"I remember when you taught me that!"
Developmental and gender differences in children's episodic memories of learning events during the early school years

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“I REMEMBER WHEN YOU TAUGHT ME THAT!” DEVELOPMENTAL AND
GENDER DIFFERENCES IN CHILDREN’S EPISODIC MEMORIES OF LEARNING
EVENTS DURING THE EARLY SCHOOL YEARS

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DISSERTATION

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ABSTRACT

“I REMEMBER WHEN YOU TAUGHT ME THAT!” DEVELOPMENTAL AND GENDER DIFFERENCES IN CHILDREN’S EPISODIC MEMORIES OF LEARNING EVENTS DURING THE EARLY SCHOOL YEARS

by

Rhyannon H. Bemis

University of New Hampshire, May, 2011

The study presented in this dissertation was designed to investigate young children’s ability to accurately recall episodic (i.e., specific-one-moment-in-time) memories of learning events and whether this ability was related to another metacognitive skill, source monitoring. Further, the study investigated possible gender differences in the ability to recall learning events. Sixty children, ages four to six years, participated in two staged learning events about two novel topics, the Aleutian Islands and the visual system. Following a delay, children were interviewed and asked both general factual knowledge questions and questions about the target material learned in the staged events. Children were asked to provide an answer to each question and to indicate 1) if they knew the answer or had guessed and 2) if they remembered the moment they learned the answer or did not remember. Two weeks after this interview, 58 of the children completed a replication of the source monitoring task developed by Taylor et al. (1994).

Results indicated that children as young as four years old could provide memories of learning events and that there were few age differences between the accuracy of four-and five-year-olds’ memories. Contrary to predictions, gender differences in episodic recall generally favored boys, with boys providing more memories that were coded as
consistent with specific and being more likely to accurately report learning the target material in the staged learning events. Finally, the ability to recall episodic memories of learning events was not entirely related to source monitoring ability, as measured by the Taylor et al. (1994) task, indicating a more nuanced view of memory development. Implications for educators and for theories of memory development are discussed.
CHAPTER I

INTRODUCTION

The average child in the United States spends approximately 181 days in school each year (Digest of Education Statistics, 2003). Although public school attendance does not begin for most American children until the age of five years, many children begin their preschool education earlier. Thus, from the age of around three or four years, children are spending a significant portion of their time in the classroom. In spite of the large amount of time that children spend in school, little is known about what they remember about specific classroom events that occur during their early school years (Martin, 1993). This gap in the research is significant because schooling has been shown to be an influential socialization agent in children’s lives, impacting both their cognitive and social development (Rogoff, Correa-Chavez, & Cotuc. 2005). Further, schooling serves to socialize children into the workforce, providing them with the factual and procedural knowledge that they will need to be successful adults in their society (Rogoff et al., 2005).

Since the focus of schooling in western societies is to provide students with factual and procedural knowledge, much of the research on memory in the classroom has focused on memory for factual information (i.e., semantic memories) (Tulving, 1983). Indeed, it is semantic memories of relevant factual information that the school system aims to provide to students (Rogoff et al., 2005). However, there is a growing body of
evidence suggesting that memories of specific classroom events (i.e., episodic memories) (Tulving, 1983) may also play a significant role in the acquisition of factual knowledge and may aid the formation of a general knowledge base of facts (Conway, Gardinder, Perfect, Anderson, & Cohen, 1997; Nuthall & Alton-Lee, 1995). Further, preliminary data indicate that, consistent with episodic memory in other domains (Buckner & Fivush, 1998; Pillemer, Wink, DiDonato, & Sanborn, 2003), females may recall classroom episodes more often than do males (Leichtman, Pillemer, Bemis, Bauer, & Malahy, 2010; Leichtman, Pillemer, Comley, Vigiliatura, & Skowronek, 2007). Thus, recalling memories of classroom events may help students to manage and effectively encode the large quantity of information that they are presented within the classroom, and this may be particularly true for females.

Extant literature on the benefits of recalling episodic memories in the classroom and potential gender differences in doing so has focused almost exclusively on adolescents (Nuthall & Alton-Lee, 1995) and college-aged students (Conway et al., 1997, Herbert & Burt, 2004). Little research has addressed how young school-aged children use and recall classroom learning episodes. The lack of research on young children’s episodic memories in the classroom may be due to the fact that children at this age are still developing the memory and metacognitive skills that they would need to accurately report a salient learning event. However, research has indicated that under certain circumstances even preschool-aged children can provide accurate memories of past events (Hamond & Fivush, 1991), identify the source of their knowledge (Thierry, Spence, & Memon, 2001), and recall memories of subjective experiences of learning (Bemis, Leichtman, & Pillemer, 2011). Thus, it is likely that when developmentally
sensitive methods are used to tap their knowledge, young school-aged children can provide accurate memories of learning episodes. The purpose of the present study was to investigate developmental differences in young children’s ability to provide accurate memories of learning events as they progress through their early school years. Further, the study investigated individual differences in young children’s recall of episodic memories of learning events, namely those differences associated with the child’s gender. The early school years are an ideal time to investigate episodic memory in the classroom because during these years children develop skills in both episodic memory and metacognition that would enable them recall of episodic memories of learning.

**Episodic Memory Development**

Children begin to spontaneously reference the past around the age of two years, but most of their early references involve scripted events, such as bedtime and dinner routines (Bauer, 2007; Hudson, 1990). Such early memories are congruent with semantic memories because they reflect the child’s general schema for routine life events, but do not reference specific events (e.g., bedtime last Tuesday) or what makes one event different from another similar event (e.g., bedtime last Tuesday vs. bedtime last Wednesday). However, by the age of three children begin to recall specific past episodes and by four years of age they can do so relatively independently (Fivush, Haden, & Reese, 2006; Hamond & Fivush, 1991; Nelson & Fivush, 2004). Hamond & Fivush (1991) demonstrated that children who had taken a trip to Disneyworld when they were 37 months old could recall significant details of that trip up to 18 months after it occurred. However, compared to children who were 49 months old at the time of the trip,
those who were 37 months old provided fewer specific memory details and were more reliant on specific prompts (Hamond & Fivush, 1991). Further, across age groups, having discussed the trip with parents more often increased the likelihood that children would provide detailed memory narratives. Thus, the opportunity to discuss the event influenced young children’s ability to report the event later.

The onset of the ability to recall a specific episode has been connected to development in other domains, most notably the onset of complex speech (Fivush & Nelson, 2006; Simcock & Hayne, 2002, 2003), increasing self-awareness (Howe, Courage, & Edison, 2003), and hippocampal development (Bauer, 2007; Liston & Kagan, 2002). However, as Hamond and Fivush (1991) noted in their classic study on children’s episodic memory development, the degree to which parents talk to their children about the past plays a pivotal role in the onset and continued development of episodic recall. The role that parent-child memory conversations play in episodic memory development is the central focus of the sociocultural theory of memory development (Fivush et al., 2006; Nelson & Fivush, 2004). According to this theoretical perspective, episodic memory develops as a result of the scaffolding that parents provide to children when engaging them in conversations about past events. Through these conversations, parents essentially instruct their children about how to structure a memory narrative and how to focus on relevant details of the event. Further, individual differences in parental conversational styles have been related to differences in children’s long-term episodic recall of a specific event as well as to their own general recall style (Fivush et al., 2006).

In a seminal study on parent-child memory conversations, Fivush & Fromhoff (1988) recorded ten mothers as they discussed a past event of their choice with their two-
and-a-half-year-old children. From these naturalistic conversations, Fivush & Fromhoff (1988) identified two major conversational styles that parents used when talking with their children, elaborative (currently labeled high-elaborative) and repetitive (currently labeled low-elaborative). Parents who were characterized as having an elaborative style not only spoke more to their children throughout the conversation, but also provided more detail and persisted in engaging their child in the conversation even if the child was reluctant to provide answers to the parent’s request for information about the past event. In contrast, parents characterized as having a repetitive conversation style spoke less to their children, provided fewer details, and would quickly change topics if the child was reluctant to give information about the selected past event (Fivush & Fromhoff, 1988). These stylistic differences in parent-child conversations had an effect on children’s ability to recall information themselves, such that children who engaged in elaborative conversations offered more novel information than did children of repetitive parents.

The children in Fivush & Fromhoff’s (1988) sample were still in the early stages of episodic memory development (average age 32 months) and may not have been able to independently recall a past event, and thus were more dependent on their parent to provide them with the necessary prompts to recall. It is possible that as children age and become more capable of recalling an event independently, parents respond by engaging in less elaborative conversations with their children (Reese, Haden, & Fivush, 1993). Alternatively, it is possible that as children become more capable conversation partners, parents engage in more elaborations because their children are providing them with more information on which to elaborate. In a longitudinal study of parent-child memory conversations with children aged 40 to 70 months, Reese et al. (1993) found that parents
did become more elaborative over time. Nonetheless, over the course of their child’s development parents still adhered to their original categorizations as high or low elaborative (Reese et al., 1993). Thus, while parents’ conversation styles tend to be consistent over time, as children become better able to independently recall events, all parents respond by providing more elaborations, creating richer conversations about the past.

The rich, detailed memory conversations that children have with their parents promote episodic memory development (Fivish et al., 2006; Fivush & Fromhoff, 1988; Reese et al. 1993; McCabe & Peterson, 1991). Children who engage in memory conversations, particularly with high elaborative parents, have more detailed and accurate memories of past events (Reese et al., 1993). Further, these gains in episodic recall can be seen up to a year after the event has occurred (McCabe & Peterson, 1991). While it is possible that merely rehearsing a past event by discussing it with a parent may help a child to more accurately recall that event, rehearsal alone does not account for the positive effect of parent-child memory conversations on children’s episodic memory reports (Hudson, 1990). When children are interviewed by a naïve interviewer after having discussed a past event with a parent, children of high elaborative parents are more likely to provide novel information about the past event (Fivush et al., 2006). Therefore, the children are not merely repeating details they talked about with their parents, but are instead searching their own memories and providing personally experienced details of the event. Thus, by engaging their children in conversations about the past parents model the structure and content of episodic recall and encourage children to reflect on their own
memories to create their own personal narratives of the past (Fivush et al., 2006; Nelson & Fivush, 2004).

The fact that parent-child memory conversations provide children with more than just rehearsal can also be seen in research indicating that parents do not have to have been present during the event they are discussing with their child for the child to benefit from a high elaborative conversational style (Leichtman, Pillemer, Wang, Koreishi, & Han, 2000b). Leichtman et al. (2000b) recorded memory conversations between parents and children about a salient event that had occurred that day in the children’s classroom, the visit of a favorite teacher and her new baby. Although parents were informed about the visit and were asked to talk with their children about it, none of the parents were present for the original event and thus did not know the details of the visit. When children were interviewed three weeks later, those children whose parents had been characterized as high elaborative were more likely to recall accurate details when asked direct questions about the event. Further, the number of accurate details that children provided in the interview three weeks later was positively related to the number of details that they provided when discussing the event with their parent; children who had the opportunity to discuss several event details with a high-elaborative parent were more likely to report accurate details later during the interview (Leichtman et al., 2000b). These findings support the claim that parent-child memory conversations provide more than mere rehearsal of jointly experienced events.

Although the children in Leichtman et al.’s (2000b) study were all in their preschool years (mean age = 5.2 years), the findings of the study are also relevant to older, elementary-aged children. As children progress through their elementary years,
they experience more events that occur when they are away from their parents, particularly events that occur during the day while they are at school. Therefore, when recalling events with their parents, older children are more likely to be discussing an event that their parents have not experienced directly. The fact that elaborative reminiscing about such non-shared events still leads to benefits in terms of later recall anticipates the benefits to older children of engaging in reminiscing well into their school years.

However, parent-child talk about school events may differ from talk about other events in several important aspects. One of these aspects is the goal the parent has for the conversation, which may affect the way the parent questions their child. Research has indicated that if a parents’ goal is to elicit a piece of information, such as a fact learned that day, they will provide more stringent control over the structure and pace of the conversation and are less likely to seek or allow their child to make their own evaluations of the day’s events (Cleveland, Reese, & Grolnick, 2007). Cleveland et al. (2007) demonstrated this effect of goal orientation by asking parents to talk about a staged event (visiting a pretend zoo and doing some activities there) with their preschool-aged children. Parents were given different information about the interviews their children would have with the researcher after the parent-child conversation. Specifically, some parents were told that the researchers would be interviewing the child about his or her perspective on the event while other parents were told that researchers would be interviewing their child to see what he or she could correctly recall about the details of the event, like a memory test. In response to these instructions, parents altered some aspects of their conversational style when compared to the style they used in a baseline
memory conversation collected before the staged event. Parents in the perspective
oriented conditions were more likely to be categorized as having a high autonomous
style, allowing their children to express their own point of view and to control the
structure of the interview. In contrast, parents in the factually-oriented condition were
more likely to be categorized as having a low autonomous style, not allowing their
children to express their subjective experiences and enforcing a set conversational
structure (Cleveland et al., 2007). Interestingly, level of elaborativeness was not affected
by the goal orientation of the parent, such that there was no increase or decrease in a
parent’s number of elaborations from the baseline conversation to the staged event
conversation (Cleveland et al., 2007). However, this may be due to the fact that
Cleveland et al. (2007) attempted to separate the variables of elaborativeness and level of
autonomy in memory conversations (two variables that are often combined) and therefore
it is possible that some aspects of conversations that were identified as high autonomous
could also be considered as high elaborative based on the definitions used in past research
(e.g., Fivush & Fromhoff, 1988).

A second aspect in which conversations about school events may differ from
other conversations is in their timing relative to the events under discussion. Many school
events may lead to prospective rather than reflective memory conversations in that
parents may speak to their children about events such as a field trip or a big test before
they occur. This is significant because there are benefits to these prospective
conversations (Hudson, 2002; Sutherland, Pipe, Schick, Murray, & Gobbo, 2003), but
they do not provide the same boost to later recollection as post-event memory
conversations (McGuigan & Salmon, 2004). In a study of children ages three to six
years, McGuigan and Salmon (2004) found that children who experienced elaborative conversations two to three days after experiencing a staged event (a trip to a pretend zoo identical to the procedure used by Cleveland et al., 2007) provided more accurate information during a subsequent memory interview than children who experienced the same elaborative conversation either two to three days before the event or during the event itself. This effect was especially profound for the oldest children in the sample (age five to six years). Thus, it appears that in order for an event to be particularly well recalled later it needs to be reflected on after it has already occurred.

The nature of some school events lowers the likelihood that they will be discussed in the kind of elaborative and retrospective conversations that provide the largest benefits to memory. Whereas this fact may be a large detriment to the recall of such events in children under the age of four, children over the age of four have internalized the rules of structure and content that their parents have modeled for them via past memory conversations and are able to recall past events independently (Bauer, 2007; Pillemer, 1998). By the onset of the school years, children’s episodic memory has developed to a point where they can independently recall and reflect on a variety of events, including those that occurred while they were away from their parents at school. Therefore, while school-aged children can benefit from elaborative memory conversations about classroom events, they may benefit less than younger children.

**Gender and Episodic Memory**

While all children begin to independently recall a past event by their early school years, there are individual differences in the episodic memories that they report. One
source of variation in episodic memory is the gender of the child. Gender differences in episodic memory are rooted in the level of elaborativeness that parents use in conversations with their children. Whereas all children benefit from increased parental elaborations, parents of both genders are more likely to be elaborative with their daughters than with their sons (Reese & Fivush, 1993).

By engaging their female children in more elaborative conversations about the past, parents are implicitly modeling a more detailed, episodic focused recall style to females, making it more likely that females will engage in more detailed episodic recall as they mature (Fivush et al., 2006; Reese & Fivush, 1993). Indeed early differences in the level of elaborativeness boys and girls experience in conversations with their parents appear to translate into modest but consistent gender differences in episodic memory performance later on, favoring girls and women. These differences appear on many distinct measures of episodic memory, including those used in laboratory tasks and naturalistic interviews.

