ABSTRACT

BROWN, BENJAMIN T. The Content and Structure of Autobiographical Memories in Children With and Without Asperger Syndrome. (Under the direction of Lynne Baker-Ward.)

Severe difficulty in interacting with others is a defining characteristic of autism spectrum disorders. In addition, even high-functioning children with autism, such as those with Asperger Syndrome, demonstrate significant delays in Theory of Mind. Nelson and Fivush's (2004) comprehensive model of the development of autobiographical memory assigns central importance to the child's social interactions and emerging theory of mind. Children with Asperger Syndrome, however, have normal IQs and show no language delays. Thus, there was reason to suspect that children with Asperger Syndrome would show differences in their autobiographical memories when compared to typically developing children. A better understanding of the strengths and weaknesses in autobiographical memory found in children with Asperger Syndrome will help future intervention efforts. The present investigation examined the factors that influence the content and structure of emotional memory narratives in 7- to 13-year-old children with and without Asperger Syndrome. Children with Asperger Syndrome had a particularly difficult time self-generating negative memory narratives compared to their typically developing peers. Typically developing children infused a good deal of positive emotion in their self-generated negative memories, whereas children with Asperger syndrome did not. Children with Asperger Syndrome were also more likely to include negative emotions such as fear and anxiety in their narratives, regardless of memory type, than typically developing children. This group difference disappears when controlling for working memory, suggesting that children with higher levels of working memory are

more likely to be able to bring meaning to an event for themselves. Finally, children with Asperger Syndrome provided less coherent memory narratives than their typically developing peers. Together, these findings suggest that children with Asperger Syndrome may be engaging less frequently in meaning-making activities.

The Content and Structure of Autobiographical Memories in Children with and without Asperger Syndrome

by
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Biography

Benjamin Brown grew up in Albuquerque, Las Cruces, and Roswell, New Mexico before moving to Memphis, Tennessee for his high school years. In 2001, he graduated from the University of New Mexico in Albuquerque with a B.A. in Psychology. In 2002, he enrolled in a combined M.S. and Ph.D. program in developmental psychology at North Carolina State University in Raleigh. In 2004, he graduated with a M.S. in Psychology. Ben is a member of the Society for Research in Child Development, the Cognitive Development Society, and the Association for Psychological Science.

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The Content and Structure of Autobiographical Memories in Children With and Without Asperger Syndrome

A hallmark of human development is the achievement of autobiographical memory, defined as "declarative, explicit memory for specific points in the past, recalled from the unique perspective of the self in relation to others" (Nelson & Fivush, 2004, p. 488). Autobiographical memory allows and reflects the ability of the individual to plan for the present and future, helps to establish a continuous sense of self, and aids in forming and maintaining relationships (Pillemer, 2003). This last function of autobiographical memory is perhaps the most significant, given the fundamentally social nature of humans. As stated by Fivush and Nelson, "The achievement of an autobiographical memory system sets the stage for the intergenerational transmission of family and cultural history, which is the bedrock of human culture" (2004, p. 577).

Having the ability to store and retrieve personal memories at will is a skill that most humans beyond early childhood take for granted. Yet, there appears to be a good deal of variability among different populations in their abilities to remember autobiographical events. Notable differences are found in autobiographical memory performance among children with and without autism, a developmental disability characterized by abnormal development of communication, social, and language skills. For example, unlike their typically developing peers, children with autism show better memory for a passively observed event than an event they personally experienced (Millward, Powell, Messer, & Jordan, 2000). Given the importance of autobiographical memory in forming and maintaining relationships, it is not surprising that autism is characterized by extreme difficulties with social interactions. The development of

autobiographical memory has been disrupted in these individuals and the question is, how?

The Emergence of Autobiographical Memory

According to Nelson and Fivush (2004), the slow emergence of autobiographical memory is guided across the childhood years by a number of concurrently developing, interacting components involving both cognitive functions (e.g., self concept, language, and theory of mind) and social interactions (e.g., joint reminiscing about the past and conversations about future events) (see Figure 1).

