participant and his/her parent are ready to begin debriefing, say:

> *Thank you for your help today! It is really cool that kids like you want to help scientists! I want to tell you a little bit more about the study. Then we hope it will all make sense.*
>
> *Here in Texas, kids like you are doing the study. We have some friends in Florida too, and they are doing the same study, but with different kids. These other kids have autism. That means they think about things in a different way. We want to know if kids like you remember different things than kids with autism.*
>
> *So in our first session, you got to meet Franny the Frog and Mary the Monkey. They read some lists of words and some stories. Remember how I asked you some questions after you watched the puppet show? We wanted to see how much you could remember. We also wanted to see if you remembered more words from a list or from a story. Do you remember the other test you did in our first time together, with blocks and words? That test tells me how you think. Then, when you came back today, you watched more puppet shows and answered more questions. They were different words and stories than before. We just wanted to learn some more about your memory. You also did a different test where I asked you about some pictures and sentences. That test tells me about how you listen.*
>
> *Do you have any questions about what you did, or why we did it?*

Give the participant a chance to think about it and respond before continuing. If he/she (or his/her guardian) has any questions, answer them as best you can.

> *Some people remember differently when they get older. So that is why we asked kids who are 5, 7, 9, and 11 years old to do the study, and grown-ups too! This study will help us learn about memory and how it changes as we grow up. Do you have any questions?*

Give the participant a chance to think about it and respond before continuing. If he/she (or his/her guardian) has any questions, answer them as best you can.

> *Okay, well thanks for letting me tell you all about the study, and thank you for coming today! If you know any other kids doing the study, please don't tell them what we did, okay? Can you help me by keeping it a secret?*

Wait for the participant to acknowledge, then say:

> *Now you can pick out a storybook to take with you!* (Show them the books and let them choose one to take home.) *Thank you again for your help! It was so nice to meet you!* **(If at UTA, walk down to their car and make sure they know how to get home.)**

Post-Session Tasks:

After each session, it is important to make sure the lab is reset to its original condition, all materials are in their original location, and data is safely stored. Make sure the following things are done before leaving the lab for the day:

1. Remove any trash from the administration room and straighten/push in chairs if needed. Close the Quicktime video files. Shut down the laptop and place it back in the bag.
2. Score the participant's WIAT form and memory task coding sheet.
3. File the participant's assent form alphabetically in the folder labeled "Signed Consent/Assent Forms". Put the participant folder back in the file cabinet. Put the stopwatch back in the file cabinet, and close it securely. Double-check that the file cabinet is locked! Turn off the lights, and close/lock LS 595.
4. Place WIAT materials, clipboard, and pens/pencils back in their proper place in LS 596. Turn off the lights, and close/lock LS 596.

"Narrative Processing in Children and Young Adults"

Procedures Manual for Administration to Young Adults

Materials:

Session 1 – WASI materials – 1 record form, manual, block set *(white shelves in 596)*
Session 2 – WIAT materials – 1 record form, Stimulus Book 2 *(white shelves in 596)*

2 copies of the "Consent" form *(black file cabinet in 595)*
Laptop *(white shelves in 596)*
Coding sheet *(black file cabinet in 595)*
2 pencils and 2 pens *(wooden file cabinet in 596)*
Clipboard *(white shelves in 596)*
Stopwatch *(black file cabinet in 595)*

Setup:

Place all materials on the large table in LS 594, or an empty table at the testing site.

On the participant's side of the table, place the following items:

1. 1 pen
2. Consent documents

On the researcher's side of the table, place the following items:

1. WASI (Session 1) or WIAT (Session 2) materials and clipboard
2. Laptop and charger
3. Coding sheet and scoring template
4. Stopwatch
5. Remaining pen and pencils

Turn the laptop on at least 15 min. prior to the participant's scheduled appointment time.

Check in the project folder on the server, check the log filed named "Order Assignments" for stimulus presentation order. Verify that you have the correct coding sheet.

Open and minimize the correct puppet show video (in Quicktime) and write the filename (i.e., O1_D1) at the top of the coding sheet, then set the laptop off to the side for later.

★ NOTE ★

For administration of the WIAT, the participant sits caddy-corner (90° angle) to the researcher.