Lewin, Wolger, and Herlitz (2001) measured men and women’s ability on a variety of episodic memory tasks including those that relied on verbal encoding of stimuli, such as recalling a previously seen face or object, and those that did not, such as recalling components of an abstract 3D image. Women outperformed men on tasks where the stimuli could be encoded verbally, but men outperformed women on tasks where verbally encoding the stimuli was not possible. However, women’s performance on the tasks, both verbal and non-verbal, was not related to their verbal ability. Thus, it appears that women’s performance is not driven by a higher verbal ability than men, but rather by a tendency to make use of verbal encoding to complete memory tasks (Lewin et al.,
2001). Other research using verbal and non-verbal measures of episodic memory have replicated this finding and have found no connection between performance and verbal ability or verbal intelligence (Herlitz & Yonker, 2002).

In addition to laboratory tasks of episodic memory, women also outperform men on naturalistic interviews tapping episodic memory. Pillemer et al. (2003) reviewed transcripts of older men and women being interviewed on a variety of topics including family, work, marriage, and health. While men and women were not specifically asked to provide episodic memories to support their answers, women tended to do so spontaneously more often than did men, both on the female-stereotypical topics of children/grandchildren and marriage and the non-stereotypical topics of political activity, ageing, and death (Pillemer et al., 2003). Further, when men and women completed the Reminiscence Functions Scale (Webster, 1993 as cited in Pillemer et al., 2003) following the interview, women were more likely to report using memories of past events to guide their present behavior (e.g., recalling a past problem to derive a solution to a present dilemma) (Pillemer et al., 2003).

This tendency to recall and report episodic memories as part of one’s natural reminiscing about the past is also present in young adolescent females. Leichtman, Pillemer, Liu, and Embree (2008) measured the tendency for female adolescents to report episodic memories in their natural conversations by asking young adolescents, ages 12.4 to 14.6 years, to wear a small digital recorder for a two-and-a-half-hour period while they completed routine social activities. During their interactions with peers and parents, adolescent females were more likely to recall a specific episode than were males
Further, a greater percentage of females’ conversations during the two-and-a-half-hour period was devoted to memory talk.

As would be predicted from the fact that through their memory conversations parents model a more detail-rich episodic style in girls, the tendency to outperform males on tasks of episodic memory is present very early in development. Buckner & Fivush (1998) interviewed 7.5-year-old children about memories related to self-characteristics, such as achievement focus or need for social belonging. Although both male and female children were able to provide memories of instances illustrating each self-characteristic, there were qualitative differences in the memories that they reported. Females were more likely to report the other people involved in the memory and provided more details (measured by the number of adjectives and adverbs) than did males (Buckner & Fivush, 1998).

Thus, by the early school years the gender differences in episodic memory seen in adult and adolescent samples are also apparent in children. This makes it likely that the ability to accurately recall classroom learning episodes may vary not only by age but also by gender.

**Development of Metacognitive Skills**

Along with the development of episodic memory skills, children in their early school years also show significant development in their metacognitive skills. One of the metacognitive skills that may influence the degree to which children recall and report learning episodes is their ability to reason where they learned a piece of information, a skill called source monitoring (Gopnik & Graf, 1988; Foley & Johnson, 1985; Johnson,
Hashtroudi, & Lindsay, 1993). Source monitoring is not just the memory of a particular source. Rather it is a metacognitive skill in which children process the details of an event, including its time, location, and relevant sensory information such as sight and sounds, and use their recollection of these details to discern the source of a piece of information associated with that event (Johnson et al., 1993).

Basic source monitoring skills appear at the age of four years with children being able to correctly differentiate between two external sources of information (Gopnik & Graf, 1988). This basic source monitoring ability is tested using a traditional drawer task (Gopnik & Graf, 1988; Leichtman, Morse, Dixon, and Spiegel, 2000a) where children learn the location of a hidden object in a set of 3 x 2 drawers via three sources (seeing it, guessing it with a clue, or being told by the experimenter what it is) and then are asked minutes later the location of each hidden object and how they learned about it. Gopnik and Graf (1988) found that whereas three-year-olds recall only about half of the sources of information ($M=3.96$), four- and five-year-olds perform near ceiling ($M=5.12$ and $M=5.66$, respectively). By the age of five years children become increasingly aware of the connection between information and its source, such that five-year-olds, but not younger children, benefit from cues that remind them of the source of information (Leichtman, et al., 2000a).

In spite of the gains in source monitoring that children make between the ages of four and five years, they still have difficulty on some source monitoring tasks, particularly those where they need to label not just how they learned a piece of information, but when they learned it (Taylor, Esbensen, & Bennett, 1994). In a series of four experiments on source monitoring during learning events, Taylor et al. (1994)
demonstrated that four- to five-year-olds were likely to report that they had always known a novel fact, even if they had just learned the fact moments earlier. However, children’s performance differed depending on the characteristics of the learning event. For example, in experiment one, children were taught a novel fact about animals (e.g. how tigers’ stripes serve as camouflage) while listening to a story. Moments after the story when children were asked when they had learned the fact, the majority of them reported that they had learned the information “a long time ago” (Taylor et al., 1994, p. 1584). This finding was replicated in a second experiment where children were taught novel science facts via staged demonstrations. Following the demonstrations, children were once again asked when they had learned the information and children in both age groups were more likely to report that they had learned the fact in the distant past, even though they had just learned it. However, Taylor et al. (1994) believed that children might have reported knowing the information for a long time because the facts to be learned were embedded in a story or demonstration and it was not made explicit to the children that they were learning something new. Thus, in two follow-up experiments children were taught specific facts (i.e., color labels) that were not part of a story or demonstration (Experiment 3) and were explicitly told that they were learning something new (Experiment 4). In both experiments, children’s performance improved, but even in experiment four when the four-year-olds were taught discrete facts and told that they were learning something new, they still had difficulty identifying when they had learned the novel fact. Taken together, the findings of Taylor et al. (1994) suggest that preschool-aged children have difficulty identifying when they learned a piece of information.
Esbensen, Taylor, and Stoes (1997) replicated and extended the findings of Taylor et al. (1994) by teaching a group of four- and five-year-olds novel facts and novel behaviors, such as learning how to make up a paper cup or a fabricated action such as to “zwib.” They found that when the new information was a novel behavior rather than a novel fact, the children were more likely to correctly identify that they had just learned this new information (Esbensen et al., 1997). Thus, the type of information learned influences children’s ability to recollect when they learned it.

In addition to the type of information, Tang, Bartsch and Nunez (2007) hypothesized that the type of question used to assess children’s knowledge of a learning event may also influence their ability to correctly identify that event. Specifically, they proposed that children may have more difficulty answering temporal location questions where they are asked if they knew the information yesterday, than answering temporal distance questions where they are asked if they knew the information a long time ago. To test this hypothesis, Tang et al. (2007) taught children ages four to six years a novel fact and action during two learning sessions that occurred over a two week period. Immediately following the second learning session children were asked both temporal location questions (did you know that wugs sleep in the sand yesterday?) and temporal distance questions (which have you known longer, that wugs sleep in the sand or that grambees eat grass?). Although children’s performance improved with age, across age groups children were more likely to respond correctly to the temporal distance questions. Further, in spite of past research demonstrating that children were more accurate when they were taught a specific behavior, like learning how to make an origami cup,
(Esbensen et al., 1997; Tang et al., 2007) found that children’s performance was congruent across information types and only differed based on type of question asked.

Children’s difficulty understanding when they learned a piece of information (Esbensen et al., 1997; Tang et al., 2007; Taylor et al., 1994;) is related to the fact that children’s notions of what it means to learn something are still developing from the ages of three to five years. Bartsch, Horvath, and Estes (2003) analyzed naturalistic language samples of five children from the CHILDES database. They found that rarely did children in the age range from 2.5 to 7 years spontaneously mention learning events, and when they did they seldom mentioned how they learned the information (Bartsch et al., 2003). Rather, children were focused on what they had learned and in some cases on who had taught it to them, but seldom mentioned any detailed information about the learning event. This may indicate that children at this point in development do not fully recognize themselves as learners and thus learning events are less salient to them. Sobel, Li, & Corriveau (2007, experiment 1) extended Bartsch et al.’s (2003) study by analyzing the same sample of children’s language taken from the CHILDES database and focusing on only the child’s utterances that occurred without prompting from an adult. By focusing on only the child’s utterances, Sobel et al. (2007) were able to assess developmental differences in the tendency to talk about learning in children’s speech. They found significant developmental differences in children’s spontaneous talk about learning between the ages of three and five years (Sobel et al., 2007). When three-year-olds referred to learning events they were more likely to focus on the content of what was learned, however, by the age of five there was more focus on how learning had occurred.
Further, in a follow-up task where children were asked to judge whether a story character would learn a new song given the constraints of attention level, desire to learn the song, and intent to learn the song, Sobel et al. (2007) found that three-year-olds put more emphasis on the child’s desire to learn the song than on the constraints of attention and intention. In contrast, five-year-olds recognized that even if the child wanted to learn the song, he or she would likely not learn if they were not paying attention or did not intend to learn the song (Sobel et al., 2007). The finding that five-year-olds were more focused on the attention and intention of the learner is congruent with research by Ziv, Solomon, and Frye (2008) showing that when told a story about instances of intended teaching or unintended imitation, five-year-olds differentiated between the two and recognized that learning would be best in the intentional teaching episode. In contrast, three-year-olds did not make this distinction (Ziv et al., 2008). This illustrates that consistent with children’s natural talk about learning, five-year-olds have a greater understanding of the learning process and are more aware of the characteristics of both the learner and the learning event.

Throughout the preschool and early school years children develop several metacognitive skills, including matured source monitoring abilities and an increased awareness of the process of learning. These skills enable children to be more active learners in their environment and to recognize salient teaching episodes that they encounter in the classroom. The combination of developed skills in episodic memory and a heightened awareness of one’s own learning make it likely that as children progress through their elementary years, episodic memories of classroom learning become both
more salient and useful to them in recalling and processing the factual information they encounter as part of their education.

**Episodic Memory and the Classroom**

Since the focus of western education is to provide children with the skills and knowledge that they will need to enter the workforce (Rogoff et al., 2005), much of the research on memory in the classroom has focused on children’s memory of factual knowledge, which is congruent with semantic memory (Tulving, 1983). Indeed forming a general knowledge base is an important component of a formal education and semantic memories play a role in the formation of such a knowledge base (Tulving, 1983). However, according to Tulving (1983) semantic memories are distinguished from episodic memories because they no longer have the contextual details associated with the learning event. Thus, semantic memories begin as episodic memories, but over time lose their contextual, episodic, details and retain only the factual information. This transition over time from remembering the moment of a learning event to just remembering the facts presented in such an event is known as the “remember to know shift” (Conway, et al., 1997, p. 408). In spite of the fact that episodic memories of learning events lay the foundation for later semantic memories of learned facts, the use of episodic memory in the classroom has not been well researched (Martin, 1993). However, those research studies that have investigated episodic memory in the classroom have demonstrated benefits to students in recalling these memories.

Conway et al. (1997) investigated the role of episodic memory in the development of a general knowledge base of factual information among students enrolled in both an
introductory psychology course and a research methods in psychology course. While taking their mid-semester and cumulative final exams for these courses, students were asked to indicate not only the answer to the question, but also what strategy they had used to arrive at that answer. Specifically, students were asked to indicate if they had 1) remembered the moment they learned the information, 2) just known the answer 3) sensed that one of the answer choices was familiar to them, or 4) guessed the answer. On the midterm exam for the introductory psychology course, performance was positively correlated with remembering the learning episode in that students were more likely to have answered the question correctly if they also indicated that they remembered the moment they learned the answer. In contrast, on practice retests of the original tests for the introductory psychology course given approximately 25 weeks later, students were more likely to report just knowing the answer and performance was not correlated with remembering the learning event (Conway et al., 1997). Conway et al. (1997) proposed that the tendency to recall more learning events on the mid-term exam than on the final exam illustrated the remember to know shift because during the period of time that elapsed between the mid-term exam and the final exam, students began to recall the factual information without recalling the contextual information that surrounded the fact.

The findings in the research methods course were different from the introductory psychology course in that across both research methods exams students who reported just knowing the answer were more often successful in answering the question correctly than students who reported remembering the moment they had learned the answer. This was not due to a larger amount of time between learning the information and being tested on it but rather due to the type of information learned (Conway et al., 1997). Unlike the
introductory psychology course, the research methods course contained more information about procedures and methods that was likely to be repeated across several lectures. Thus, this information may have more quickly become part of a general knowledge base of semantic memories. The remember-to-know shift had already taken place by the time of the mid-term exam (Conway et al., 1997).

The findings of Conway et al. (1997) indicate a benefit to students in recalling learning episodes, particularly in a course where there is a large amount of factual, rather than procedural information. However, using a sample of 39 introductory statistics students Herbert and Burt (2004) found that even in courses where procedural knowledge was emphasized, students could still benefit from material that was presented in an episodic-rich manner. In their study, Herbert and Burt (2004) presented students with information about two specific statistical tests (independent groups and repeated-measures t-tests) that was either deemed to be episode-rich, containing narrative examples, or episode-poor, containing just factual information without narrative-rich examples. Consistent with the findings from Conway et al.’s (1997) introductory psychology sample, students in the episodic-rich condition reported more episodic memories of learning when tested both two days and five weeks later. Further, students in the episodic rich condition outperformed students in the episodic poor condition when tested five weeks later on the material (Herbert & Burt, 2004). Thus, although the content of the statistics material emphasized learning procedures of conducting a statistical analysis, students still benefited from episodic rich material. Further, although students in the episodic-rich condition exhibited a remember-to-know shift in the five-
week delay interval, they were still able to recall some details of the learning episodes when specifically prompted.

The positive effects of episodic memory in the classroom have also been demonstrated in middle-school aged students. Nuthall and Alton-Lee (1995) observed late elementary and middle school aged children (ages 9.6 year to 12.5 years) in their classrooms and then measured their performance on achievement test questions both immediately following a unit and one year later. In addition to comparing children’s performance with observations of the children during the learning events Nuthall & Alton-Lee (1995) also interviewed children at both time intervals about how they had learned the answer to particular achievement test questions. During these interviews following the completion of the achievement test questions, children would spontaneously report episodic memories of classroom learning that occurred as much as a year earlier. For example, one child recalled an event that had occurred the previous year when the class was learning about mercury. She said “Last year Mr. B said does anyone know what mercury is? And Tony put up his hand and said...oh no!....Mr. B said what’s in a thermometer? And Tony put up his hand and said it was mercury. And it was right. And since then I have remembered” (Nuthall & Alton-Lee, 1995, p. 195). This memory has all of the factual information about mercury that could become a semantic memory, but it is an episodic memory of the learning event because the child is describing the one-moment-in-time event where she learned this information. Nuthall and Alton-Lee (1995) found that children who had at least three meaningful learning episodes about a piece of information were more likely to recall both the learning event and the factual knowledge
associated with that event later. Thus, the details of the event itself appeared to cue the recall of factual knowledge (Nuthall & Alton-Lee, 1995).

In addition to cueing factual information, episodic memories also help children to infer general lessons or concepts that they were never explicitly taught (Nuthall, 1999, 2000). In a study investigating changes that occur in children’s recollections of learning events over the period of year, Nuthall (1999, 2000) found that over time children come to report fewer objective details of the event and offer more inferences and global summaries. By making inferences students are not only able to arrive at the correct answer but can rule out incorrect answers. For example, one student was able to correctly identify the term Chivalry a year after she had learned because she vaguely remembered it being discussed in the medieval unit and that it pertained to behavior. Using this vague episodic memory, the student was able to eliminate answers that did not pertain to behavior and arrive at the correct response (Nuthall, 2000). However, inferences can also lead to incorrect conclusions, such as in an instance where a student incorrectly assumed that black death referred to people who had died in a town-wide fire because she recalled seeing pictures of charred black buildings in her social studies unit at the time when she learned the term “black death” (Nuthall, 2000). Students’ tendencies to form summaries of the event can also lead to incorrect judgments. For example, one student recalled doing a series of worksheets, all of which were about the Magna Carta, but she could not associate the factual information with these worksheets and thus was unable to report knowing anything about the Magna Carta when interviewed a year later (Nuthall, 2000). Therefore, in order for episodic memories to lead to the correct recall of factual knowledge they must be clearly associated with the factual knowledge to be attained and
the student must be able to detect this association both at the time of the event and in their later recollections of it (Nuthall, 2000).