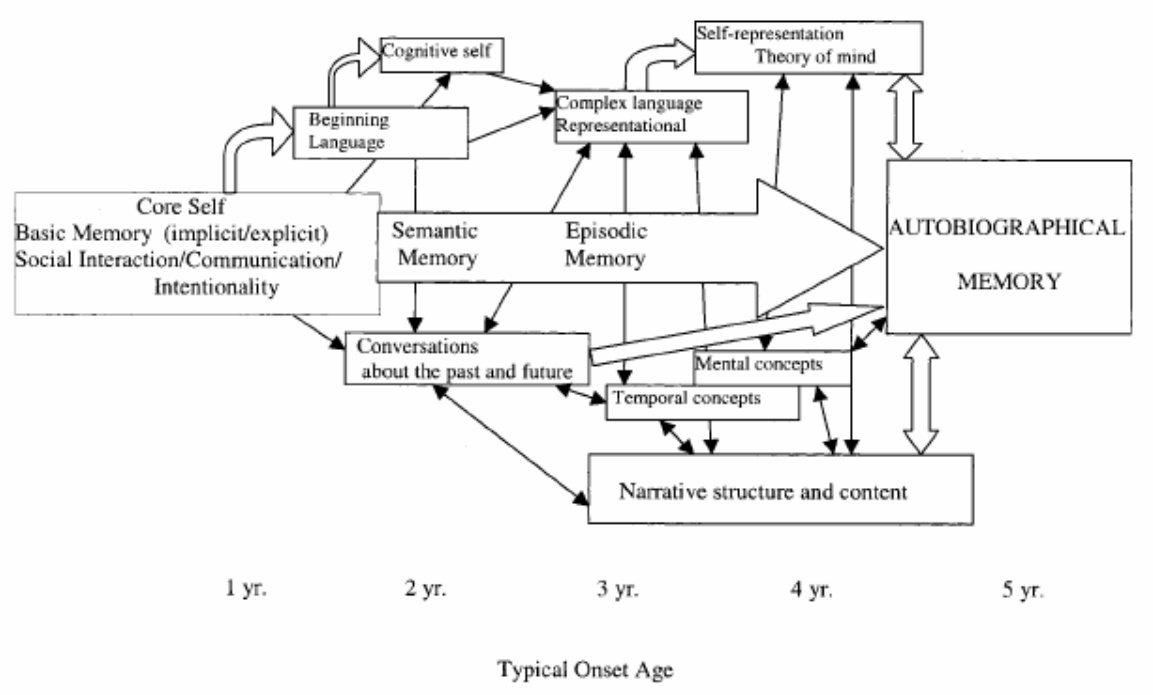

Figure 1. "Hypothetical relations in developments from 1 to 5 years of age leading to the emergence of autobiographical memory. Large arrows indicate more direct influence; double-headed arrows indicate reciprocal influences. Years (yr.) in the bottom scale indicate approximate age when influences come into play on average in normal development. Areas above the center are presumed to be endogenous and those below more exogenous as sources of development" (Nelson & Fivush, 2004, p. 490)

During infancy and early childhood, the development of basic memory processes (e.g. explicit and then episodic memory) and other primarily maturational changes are posited to exert a strong, causal influence on the development of autobiographical memory. However, social and cognitive factors are also theorized to make substantial contributions to individual differences in the emergence of autobiographical memory (for a full discussion of their theory, see Nelson and Fivush, 2004). Cognitive, social, and cultural factors all interact in complex ways to bring about the development of autobiographical memory. Individual differences are expected in the development of the factors identified above, with these differences, both in timing and quality, having an impact on the emergence of autobiographical memory. Given this, the development of autobiographical memory should be disrupted in special populations that display delays and/or deficiencies in the development of these cognitive and social factors. Thus, it was expected that comparing typically developing children and those with Asperger Syndrome, a population that is already impaired in certain social domains, would reveal a number of important differences in their autobiographical memories.

Diagnostic Criteria for Asperger Syndrome

Asperger Syndrome is a developmental disorder that falls under the banner of autism spectrum disorders. The DSM-IV (American Psychiatric Association, 1994) criteria for a diagnosis of Asperger Syndrome include: (1) An impairment in social interactions; (2) Restrictive, repetitive, and stereotyped patterns of behavior, interests, and activities; (3) No clinically significant general delay in language development; and (4) No clinically significant delay in cognitive development. The third and fourth requirements are what distinguish a diagnosis of Asperger Syndrome from that of autism.

Because individuals with Asperger Syndrome do not display delays in language and cognitive development, they provide an ideal comparison group to typically developing children. In this case, such a comparison may reveal the influence that social interactions have on the development of autobiographical memory.

The social interaction impairment seen in Asperger Syndrome is often observable in a number of ways. Individuals with the Syndrome often have difficulty engaging in nonverbal social behaviors, such as maintaining eye contact, regulating facial expressions, and using gestures. These problems no doubt contribute to the failure with peer relationships that individuals with Asperger Syndrome often experience. A lack of interest in communicating interests and feelings is also common, as is a lack of emotional reciprocity (American Psychiatric Association, 1994). Given these deficits, children with Asperger Syndrome should have great difficulty engaging in conversations about the past and future, an activity that Nelson and Fivush (2004) identify as vital to the development of autobiographical memory. As will now be discussed, individuals with Asperger Syndrome also show delays and/or deficits in other components of the Nelson and Fivush (2004) model.

Language in Children With and Without Asperger Syndrome

By the second year, typically developing children have some beginning skill with language comprehension and expression. Being able to attach language labels to objects and actions allows for better retention. In order to use scripts to refer to past events, as discussed above, some level of language competency is necessary. By two years of age, children are able to construct short sentences, but references to the past still require guidance and interpretation by parents (Nelson & Ross, 1980). When asked to recall

specific events, children between the ages of two and three are generally better able to remember aspects of events that have been specifically scaffolded by parents through language than those that occurred without such facilitation (e.g. Haden, Ornstein, Eckerman, & Didow, 2001; Tessler & Nelson, 1994). As noted above, the DSM-IV requires that there are no delays or deficits in language development for a diagnosis of Asperger Syndrome. Thus, it is not expected that there would be any language differences between these groups.

Conversations About the Past and Future in Children With and Without Asperger Syndrome

A good deal of evidence has emerged indicating that the way in which parents, particularly mothers, talk to their children about past events shapes children's later autobiographical skills (e.g. Fivush & Fromhoff, 1988). The most common finding is that children with "high elaborative" mothers, defined as those who provide more detail in conversations with their children, remember more than children with less elaborative mothers. Harley and Reese (1999) followed mothers and their 18-, 24-, and 30-month-old children longitudinally. Mothers generally showed stability in their level of elaboration across all time points. More importantly, children of elaborative mothers paid more attention, which translated to better recall as the children aged. Engaging in conversations about the past and future not only aids subsequent recall, but may also develop autobiographical skills in other ways. Through these conversations, children may be socialized to understand what sorts of events are important to remember. Not only that, but children will learn appropriate ways to structure their recollections. Additionally, conversations about the past and future foster the child's developing understanding of

temporal concepts. Inevitably, when engaging in conversations about the past, mothers and children will inevitably remember events differently (Fivush, Haden, & Reese, 2006). Such situations help to highlight the distinction between mental states of self and other, spurring the development of Theory of Mind.