For administration of the WASI, the participant sits directly across from the researcher.

Introduction and Consent:

When the participant arrives, say:

> *Hi! My name is ______________, and I will be working with you today. It's nice to meet you; I appreciate you taking time to participate in our project! How are you today?*

Spend a moment casually speaking with the participant until they seem comfortable. Then say:

> *Okay, I want to tell you what we are going to do today. We are interested in how memory develops, so we are asking children ages 5-11 and young adults to complete a memory task. You will watch some puppet shows, remember some words, and answer questions about the words you heard. We are interested in learning about age-related changes in memory, and memory for information presented in stories and lists.*
>
> *It will take you about 3 hours to do everything. You will come to the lab for a total of 2 sessions that take about 1 ½ hours each. In session 1, you will listen to some stories, and complete the puppet show memory task. In session 2, you will make patterns with blocks, define words, describe similarities, and match patterns. You will then complete the same type of puppet show memory task.*
>
> *You may have fun completing some of the tasks and watching the puppet shows, and you will help us learn more about memory development. At the end of the study, you will be given 2.25 credits for each session in the Sona system, for a total of 4.5 credits. There are no more risks to you in participating than you would experience in normal daily life. You are free to withdraw at any time without penalty.*
>
> *About 150 children and young adults will be part of this study. Each participant is given an anonymous ID number and data are kept in a locked file cabinet in a locked lab room. The only people with access are members of the Reading & Memory Lab. Here on the consent form there is a detailed explanation of confidentiality procedures…go ahead and take a moment to read through it.* (At this time, explain confidentiality procedures in more detail according to the language on the consent form.)
>
> *Do you have any questions?* (If they have questions, answer them as best you can…if not, continue.) *Great! If you consent to participate in this study, go ahead and sign here on both copies…one is for you to keep and one is for me* (indicate the correct line, and give them plenty of time to read the document ask questions if necessary.)

When the participant is finished signing, take the lab copy and give them their copy to take home. Say:

> *Okay, now it is time to begin.*

Escort the participant to the testing room to begin the study.

Session 1 Administration:

Begin by thanking the participant again for their time, and then maximize the Practice 1 video.

Administer the **Memory Task** test. Record the participant's answers on the coding sheets. Before starting the video say:

> *Now I am going to show you a video of two puppets named Mary the Monkey and Franny the Frog. This is Mary* (present picture card #1) *and this is Franny* (present picture card #2). *Can you point to Mary? That's right, this is Mary, and this is Franny* (again indicate the appropriate pictures). *These puppets will read you a list of words or a story, and I want you to try to remember all of the words you hear. You may not remember them all, but try to remember as many as you can. Do you have any questions? Okay, let's do one for practice. Remember, this puppet is Franny, and this puppet is Mary.*

Start the Practice1 video and use the coding sheet to go through the 2 Practice and 1 test trial.

When Memory Task administration is complete, say:

> *Okay, that part is finished. Let's take a 5-minute break so that you can get a drink, stretch your legs, or use the restroom.*

At the end of the break, say: *Okay, it is time to get started, are you ready?*

Take out the WASI materials. Begin reading the introductory text on **page 53 of the WASI Manual**, and administer all sections using the EXACT instructions written in the manual. Record participant answers on the response form, and be careful to not let the participant see your notes or read your facial reactions to their answers.

When the participant is finished with all practice/test trials, say:

> *Okay, you're finished, that's all for today. Thank you so much for your help! Let's pick a day for you to come back for the second session, and then you will be free to go.*

Work with the participant to set up Session 2, and then escort them out of the testing area, thanking them again for their time.

Post-Session Tasks:

After each session, it is important to make sure the lab is reset to its original condition, all materials are in their original location, and data is safely stored. Make sure the following things are done before leaving the lab for the day:

1. Remove any trash from the administration room and straighten/push in chairs if needed. Close the Quicktime video files. Shut down the laptop and place it back in the bag.
2. Score the participant's WASI form and memory task coding sheet.
3. File the participant's assent form alphabetically in the folder labeled "Signed Consent/Assent Forms". Put the participant folder back in the file cabinet. Put the stopwatch back in the file cabinet, and close it securely. Double-check that the file cabinet is locked! Turn off the lights, and close/lock LS 595.
4. Place WASI materials, scoring template, clipboard, and pens/pencils back in their proper place in LS 596. Turn off the lights, and close/lock LS 596.