The observational studies conducted by Nuthall and colleagues (Nuthall & Alton-Lee, 1995; Nuthall, 1999, 2000) indicate that children benefit from vivid learning episodes particularly if they experience three or more distinct episodes for each learned fact and if the connection between the fact and the event is clear. However, all of these studies were based on classroom observations and detailed interviews of a select group of students in their natural classrooms. While this approach has obvious ecological advantages, it is possible that some of the findings that Nuthall and Alton-Lee (1995) and Nuthall (1999, 2000) observed could be explained by the differences in teaching style that the children in their studies experienced as result of having different teachers who presented the material. Some teachers may offer more learning episodes, implicitly encouraging a more episodic recall style. Further, as Conway et al. (1997) suggest, some material may more naturally lend itself to learning episodes, so teachers who teach this type of material may be more episodic in their teaching and have students who report more specific learning episodes.

To control for teaching style, Prupas (1993) conducted a controlled experimental study of episodic memory in the middle school classroom. As part of this experimental study, Prupas (1993) presented sixth graders with four lessons on topics generally covered in middle school geometry (including flipping images and sliding images). Each lesson followed a scripted format and included both definitions presented in a lecture format and interactive learning activities. Immediately following each lesson students completed a quiz on the material and filled out an episodic memory questionnaire where
they were asked to “replay” the lesson in their mind and then to write about any event they could recall that occurred during the lesson even if it did not totally relate to the material being taught. Contrary to the findings of all of the previously mentioned studies of episodic memory in the classroom (e.g. Conway et al., 1997; Herbert & Burt, 2004; Nuthall & Alton-Lee, 1995; Nuthall, 1999, 2000), Prupas (1993) did not find a relationship between students’ recall of learning events and their ability to recall the material. Thus, there was no relationship between the number of episodes that students recalled and their ability to correctly answer quiz questions based on those episodes. However, this may be due to the fact that Prupas (1993) asked the children to recall the episodes immediately after the learning event. Therefore, most children remembered aspects of the learning event that could be coded as an episodic memory (M = 1.1 episodic memories). It is possible that if Prupas (1993) had measured episodic recall and retention of the material over a longer interval of time, the results may have been more congruent with what has been shown in college (Conway et al., 1997; Herbert & Burt, 2004) and other middle school samples (Nuthall & Alton-Lee, 1995; Nuthall, 1999, 2000).

While Prupas (1993) did not find a relationship between episodic recall and performance, he did find individual differences in the degree to which children reported episodic memories. Specifically, students who had more mature metacognitive abilities, as measured by the Self-Regulated Learning Scale (Corno, Collins, & Capper, 1982 as cited in Prupas, 1993), were more likely to recall episodic memories of the learning event. Therefore, children’s cognitive skills appeared to be a mitigating factor in the number of memories reported.
Another factor that has been shown to impact the number and quality of learning episodes that students report is gender. As mentioned previously, there are modest but consistent gender difference on episodic memory tasks, generally favoring women and girls. This advantage also emerges when females recall episodic memories of classroom learning (Leichtman et al., 2010; Leichtman et al., 2007;). Leichtman et al. (2007) investigated gender differences in episodic memory in the middle school classroom. Following a naturally occurring exam in their math, science, social studies, and language arts classes, eighth graders were asked to indicate how they had learned the answer to a selected number of test questions they had just completed. Specifically, the students were asked to indicate whether they 1) remembered the moment they learned the answer, 2) knew the answer, but could not remember when they learned it, 3) guessed the answer, or 4) used some other problem-solving strategy to arrive at the answer. In math and science courses females reported using more episodic memories than males, but both genders use of episodic memory was correlated with their performance on the math and science exams (Leichtman et al., 2007). Thus, while females may have used the strategy slightly more often, recalling episodic memories appeared to be beneficial to both genders.

The findings of Leichtman et al. (2007) have also been replicated in several samples of college students, including those enrolled in introductory level nutrition and chemistry courses. Leichtman et al. (2010) administered a questionnaire identical to that used by Leichtman et al. (2007) in the middle school sample except that instead of being given verbal instructions on how to complete the questionnaire, the college students were given written instructions about the distinction between remembering the moment one
learned the answer and not remembering. Just as in the middle school sample, students completed the questionnaire immediately following a regularly scheduled exam in their course. Results indicated that across all exams there was a trend for women to report more episodes than men. On two of the exams (one in an introductory nutrition course and one in a chemistry course) this trend reached statistical significance. Further, on all of the exams a greater percentage of remember responses was associated with correct answers. That is, when students reported remembering a specific episodic memory of learning, they were more likely to answer the exam question correctly (Leichtman et al., 2010).

The findings of Leichtman et al. (2007) and Leichtman et al. (2010) indicate that students in a variety of courses, including courses in the applied and natural sciences, can benefit from recalling episodic memories of learning events and that there are consistent gender differences in students’ tendency to do so. In a study of developmental and gender differences in the use of episodic memory in preschool and early-school aged children, Bemis et al. (2011) found gender differences similar to those in the middle school and college student samples. Since this study included a sample of young children ages four to nine years who were unlikely to have regularly scheduled classroom exams, children were asked six factual knowledge questions taken from the Brain Quest Trivia games for children (Feder, 2005). After answering each question, children completed a scripted interview based on the questionnaire method used by Leichtman et al. (2007) and Leichtman et al. (2010). Specifically, children were first asked if they knew the answer or had guessed it and if they indicated the former, they were asked if they remembered the moment they had learned the answer or could not remember. Finally, if children indicated
that they could remember when they learned the answer to the factual knowledge questions, they were asked to give a free-report narrative of all that they could remember and were then prompted by five follow-up questions (How old were you? Who was there? Where were you? What happened? What did you see and hear?). Results indicated that there was a general increase in the number of episodes that children reported from four to nine years and that as children aged they were more likely to report memories that were coded as specific. However, although the majority of the youngest children in the sample also reported specific memories, they had a larger proportion of memories that lacked sufficient detail to be coded as specific and thus were coded as “consistent with specific” memories. For example, a young child who reported having learned that pigs lived in a sty because “I saw them at Grandma’s house” was clearly identifying a learning episode, but was not giving the details of a specifically defined unit of time to indicate that the memory occurred at one specific moment (Bemis et al., 2011). Regarding gender differences, females of all ages were more likely to report learning episodes when they said that they knew the answer and had answered the question correctly. Additionally, girls reported narratives that were longer and were more focused on active learning events, such as participating in a conversation or trivia game on the topics. In contrast, boys provided shorter narratives that were more focused on visual learning events, such as looking at a map or illustration (Bemis et al., 2011).

The findings of the study conducted by Bemis et al. (2011) indicate that even young children are able to provide specific episodic memories of learning events. This is contrary to the findings of other researchers investigating source monitoring (e.g. Taylor et al., 1994; Esbensen et al., 1997; Tang et al., 2007), who have shown that young
children have difficulty reporting when they have learned a new piece of information. One possible explanation for this contrast in findings is that in the study by Bemis et al. (2011) children were asked to provide narratives when they believed that they had learned the fact. Thus, children reported on their subjective experiences of learning and since none of these experiences could be verified for accuracy as children reported a variety of learning episodes ranging from something that occurred at birthday parties to events that had happened a week earlier in their classroom, it is possible that not all of the reported events were accurate (Bemis et al., 2011). In contrast Taylor et al. (1994), Esbensen et al. (1997) and Tang et al. (2007) all used staged learning events. In these studies, children were asked immediately after the learning events (or in the case of Tang et al. (2007) one week after the first event and immediately after the second) to recall when they had learned the information. While this approach allowed for measures of accuracy, it does not reflect the kind of long-term recall that children have to engage in when learning information in their natural environment. Further, the fact that children were only asked to indicate when they had learned the information is significant considering that the tendency to talk about when an event occurred emerges later in development, with other details of learning, such as who and what, emerging earlier (Bartsch et al., 2003). Therefore, it is possible that children may have performed better in the task conducted by Bemis et al. (2011) because they were asked about details other than just when the actual learning occurred. Indeed it was noted anecdotally, that in some instances children in Bemis et al.’s (2011) study reported times when learning occurred that seemed incorrect. For example, a child reported that he was a year old when he learned the name of a shape but described an event that clearly happened in his preschool
classroom, a classroom in which all children were between the ages of three- and four years.

In order to determine whether the differences between Bemis et al.’s (2011) findings and those of Taylor et al. (1994), Esbensen et al. (1997) and Tang et al. (2007) were due to children’s inaccuracy in their subjective memories of learning events or their inaccuracy in reporting when an event occurred (but still possibly recalling other details of the event), it was necessary to combine the methods used by the various studies. The present study sought to do this by replicating the studies of Bemis et al. (2011) and Taylor et al. (1994) and by extending the methods of both by including staged learning events and testing recall of these events after a longer delay with recall questions that included not only when the event occurred but other details as well, including what and who. By comparing performance of the same group of children on a variety of tasks used to assess their ability to recall learning events, it was possible to discern the degree to which young children accurately recall learning events and to assess developmental changes in this ability. Further, since gender differences in the use of episodic memory in the classroom have been noted in several samples, the present study investigated gender as a possible source of individual variation in reporting learning episodes across tasks. Thus, the purpose of the present study was to 1) identify the accuracy of reported episodic memories of learning events 2) investigate developmental changes in the recall of episodic memories for learning events throughout the early schools years 3) compare children’s ability to provide accurate episodic memories of learning events across different tasks and 4) determine if there are gender differences in the tendency to report episodic memories of learning events.
It was predicted that, while the ability to recall episodic memories of learning would improve between the age of four and five years, even four-year-olds would be able to accurately recall episodic memories of learning events. Further, it was predicted that source monitoring ability would not be related to the ability to report episodic memories of learning, but that children who showed greater source monitoring ability would be more accurate in the episodic memories that they reported. Finally, it was predicted that females would report more episodic memories of learning and that these memories would contain more accurate details.
CHAPTER II

METHOD

Participants

Seventy-seven participants, ages four to six years, were recruited from local schools. Seventeen children were excluded from the final sample because of absence on one or more of the learning events or the factual knowledge interview (n= 7), issues with the training given before the factual knowledge interview (n=6), or refusal to participate in one of the sessions (n=4). The final sample consisted of sixty children (27 males, 33 females). Children were divided into groups based on their age and gender. The final sample included 17 four-year-old girls (M= 4 years, 7 months), 13 four-year-old boys (M= 4 years, 8 months), 16 five-year-old girls (M= 5 years, 7 months), and 14 five-year-old boys (M= 5 years, 7 months). Eighty-five percent of children were Caucasian, 10% were Asian, and 5% were bi-racial. Most children came from relatively highly educated families with 44% of mothers and 38% of father reporting having a graduate degree, 20% of mothers and 12% of father reporting taking some graduate course, and 30% of mothers and 36% of fathers reporting having a college degree.

All children were typically developing based on teacher and parent report and parental consent was obtained for both tasks included in the study via a signed permission slip sent home in advance and verbal assent was obtained from all children.
In addition to the main sample of sixty children, an additional sample of nine four-to seven-year-olds, similar in demographic characteristics to the main sample, participated in one session designed to pilot test the questions that were used in the memory interview. This was done to ensure that the material presented in the staged-events was novel and that all of the questions were understandable to young children.

**Materials**

**Staged Learning Events**

Two sets of props were used in each of the two learning sessions. The first set of props were used to teach about the visual system and included a plastic, color-coded model of the human brain, a printed image of the eye, a large image of the visual system (e.g., the connection between the eyes, the optic nerve, and the brain) printed on a standard white shower curtain, and a large computer box that looked like a green suitcase. The second set of props were used to teach about the Aleutian Islands and included an inflatable globe with the Aleutian Islands circled in red, a printed map of Alaska and the Aleutian Islands, a large print out of Alaska, the Aleutian Islands, the Pacific ocean, and the Bering sea, and a black plastic treasure chest.

**Replication of Taylor et al. (1994) task**

This task was a replication of the task by Taylor, Esbensen, and Bennett (1994, Experiment 3). The task included two plush bear hand puppets, one with a ribbon to resemble a female (“Betsy”) and one with a bow tie to resemble a male (“Barnaby”). In addition to the bear hand puppets, one poster board cutout was created to resemble the bears, with Velcro attached where buttons and a hair bow (for Betsy) and a bow tie (for
Barnaby) would go. Smaller cutouts of buttons, a hair bow, and a bow tie were created to attach to the poster board bear cutout. Along with bear puppets and cutouts, there were also a photocopied line drawings of a house with one door and two windows for the child to color using ten selected crayon colors.

**Procedure**

All children participated in two staged and scripted learning events, occurring over a period of 7 days, with the learning events being separated by a 4-5 day interval. The order of these events were randomized within each of the two age groups. The staged events were led by the primary researcher and contained both visual and interactive components (see Appendix A). The events occurred in children’s natural classrooms with their peers. Thus, children learned together in groups of 3-5 children of similar ages. Whenever possible children completed the events in gender balanced groups. A gender balanced group was defined as any group where there were at least two children of each gender (i.e., either a 2:2 or a 3:2 ratio). Eight of the twenty groups in the present study were gender balanced. Six of the groups were female dominant with only one male in the group. Four of the groups were male dominant with only one female in the group. Finally, there were two groups that had no child of the opposite gender; one of these groups was comprised of three females and other was comprised of three males.

At the beginning of each staged learning event, the primary research reminded the children of her name (i.e., Rhy) and said, “I am interested in how children learn and remember. I have some interesting things to teach you about today and I want you to listen carefully so that you can remember what you learn about.” This script was used
prior to each staged learning events for two main reasons. First, the language used was very similar to what children hear from their teachers prior to a classroom activity and thus using this script made the learning events more similar to natural events that children would experience in their school. Secondly, telling children that they are going to learn something has been shown to improve their ability to reflect on their own learning (Taylor et al., 1994).

Two to three days following the final staged learning event children were interviewed individually by a trained researcher not present at the original learning event in a quiet area in their classroom. Children were asked ten factual questions. Six of these questions (called the staged-event questions) were from material that was presented during the two staged learning events (three questions were selected from each of the two events, see Appendix B) and four of the questions (called the factual knowledge questions) were from randomly selected trivia questions from the Brain Quest Trivia games (Feder, 2005) that were one year behind the child’s current developmental level, such that kindergartners received preschool questions. The trivia questions were from the same science and social studies questions used by Bemis et al. (2011). The four trivia questions were used to ensure that children did not show a response bias, saying that they learned everything from the staged learning events, and to replicate the findings of Bemis et al. (2011). Further, factual knowledge questions and staged-event questions were presented in a random order and a mixed format such that a staged-event could be presented immediately following a factual knowledge question and vice versa.

Following each factual knowledge question, children were asked a series of scripted interview questions designed to determine whether they remembered the moment
they learned the answer to the question (see Appendix C). These interview questions were identical to the ones used by Bemis et al. (2011). Prior to completing the scripted interview questions children were trained on the distinction between remembering the moment you learned the answer to the question and not remembering the moment. This training procedure was used in the present study for two reasons. First, because children in the present study were relatively young and still developing the ability to understand their own thought processes, the training procedure ensured that children understood what it meant to remember or not remember instances of learning. Secondly, the training procedure illustrated to children that not remembering the moment that you learned the answer was both an acceptable and common response. Understanding that not remembering is an acceptable answer is particularly important to children in this age range because past research has indicated that preschoolers can be highly suggestible and will provide false memories if they feel that providing a memory is the only “correct” response (Ceci & Bruck, 1995).