Opportunities to engage in social interactions may represent the clearest distinction between typically developing children and those with Asperger Syndrome. As described above, children with Asperger Syndrome are likely to show impairments in social interactions such as eye gaze, social reciprocity, and peer relationships. Compared to those with other autism spectrum disorders, individuals with Asperger Syndrome are more aware of other people and more likely to desire to be a part of the social world (Church, Alisanski, & Amanullah, 2000). Despite this interest, they are often unsuccessful in their attempts at social interactions (Williams, 1995). These failures can be attributed to their inability to decode social phenomena and their lack of appropriate social behavior (Volkmar, Klin, Schultz, Rubin, & Bronen, 2000). Because children with Asperger Syndrome have difficulties engaging in social interactions, they have fewer opportunities for joint reminiscing than do typically developing children, likely leading to lesser consolidation of memories, limited scaffolding of personal narratives, and a lesser understanding of narrative structure. If so, children with Asperger Syndrome would be less likely to reminisce with others about their personal experiences than typically developing children and hence these memories would be less available to children with Asperger Syndrome for discussion in the future.

Theory of Mind in Children With and Without Asperger Syndrome

Theory of Mind is defined broadly as the ability to attribute mental states to others. Children by about four years of age begin to understand that both they themselves and others can have false beliefs (Wellman, Cross, & Watson, 2001). There is a good deal of variability in theory of mind development, however. Dunn and Slomkowski (1992), for example, found that the amount of talk in families regarding conflicts predicts children's theory of mind development. Through such conversations about past conflicts, children develop an understanding that people do not always share the same memories and mental states surrounding an event. In addition, interactions with peers outside the home can help to foster the development of theory of mind (Dunn, Cutting, & Fisher, 2002). Developing Theory of Mind depends upon an understanding of mental concepts such as thoughts, emotions, and motivations. This understanding is likely the product of extensive conversations about past events. Understanding that you may have a unique perspective of an event is key to developing autobiographical memories.

Whereas Theory of Mind appears to be impaired in individuals with Asperger Syndrome, this deficit appears to be less severe than is generally seen among those with autism (Ozonoff, Rogers, & Pennington, 1991). Although children with Asperger Syndrome show delays compared to typical children, there is evidence that these children can attain a well-developed Theory of Mind (Bowler, 1992). Asperger individuals still generally do well when presented with more difficult "second-order" theory of mind tasks. These tasks require participants to consider what one person thinks about another person's thought processes. Kaland, Moller-Nielsen, Callesen, et al. (2002) found that

almost all of the children and adolescents with Asperger Syndrome in their study were able to pass second-order Theory of Mind tasks.

There is evidence, however, that Theory of Mind in Asperger Syndrome does not operate the same way as it does in typical populations. Theory of Mind in Asperger Syndrome is described as being an effortful, controlled process, in contrast to the almost automatic nature of Theory of Mind in typically developing individuals (Happé, 1995). In addition, neuroimaging studies suggest that different areas of the brain are associated with the effortless Theory of Mind in typical populations and the late-developing, effortful Theory of Mind task performance observed among individuals with Asperger Syndrome (Happé, Ehlers, Fletcher, et al., 1996).

Individuals with Asperger Syndrome who pass Theory of Mind tasks in experimental situations may continue to have difficulty applying these abilities in real-life situations (Ozonoff, Rogers, & Pennington, 1991). Kaland et al. (2002) found that Asperger individuals generally do not have a hard time making inferences about physical states in stories that approximate real-world situations. They did, however, have significantly more difficulty (measured as the number of prompts needed and amount of time needed) than typically developing children in making correct inferences about mental states in these real-world scenarios. Baron-Cohen, O'Riordan, Stone, et al. (1999) found that children with Asperger syndrome had great difficulty detecting faux pas, whereas their typically-developing peers did so with ease. Thus, whereas individuals with Asperger Syndrome may outperform those with autism in Theory of Mind assessments, both groups may approach Theory of Mind tasks in qualitatively different ways than do typically developing children.

Narrative Structure in Children With and Without Asperger Syndrome

Beginning around three years of age, and continuing with age, children develop competencies in constructing memory narratives. These narratives become more coherent across the preschool years, with children providing more complete temporal and evaluative information (Fivush, Haden, & Adam, 1995). By the time they reach elementary school, children are producing plot-driven narratives containing distinct beginnings, middles, and resolutions (Applebee, 1978).