Session 2 Administration:

Begin by thanking the participant for coming in, and re-introduce yourself. Remind them that the consent forms they signed last time are for this session as well, and ask if they have any questions before beginning.

Administer the **Memory Task** test. Record the participant's answers on the coding sheets. Before starting the video say:

> *Okay, it is time to get started, are you ready? Now I am going to show you a video of two puppets named Mary the Monkey and Franny the Frog. This is Mary* (present picture card #1) *and this is Franny* (present picture card #2). *Can you point to Mary? That's right, this is Mary, and this is Franny* (again indicate the appropriate pictures). *These puppets will read you a list of words or a story, and I want you to try to remember all of the words you hear. You may not remember them all, but try to remember as many as you can. Do you have any questions? Okay, let's do one for practice. Remember, this puppet is Franny, and this puppet is Mary.*

Start the Practice1 video and use the coding sheet to go through the 2 Practice and 1 test trial.

When Memory Task administration is complete, say:

> *Okay, that part is finished. Let's take a 5-minute break so that you can get a drink, stretch your legs, or use the restroom.*

At the end of the break, say: *Okay, it is time to get started, are you ready?*

Administer the **Listening Comprehension** subtest from **WIAT Stimulus Booklet 2.** Record participant answers on the response form, and be careful to not give any positive/negative feedback.

When the participant is finished with all practice/test trials, say:

> *Okay, you're finished! Let me tell you about the purpose of the project and what we are trying to learn from it. Then you will be free to go!*

Debriefing:

Debriefing is a very important part of the research process. It is important that the participant understands the procedures and the purpose of the study. It is our responsibility to make sure they do not have any remaining questions or concerns when they leave the lab, and that they are comfortable with everything that went on during their session(s). When the participant has finished Session 2, offer him/her the opportunity to take a water/restroom break before beginning the debriefing process.

When the participant is ready to begin debriefing, say:

> *I want to first thank you for all your help. We could not do this project without participants like you who volunteer their time, and we appreciate your efforts in these past two sessions! I would like to give you a little more information now, so that you understand the purpose of the project and why we had you do certain tasks. We are collecting data on typically developing and autistic individuals from age 5 to age 30. You*

were part of a project that will eventually have about 150 different people involved, each giving us different answers to the questions we asked.

The test you took during Session 1 was a test of cognitive skills, commonly known as an IQ test, that tells us about your memory and information processing ability. The test you took during Session 2 measured listening comprehension, or how well you understand stories when they are read to you aloud. We mainly look at these scores to see if there is any reason you might have trouble with the memory task we did in both sessions.

The videos you watched of Mary the Monkey and Franny the Frog contained words, either presented as a list or a story, that all related to what we call a "target word". For example, "bed", "rest", and "pillow" are all related to the target word "sleep". You didn't actually hear the word "sleep" presented in the list or story, but because all of those other words are so closely related to "sleep", many people will think they heard it. That is why we asked you to answer questions like, "Who said the word 'sleep'?" We are mainly interested in two things: whether you thought you heard a word that wasn't actually presented, and whether you could remember which puppet said the word. Do you have any questions about the tasks you did in Session 1 or Session 2?

Give the participant a chance to think about it and respond before continuing. If he/she has any questions, answer them as best you can.

Great! So I'm sure you're wondering why we did all of this. We are interested in learning about differences in memory and information processing between typically developing and autistic individuals. When we are young, we do not think about the "big picture", or what we call the "gist". So when I read the words, "bed", "rest", and "pillow" to a 5-year-old, he or she will remember those exact words, but probably won't think they heard the word "sleep". At this age, we have very good memory for exactly what is presented to us, but we do not put it all together in a big picture. As we get older, we learn to put information into context and take away a bigger meaning from it all. So an 11-year-old might think they heard the word "sleep" because it fits with the other words in the big picture. Adults actually have a harder time remembering the exact words they hear, but they are very good at remembering the big picture.