In the training procedure, children heard two examples of people answering basic factual knowledge questions (e.g., asked to identify the number two). In one example the person said that he/she remembers the number because his/her mom was at the kitchen table and helped her to draw the number two in his/her coloring book. In a second example the person said that he/she knows the number, but cannot remember learning that. Following each example children were asked to say whether the person in the example remembered the moment they learned the answer or did not remember. If children gave an incorrect response they were given corrective feedback and the example was repeated. If children failed to give a correct response on the repetition of the
example, they were not included in the final sample. This training procedure had been
used with success in past research with children in this age group (e.g., Bemis et al.,
2011).

Following the training procedure, children completed the scripted interview. To
begin the interview children were asked to answer the factual knowledge or staged-event
question. Regardless of the correctness of their answer, children were asked to indicate
whether they knew the answer or guessed. If children indicated that they had guessed the
answer, then the interviewer moved to the next question, but if children said that they
knew the answer they were asked if they remembered the moment they learned the
answer of if they did not remember. If children indicated that they did not remember, the
interviewer asked the next question, but if they indicated that they did remember then the
interviewer asked children to report all they can remember about the event and followed-
up with five follow-up questions: 1) how old were you? 2) where were you? 3) who was
there? 4) what happened? 5) what did you see and hear when this happened?. This
procedure was repeated for all ten questions. Following the ten questions children were
asked event-specific questions about their memory for the two staged learning events.
Specifically, children were asked one open-ended event question about each event, “I
heard Rhy came to your classroom and taught you and the other children about the
Aleutian Islands/visual system. Can you tell me everything you can remember about the
time that she came to teach you about the Aleutian Islands/visual system?” After this
open-ended question children were asked four specific follow-up questions, 1) what did
you learn about the Aleutian Islands/visual system? 2) what did you do to help you learn
about the Aleutian Islands/visual system? 3) what did Rhy bring to help you learn about
the Aleutian Islands/visual system? 4) what did Rhy bring to carry all of her things in when she taught you about the Aleutian Islands/visual system? (see Appendix C). All of children’s responses were audiorecorded and transcribed.

In addition to completing the two staged learning events and memory interview, children completed a replication of Taylor, et al.’s (1994, experiment 4, explicit learning condition) source monitoring task. This task was always completed after the interview about the staged events and factual knowledge questions and was used to compare children’s ability to provide episodic memories of salient learning episodes with their ability to accurately label the source of their knowledge in a traditional source monitoring task; a task in which the youngest children (i.e., 4-year-olds) in this sample have struggled to accurately identify sources (Taylor, et al., 1994).

**Coding**

All children’s narrative responses in the memory interview were recorded and transcribed. A single coder coded all response and then a hypothesis-blind coder coded twenty-five percent of these narratives to establish reliability for the main narrative codes.

**Total Number of Words**

The number of words in children’s total narrative reports, including responses to the follow-up questions, were counted using the word count function in Microsoft word. Thus, determining the number of words per memory was straightforward. Word counts did not included unintelligible utterances or non-word utterances, such as um or uh.
**Location and Learning Event**

Narrative responses given for both the staged-event questions and factual knowledge questions were coded for the primary location of the learning event. Specifically, location codes included 1) the staged learning event, 2) classroom (not during the staged learning event, 3) home, 4) other (e.g. learning at the zoo, on vacation, etc.), and 5) no location mentioned. In addition to location of the learning event, the type of learning event was also coded as being visual (i.e., child learned the information by seeing it on a map, model, or other visual aid), spoken (i.e., child was told the information by a teacher, adult, or peer), interactive (i.e., child participated in an active learning experience, such as a game, demonstration or conversation, where he or she contributed to his or her own learning), or no activity mentioned. Just as with the location codes, the codes for type of learning event were used for narratives given in response to both staged-event and factual knowledge questions. This is possible because each staged learning event is designed to have visual, spoken, and interactive components. Inter-rater agreement on the location codes was 98% and agreement on the activity codes was 84%.

**Specificity**

Each narrative response was coded to determine the degree to which it corresponded to the definition of episodic memory as being a specific, one-moment-in-time episode (Tulving, 1983). Using an adaption of the criteria developed by Pillemer, Goldsmith, Panter, and White (1988), children’s responses were coded as being either specific, consistent with specific, general, procedural, or no memory. Specific memories were those memories that clearly identified a one-moment-in-time event (i.e., my dad
told me that last Saturday morning). Consistent with specific memories were those memories that lacked enough detail to clearly identify them as specific but did seem to allude to an isolated event (i.e., my dad told me that). General memories were those memories that reported either a repeated event or an event that occurred over an extended period of time (i.e., my dad tells me that every day). Procedural memories were those memories that did not detail an event, but rather outlined the steps in solving the problem (i.e., well first you see something and then the information goes into the optic nerve). Finally, a code of no memory was given when children said they remembered when they learned the answer but failed to describe the event, even when prompted with follow-up questions. Inter-rater agreement on the specificity code was 84%.

**Accuracy of Event**

Narratives given in response to staged-event and the open-ended event-specific questions were coded for accuracy. Specifically, details were coded using a checklist of details that occurred during the staged-events as well as a checklist of comparable unrelated details that children could have mentioned. This checklist was grouped into four categories with each category containing eight specific details that a child could have mentioned in his or her memory (see Appendix D). The four categories on the checklist included 1) **event-specific details** which were defined as details that were accurate and clearly related to the one of the staged learning events (e.g., walking on a picture of the eye), 2) **event-non-specific details** which were defined as details that were accurate but could refer to either learning event (e.g., walking on a picture), 3) unrelated details which were defined as details that were not related to the event because they were unrelated contextual details or an activity that was clearly not related to the event (e.g.,
sitting on the rug, hearing the information from a parent), and 4) event-confused which were defined as details that were inaccurate they referred to the other staged event, not the one being questioned (e.g., walking on a picture of Alaska during the visual event). The number of distinct details falling in each category was summed to determine the total number of details that the child reported in each category. For the staged-event questions this total was divided by the total number of memories reported in response to the staged-event questions to create an average number of details reported per memory. Inter-rater agreement on memory accuracy for each category for the staged-event questions ranged from 93%-100% and agreement for the open-ended event specific questions ranged from 99%-100%.

The four follow-up questions (i.e., what did you learn? what did you do? what did Rhy bring? what did Rhy bring to carry all of her things in?) to the event-specific questions were also coded for accuracy using a checklist of possible details that the child could report for each question. The total number of details that the child reported was summed for each question and the percentage of children recalling each fact, item, or activity was also calculated to determine commonly recalled aspects of the event. Interrater agreement for each question ranged from 98%-100%.

In addition to this more nuanced coding of accurate details, children’s memories were also coded as being globally accurate or inaccurate. Children’s memories were deemed globally accurate if the majority of details they reported were accurate. Likewise, children’s memories were deemed globally inaccurate if they majority of details they reported were unrelated to the event or confused the events.
CHAPTER III

RESULTS

For all of the main analyses, children were divided into two age groups, four-year-olds (n=30) and five-year-olds (n=30), and two gender groups, males (n=27) and females (n=33). These groups were used for all analyses unless otherwise noted.

**Piloting of Staged-event Questions**

To assure that the information presented in the staged learning events (i.e., the visual system and the Aleutian Islands) was novel to children in the target age range, a sample of nine children in a similar age range (4-7 years) answered each of the staged-event questions and factual knowledge questions. As anticipated, children answered most of the factual knowledge questions correctly ($M = 3.56$, $SD = .73$, max = 4), but were below chance levels in answering the staged event questions ($M = 2.11$, $SD = 1.17$, max = 6) answering fewer than half of the staged-event questions correctly. This indicates that children in the target age range were not familiar with the topics presented in the staged learning events and that the information was indeed novel.

**Number of Questions Children Answered Correctly, Knew, and Guessed**

Table 1 summarizes the number of questions that children answered correctly, reported that they knew, and reported that they had guessed for both the factual
knowledge questions and the staged-event questions.

**Factual Knowledge Questions**

A 2(gender) x 2(age) ANOVA on number of factual questions answered correctly indicated that there were no significant differences in correct responses due to gender, $F(1,56) = .068, p = .796$. Five-year-olds ($M = 3.83$, $SD=.46$) answered slightly more factual questions correctly than did four-year-olds ($M = 3.60$, $SD=.56$), $F(1,56) = 3.356, p=.072$. However, both age groups were near ceiling in their performance indicating that, similar to Bemis et al. (2011), they knew the information being asked of them in the factual knowledge questions (see Table 1).

Two 2(gender) x 2(age) ANOVAs using the number of questions children reported knowing (but not remembering) and guessing respectively indicated that there were no significant age, $F(1,56)=1.695, p=.198$ or gender $F(1,56)=.440, p=.510$ differences in the number of questions that children reported knowing (see Table 1). However, there were moderately significant age differences in the number of questions that children reported guessing on, $F(1,56) =3.677, p=.060$, with four-year-olds ($M=1.33$, $SD=1.56$) guessing on more questions than five year-olds ($M=.73$, $SD=1.01$). There was no main effect of gender on the number of questions where children reported guessing, $F(1,56) = .994, p=.323$.

**Staged-event Questions**

To determine the amount of information that children retained from the staged learning events, a 2(gender) x 2(age) ANOVA was conducted with the number of staged-event questions answered correctly as the dependent variable. There were no significant main effects due to age, $F(1,56) =.259, p=.613$, or gender, $F(1,56) =.144, p=.706$,.
Table 1. Mean number (and standard deviation) of correct responses, known answers, and guessed answers for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 years</td>
<td>5 years</td>
<td>4 years</td>
<td>5 years</td>
</tr>
<tr>
<td><strong>Factual knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>3.54(0.66)</td>
<td>3.93(0.27)</td>
<td>3.65(0.49)</td>
<td>3.75(0.58)</td>
</tr>
<tr>
<td>Know</td>
<td>1.15 (1.28)</td>
<td>1.88(1.29)</td>
<td>1.18(1.29)</td>
<td>1.38(1.45)</td>
</tr>
<tr>
<td>Guess</td>
<td>1.77(1.79)</td>
<td>0.71(0.83)</td>
<td>1.00(1.32)</td>
<td>0.75(1.18)</td>
</tr>
<tr>
<td><strong>Staged event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>4.46 (1.27)</td>
<td>4.50(1.09)</td>
<td>4.24(1.30)</td>
<td>4.50(.89)</td>
</tr>
<tr>
<td>Know</td>
<td>0.69(1.18)</td>
<td>0.86(1.17)</td>
<td>1.59(1.94)</td>
<td>0.81(1.17)</td>
</tr>
<tr>
<td>Guess</td>
<td>3.69(2.25)</td>
<td>3.21(1.80)</td>
<td>2.88(2.06)</td>
<td>3.25(1.91)</td>
</tr>
</tbody>
</table>
indicating that both four-year-olds and five-year-olds retained similar amounts of information from the staged learning event. Also, it should be noted that average number of questions answered correctly by both four- \((M = 4.33, SD = 1.27)\) and five-year-olds \((M = 4.50, SD = .97)\) exceeded what would be expected by chance on the six dichotomous choice questions.

Regarding the number of questions that children reported knowing or guessing, two 2(gender) x 2(age) ANOVAs indicated that were no main effects of age for the number of questions that children reported knowing, \(F(1, 56) = .674, p = .415\) or guessing, \(F(1, 56) = .011, p = .916\). There were also no main effects of gender for either knowing, \(F(1, 56) = 1.308, p = .258\) or guessing, \(F(1, 56) = .657, p = .421\) (see Table 1).

**Number of Episodes Reported**

Table 2 summarizes the number of episodes and the proportion of episodes for known and correct responses that children reported in response to both the factual knowledge and staged event questions.

**Factual Knowledge Questions**

A 2(gender) x 2(age) ANOVA with number of episodes reported as the dependent variable indicated that there was a marginally significant main effect of gender, \(F(1, 56) = 3.495, p = .067\), with girls \((M = 1.85, SD = 1.30)\) reporting more episodic memories in response to factual knowledge questions than boys \((M = 1.26, SD = 1.10)\). However, there was no effect of age, \(F(1, 56) = .399, p = .530\), indicating that four-year-olds \((M = 1.50, SD = 1.22)\) and five-year-olds \((M = 1.67, SD = 1.27)\) reported a similar number of
episodic responses. There was also no significant age by gender interaction, $F(1,56)= .221$, $p=.640$.

Contrary to past research conducted by Bemis et al. (2011), a 2(gender) x 2(age) ANOVA with proportion of episodes reported for answers that were both known and correct indicated no significant effect of gender, $F(1,56)=2.747$, $p=.103$. There were also no significant differences due to age, $F(1,56) = .386$ $p=.537$, indicating that four-year-olds ($M=.48$, $SD=.38$) and five-year-olds ($M=.53$, $SD=.37$) recalled similar proportion of episodes for known and correct responses. There was also no significant age by gender interaction, $F(1,56)= .224$, $p=.638$ (see Table 2).

Regarding the relationship between episodic memory and correct responses, 99% of the time when children said they remembered the moment that they learned the answer, they gave a correct response.

**Staged-event Questions**

In contrast to responses on the factual knowledge questions, a 2(gender) x 2(age) ANOVAs with number of episodes reported indicated no effect of either age, $F(1,56)=1.248$, $p=.269$, or gender, $F(1,56)=.017$, $p=.897$. This pattern was also true for the proportion of episodes reported for known and correct responses with a 2(gender) x 2(age) ANOVA indicating that there were no significant age, $F(1,56)=1.364$, $p=.248$, or gender, $F(1,56)=.007$, $p=.932$, differences (see Table 2).

Similar to the findings from the factual knowledge questions, children were very likely to be correct when they said that they remembered an episodic memory in response to a staged-event question. In fact, 88% of children’s remember responses were associated with correct answers.
Table 2. Mean number (and standard deviation) of remember responses and proportion of memories for known and correct questions for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 years</td>
<td>5 years</td>
<td>4 years</td>
<td>5 years</td>
</tr>
<tr>
<td><strong>Factual knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>1.08(1.19)</td>
<td>1.43(1.02)</td>
<td>1.82(1.19)</td>
<td>1.88(1.45)</td>
</tr>
<tr>
<td>Prop. Remember</td>
<td>0.36(0.37)</td>
<td>0.46(0.31)</td>
<td>0.56(0.37)</td>
<td>0.58(0.42)</td>
</tr>
<tr>
<td><strong>Staged event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>1.54(1.85)</td>
<td>1.86(1.41)</td>
<td>1.35(1.22)</td>
<td>1.94(1.73)</td>
</tr>
<tr>
<td>Prop. Remember</td>
<td>0.44(0.43)</td>
<td>0.61(0.35)</td>
<td>0.49(0.45)</td>
<td>0.58(0.44)</td>
</tr>
</tbody>
</table>
Narrative Length, Location, and Type of Learning Activity

Analyses of narratives in response to both the factual knowledge question and the staged-event questions were conducted on the subset of participants in the sample who provided at least one episodic memory (i.e., said they remembered the moment they learned the answer) in response to either question type. For analyses of the factual knowledge questions the sample consisted of 19 boys (7 4-year-olds and 12 5-year-olds) and 26 girls (14 4-year-olds and 12 five-year-olds). For analyses of the staged event questions the sample consisted of 20 boys (8 4-year-olds and 12 5-year-olds) and 24 girls (12 4-year-olds and 12 5-year-olds).