Although there has not been a great deal of research looking specifically at the structuring of narratives provided by individuals with Asperger Syndrome, this capacity has been investigated more broadly in populations with autism spectrum disorders. No differences have emerged in length, structure, and complexity between narratives generated by individuals with autism and those without the disorder matched on language abilities (e.g., Tager-Flusberg & Sullivan, 1995). Diehl, Bennetto, and Young (2006) examined story recall in a sample of children with high-functioning autism spectrum disorders (15 children with autism, two with Asperger Syndrome) and typically developing children matched on age, gender, and language and cognitive abilities. Whereas they also found no differences in narrative length or complexity, children with autism spectrum disorders produced memory narratives of the story that were less coherent that those generated by their typically developing peers. Diehl and colleagues measured coherence by examining the causal relationships between events within a story, applying the story grammar framework developed by Trabasso and Sperry (1985). Within this framework, a child must be able to generate a narrative that contains the causal chain of events within the retold story for that narrative to be considered coherent.

Children with autism spectrum disorders included a lower percentage of causal connections in their retellings of the story. Diehl and colleagues then concluded that the children with autism spectrum disorders had less coherent memory representations of the story than the typically developing children.

This conclusion may be overstating things a bit, as causal connections are just one small part of how coherence is often measured. Baker-Ward, Bauer, Fivush, et al., (2007) have developed a systematic method for coding coherence that considers three distinct dimensions: context, chronology, and theme, based on Labov's (1972) theoretical work on narrative. The context dimension measures the provision of information about when and where an event occurred. The chronology dimension assesses whether the events can be placed on a timeline by a naive listener. Diehl et al. (2006) did not consider either of these important dimensions of coherence in their analysis. The theme dimension considers whether there is a clear focus to the narrative, containing both causal linkages and a resolution. It appears that Diehl et al. (2006) only account for one component of the theme dimension in their conceptualization of coherence.

The present investigation will provide a more systematic examination of narrative coherence among individuals with Asperger Syndrome. Differences in coherence by diagnosis can be examined specifically in the dimensions of context, chronology, and theme. Diehl et al. (2006) provide some initial evidence that populations with autism spectrum disorders may have more difficulty generating coherent narratives than typically developing children. Considering multiple dimensions of coherence, however, may lead to a better understanding of the exact nature of the deficiencies associated with autism spectrum disorders.

Narrative Content in Children With and Without Asperger Syndrome

As children mature, they begin to use more internal states language (ISL) in their narratives (e.g. Bauer, Stark, Lukowski, et al., 2005). ISL conveys emotional, cognitive, perceptual, and physiological states (Fivush & Baker-Ward, 2005), and is indicative of "meaning making." Words that describe an emotional state may do so explicitly (e.g. sad or happy) or they may simply imply an emotion (e.g. crying or laughing). Individuals who use more emotional and cognitive terms in narratives of their personal experiences show a variety of positive outcomes, such as lower anxiety and better physical health (see Pennebaker, 1997). Thus, it appears that use of internal state language is an important marker for "meaning making," which leads to positive psychological and physical health outcomes.

Losh and Capps (2003) examined narrative ability in groups of children with high-functioning autism and Asperger Syndrome across two contexts: narratives of storybook and personal experience. Regardless of narration condition, children with autism spectrum disorders were less likely than typically developing children to include references to internal states. Thus, individuals with autism spectrum disorders may have particular general difficulties including ISL in their narratives that extend beyond narratives of personal experience. Thus, whereas we know that children with autism spectrum disorders include less ISL in their narratives, we still do not know what factors may be influencing the inclusion of such narrative devices, nor do we know if this group difference would be seen with an Asperger-only clinical sample.

Basic Memory Abilities in Children With and Without Asperger Syndrome

Whereas it was once thought that infants lacked the cognitive ability to represent past events in memory (Piaget, 1952), effectively limiting them to the "here and now," more recent evidence suggests that the memory abilities of young children were greatly underestimated. Infants only a few months of age are able to demonstrate implicit memory abilities (e.g. Rovee-Collier & Hayne, 2000). Explicit memory functioning has been demonstrated in children as young as fourteen months of age, using deferred imitation techniques (Meltzoff, 1985). These basic memory abilities translate directly into developing semantic memory skills observed around the second year of life. Over the first two years of life, children become skilled at forming scripts for repeated events. For example, when presented with toys to use as props, 21-month-old children are able to act out familiar routines, such as taking a bath (Bauer & Thal, 1990). This type of script use is a good example of the child's developing semantic memory. Such use of semantic memory allows children to form expectations and navigate the world with more confidence. Even when children this age do refer to past events, their descriptions are highly generic and usually require a good deal of scaffolding and interpretation by the child's parents (Nelson & Ross, 1980). By the third year of age, children are better able to independently talk about past events. They rely less on scripts, and talk more about specific episodes. Through conversations about past and future events, children have a better understanding of what sorts of events are important to remember. Children have increasingly developed language skills that allow them to engage more fully in joint reminiscing. These episodic memory skills are central to the emergence of

autobiographical memory, as autobiographical memory is simply be a subcategory of episodic memory (Wheeler, Stuss & Tulving, 1997).

Individuals with Asperger Syndrome demonstrate deficits in memory processes. Compared to typically developing peers, adults with Asperger Syndrome display impaired recall for semantically-related word lists but not for lists of unrelated words (Bowler, Matthews, & Gardiner, 1997). Thus, individuals with Asperger Syndrome also seem less able to make use of categorical information as an organizational strategy. Moreover, like individuals with autism (Bennetto, Pennington, & Rogers, 1996), individuals with Asperger Syndrome have difficulties with source monitoring (Bowler, Gardiner, & Berthollier, 2004). When given support at retrieval in the form of a recognition test, deficits in source monitoring largely disappear.