One of the things autistic individuals have trouble with is getting the big picture. So we are interested in knowing if they follow the same pattern as typically developing individuals do in learning to get the big picture, or if they only learn to remember exactly what is presented to them. Some of the things that might affect this skill include age, reading ability, verbal skills, and basic memory problems. By asking lots of questions and giving participants many lists and stories to remember, we have a large amount of information to look at. It will tell us a lot about how these skills develop and how to help people who struggle in the area of gist processing. Do you have any questions about why we are doing this project or what it will tell us?

Give the participant a chance to think about it and respond before continuing. If he/she has any questions, answer them as best you can.

Okay, well thanks for letting me tell you all about the project, and thank you again for participating! If you know anyone else participating in our project, please don't tell them about it. It is important for everyone to come in without any expectations, okay?

Your Sona credit will be posted by the end of the week, and you will get 2.25 credits for each session, for a total of 4.5 credits. It was so nice to meet you! Have a great (afternoon/evening)!

Post-Session Tasks:

After each session, it is important to make sure the lab is reset to its original condition, all materials are in their original location, and data is safely stored. Make sure the following things are done before leaving the lab for the day:

1. Remove any trash from the administration room and straighten/push in chairs if needed. Close the Quicktime video files. Shut down the laptop and place it back in the bag.

2. Score the participant's WIAT form and memory task coding sheet.

3. File the participant's assent form alphabetically in the folder labeled "Signed Consent/Assent Forms". Put the participant folder back in the file cabinet. Put the stopwatch back in the file cabinet, and close it securely. Double-check that the file cabinet is locked! Turn off the lights, and close/lock LS 595.

4. Place WIAT materials, clipboard, and pens/pencils back in their proper place in LS 596. Turn off the lights, and close/lock LS 596.

APPENDIX D

SAMPLE CODING SHEET

Video Filename:_______________ **Participant ID:______**

ORDER 1 – DAY 1

Practice Test 1

So now you have met Franny and Mary. They read some words to you. Now I'm going to ask you some questions about the words you heard. Do you understand? Let's begin.

First, I want you to tell me if you heard the word I am going to read to you. You can answer "Yes" if you think you heard it in the puppet show, or "No", if you do not remember hearing it. If you think you heard the word, I am going to ask you which puppet said it. You can say 'Franny', 'Mary', or 'I don't know'. It's okay to say 'I don't know' if you don't remember who said it.

Did you hear the word 'circle'? (Yes) Who said it? (Franny) That's right, Franny said 'circle'!

Did you hear the word 'square'? (Yes) Who said it? (Mary) Good try, but it was really Franny who said 'square'.

Did you hear the word 'triangle'? (No) Well, really you did hear the word 'triangle'. Franny said 'triangle'.

Did you hear the word 'toy'? (No) That's right, nobody said 'toy'.

Word	Heard it?	Who said it?	Repeated?	Notes
Circle	Y N	M F DK	1x 2x 3x	
Square	Y N	M F DK	1x 2x 3x	
Triangle	Y N	M F DK	1x 2x 3x	
Toy	Y N	M F DK	1x 2x 3x	

Good job! Now let's do one more practice just to make sure you understand the instructions really well. Franny and Mary are going to read some more words, and then I will ask you some more questions. Watch carefully…

(Start the Practice2 video. When it stops, continue on to the next page...)

Video Filename:_______________ **Participant ID:______**

ORDER 1 – DAY 1

Practice Test 2

Just like before, I want you to tell me who said each word. You can answer 'Franny', 'Mary', or 'I don't know'. Are you ready? Okay, let's begin.

Did you hear the word 'blue'? (Yes) Who said it? (Mary) That's right, Mary said 'blue'!

Did you hear the word 'green'? (No) Well, you did hear the word 'green'. Mary said it.

Did you hear the word 'pink'? (Yes) Who said it? (Franny) Well, really it was Mary said 'pink'!

Did you hear the word 'book'? (No) Good job, nobody said 'book'.