Factual Knowledge Questions

A 2(gender) x 2(age) ANOVA using average number of words as the dependent variable indicated that there were no significant main effects of age, $F(1, 41) = .222$, $p = .640$, or gender, $F(1,41) = 2.543$, $p = .118$. Therefore, both 4-year-olds ($M= 42.11, SD=23.94$) and five-year-olds ($M= 39.33, SD=22.40$) and girls ($M= 35.87, SD=19.80$) and boys ($M= 47.14, SD=25.70$) provided narratives that were similar in length.

Table 3 summarizes the proportion of memories in response to the factual knowledge questions that were coded for each location and activity type. The location and type of learning activity were analyzed by a series of 2(gender) X 2(age) ANOVAs using the proportion of memories reported for each location and learning event type (i.e., number of memories coded as visual divided by the total number of memories reported in response to factual knowledge) as the dependent variables. Regarding location, results indicated that there were no main effects of age for proportion of memories coded as occurring in any location including the staged event ($F(1,41)=1.530, p=.223$), classroom
Table 3. Proportion of memories coded for each location and learning activity for each age and gender group.

<table>
<thead>
<tr>
<th>Location</th>
<th>Males 4 years</th>
<th>Males 5 years</th>
<th>Females 4 years</th>
<th>Females 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factual knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staged event</td>
<td>0.14(0.38)</td>
<td>0.04(0.14)</td>
<td>0.04(0.13)</td>
<td>---</td>
</tr>
<tr>
<td>Classroom</td>
<td>---</td>
<td>0.13(0.31)</td>
<td>0.04(0.13)</td>
<td>---</td>
</tr>
<tr>
<td>Home</td>
<td>0.45(0.46)</td>
<td>0.17(0.33)</td>
<td>0.51(0.44)</td>
<td>0.50(0.43)</td>
</tr>
<tr>
<td>Other</td>
<td>0.12(0.21)</td>
<td>0.54(0.45)</td>
<td>0.35(0.41)</td>
<td>0.29(0.40)</td>
</tr>
<tr>
<td>No location</td>
<td>0.29(0.49)</td>
<td>0.13(0.27)</td>
<td>0.07(0.27)</td>
<td>0.22(0.32)</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>0.19(0.24)</td>
<td>0.21(0.33)</td>
<td>0.17(0.22)</td>
<td>0.15(0.31)</td>
</tr>
<tr>
<td>Spoken</td>
<td>---</td>
<td>0.17(0.33)</td>
<td>0.08(0.22)</td>
<td>---</td>
</tr>
<tr>
<td>Interactive</td>
<td>0.33(0.37)</td>
<td>0.13(0.31)</td>
<td>0.49(0.40)</td>
<td>0.30(0.38)</td>
</tr>
<tr>
<td>No activity</td>
<td>0.48(0.50)</td>
<td>0.50(0.43)</td>
<td>0.25(0.38)</td>
<td>0.56(0.45)</td>
</tr>
</tbody>
</table>

| Staged event  |              |              |                 |                 |
| Location      |              |              |                 |                 |
| Staged event  | 0.96(0.12)   | 0.94(0.19)   | 0.54(0.50)      | 0.60(0.47)      |
| Classroom     | ---          | ---          | ---             | ---             |
| Home          | ---          | 0.06(0.19)   | 0.24(0.39)      | 0.03(0.10)      |
| Other         | 0.04(0.12)   | ---          | 0.22(0.41)      | 0.07(0.17)      |
| No location   | ---          | ---          | ---             | 0.31(0.44)      |

| Activity      |              |              |                 |                 |
| Visual        | 0.17(0.36)   | 0.08(0.16)   | 0.04(0.14)      | 0.18(0.34)      |
| Spoken        | ---          | 0.21(0.40)   | 0.11(0.30)      | 0.14(0.31)      |
| Interactive   | 0.08(0.18)   | 0.25(0.40)   | 0.51(0.48)      | 0.15(0.29)      |
| No activity   | 0.75(0.37)   | 0.46(0.47)   | 0.33(0.44)      | 0.54(0.46)      |
There were also no age differences in the proportion of memories where children failed to report a location, $F(1,41)=.008$, $p=.930$. There were also no significant gender differences for any of the memory locations including the staged event ($F(1,41)=1.808$, $p=.186$), classroom ($F(1,41)=.663$, $p=.420$), home ($F(1,41)=2.385$, $p=.130$), other location ($F(1,41)=.015$, $p=.902$), or no location mentioned ($F(1,41)=.412$, $p=.525$). Finally, results indicated a significant age by gender interaction, $F(1,41)=3.883$, $p=.056$, for locations coded as other, with four-year-old girls ($M=.35$, $SD=.41$) reporting more memories coded as other than four-year-old boys ($M=.12$, $SD=.21$), but five-year-old girls ($M=.29$, $SD=.40$) showing the reverse pattern, reporting fewer memories coded as other than five-year-old boys ($M=.54$, $SD=.45$). All other age by gender interactions for memory location were not significant (staged, $F(1,41)=.350$, $p=.557$; classroom, $F(1,41)=2.147$, $p=.150$; home, $F(1,41)=.1.162$, $p=.287$; no location, $F(1,41)=2.469$, $p=.124$).

In addition to the ANOVAs conducted on the proportion of memories reported at each location, a paired-samples t-test was also conducted on proportion of memories coded as occurring in and out of the classroom, a broader classification of memory location. Results indicated that children reported significantly more learning events that occurred outside of their classroom ($M=.95$, $SD=.18$) than in their classroom ($M=.04$, $SD=.18$), $t(44)=16.90$, $p<.001$.

Regarding the type of activities that children reported in their memories, results indicated that there was a modest main affect of age for interactive activities, $F(1,41)=3.139$, $p=.084$ with four-year-olds ($M=.44$, $SD=.39$) reporting more interactive activities.
in their memories than five-year-olds \((M=.21, SD=.35)\). There were no other main effects of age (visual, \(F(1,41)=.002, p=.964\); spoken, \(F(1,41)=.420, p=.520\); no activity mentioned, \(F(1,41)=1.535, p=.222\)). There were also no significant gender differences (visual, \(F(1,41)=.213, p=.647\); spoken, \(F(1,41)=.420, p=.520\); interactive, \(F(1,41)=2.158, p=.150\); no activity mentioned, \(F(1,41)=.406, p=.527\)) for any activity type. However, there was a significant age by gender interaction for activities coded as spoken, \(F(1,41)=3.812, p=.058\), but this interaction was largely due to the fact that both 4-year-old boys and 5-year-old girls did not provide any memories that were coded as spoken, but 4-year-old girls \((M=.08, SD=.21)\) and 5-year-old boys \((M=.17, SD=.33)\) provided a modest number of memories that were coded as spoken. No other age by gender interactions were significant (visual, \(F(1,41)=.066, p=.799\); interactive, \(F(1,41)=.003, p=.959\); no activity mentioned, \(F(1,41)=1.116, p=.297\)).

**Staged event Questions**

A 2(gender) x 2(age) ANOVA using the average number of words reported in memories given in response to staged-event questions indicated that there were no significant age, \(F(1,40)=.041, p=.841\), or gender differences, \(F(1,40)=2.289, p=.138\) in memory length. Four-year-olds \((M=37.85, SD=18.90)\) and five-year-olds \((M=36.91, SD=25.70)\) reported memories of similar length as did girls \((M=32.39, SD=18.59)\) and boys \((M=43.27, SD=25.91)\).

Table 3 summarizes the proportion of memories given in response to the staged-event questions coded as each location and activity type. A series of 2(gender) x 2(age) ANOVAs with proportion of episodes reported at each location as the dependent variable indicated that five-year-olds were more likely than four-year-olds to report not recalling a
location where the event occurred, $F(1,40)=4.722, p=.036$ (see Table 3). However, this largely due to the fact that not recalling a location in response to a staged event question was rare across groups and only occurred in the 5-year-old girl group ($M=.31, SD=.44$). There were no other significant main effects of age (staged, $F(1,41)=.032, p=.859$; home, $F(1,40)=1.126, p=.295$; other, $F(1,40)=1.794, p=.188$).

Regarding gender differences, boys ($M=.95, SD=.16$) were significantly more likely than girls ($M=.57, SD=.47$) to report that they learned the answer to the staged-event questions as part of the staged learning event, $F(1,40)=11.01, p=.002$. In contrast, girls ($M=.15, SD=.32$) were slightly more likely than boys ($M=.02, SD=.07$) to report that they learned these answers at another location, $F(1,40)=2.971, p=.093$. Girls ($M=.15, SD=.34$) reported not recalling a location where they learned the information questioned in the staged learning event question, $F(1,40)=4.722, p=.036$, whereas this never happened in boy’s memories (see Table 3). There was no gender difference in the proportion of memories that were reported to occur at home, $F(1,40)=2.085, p=.157$ and neither boys nor girls ever reported learning an answer to the staged-event question in their general classroom environment.

A series of 2(gender) x 2(age) ANOVAs using proportion of memories coded as each type of activity as the dependent variable indicated that there were no significant main effects of age (visual, $F(1,41)=.107, p=.745$; spoken, $F(1,41)=1.599, p=.213$; interactive, $F(1,40)=.797, p=.377$; no activity mentioned, $F(1,40)=.102, p=.751$) or gender (visual, $F(1,40)=.021, p=.886$; spoken, $F(1,40)=.050, p=.825$; interactive, $F(1,40)=2.090, p=.156$; no activity mentioned, $F(1,410=1.630, p=.209$). There was a significant age by gender interaction for the proportion of memories where children
reported an interactive activity, $F(1,40)=5.607, p=.023$, with four-year-old girls ($M=.51, SD=.48$) reporting more interactive activities than four-year-old boys ($M=.08, SD=.18$) but five-year-old girls showing the opposite pattern, reporting fewer interactive activities ($M=.15, SD=.29$) than boys ($M=.25, SD=.40$).

**Specificity of Children’s Episodic Memories**

Table 4 summarizes the proportion of children’s memories in response to both the factual knowledge and staged-event questions that were coded as either specific, consistent with specific, general, procedural, or no memory.

**Factual Knowledge Questions**

No children reported memories that were coded as procedural in response to the factual knowledge question. Therefore, the proportion of memories coded as procedural were not included in the analyses. A series of 2(gender) x 2(age) ANOVAs using the proportion of memories coded as specific, consistent with specific, general, procedural, and no memory (e.g., number of memories coded as specific over the total number of memories reported) as the dependent variables indicated that that there was a significant main effect of age for memories coded as consistent with specific, $F(1,41)=5.254, p=.027$, and general, $F(1, 41)=5.550, p=.023$, with 5-year-olds reporting more memories that were codes as consistent with specific and 4-year-olds reporting more memories that were coded as general (see table 4). There were no significant age difference for memories coded as specific, $F(1,41)=.148, p=.702$, or no memory, $F(1,41)=.014, p=.905$.

Regarding gender differences, there was a significant main effect of gender for memories coded as consistent, $F(1,41)=7.204, p=.010$, with boys reporting more
Table 4. Proportion of memories coded in each specificity category for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Factual knowledge</th>
<th>4 years</th>
<th>5 years</th>
<th>Females</th>
<th>4 years</th>
<th>5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specific</td>
<td>Consistent</td>
<td>General</td>
<td>Procedural</td>
<td>No Memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.31(0.41)</td>
<td>0.19(0.38)</td>
<td>0.21(0.39)</td>
<td>---</td>
<td>0.29(0.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.38(0.43)</td>
<td>0.58(0.42)</td>
<td>0.04(0.14)</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.61(0.36)</td>
<td>0.11(0.21)</td>
<td>0.14(0.24)</td>
<td>---</td>
<td>0.14(0.31)</td>
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</tr>
<tr>
<td></td>
<td>0.44(0.45)</td>
<td>0.15(0.23)</td>
<td></td>
<td>---</td>
<td>0.40(0.47)</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Staged event</th>
<th>Specific</th>
<th>Consistent</th>
<th>General</th>
<th>Procedural</th>
<th>No Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.37(0.42)</td>
<td>0.63(0.42)</td>
<td>0.08(0.29)</td>
<td>0.08(0.29)</td>
<td>0.32(0.44)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.60(0.44)</td>
<td>0.32(0.42)</td>
<td>0.30(0.41)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.69(0.44)</td>
<td>0.23(0.39)</td>
<td>0.30(0.41)</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.38(0.44)</td>
<td>0.30(0.41)</td>
<td>0.32(0.44)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
memories that were coded as consistent than girls (see Table 4). There were no gender differences for memories coded as specific, $F(1,41)=2.070$, $p=.158$, general, $F(1,41)=.713$, $p=.403$, or no memory, $F(1,41)=1.435$, $p=.238$. There was a significant age by gender interaction for memories coded as no memory, $F(1, 41)=6.329$, $p=.016$, with 4-year-old girls reporting fewer memories coded as no memory than 4-year-old boys, but with 5-year-old girls showing the reverse pattern, reporting more memories coded a no memory than 5-year-old boys. There was also a marginally significant interaction for memories coded as consistent, $F(1,41)=3.306$, $p=.076$, with the difference between 5-year-old boys and girls being greater than the difference between 4-year-old boys and girls. There were no significant interactions for memories coded as specific, $F(1,41)=.802$, $p=.376$, or general, $F(1,41)=.049$, $p=.825$.

**Staged-event Questions**

None of the children reported general or procedural memories in response to the staged-event questions. Therefore, the proportion of general and procedural memories was not analyzed.

A series of 2(gender) x 2(age) ANOVAs using proportion of memories coded as specific, consistent with specific, and no memory as the dependent variables indicated no significant main effects of age (specific, $F(1,40)=.089$, $p=.768$; consistent, $F(1,40)=.898$, $p=.349$; no memory, $F(1,40)=2.737$, $p=.106$). There were also no significant main effects of gender (specific, $F(1,40)=.122$, $p=.728$; consistent, $F(1,40)=2.697$, $p=.108$; no memory, $F(1,40)=2.737$, $p=.106$. There was a marginally significant age x gender interaction for memories coded as specific, $F(1,40)=3.860$, $p=.056$, with four-year-old girls ($M=.69$, $SD=.44$) reporting more specific memories than four-year-olds boys
(M=.37, SD=.43), but five-year-old girls (M=.38, SD=.44) reporting fewer specific memories than five-year-old boys (M=.60, SD=.45).

Accuracy of Children’s Episodic Memories: Staged–event Questions

Number of Globally Accurate Memories

A 2(gender) x 2(age) ANOVA using the number of memories that were coded as globally accurate indicated no significant effects of gender, F(1,40)= 1.951, p=.170, or age, F(1,40)=.088, p=.769. This indicates that both boys (M=2.10, SD =1.48) and girls (M=1.45, SD=1.69) and four- (M=1.60, SD=1.60) and five-year-olds (M=1.88, SD=1.65) recalled a similar number of globally accurate memories. Further, the number of globally accurate memories was positively correlated with the number of correct responses, r(58) =.475, p<.001, such that children who provided more globally accurate memories were also more likely to be correct in their responses.

Average Number of Details

The proportion of event-specific, event-non-specific, unrelated, and event-confused details was calculating by the summing the number of details reported in each category and then dividing by the number of event memories that children reported. A series of 2(gender) x 2 (age) ANOVAs were conducted using these proportions as dependent variables. Results of these analyses indicated a significant main effect of gender for the proportion of event-non-specific details (i.e., details that were accurate but could refer to either event), F(1,40)=4.691, p=.036 and a marginally significant effect for the proportion of unrelated details (i.e., details that were unrelated to the event), F(1,40)=3.025, p=.09. Specifically, boys (M= 1.96, SD=.62) reported more event-non-
specific details than girls ($M=1.25$, $SD=1.27$), but girls ($M=1.05$, $SD=1.35$) reported more unrelated details than boys ($M=.46$, $SD=.75$). There were no other significant effects of gender (event-specific, $F(1,40)=.005$, $p=.946$; event-confused, $F(1,40)=0.000$, $p=1.00$). There were also no significant main effects of age (event-specific, $F(1,40)=.949$, $p=.336$; event-non-specific, $F(1,40)=1.437$, $p=.238$; unrelated, $F(1,40)=.723$, $p=.400$; confused, $F(1,40)=1.466$, $p=.233$) or significant age by gender interactions (event-specific, $F(1,40)=.097$, $p=.757$; event-non-specific, $F(1,40)=.035$, $p=.852$; unrelated, $F(1,40)=.905$, $p=.347$; confused, $F(1,40)=.367$, $p=.548$). Table 5 summarizes the average number of event-specific, event-non-specific, unrelated, and event-confused details reported by children in each age and gender group.