Importantly, individuals with Asperger Syndrome show some minor impairments in episodic memory (Bolwer, Gardiner, & Grice, 2000). Adults with Asperger Syndrome do not differ from typically developing adults in their recognition of words previously presented. When participants indicated that they recognized a word as appearing on the previous list, they were probed as to whether they actually remember that word, or whether they just know the word was on the list without any conscious recollection of seeing the word. Remember responses are indicative of episodic memory and autonoesis (Tulving & Lepage, 2000), meaning that they involve a sense of reliving the past, specific to both time and location. The Asperger group was more likely to indicate that they simply knew the word appeared on the list, whereas typical controls were more likely to indicate remembering the word.

Given that individuals with Asperger Syndrome display these impairments in episodic recall, it would not be surprising if they also had difficulty generating personal memory narratives. This type of recognition, however, is very different from autobiographical memory. Whereas remember responses would indicate that the participant is displaying memory for a specific point in the past, they would not be recalling the event from the perspective of the self in relation to others (Conway, 1996). Memories of word lists are qualitatively different from the sort of memories of personally meaningful events that make up autobiographical memory. These would not be the sorts of memories that one would share with friends and family. In fact, once the experiment is over, this is not the sort of memory that would likely ever be reinstated. It is also worth highlighting the fact that those individuals with Asperger Syndrome in this study only differed in their self-reports of autonoesis compared to typically developing peers. The groups were not different in their accuracy of recognition for word lists. Thus, it appears that individuals from both groups have similar episodic memory capabilities. Where the groups differ is in their interpretations of these memories. In the present investigation, it will be important to demonstrate that children with Asperger Syndrome do not differ from typically developing children on autobiographical memory measures simply because of overall differences in episodic memory. Evidence that the groups do not simply differ in episodic memory skills would be found, however, if children with Asperger Syndrome show impairments for some types of autobiographical memory but not others.

Autobiographical Memory in Children With and Without Asperger Syndrome

Beginning around three years of age, and continuing with age, children develop competencies in constructing personal memory narratives. Narratives become more

coherent across the preschool years, with children providing more complete temporal and evaluative information (Fivush, Haden, & Adam, 1995). Through socializing conversations with others, children learn how to structure their narratives, including contextual, temporal, and evaluative information, and thus form more complete autobiographical memories. Because children with Asperger Syndrome are less likely to have these conversations about past events, it would be expected that they would have impoverished autobiographical memory narratives.

Only two studies have examined the ability to narrate autobiographical experience in individuals with Asperger Syndrome. Losh and Capps (2003) examined narrative ability in groups of children with high-functioning autism and Asperger Syndrome across two contexts: narratives of storybook and personal experience. The storybook condition involved children telling the story of a wordless picture book. Narratives of personal experience were elicited using open-ended questions. Thus, the storybook condition was a more structured task than the personal experience condition. No differences were observed on any narrative measure between the high-functioning individuals with autism and those with Asperger Syndrome. There were, however, only eight children with Asperger Syndrome included in the sample, so there may have not been enough power to detect differences. Thus, all group comparisons in this study were between those with autism spectrum disorders and typically developing children.

Regardless of narration condition, children with autism spectrum disorders were less likely than typically developing children to include references to causal mechanisms. Other than this difference, autistic and Asperger children performed similarly to typically developing children in the storybook condition. Differences between the groups emerged

in the personal narrative condition. Children with autism spectrum disorders relied heavily on prompts when providing personal narratives, indicating their difficulties in generating narratives in less structured contexts. They also included fewer categories of sophisticated narrative devices in their personal narratives, but not in their storybook narratives. Thus, it is possible that high-functioning individuals with autism spectrum disorders may have particular difficulty in narrating personal experiences. Unfortunately, there is a potential confound in this study: individual with autism spectrum disorders may simply have had difficulties providing narratives when they were less structured by the experimenter.

Unlike previous studies examining lower-functioning individuals with autism (Capps, Losh, & Thurber, 2000; Tager-Flusberg & Sullivan, 1995), Losh and Capps (2003) did not find that Theory of Mind performance (as measured by Happé's Strange Stories [1994]) was correlated with narrative abilities in these high-functioning individuals. Instead, emotional understanding, measured as both their ability to provide appropriate definitions for emotion terms and labeling emotions depicted in an observed video, emerged as predictive of narrative abilities.

Given this, it may be particularly important to examine emotionally-charged personal memories in children with and without Asperger Syndrome. Losh and Capps (2006) did just that in a follow-up study. Children between the ages of 7 and 13 with and without autism spectrum disorders were prompted to describe a variety of personal experiences. Four types of narratives were provided by each child, three of which were emotional in nature. Children were presented with a list of simple emotions (e.g. sad, happy), complex emotions (e.g. curious, surprised), complex self-conscious emotions

(e.g. guilty, proud) and nonemotions (e.g. tired, sick) and were asked to describe a specific point in time they felt that way.