Word	Heard it?	Who said it?	Repeated?	Notes
Blue	Y N	M F DK	1x 2x 3x	
Green	Y N	M F DK	1x 2x 3x	
Pink	Y N	M F DK	1x 2x 3x	
Book	Y N	M F DK	1x 2x 3x	

Good! That's the end of the practice. This next set is not practice, so I can't help you any more. Watch carefully and try to remember as much as you can.

(Start the test video. When it stops, continue on to the next page…)

Video Filename:_______________ Participant ID:______

ORDER 1 – DAY 1

Memory Test

Just like before, I'm going to ask you if you heard some words in the puppet show. If you think you heard the word, answer 'Yes'. If you do not remember hearing the word, answer 'No'. Then, if you think you heard the word, I'm going to ask you who said it. Answer 'Franny', 'Mary', or 'I don't know' to each question. Ready? Let's begin.

Ask, *"Did you hear the word __________?"* and circle the participant's response. If they answer yes, ask, *"Who said it?"* and circle their response. Mark the number of times you repeat the word (if needed), and make notes if anything unusual comes up.

Word	***Heard it?***	***Who said it?***	***Repeated?***	***Notes***
House	Y N	M F DK	1x 2x 3x	
Steep	Y N	M F DK	1x 2x 3x	
Above	Y N	M F DK	1x 2x 3x	
Lion	Y N	M F DK	1x 2x 3x	
Bite	Y N	M F DK	1x 2x 3x	
Pie	Y N	M F DK	1x 2x 3x	
Instrument	Y N	M F DK	1x 2x 3x	
Sewing	Y N	M F DK	1x 2x 3x	
Tie	Y N	M F DK	1x 2x 3x	
Barge	Y N	M F DK	1x 2x 3x	
Toast	Y N	M F DK	1x 2x 3x	
Fright	Y N	M F DK	1x 2x 3x	
Music	Y N	M F DK	1x 2x 3x	
Winding	Y N	M F DK	1x 2x 3x	
Pride	Y N	M F DK	1x 2x 3x	
Plastic	Y N	M F DK	1x 2x 3x	
Frame	Y N	M F DK	1x 2x 3x	
Swim	Y N	M F DK	1x 2x 3x	

Video Filename:________________ **Participant ID:______**

Summit	Y N	M F DK	1x 2x 3x	
Thorn	Y N	M F DK	1x 2x 3x	
High	Y N	M F DK	1x 2x 3x	
Sweet	Y N	M F DK	1x 2x 3x	
Dive	Y N	M F DK	1x 2x 3x	
Cliff	Y N	M F DK	1x 2x 3x	
Feelers	Y N	M F DK	1x 2x 3x	
Peak	Y N	M F DK	1x 2x 3x	
Loaf	Y N	M F DK	1x 2x 3x	
Iron	Y N	M F DK	1x 2x 3x	
Crawl	Y N	M F DK	1x 2x 3x	
River	Y N	M F DK	1x 2x 3x	
Dough	Y N	M F DK	1x 2x 3x	
Tall	Y N	M F DK	1x 2x 3x	
Linen	Y N	M F DK	1x 2x 3x	
Tooth	Y N	M F DK	1x 2x 3x	
Cloth	Y N	M F DK	1x 2x 3x	
Handle	Y N	M F DK	1x 2x 3x	
Melody	Y N	M F DK	1x 2x 3x	
Knitting	Y N	M F DK	1x 2x 3x	
Small	Y N	M F DK	1x 2x 3x	
Shutters	Y N	M F DK	1x 2x 3x	
Sing	Y N	M F DK	1x 2x 3x	
Africa	Y N	M F DK	1x 2x 3x	
Shade	Y N	M F DK	1x 2x 3x	
Cup	Y N	M F DK	1x 2x 3x	
Vest	Y N	M F DK	1x 2x 3x	
Milk	Y N	M F DK	1x 2x 3x	