Regarding the relationship between accurate details and the number of staged-event questions answered correctly, there were significant positive correlations between the number of staged-event questions answered correctly and both the number of event-specific details recalled ($r(58)=.405$, $p=.006$) and the number of event-non-specific details recalled ($r(58)=.287$, $p=.059$).

**Accuracy of Children’s Episodic Memories: Event-specific Questions**

Since all children answered the event-specific questions at the conclusion of the memory interview, the following analyses were conducted on the entire sample of sixty children. Further, since the purpose of these questions was to assess what children recalled about each individual event when specifically prompted about it, analyses are reported for the Aleutian Islands and visual system events separately.
Table 5. Mean number (and standard deviation) of each type of detail reported in memories in response to the staged-event questions for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 years</td>
<td>5 years</td>
<td>4 years</td>
<td>5 years</td>
</tr>
<tr>
<td>Event-specific</td>
<td>0.59(0.80)</td>
<td>0.45(0.49)</td>
<td>0.67(0.89)</td>
<td>0.40(0.53)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>1.77(0.047)</td>
<td>2.09(0.68)</td>
<td>1.03(1.13)</td>
<td>1.47(1.40)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>0.44(0.73)</td>
<td>0.47(0.79)</td>
<td>1.36(1.38)</td>
<td>0.74(1.30)</td>
</tr>
<tr>
<td>Event-confused</td>
<td>0.06(0.17)</td>
<td>---</td>
<td>0.04(0.14)</td>
<td>0.02(0.07)</td>
</tr>
</tbody>
</table>
Open-ended Questions

A series of 2(gender) x 2(age) ANOVAs using the total number of details reported in each accuracy category indicated no significant effects of gender (event-specific, $F(1,56) = .308, p = .581$; event-non-specific, $F(1,56) = 1.951, p = .168$; unrelated, $F(1,56) = .865, p = .356$; confused, $F(1,56) = .865, p = .356$) or age (event-specific, $F(1,56) = 2.463, p = .122$; event-non-specific, $F(1,56) = .221, p = .640$; unrelated, $F(1,56) = .865, p = .356$; confused, $F(1,56) = .856, p = .356$) in the visual system event. There were also no significant main effects of age (event-specific, $F(1,56) = .154, p = .696$; event-non-specific, $F(1,56) = .823, p = .368$; unrelated, $F(1,56) = 1.141, p = .290$; event-confused, $F(1,56) = 1.854, p = .179$) or gender (event-specific, $F(1,56) = .352, p = .555$; event-non-specific, $F(1,56) = .031, p = .860$; unrelated, $F(1,56) = 1.141, p = .290$; event-confused, $F(1,56) = 1.854, p = .179$) in the Aleutian Islands event. Table 6 summarizes the number of details reported for each event in response to the open-ended event-specific questions.

Number of Facts

Two 2(gender) x 2(age) ANOVAs using number of facts reported in response to the event-specific questions prompting recall of facts (i.e., what did you learn about the Aleutian Islands/visual system?) indicated that were no significant main effects of age (Aleutian, $F(1,56) = .044, p = .835$; visual, $F(1,56) = .142, p = .708$) or gender (Aleutian, $F(1,56) = 1.361, p = .248$; visual, $F(1,56) = .843, p = .362$) in the recall of facts for either event. The most commonly recalled fact for the Aleutian Islands event was that you had to travel to the islands in air taxi. Fifty-seven percent of children recalled this fact. The most commonly recalled fact in the visual system event was that the back of the brain helped you see, but only 5% of children reported this fact, indicating that facts from the
Table 6. Mean number (and standard deviation) of each type of detail reported in response to the open-ended event-specific questions for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 years</td>
<td>5 years</td>
</tr>
<tr>
<td><strong>Aleutian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event-specific</td>
<td>0.23(0.44)</td>
<td>0.50(0.65)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>0.08(0.28)</td>
<td>0.07(0.27)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>---</td>
<td>0.07(0.27)</td>
</tr>
<tr>
<td>Event-confused</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event-specific</td>
<td>0.23(0.44)</td>
<td>0.79(1.12)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>0.07(0.28)</td>
<td>0.07(0.27)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Event-confused</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
visual system event may not have been as readily recalled by children. Table 7 summarizes the average number of facts reported by each age and gender group for each event.

**Number of Activities**

Two 2(gender) x 2(age) ANOVAs using the number of activities that children reported in response to the question, “what did you do to help you learn about the Aleutian Islands/visual system?” indicated that there were no significant main effects of age (Aleutian, $F(1,56)=.072, p=.789$; visual, $F(1,56)=1.334, p=.253$) or gender (Aleutian, $F(1,56)=2.530, p=.117$; visual, $F(1,56)=.041, p=.840$) in the recall of event activities. The most commonly recalled activity in both events was walking on the big picture of the islands and the brain with 20% of children recalling this activity for both the visual system and Aleutian Islands events. Table 7 summarizes the average number of activities reported by each age and gender group for each event.

**Number of Items**

Two 2(gender) x 2(age) ANOVAs using the number of items that children reported in the response to the question, “what did Rhy bring to help you learn about the Aleutian Islands/visual system?” indicated no significant main effects of age (Aleutian, $F(1,56)=.571, p=.453$; visual, $F(1,56)=1.124, p=.294$) or gender (Aleutian, $F(1,56)=.142, p=.708$; visual, $F(1,56)=.201, p=.656$) for either event. The most commonly reported item for each event was the big picture of the Aleutian Islands and the brain that children could walk on with 31.7% of children recalling this item for the Aleutian Islands event and 46.7% of children recalling it for the visual system event. However, the three-dimensional objects in each event were also commonly mentioned with 26.7% of
Table 7. Mean number (and standard deviation) of facts, activities, and items reported and proportion of children recalling the treasure chest or suitcase in response to the event-specific questions for each age and gender group.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 years</td>
<td>5 years</td>
</tr>
<tr>
<td><strong>Aleutian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facts</td>
<td>0.54(0.52)</td>
<td>0.50(0.65)</td>
</tr>
<tr>
<td>Activities</td>
<td>0.38(0.65)</td>
<td>0.57(0.64)</td>
</tr>
<tr>
<td>Items</td>
<td>0.69(0.63)</td>
<td>0.64(0.63)</td>
</tr>
<tr>
<td>Treasure chest</td>
<td>0.54</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facts</td>
<td>0.07(0.27)</td>
<td>0.07(0.27)</td>
</tr>
<tr>
<td>Activities</td>
<td>0.23(0.44)</td>
<td>0.50(0.76)</td>
</tr>
<tr>
<td>Items</td>
<td>0.62(0.77)</td>
<td>1.21(0.97)</td>
</tr>
<tr>
<td>Suitcase</td>
<td>0.69</td>
<td>0.71</td>
</tr>
</tbody>
</table>

62
children recalling the globe in the Aleutian Islands event and 21.7% of children recalling the model brain in the visual system event. Table 7 summarizes the average number of items reported by each age and gender group for each event.

**Mention of Treasure Chest or Suitcase**

Chi square analyses on the percentage of children accurately recalling the suitcase or treasure chest when asked the question, “What did Rhy bring to carry all of her things in when she taught you about the Aleutian Islands/visual system?” indicated that there were marginally significant age differences, \( \chi^2 (1, N=60) = 3.455, p = .063 \), in the proportion of children recalling the treasure chest with 73% of five-year-olds recalling the treasure chest, but only 50% of four-year-olds recalling it. While there were no gender differences, \( \chi^2 (1, N=60) = .035, p = .852 \), in the proportion of children recalling the treasure chest, there were gender differences, \( \chi^2 (1, N=60) = 4.686, p = .030 \), in the proportion of children recalling the suitcase with 70% of boys but only 42% of girls recalling it. However, there were no age differences, \( \chi^2 (1, N=60) = .067, p = .795 \), in the proportion of children recalling the suitcase. Table 7 summarizes the percentage of children recalling either the suitcase or the treasure chest by each age and gender group.

**Replication of Taylor et al. (1994) Task**

Analyses of the responses on the Taylor et al. (1994) task were conducted on a sample of 58 participants because one child was absent and one child did not complete the entire task. Responses to the Taylor et al. (1994) task were coding according to the guidelines in the original study. Specifically, children’s responses were coded as “today” if the child said they learned the novel color during the task or if the child said they had
not known the color yesterday; responses were coded as “before today” if children said they knew the color yesterday or indicated a specific time in the past when they learned the color (i.e., at preschool, when they were 2, etc.); responses were coded as “baby” if the child said they learned the color when they were a baby or responded affirmatively when asked if they knew the color when they were a baby. Table 8 shows the number of responses coded in each category for children in the two age groups. Contrary to the original findings by Taylor et al. (1994) four-year-olds in the present sample were more accurate in reporting when they learned the novel colors with children correctly saying they learned the color today in 66% of their responses. In contrast, children in the Taylor et al. (1994) sample only correctly reported learning the novel color today in 44% of their responses. However, children in the present study were less accurate in reporting when they learned the familiar colors with children reporting that they learned the familiar colors today (an inaccurate response for a familiar color) in 22% of their responses. Whereas children in the Taylor et al. (1994) task only reported learning the familiar colors today in 7% of their responses.

**Comparison of Episodic Recall Across Tasks**

To compare memory performance on the factual knowledge interview (i.e., the factual knowledge questions, staged-event questions, and the event-specific questions) to performance on the replication of the Taylor et al. (1994) task, the total number of correct responses on the Taylor et al. (1994) task were summed for each child. Correct responses were defined as a response of today to the two questions asking when the colors taupe and chartreuse had been learned and responding yellow and green as the colors that had
Table 8. Number of children in each age group responding today, yesterday, or baby in the replication of the Taylor et al. (1994) task.

<table>
<thead>
<tr>
<th></th>
<th>4 years</th>
<th>Baby</th>
<th>5 years</th>
<th>Before</th>
<th>Baby</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Today</strong></td>
<td></td>
<td></td>
<td><strong>Before</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Novel colors</strong></td>
<td></td>
<td></td>
<td><strong>Today</strong></td>
<td></td>
<td><strong>Before</strong></td>
</tr>
<tr>
<td>Chartreuse</td>
<td>17</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Taupe</td>
<td>18</td>
<td>2</td>
<td>9</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td><strong>Familiar colors</strong></td>
<td></td>
<td></td>
<td><strong>Today</strong></td>
<td></td>
<td><strong>Before</strong></td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>8</td>
<td>16</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Yellow</td>
<td>8</td>
<td>8</td>
<td>13</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>
been known for a longer time. Thus, the maximum number of correct responses for any child was four. Responses to questions about when the familiar colors were learned and when Barnaby’s name was learned were not counted as correct responses because they tested either familiar information that could not be verified or tested an event detail rather than a learned fact.

Children were divided into two groups, mastery and non-mastery, using the number of correct responses in the Taylor et al. (1994) task. Specifically, mastery was defined as responding correctly to all items (i.e., four questions answered correctly) and non-mastery was defined as responding incorrectly to at least one of the items. Twenty-five children were included in the mastery group ($M_{age}=5$ years, 5 months) and 33 children were included in the non-mastery group ($M_{age}=4$ years, 11 months). The mastery group was significantly older than the non-mastery group, $t(56)=3.699, p<.001$, but both groups contained children who were both four- and five-years-old.

These groups were used in a series of independent samples t-tests with performance on the factual knowledge, staged-event, and event-specific questions as the dependent variables. In addition to these analyses, a series of correlations between the number of accurate details reported (for the staged-event and event-specific questions only) and number of questions answered correctly in the Taylor task were also calculated.

**Factual knowledge Questions**

An independent samples t-test with mastery group as the independent variable and number of memories reported in response to the factual knowledge questions as the dependent variable indicated no main effect of mastery group, $t(56)=.193, p=.847$. Therefore, children in both the mastery ($M=1.64, SD=1.11$) and non-mastery ($M=1.58, SD=1.16$) groups reported similar numbers of memories.
SD=1.35) groups reported a similar number of memories in response to the factual knowledge questions. Further, the number of memories reported in responses to the factual knowledge questions was not significantly correlated with the number of correct responses in the Taylor et al. (1994) task, $r(56)= .132, p=.323$. Table 9 summarizes the number of memories reported in the factual knowledge task by each mastery group.

**Staged-event Questions**

An independent samples t-test with mastery group as the independent variable and number of memories reported in response to staged event questions as the dependent variable indicated no significant main effect of mastery group, $t(56)=.976, p=.333$. A similar analysis on number of globally accurate memories indicated that there was a marginally significant main effect of mastery group for the number of globally accurate memories that children reported, $t(56)=1.790, p=.079$, with children in the mastery group recalling more globally accurate memories than children in the non-mastery group (see table 9). There was no significant correlation between the number of questions answered correctly in the Taylor et al. (1994) task and the number of memories reported, $r(56)=.146, p=.275$, but there was a marginally significant correlation between the number of questions answered correctly on the Taylor et al. (1994) task and the number of globally accurate memories, $r(56)= .232, p=.080$.

There was a significant main effect of mastery group for the number of event-non-specific details that children who provided memories in response to the staged-event questions reported, $t(40)=2.144, p=.038$ with children in the mastery group ($M=1.92, SD=1.16$) reporting more event-non-specific details than children in the non-mastery group ($M=1.23, SD=.95$). The reverse was true for the average number of unrelated
Table 9. Mean number of memories and type of details reported for each mastery group.

<table>
<thead>
<tr>
<th>Memories reported</th>
<th>Mastery</th>
<th>Non-Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual knowledge</td>
<td>1.64(1.11)</td>
<td>1.58(1.35)</td>
</tr>
<tr>
<td>Staged-event</td>
<td>1.80(1.58)</td>
<td>1.42(1.35)</td>
</tr>
<tr>
<td>Globally accurate</td>
<td>1.60(1.68)</td>
<td>0.91(1.26)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Details reported</th>
<th>Mastery</th>
<th>Non-Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event-specific</td>
<td>0.55(0.63)</td>
<td>0.53(0.74)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>1.92(1.16)</td>
<td>1.23(0.95)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>0.30(0.44)</td>
<td>1.27(1.41)</td>
</tr>
<tr>
<td>Event-confused</td>
<td>0.01(0.06)</td>
<td>0.05(0.14)</td>
</tr>
</tbody>
</table>
details that children reported with children in the non-mastery group ($M=1.27$, $SD=1.41$) significantly more likely to report more unrelated details than children in the mastery group ($M=.30$, $SD=.44$), $t(40)=2.957, p=.005$. However, the only significant correlation was between total number of questions correct on the Taylor et al. (1994) task and the number of unrelated details reported, $r(40)=-.467, p=.002$, with children who reported more unrelated details answering fewer questions in the Taylor et al. (1994) task correctly. There were no significant main effects of mastery group or significant correlations for the event-specific, event-non-specific, or event-confused details, $ns$.

Table 9 summarizes the number of memories reported in the factual knowledge task by each mastery group.

**Event-specific Questions**

A series of one-way independent samples t-tests with mastery group as the independent variable and number of event-specific, event-non-specific, unrelated and, event-confused details that children reported in the Aleutian Islands and visual system event as the dependent variables indicated no significant main effects of mastery group for number of even-specific details (Aleutian, $t(56)=.571, p=.571$; visual, $t(56)=.076, p=.940$), event-non-specific details (Aleutian, $t(56)=.284, p=.778$; visual, $t(56)=1.329, p=.189$), unrelated details (Aleutian, no unrelated detail were reported; visual, $t(56)=.869, p=.389$), and event-confused details (Aleutian, $t(56)=1.665, p=.102$; visual, $t(56)=.869, p=.389$). Table 10 summarizes the number of event-specific, event-non-specific, unrelated, and event-confused details for each mastery group.
Table 10. Mean number of details reported in response to the event-specific questions for each mastery group.