Whereas Losh and Capps (2006) found no differences on the nonemotional narratives, differences did emerge between groups in their emotional narratives. Compared to typically developing children, participants with autism spectrum disorders were less likely to give contextually appropriate accounts for complex emotion prompts. Accounts were judged to be contextually appropriate when the described episode would tend to elicit feelings appropriate to the prompt. Children with autism spectrum disorders gave the least contextually appropriate narratives for the self-conscious complex emotion prompts, providing insufficient detail to understand why the situation evoked that emotional response. Surprisingly, as other research has found differences in length (see Dillard, Brown, Nida, Baker-Ward, & Peterson, 2005), children with Asperger Syndrome provided narratives that did not differ in length from their typically developing peers. It was also the case that the children with autism spectrum disorders were less likely to provide personalized narrative accounts, as defined by Labov (1972). Personalized narrative accounts focus on an event in which the child was the protagonist, and must include at least two actions that can be temporally ordered. Children with autism spectrum disorders were also less likely to identify the causal circumstances leading to their emotional experiences than typically developing children. Additionally, they were less likely to evaluate the meaning of their emotional experience, as indicated by descriptions of thoughts and feelings, references to social comparisons, and explanations of interpersonal consequences. Finally, they required more prompting to access these memories than did their typically developing peers.

As mentioned above, Losh and Capps (2003, 2006) did not differentiate between high-functioning autism and Asperger Syndrome in their studies. Although preliminary analyses did not reveal any differences between these populations, their small sample size of individuals with Asperger Syndrome did not likely afford enough power to detect differences. Additionally, one would expect there to be differences between these groups in their ability to narrate autobiographical memories. The primary difference between a diagnosis of autism and Asperger Syndrome centers on the presence or absence of delays in language development. Given the central role that Nelson and Fivush (2004) assign to language development in the emergence of autobiographical memory, one would expect individuals with Asperger Syndrome to have more a fully developed autobiographical memory system than those with autism. Despite their lack of delays in language development, individuals with Asperger Syndrome experience difficulties with social interactions and on Theory of Mind tasks. Because of this, they provide a nice comparison to typically developing children, perhaps highlighting the roles that social interactions and Theory of Mind play in autobiographical memory development.

Rationale for the Present Investigation

The present investigation builds on the Losh and Capps work by further examining autobiographical memory in children with and without Asperger Syndrome. By comparing typically developing children to those with Asperger Syndrome (and not those with autism spectrum disorders more broadly), we can be more certain what may be driving any observed differences between the groups. Like typically developing children, those with Asperger Syndrome do not experience delays in cognitive or language development. They do, however, have difficulties with social phenomenon, such as

engaging in conversations and understanding the mental states of others. By comparing the autobiographical memories of children with and without Asperger Syndrome, it will become clearer how much of an influence the social world plays in the development of autobiographical memory.

Losh and Capps (2006) examined the effects of prompting for simple, complex, and complex self-conscious emotions. They did not, however, consider the valence of the prompts in their report. In the present investigation, I examined the effect of prompting for positive and negative emotional memories. It was hypothesized that children with Asperger Syndrome would provide particularly sparse autobiographical narratives of negative events given their fewer opportunities to consolidate such memories through social interactions. Conversing with parents about past events provides typically developing children an ability to evaluate and bring meaning to personal experiences (e.g. Welch-Ross, 1995). When parents provide the scaffolding necessary for children to explain and resolve their negative emotion, this provides a framework for understanding and coping with negative life events (Bird & Reese, 2006). In typically developing children, reports of negative experience are likely to be more coherent because of this increased processing (Fivush, Hazzard, Sales, et al., 2003). Because children with Asperger Syndrome are less likely to have such interactions with their parents, they may lack this framework that supports the construction of coherent memory reports. Thus, it was expected that typically developing children will display more coherence for negative memories than positive memories, whereas children with Asperger Syndrome will show no difference across event types.

Additionally, the children in the Losh and Capps (2006) study nominated all of the events that they then narrated. In the present investigation, I investigated whether additional scaffolding provided through maternal nomination of events helped to minimize differences between groups. Memories nominated by the mother for the child to discuss are presumably more likely to have been discussed by the mother and child. This joint reminiscing would provide the mother an opportunity to scaffold the child's understanding and structuring of the event.

Losh and Capps (2006) were primarily concerned with the structuring of these emotional narratives. Their findings were suggestive that individuals with autism spectrum disorders may have less coherent memory representations of emotional events than their typically developing peers. The present investigation applied a standardized coherence coding scheme (Reese & Haden, in preparation, Baker-Ward, Bauer, Fivush, et al. 2007) to explore this possibility. This will provide a multifaceted perspective on coherence, enabling a better understanding of the deficits associated with Asperger Syndrome.

Additionally, the present investigation made an additional contribution to the examination of autobiographical memory in Asperger Syndrome by also examining the content of these memories. Specifically, this study examined the use of internal states language (ISL), such as cognitive, emotional, and perceptual content, in these emotional memory reports. Given that the inclusion of such content in narratives of personal experiences is related to a variety of positive physical and psychological health outcomes (see Pennebaker, 1997), it would be of particular clinical importance if children with Asperger Syndrome included less ISL in their emotional narratives.

Perhaps most importantly, a better understanding of the strengths and weaknesses in autobiographical memory found in children with Asperger Syndrome will likely help future intervention efforts. There is at least one ongoing intervention effort, The Florida Autism Connection (2006) treatment program, that specifically teaches autobiographical memory skills to individuals with autism as part of their remediation effort. In order to see enhancements in autobiographical memory skills, it is likely that language, social interaction, and Theory of Mind skills must be improved first (Nelson & Fivush, 2004). Autistic individuals participating in this treatment program are indeed reported to show improvements in domains such as language, communication, and Theory of Mind.

Specific Aims, Hypotheses, and Research Questions

Aim 1. Examine the Content of Autobiographical Memory Narratives (i.e. Narrative Length, Use of Internal States Language, References to Social World) in Children With and Without Asperger Syndrome.