Video Filename:_______________ **Participant ID:______**

Chocolate	Y N	M F DK	1x 2x 3x	
Cuffs	Y N	M F DK	1x 2x 3x	
Feline	Y N	M F DK	1x 2x 3x	
Sip	Y N	M F DK	1x 2x 3x	
Window	Y N	M F DK	1x 2x 3x	
Measuring	Y N	M F DK	1x 2x 3x	
Sandwich	Y N	M F DK	1x 2x 3x	
Spider	Y N	M F DK	1x 2x 3x	
Goat	Y N	M F DK	1x 2x 3x	
Rhythm	Y N	M F DK	1x 2x 3x	
Goblet	Y N	M F DK	1x 2x 3x	
Ski	Y N	M F DK	1x 2x 3x	
Hunt	Y N	M F DK	1x 2x 3x	
Screen	Y N	M F DK	1x 2x 3x	
Bridge	Y N	M F DK	1x 2x 3x	
Mountain	Y N	M F DK	1x 2x 3x	
Art	Y N	M F DK	1x 2x 3x	
Tamer	Y N	M F DK	1x 2x 3x	
Bread	Y N	M F DK	1x 2x 3x	
Prick	Y N	M F DK	1x 2x 3x	
Elevate	Y N	M F DK	1x 2x 3x	
Shirt	Y N	M F DK	1x 2x 3x	
Needle	Y N	M F DK	1x 2x 3x	
Bitter	Y N	M F DK	1x 2x 3x	
Mississippi	Y N	M F DK	1x 2x 3x	
Tart	Y N	M F DK	1x 2x 3x	

APPENDIX E

CALCULATIONS

Proportion Calculations

Proportions for recognition judgments were computed as the number of "yes"/old recognition judgments divided by the total number of test items.

Prop. Recognition = "Old" Judgments / Total Possible

Proportions for source judgments were computed as the number of correct (for targets) and gist-consistent (for related distracters and critical lures) source judgments divided by the total number of test items.

Prop. Source = Correct & Gist-Consistent Source Judgments / Total Possible

Proportions for conditional source judgments were computed as the proportion of recognition judgments divided by the proportion of correct and gist-consistent source judgments.

Cond. Prop. Source = Prop. Recognition / Prop. Source

A' Calculations

Hits (H) are defined as "yes"/old recognition judgments to presented targets, and False Alarms (FA) are defined as "yes"/old recognition judgments to unpresented items.

When $H \geq FA$ (i.e., performance higher than chance):

$$A' = 0.5 + [(H - FA)(1 + H - FA)] / [4H(1 - FA)]$$

When $H \leq FA$ (i.e., performance lower than chance):

$$A' = 0.5 - [(FA - H)(1 + FA - H)] / [4FA(1 - H)]$$

When $H = FA$ (i.e., performance equal to chance):

$$A' = 0.5$$

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BIOGRAPHICAL INFORMATION

Haylie Miller earned her Bachelor of Arts degree in 2006 at Vanderbilt University in Nashville, TN, with a double-major in psychology and music. She went on to earn her Master of Science degree in 2009 at the University of Texas at Arlington in Arlington, TX. Under the supervision of Dr. Lauri Jensen-Campbell, Haylie completed a thesis project investigating the influence of chronic ostracism on individuals' attributions in subsequent social situations and corresponding brain activity *("Does Chronic Victimization Lead to a Rejection Attribution Bias?",* Gomez, 2009). Haylie then transitioned into the Reading and Memory Lab at UT Arlington, under the supervision of Dr. Timothy Odegard, with the aim of obtaining further experience with neuroimaging and developmental research in younger populations. Having successfully defended this dissertation, Haylie will earn the degree of Doctor of Philosophy with her focus in Experimental Psychology.

Haylie intends to pursue a career in research, specifically with a focus on neurobiological underpinnings of social-cognitive development. Although her research to date has been in typically-developing populations, she developed an interest in intervention research and the development of cognitive mechanisms supporting social behavior during her time in Dr. Odegard's lab. To that end, Haylie will continue her training as a Postdoctoral Researcher at the University of Texas Southwestern Medical Center. Working under the mentorship of Dr. John Sweeney in the newly-established Autism Center, Haylie will study attention and other cognitive processes in individuals with Autism Spectrum Disorders (ASD). Haylie aims to modify several existing paradigms for use in individuals with ASD, with the goal of understanding cognition in this unique population as compared to the typical developmental trajectory. Her long-term career goal is to systematically test social-cognitive interventions for ASD, in order to determine the efficacy of existing approaches and identify biomarkers of treatment response.