<table>
<thead>
<tr>
<th></th>
<th>Mastery</th>
<th>Non-Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aleutian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event-specific</td>
<td>0.48(0.59)</td>
<td>0.39(0.56)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>0.08(0.28)</td>
<td>0.06(0.24)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Event-confused</td>
<td>0.08(0.28)</td>
<td>---</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event-specific</td>
<td>0.44(0.71)</td>
<td>0.42(0.83)</td>
</tr>
<tr>
<td>Event-non-specific</td>
<td>0.08(0.40)</td>
<td>0.24(0.50)</td>
</tr>
<tr>
<td>Unrelated</td>
<td>---</td>
<td>0.03(0.17)</td>
</tr>
<tr>
<td>Event-confused</td>
<td>---</td>
<td>0.03(0.17)</td>
</tr>
</tbody>
</table>
There were also no significant main effects of mastery group for number of facts reported (Aleutian, $t(56)=1.399, p=.167$; visual, $t(56)=.790, p=.433$), number of activities reported (Aleutian, $t(56)=.172, p=.864$; visual, $t(56)=.475, p=.637$), or number of items reported, (Aleutian, $t(56)=1.205, p=.233$; visual, $t(56)= 1.245, p=.218$). Similarly, there were no significant correlations between performance on the event-specific question and performance on the Taylor et al. (1994) task, $ns$. Table 11 summarizes the number of facts, items, and activities children reported in each mastery group.
Table 11. Mean number (and standard deviation) of facts, activities, and items reported and proportion of children who recalled the treasure chest or suitcase for each mastery group.

<table>
<thead>
<tr>
<th></th>
<th>Mastery</th>
<th>Non-Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aleutian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facts</td>
<td>0.76(0.52)</td>
<td>0.55(0.62)</td>
</tr>
<tr>
<td>Activities</td>
<td>0.36(0.64)</td>
<td>0.33(0.54)</td>
</tr>
<tr>
<td>Items</td>
<td>0.76(0.52)</td>
<td>0.58(0.61)</td>
</tr>
<tr>
<td>Treasure chest</td>
<td>0.64</td>
<td>0.58</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facts</td>
<td>0.16(0.37)</td>
<td>0.09(0.29)</td>
</tr>
<tr>
<td>Activities</td>
<td>0.32(0.56)</td>
<td>0.39(0.61)</td>
</tr>
<tr>
<td>Items</td>
<td>1.04(0.89)</td>
<td>0.76(0.83)</td>
</tr>
<tr>
<td>Suitcase</td>
<td>0.68</td>
<td>0.42</td>
</tr>
</tbody>
</table>
CHAPTER IV

DISCUSSION

The purpose of the present study was to assess developmental and gender differences in children’s developing ability to provide accurate memories of learning events, using different measures of recall; a traditional source monitoring task (Taylor et al., 1994), a general factual knowledge task (Bemis et al., 2011), and a staged-event task. Further, the degree to which performance on the source monitoring task was related to performance on the factual knowledge and staged-event tasks was also evaluated.

Overall findings supported the hypothesis that young children could accurately recall memories of learning events, but contrary to hypotheses there were few age differences in this ability. The findings regarding age provide a more optimistic view of four-year-olds’ ability to reflect on their own learning than previous literature would have suggested (i.e., Bartsch et al., 2003; Tang et al., 2007; Taylor et al., 1994; Sobel et al., 2007; Ziv et al., 2008). Also, while there were gender differences in the types of information that children included in their memories and in the degree to which their memories in response to the staged-event questions were accurate, contrary to original hypotheses, the direction of these differences did not always favor a female episodic-memory advantage. Finally, while there was some relationship between source monitoring ability and memory performance on both the factual knowledge and staged-event tasks, congruent with predictions source monitoring ability did not relate to all
measures of accuracy.

Similar to previous findings by Bemis et al. (2011) children were able to answer the majority of factual knowledge questions correctly. Five-year-olds answered more questions correctly than four-year-olds, but both age groups were near ceiling in their responses. Contrary, to performance on the factual knowledge questions, both four- and five-year-olds answered an equal number of the staged-event questions correctly ($M_{\text{four}}=4.3$ and $M_{\text{five}}=4.5$, max=6 ). This shows that children in both age groups learned the target material and were able to answer questions on this material correctly.

Children in each age group reported a similar number of memories in response to both the factual knowledge and staged-event questions. Thus, contrary to past research on children’s talk about learning (Bartsch et al, 2003; Sobel et al. 2007) and understanding of learning processes (Ziv et al., 2008) which indicated significant differences between five-year-olds and younger children, five-year-olds in the present study did not recollect memories of their own learning more often than four-year-olds. One reason why the performance between the five-year-olds and younger children may not have differed in the present study was that children in the younger sample were only one year younger (i.e., four-year-olds) whereas the younger children in past research have been on average closer to three years of age. Therefore, the age difference between older and younger children in the present study may not have been large enough to see significant differences. In spite of the closeness in age, the profound increase in recognition of learning that five-year-olds have exhibited in past research was not apparent in the present study. Compared to four-year-olds, five-year-olds did not show the predicted increase in recalling memories of their own learning.
Contrary to predictions, there were only minimal age differences in the length and content of children’s memories in response to the factual knowledge and staged-event questions. In fact, the only noted difference was against predictions, with five-year-olds being more likely to report not recalling the location in response to the staged-event questions. However, as noted in the results section, this was largely due to the fact that only children in the five-year-old-girl group reported not remembering the location in their memories about the staged event. Thus, the content of four- and five-year-olds’ memories about when they learned the answers to both the factual knowledge and staged-event questions was virtually identical.

However, consistent with predictions and the findings of Bemis et al. (2011), when answering the factual knowledge questions children of both ages recalled significantly fewer memories that occurred in the classroom compared to other locations (i.e., home, other). This indicates that for young children the classroom may still not be the dominant learning location because children were more likely to report learning answers in other locations. This could be due to the fact that the factual knowledge questions tested general knowledge and much of this knowledge may be acquired in children’s daily activities rather than specifically taught in the classroom.

Regarding the types of memories that children reported, as predicted in response to the factual knowledge questions older children provided more memories that were consistent with episodic whereas younger children reported more memories that were coded as general. This indicates that older children were more able to recall a memory that was likely to be a one-moment-in-time event. However, in contrast with Bemis et al. (2011) where the majority of children’s memories were of specific one-moment-in-time
events ($M=.77$), the largest percentage of children’s memories to the factual knowledge questions in the present study were not specific ($M=.46$). This could be due to the fact that having to recollect memories from the staged events made it more difficult for children to recall their own naturally occurring memories of learning. Indeed, the proportion of memory types for the staged-event questions show a pattern that is more congruent with the findings of Bemis et al. (2011) with the majority of memories that children recalled coded as specific ($M=.52$) This indicates that the staged-events may have been more salient to children and perhaps recalling them interfered with their ability to provide specific memories of, possibly more distant, naturally occurring memories.

In addition to similarities in the content and type of memories recalled, four- and five-year-olds also recalled memories that were similar in their degree of accuracy in response to the staged-event questions. As anticipated even four-year-olds in the present study could provide accurate memories of how they learned the target facts in the staged learned events. In fact, they provided an average of 1.60 accurate memories out of a possible 6 memories. Yet, contrary to hypotheses four-year-olds provided a similar number of globally accurate memories as five-year-olds ($M=1.88$) and both age groups provided a similar number of accurate, event-specific details ($M_{four}=.64$ and $M_{five}=.43$) and accurate, event-non-specific details ($M_{four}=1.32$ and $M_{five}=1.78$) in response to the staged-event questions. Both of these findings are in stark contrast to the findings from the source monitoring literature (i.e., Esbensen et al., 1997; Leichtman et al., 2000a; Tang et al. 2007; Taylor et al., 1994). Leichtman et al. (2000a) have indicated that four-year-olds have significant difficulty recognizing how they learned a piece of recently learned information. Further, in the original study by Taylor et al. (1994) and in several
subsequent replications and extensions of this study by Esbensen et al. (1997) and Tang et al. (2007), when young children are asked to indicate when they learned a novel fact they tend to erroneously claim that they have known it for a very long time, even when they were a baby.

Indeed some of the four-year-olds in the present study claimed to not remember when they learned the novel fact and some were inaccurate in the memories that they reported. However, when children were inaccurate they tended to provide a specific event connected to their own knowledge, rather than just saying that they had always known the fact or had known it when they were a baby. For example, one four-year-old girl said that she knew that the retina was the part at the back of the eye because, “We were camping. Mommy and Daddy knowed that you were coming. I hear ‘cause Grampy said, ‘You’re going to school and you’re gonna learn about brain and eyes’.” Clearly this memory does not describe the staged learning event where the child learned about the parts of the eye, but it is a clear event where the child is reflecting on her own learning, albeit inaccurately. In contrast to this inaccurate memory, 75% of four-year-olds who reporting recalling a memory in response to the staged-event questions provide at least one memory that was clearly an accurate description of the staged learning event. For example, in response to the same question about the retina, another four-year-old girl said that she knew the answer because, “Because I go with her [Rhy] and then she told me it’s up to the retina…. [I was] right here, right there… I was walking around on the body.”

In addition to being able to simply recall globally accurate memories, four-year-olds were as able as five-year-olds to provide accurate details in their memories. This was contrary to original hypotheses because research on source monitoring has indicated that
five-year-olds generally outperform four-year-olds in their ability to accurately report on how and when they learned information (Esbensen et al., 1997; Taylor et al., 1994; Tang et al., 2007). Further, unlike younger children, five-year-olds have been shown to be more aware of the connection between knowledge and its source (Leichtman et al., 2000), to be more likely to talk about how they learned in their natural conversations, and to recognize the intentional nature of learning (Sobel et al., 2007; Ziv et al., 2008). This increased awareness of learning would have made it likely that five-year-olds would have been more attuned to the learning events and would have increased ability to accurately report on the specific details in these events. However, not only did five-year-olds provide a similar number of accurate memories as four-year-olds, their memories also contained a similar level of detail. For example in response to the previously mentioned question about the retina, a five-year-old girl reported that she knew the answer because, “We were down in the art room with …. I don’t remember her name the same the girl that you know that teaches…. [I heard] her words.” Although this memory was given by a five-year-old, it is remarkably similar to the memories that were reported by children who were four-years-old.

While there were no age differences in children’s level of accuracy, there were significant gender differences. Contrary to hypotheses most gender differences in response to the staged-event questions favored boys. Boys were more likely to provide accurate, but event-non-specific (i.e., details that were accurate but could pertain to either event), details of the events and were more likely to correctly say that they learned the target information in the staged-event rather than another location. Further, boys were more likely to provide memories that were coded as consistent with specific on the
factual knowledge questions. These findings seemingly contradict the findings that women outperform men on a variety of episodic memory tasks (Herlitz & Yonker, 2002; Lewin et al., 2001) and that they tend to be more likely to provide detailed episodic memories in interview settings (Buckner & Fivush, 1998; Pillemer et al., 2003), in the classroom (Leichtman et al. 2011; Leichtman et al., 2007), and in their natural speech (Leichtman et al., 2008). Given these findings, it would seem likely that girls would provide more accurate and detail-rich episodic memories of the staged learning events.

There are two possible reasons why boys may have provided more accurate details and why they were more able to correctly report learning the target material in the staged learning events. The first is that they were less likely to be distracted by other unrelated details in the staged-events. In fact, girls did recall these unrelated details significantly more often than boys. These details were not always inaccurate, but their accuracy could not be verified and they were not the central components of the event and did not relate at all to the information being presented. For example, one five-year-old girl reported remembering that, “I had to blow my nose” during one of the events and another four-year-old girl reported that “I remember a little thing one of the kids actually opened up the same one we already did about the Aleutian Islands and she brought out her green suitcase” when asked about what happened during the learning event. In both cases, these details could have been accurate, but had nothing to do with the material being learned and actually could have served to distract the girls from the central learning events, making it more difficult for them to connect the event to their own learning.

Indeed, research on text processing in older students has indicated that irrelevant, “seductive,” details can inhibit students’ ability to comprehend and recall the target
information in the text (Harp & Mayer, 1998). A similar phenomenon could have been occurring with the girls in the present study in that they recalled irrelevant details that interfered with their ability to recall the most relevant and meaningful details of the event.

The second reason why boys may have been more accurate in their memory reports is that they were less likely than girls to report memories of other learning events in response to the factual knowledge questions and thus were less likely to confuse these events with the staged-events. In contrast, girls recalled more memories in response to the factual knowledge questions, making it more likely that they could have experienced an interference effect where they confused their memories of when they learned the answers to the factual knowledge questions with when they learned the material in the staged-events. In fact, girls were more likely than boys to provide more unrelated details because the details were part of a memory that was completely inaccurate. For example, one four-year-old girl reported remembering that the occipital lobe helps us know what we see because, “I was in his [her brother’s] room … I was jumping on his bed.” Girls may have been more likely to recall memories like these in response to the staged-event questions because they were providing similar naturalistic memories in response to the factual knowledge questions. So, essentially when girls were asked how they learned the answer to a staged-event question, they considered three possible alternatives: that they did not remember how they learned the answer, that they learned the answer in the staged event, or that they learned the answer in some other event. In contrast, the fact that boys reported so few memories in response to the factual knowledge questions make it more likely that when they were asked how they learned the answer to the staged-event
question they failed to consider that they could have learned the information in any other location and instead made a more dichotomous choice, deciding whether they learned the material in the staged-event or not.

It is possible that girls experienced more interference from their memories in response to factual knowledge questions because they were more inclined to thoroughly search for episodic memories. This more exhaustive search for episodic memories could have been due to the fact that girls were trying to be more compliant to the experimenter’s request to consider whether they remembered the moment that they learned the answer or did not remember or that the primarily verbal nature of the interview favored both the language skills and attention span of girls. However, it should be noted that both boys and girls were informed in the training task that not remembering was an acceptable response, and both boys and girls did report not remembering for a substantial proportion of their answers. Finally, it is possible that the predominately visual nature of the learning events could have been more memorable to boys and could explain why they recalled more details of these events.

These gender differences in accuracy in response to the staged-event questions were not due to the fact that girls had difficulty remember the specific details of the learning event when asked about them specifically. In fact, the only gender difference on event-specific questions was relatively small and pertained to a specific aspect of the visual event only with boys more often recalling the suitcase when asked what Rhy brought to carry all of her things in during the visual system event.

Overall, children in both age and gender groups recalled many aspects of the learning event when asked specifically about them. As predicted the interactive
components of the events were particularly well-remembered, with a significant percentage of children recalling the large mat or walking on the large mat when asked about what objects were in the event or about activities they had done. Regarding factual information, a significant percentage of children remembered that you had to fly in an air taxi to get to the Aleutian Islands. Recall of this fact may have been enhanced by the fact that it was very concrete and that children in this age range may have been drawn to facts surrounding methods of transportation.