Losh and Capps (2006) examined the content of the narratives in their study, but in a very global manner. They evaluated whether each memory contained "contextually appropriate content" given the prompt. The content was subjectively judged by the experimenters as contextually appropriate if the child talked about an episode that would tend to elicit the emotions for which the child was prompted (e.g. happy, disappointed, ashamed, etc.). The present study examined the content of emotional memories. By coding each narrative for its inclusion of various types of ISL (e.g. emotional, cognitive, perceptual, or physiological terms) and social terms, I was better able to describe the content of memory narratives.

Hypothesis 1A. It was hypothesized that children with Asperger syndrome would provide memory narratives than are shorter in length than will their typically developing peers. This would replicate the Dillard et al. (2005) findings of differences in narrative length between children with Asperger Syndrome and their typically developing peers. Losh and Capps (2006), hwowever, found no differences in narrative length between high-functioning children with and without autism spectrum disorders.

Hypothesis 1B. It was hypothesized that children with Asperger Syndrome would include fewer references to emotional, cognitive, perceptual, and physiological states than will their typically developing peers. This hypothesis was included to replicate previous research that has found that children with autism spectrum disorders are less likely than typically developing children to include references to internal states in their narratives (Losh & Capps, 2003). Replicating this finding in an Asperger-only population would not be surprising, given that children with Asperger Syndrome have limited success in identifying their own and others' thoughts and feelings (Frith & Happe, 1999). Use of ISL has been linked to a variety of positive physical and psychological health outcomes (see Pennebaker, 1997). Thus, it may be of significant clinical importance if children with Asperger Syndrome include fewer references to cognitive and emotional states in their memory reports.

Hypothesis 1C. It was hypothesized that children with Asperger Syndrome would include fewer references to the social world in their narratives than will their typically developing peers. This prediction was expected given the diagnostic social disconnect seen in Asperger Syndrome (American Psychiatric Association, 1994). Specifically, it

was expected that children with Asperger Syndrome would provide narratives that will be both more egocentric and less likely to include references to other people.

Aim 2: To Examine the Influences of Age, Memory Valence, Memory Source, IQ, Theory of Mind, Working Memory, and Verbal Comprehension on the Content of Emotional Memory Reports in Children With and Without Asperger Syndrome.

When differences in use of ISL were found between children with and without Asperger Syndrome, it was unclear what specific factors were driving these differences. As discussed above, the primary difference between the two groups centers on the ease with which each group engages in social interactions. That said, there are a number of other variables that distinguish the two groups, such as Theory of Mind. Thus, the influence that each of the above factors play in the usage of ISL was examined.

Research question 2. I conducted an exploratory analysis to determine if age, memory valence (positive or negative), memory source (nominated by mother or child), IQ, theory of mind skills, working memory, and verbal comprehension do indeed influence the use of ISL in children's memory narratives.

Aim 3. Examine the Coherence of Autobiographical Memory Narratives in Children With and Without Asperger Syndrome.

Losh and Capps (2006) suggest that individuals with autism spectrum disorders have less coherent memory representations of emotional events than their typically developing peers. Diehl et al. (2006) present evidence that children with Asperger Syndrome may have difficulties constructing coherent narratives in general, a difficulty extending beyond autobiographical memory specifically. It appears that Diehl et al. (2006) employed a narrow conceptualization of coherence that may not capture the whole

story. The present investigation investigated this possibility by applying a standardized coherence coding scheme (Reese & Haden, in preparation). This coding scheme incorporates three dimensions of coherence: context, chronology, and theme.

Hypothesis 3A. It was hypothesized that children with Asperger Syndrome would be less likely to generate narratives high in the context dimension of coherence than typically developing children. Losh and Capps (2006) found that children with autism spectrum disorders were less likely to provide contextual information such as time and place in their narratives than their typical peers. There was no reason to expect this relationship will not hold true in an Asperger-only population.

Hypothesis 3B. It was hypothesized that children with Asperger Syndrome would be less likely to generate narratives high in the chronology dimension of coherence than typically developing children. Naïve listeners would be unaware of the actual sequence of events in a memory report, and would need this information explicitly provided to them within the narrative. Given the difficulties that those with Asperger Syndrome have in making inferences about the mental states of others in real-world situations (Kaland et al., 2002), these individuals may be less sensitive of the need to provide temporal information in social situations.

Hypothesis 3C. It was hypothesized that children with Asperger Syndrome would be less likely to generate narratives high in the theme dimension of coherence than typically developing children. Diehl et al. (2006) found that in comparison to typically developing children, those with Asperger Syndrome were less likely to produce coherent narratives, as measured by their inclusion of causal linkages. The theme dimension of coherence is a rating of how well the events in a particular narrative are described,

elaborated, evaluated, causally-linked, and related to other autobiographical memories or to the self. Thus, it appears that Diehl's conceptualization of coherence is tapping into the theme dimension. Given this, there was reason to expect that children with Asperger Syndrome will provide narratives that will be score lower on this theme dimension than their typically developing peers. For a memory report to be scored high in theme, it must be developed, evaluated, and tied to the self. It is likely that an event needs to be shared with others for such meaning-making processes to occur. Again, given the social difficulties seen in Asperger Syndrome, it appears that opportunities to develop and make sense of emotional events would be limited.