Overall the findings from the memory interview indicate that children were able to provide memories of learning events and were able to do so with some degree of accuracy regardless of their age. However, another central question of the present study was the degree to which children’s performance on the factual knowledge interview was related to their performance on the traditional source monitoring task developed by Taylor et al. (1994). The children in the present study did replicate the overall pattern of findings in the Taylor et al. (1994) task, with some children in each age group erroneously claiming to have learned the novel color when they were a baby. Yet, more children in the present study (66% in the present replication vs. 44% in the Taylor et al. (1994) task) were accurate in reporting that they had learned the novel color just today. This could be due to the fact that children completed the Taylor et al. (1994) task after the factual knowledge interview and thus could have been made more aware of their own learning processes simply in completing this interview. It is also possible that since children had completed two study sessions prior to the Taylor et al. (1994) where they learned new facts and then talked about them, that they were more likely to attribute any learning to a recent event. Indeed, unlike in the original study, children in the present
replication of the Taylor et al. (1994) task were also more likely (22% in the present replication and 7% in the Taylor et al. (1994) task) to report learning the familiar colors today (an inaccurate response since children had known these colors prior to the task). Thus, it is possible that children in the present study struggled with when they learned the colors, but were more likely to use “I learned it today” as a sort of default answer when they were uncertain because they had been spending so much time in recent weeks talking about learning new facts.

In spite of children’s increased ability to correctly determine when they learned the novel colors, it was still possible to divide children into one group that showed clear mastery on the task and one group that did not. In fact, there were more children in the non-mastery group (n=33) than in the mastery group (n=25). This indicates that many children were able to answer one of the novel color questions correctly, but that their ability to accurately reflect on their own learning was fragile in that they could not answer all of the questions correctly. Further, even though children in mastery group were significantly older ($M= 5$ year 5, months) than children in the non-mastery group ($M= 4$ years, 11 months), there were both older and younger children in each of the two mastery groups. In fact, the maximum age in each group was 6 years, 1 month. Thus, it was not the case that mastery group reflected only the age of the child.

Similar to the findings between the two age groups, there were few significant differences due to source monitoring mastery. In fact, the only significant differences between mastery groups were in the number of details that children reported in their memories given in response to the staged-event questions. Children in the mastery group reported more accurate, event-non-specific details (i.e., detail that were correct but could
pertain to either event) and in contrast, children in the non-mastery group reported more inaccurate, unrelated details (i.e., details that were inaccurate because they were not part of the scripted event). Thus, source monitoring ability played a role in children’s degree of accuracy in that children who had matured source monitoring skills (as shown by their mastery status) provided more accurate details and children who had immature source monitoring ability (as shown by their non-mastery statues) provided more inaccurate details. This is consistent with past research showing that children who are able to effectively source monitor are more likely to resist misleading information and provide more accurate memories (Leichtman et al., 2000). However, contrary to what would have been predicted by most of the source monitoring literature (i.e., Esbensen et al., 1997; Taylor et al., 1994; Tang et al., 2007) there was only a marginally significant difference between the two mastery groups in the number of globally accurate memories that they provided. Yet, consistent with predictions based on the finding by Bemis et al. (2011) that four-year-olds did report memories of learning events, children in the present study could provide accurate memories in response to the staged-event questions without matured source monitoring skills. Further, there were also no differences between the mastery groups and the number of memories that they provided in either the staged-event or factual knowledge questions indicating that children may be able to reflect on some details of their own learning (i.e., details of who, what and where) before they are able to reflect on when learning occurred.

The findings of the present study support a nuanced view of memory development in that children’s ability to reflect on when they learned a piece of information did not perfectly predict their ability to reflect on other details of the learning event. This is
congruent with past findings on children’s spontaneous speech indicating that utterances of when learning occurred were the last to emerge (Sobel et al., 2007). However, as the present study illustrates, preschoolers are able to accurately recall salient learning events before they show clear mastery in their ability to identify when this learning occur. Since many source monitoring paradigms (i.e., Esbensen et al., 1997; Tang et al., 2007; Taylor et al., 1994) have focused on details of when learning occurred, they may have underestimated preschoolers’ ability to reflect on their own learning. Indeed, tasks that focus more on how learning occurred (i.e., Gopnik & Graf, 1988) have found four-year-olds to be relatively capable. Future research should address, more specifically, the degree to which the ability to report on when learning occurred is related to the ability to report on how learning occurred.

A central limitation of the present study was that the sample consisted of children who were from relatively well-educated families, indicative of a high socioeconomic status. These children were likely to be familiar with school-like events, similar to the staged-learning events in the present study. Thus, children in the present sample may have recalled these events more easily than the general population. Further, children in the present sample all had some past experience with both schooling and conversations about school and the learning process. Therefore, these children may have been more comfortable in the interview, specifically answering test-like questions about their own learning. Future research should be conducted with children from a more diverse sample who have less experience and exposure to formal education.

The findings of the present study have implications for early-childhood educators in that they illustrate that young children are at least modestly able to reflect on their own
learning. Due to this emerging ability, young children could benefit from conversations focused on their memories of learning events. Indeed, the findings of the present study indicate that young children are ready and able to discuss their own learning. Early childhood teachers could implement classroom conversations designed to engage young children in meaningful discussion about their own learning, focusing on the details that appear to be especially salient to young children, such as what was learned, who was there, and where learning occurred. These conversations could enable young children to become more aware of their own learning processes and to more readily connect their knowledge with its source. The results of the present study indicate that this increased metacognitive awareness is an emerging skill in the preschool years and encouraging its development could be an important goal of early childhood curricula.

In addition to supporting metacognitive development, engaging young children in the process of recalling episodic memories of learning could promote greater retention of material. Similar to findings in older students (i.e., Conway et al., 1997; Leichtman et al., 2010), the majority of responses (88% of responses to staged-event questions and 99% of responses to factual knowledge questions) where children claimed to have remembered a learning event were correct. Further, the number of correct responses that children gave in response to the staged-event questions was positively correlated with several measures of memory accuracy, including the number of globally accurate memories and the average number of event-specific and event-non-specific details. All of these results indicate that recalling episodic memories and providing accurate memories was related to children’s ability to accurately recall factual information. This could indicate that, consistent with the findings of Conway et al. (1997), recalling salient episodic memories
of learning may facilitate children’s ability to integrate information into their general knowledge base (i.e., “the remember to know shift “ (Conway et al., 1997, p.408)). However, it should be noted that in order for the recollection of episodic memories to promote greater retention of material, the events must be clearly related to the target fact, such that recalling the event highlights the learned fact. In the present study, the learning events were carefully designed to highlight and reinforce specific target facts so that if children remembered any aspect of the event it would be clearly connected to a piece of target information. This could be why recalling the event was associated with correct responding in the present study. Thus, for recalling episodic memories of learning events to be a successful recall strategy in children’s classroom learning, educators should be concerned with designed episodes that reinforce the sole learning objectives.

Overall, the young children in the present study demonstrated the ability to accurately recall episodic memories of learning. This indicates that the ability to reflect on one’s own learning may be more nuanced than was previously believed. While preschoolers do indeed appear to struggle to indicate exactly when they learned a piece of information, they also appear to be aware of many other details of the learning event. Further, since the preschool years represent a particularly important period for developing awareness of one’s own learning process, educators could promote this development by offering young children the opportunity to reflect on salient classroom learning events. Such opportunities would likely enable preschoolers to become increasingly able to engage in metacognition and to become more aware of themselves as learners.
REFERENCES


APPENDICES
APPENDIX A

SCRIPT FOR LEARNING EVENTS
Learning Event 1: The visual system
The experimenter will show a picture of the eye (2D) and will point out the main structures (the retina and the optic nerve which connects to the brain). The experimenter will then bring in a model of the brain and point out the two different parts involved in vision (the thalamus, the occipital lobe). Then the experimenter will say that the parts in the eye and the parts in the brain work together to get things we see to the occipital lobe in the brain which actually does the thinking and let us know what we are seeing. The experimenter will lay a large picture of visual system (eye and brain) on the floor (drawn on a shower curtain show that it is “step proof”) Children will be asked to walk across the picture to imitate the movement of information from the eye to the brain, and will also be asked to label each “part” they are in.

New information presented:
The Retina is at the back of the eye
The Optic nerve connects the eye to the brain
The Thalamus is in the middle of the brain
Occipital lobe processes (makes sense of) visual information

Target facts (asked about in questions):
Optic nerve connects the brain and the eye
The occipital lobe helps us know what we see (it does the thinking)
The retina is at the back of the eye

Learning event 2: The Aleutian Islands
The experimenter will bring out a globe (3D) with the Islands circled on it and point out that the islands are surrounded by two large bodies of water (the Bering Sea and the Pacific Ocean). Then the experimenter will show children a map (2D) and say that the islands are a part of the state of Alaska but are really far away from it. To get to the islands you have to take an air taxi (a special small plane that can only move a few people at a time) from the state of Alaska. The experimenter will then lay out an enlarged map of Alaska, the Aleutian Islands, and the Pacific ocean an the Bering sea (printed on a shower curtain) and will tell children that they are going to pretend to get in an air taxi and travel to the Aleutian Islands. The children will then travel from the state of Alaska across the Bering Sea, will land on the Islands and look at the Pacific ocean, labeling each landmark as they go.

New information presented
Islands are next to the Pacific ocean
Islands are next to the Bering sea
Islands are part of Alaska
You have ride in an Air taxi to get to the islands

Target facts (asked about in questions)
The Aleutian Islands are part of the state of Alaska
To get to the Aleutian Islands you have to ride in an air taxi
The Aleutian Islands are surrounded by the Pacific ocean
APPENDIX B

STAGED-EVENT QUESTIONS
All age groups will receive the same questions

What connects the eye to the brain? The optic nerve or the cochlear nerve (optic nerve).

Is the back of the eye called the retina or the lens? (Retina)

Does the occipital lobe help us know what we see or hear? (see)

The Aleutian Islands are part of what state? Alaska or Hawaii (Alaska)

What do you have to travel in to get to the Aleutian Islands? A boat or an air taxi? (air taxi)

Are the Aleutian Islands next to the Atlantic ocean or the Pacific Ocean? (Pacific)
APPENDIX C

INTERVIEW SCRIPT AND EVENT-SPECIFIC QUESTIONS
Scripted interview for factual knowledge and staged-event questions:

Did you know the answer or did you guess?

Do you remember the moment when you learned that answer or do you not remember?

For your answer you said that (answer). Can you tell me everything that you remember about the moment when you learned that answer?

*If remember:* Can you tell me everything that you remember about the moment you learned the answer?

Follow-up questions:
1. How old were you?
2. Who was there?
3. Where were you?
4. What happened when you learned the answer?
5. What did you see and hear when this happened?

Event-specific questions:

*Aleutian Islands open-ended question:*
I heard Rhy came to your class and taught you and other children about the where Aleutian Islands are and how you can get to them. Can you tell me everything that you can remember about the time that she came to teach you about the Aleutian Islands?

*Aleutian Islands follow-up questions:*
1. What did you learn about where the Aleutian Islands are and how you can get to them?
2. What kind of things did you do to help you learn about the Aleutian Islands?
3. What things did Rhy bring to help you learn about the Aleutian Islands?
4. What did Rhy bring to carry all of her things in when she taught you about the Aleutian Islands?

*Visual system open-ended question:*
I heard Rhy came to your class and taught you and other children about how our eyes work with our brain to help us know what we see. Can you tell me everything that you can remember about the time that she came to teach you about the eyes and the brain?

*Visual system follow-up questions:*

100
1. What did you learn about how our eyes work with our brain to help us know what we see?
2. What kind of things did you do to help you learn about the eyes and the brain?
3. What things did Rhy bring to help you learn about the eyes and the brain?
4. What did Rhy bring to carry all of her things in when she taught you about the eyes and the brain?
APPENDIX D

ACCURACY CODING CATEGORIES
Categories of details for staged-event and open-ended event-specific questions about the Aleutian Islands

### Event-specific
- Globe Ball
- Map
- Walking on Islands
- Spoken Fact about Islands
- Specific Dialogue about Island event
- Treasure Chest/specific time statement
- Specifics about location
- Specific about people

**TOTAL**

### Event-non-specific
- General Object (e.g., notecards)
- Picture (without specification)
- Walking on Mat General
- Talked about things (not specifics)
- General Dialogue
- Something to carry items
- General location
- General people

**TOTAL**

### Unrelated
- Unrelated object
- Unrelated picture
- Unrelated action
- Stated Factual Information
- Unrelated Dialogue
- Unrelated time
- Unrelated location (if most details unrelated)
- Unrelated people (if most details unrelated)

**TOTAL**

### Confused-events
- Brain model
- Picture of eye
- Walking on brain/eye/body
- Spoken fact about eyes and brain
- Specific dialogue about other
- Suitcase or incorrect (bag)
- Incorrect location
- Incorrect people

**TOTAL**

103
Categories of details for staged-event and open-ended event-specific questions about the visual system.

<table>
<thead>
<tr>
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<th>Event-non-specific</th>
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<tr>
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</tr>
<tr>
<td>_Picture of eye</td>
<td>_Picture (without specification)</td>
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<tr>
<td>_Walking on brain/eye/body</td>
<td>_Walking on Mat General</td>
</tr>
<tr>
<td>_Spoken Fact about eyes and brain</td>
<td>_Talked about things (not specifics)</td>
</tr>
<tr>
<td>_Specific Dialogue about eyes and brain event</td>
<td>_General Dialogue</td>
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<tr>
<td>_Suitcase/specific time statement</td>
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<td>_Specifics about location</td>
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<td>_Specific about people</td>
<td>_General people</td>
</tr>
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<table>
<thead>
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<th>Confused-events</th>
</tr>
</thead>
<tbody>
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<td>_Globe ball</td>
</tr>
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<td>_Unrelated picture</td>
<td>_Map</td>
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<td>_Unrelated action</td>
<td>_Walking on Islands</td>
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<td>_Spoken fact about Islands</td>
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<td>_Unrelated Dialogue</td>
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<td>TOTAL</td>
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</tbody>
</table>
Categories of details reported to event-specific follow-up questions

**Aleutian Islands**

1. What did you learn about where the Aleutian Islands are and how you can get to them?
   - Islands are next to the Pacific ocean
   - Islands are next to the Bering sea
   - Islands are part of Alaska
   - Islands are very far away
   - You have ride in an Air taxi to get to the islands

2. What kind of things did you do to help you learn about the Aleutian Islands?
   - Walked on mat
   - Looked at globe
   - Looked at map/picture
   - Told us about it/showed us stuff

3. What things did Rhy bring to help you learn about the Aleutian Islands?
   - Globe/Ball
   - Map/Picture of Alaska
   - Mat/Big picture of Alaska
   - Treasure Chest
   - Notecards/clipboard

4. What did Rhy bring to carry all of her things in when she taught you about the Aleutian Islands?
   - Treasure chest (any mention)

**Visual system**

1. What did you learn about how our eyes work with our brain to help us know what we see?
   - The Retina is at the back of the eye
   - The Optic nerve connects the eye to the brain
   - The Thalamus is in the middle of the brain
   - Eyes and the brain work together to help us know what we see
   - Occipital lobe processes (makes sense of) visual information

2. What kind of things did you do to help you learn about the eyes and the brain?
   - Walked on mat
   - Looked at brain
   - Looked at picture of eye
   - Told us about it/showed us stuff

3. What things did Rhy bring to help you learn about the eyes and the brain?
   - Model brain
   - Picture of eye
   - Mat/Big picture of eye and brain
   - Suitcase
4. What did Rhy bring to carry all of her things in when she taught you about the eyes and the brain?
   __Suitcase (any mention)
APPENDIX E

IRB APPROVAL LETTER
29-Mar-2010

Bemis, Rhyannon
Psychology, Conant
60 Silver Street, Apt. 2
Dover, NH 03820

IRB #: 4846
Study: Developmental and gender differences in children's episodic memories of learning events during the early school years
Approval Date: 25-Mar-2010

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study as Expedited as described in Title 45, Code of Federal Regulations (CFR), Part 46, Subsection 110 with the following comment(s):

Before starting the study in a site, the researcher needs to forward to the IRB for the file a copy of the letter from the principal/director in support of the study.

Approval is granted to conduct your study as described in your protocol for one year from the approval date above. At the end of the approval date you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the attached document, Responsibilities of Directors of Research Studies Involving Human Subjects. (This document is also available at http://www.unh.edu/osr/compliance/irb.htm). Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Manager

cc: File
    Leichtman, Michelle