Aim 4: Examine the Influences of Age, Memory Valence, Memory Source, IQ, Theory of Mind, Working Memory, and Verbal Comprehension on the Coherence of Emotional Memory Reports in Children With and Without Asperger Syndrome.

If differences in coherence were found between children with and without Asperger Syndrome, it would remain unclear what specific factors were driving these differences. As discussed in Aim 2, there were a number of variables that may be the driving force behind any observed differences between children with and without Asperger Syndrome. Thus, I examined the influence that each of the above factors play in the formation of coherent memory narratives.

Research question 4. I conducted an exploratory analysis to determine if age, memory valence (positive or negative), memory source (nominated by mother or child), IQ, theory of mind skills, working memory, and linguistic abilities do indeed influence the coherence (context, chronology, theme, and overall coherence) of children's memory narratives. Based on the Nelson and Fivush (2004) theory of the emergence of

autobiographical memory, it was expected that verbal comprehension, theory of mind skills, and memory source (i.e. the presence or absence of social scaffolding) will exert strong influences on autobiographical memory measures. In particular, both Theory of Mind and opportunities to engage in conversations about the past and future directly influence autobiographical memory (Nelson & Fivush, 2004) and were expected to particularly influence the ability to form coherent memory narratives.

Method

Participants

Children diagnosed with Asperger Syndrome. Male children with established diagnoses of Asperger Syndrome between the ages of 6 and 13 were recruited from the Canisius College/SUNY-Buffalo's Asperger Treatment Day Camp, which is also referred to as the Connections Program. Female participants with Asperger Syndrome were not available for recruitment, which is probably not surprising given that Asperger Syndrome is four times more likely to be found in males than females (Ehlers & Gillberg, 1993). All of the children participated in a three-stage screening process to confirm their diagnoses. First, written documentation of a formal diagnosis of Asperger Syndrome was provided by a licensed psychiatrist, physician, or psychologist. Second, parents were required to submit prior testing and evaluation records. A comprehensive records review took place to determine if the testing and evaluation results were consistent with the diagnostic criteria of Asperger Syndrome, as specified in the DSM-IV. Children who met the requirements of the first two stages were then invited to participate in the third stage, which involved formal assessment of intelligence (IQ) and social-emotional functioning (behavior rating scale, adaptive scale, and an Asperger symptomatology

scale). Only children whose characteristics were consistent with the Asperger Syndrome diagnosis at all stages of the screening process were included in the final sample of children with Asperger syndrome.

Parental permission was obtained for the participation of 42 children, representing about 81% of the potential sample of children at the Asperger Treatment Day Camp. Eleven participants were excluded from the final sample because they were diagnosed with autism spectrum disorders other than Asperger Syndrome. An additional participant with Asperger Syndrome for whom informed consent was provided was not included in the study because he was not asked to provide any memory narratives during data collection. Thus, the final clinical sample consisted of 30 children. The participants with Asperger syndrome included in the final sample ranged from 63-131 (M = 107.5, SD = 15.6) on the Asperger Syndrome Diagnostic Scale (Myles, Bock, & Simpson, 2000), indicating a "likely" diagnosis (see Appendix A). The age, IQ, and verbal comprehension data of the sample of children with Asperger Syndrome are presented in Table 1 below.

The comparison sample. Twenty-seven typically developing children were recruited informally by word of mouth. Researchers involved at the Connections Program approached families that were known personally by various collaborators. The sample of typically developing children was equivalent to the group of children with Asperger Syndrome to the extent possible on the dimensions of age, IQ, and SES.

The typically developing children and those with Asperger syndrome did not significantly differ in age (see Table 1). The sample did, however, differ with regard to gender distribution. Whereas the sample of children with Asperger syndrome was

entirely male, there were seven females in the sample of typically developing children. These females did not significantly differ in age (t = -0.41, p = 0.64), IQ (t = 0.67, p = 0.51), or verbal comprehension (t = 0.02, p = 0.98) when compared to the males in the typically-developing group. Despite this, it would be possible that any group differences seen between typically developing children and those with Asperger Syndrome could be a result of their differing gender compositions. Given this, the influence of gender was examined for all dependent measures, and was controlled for in MLM models as needed.

Both samples were predominantly white and of middle-to-upper socioeconomic status, as assessed by the interviewer's impression. Although it should be noted that the means of both groups are within the normal range, the samples of children with Asperger syndrome and typically developing children are significantly different with regard to their IQ (WISC-IV – Full Scale IQ 4 Subtest Short Form) and verbal comprehension scores (WISC-IV – Vocabulary and Similarities Subtests) (see Table 1). Given that these two measures are strongly correlated (r = .752, p < .001), only IQ was used as a covariate in the subsequent analyses when it was significantly related to the dependent measures.

Table 1

Demographic Data for Children with and without Asperger Syndrome

	Mean Age		*IQ**		*Verbal Comprehension**	
	M (SD)	*Range*	*M (SD)*	*Range*	*M (SD)*	*Range*
Children with AS (n = 30)	9.67 (2.17)	6-13	104.64 (11.78)	86-134	104.71 (14.59)	87-140
Typical Children (n = 27)	9.00 (2.18)	6-13	110.66 (10.69)	91-126	112.68 (11.91)	92-132

Note: * indicates a significant difference between diagnostic groups at the .05 level

Materials

Wechsler Intelligence Scale for Children (WISC-IV). The WISC-IV (Wechsler, 2003) was used to assess children's IQ based on the Full Scale IQ 4 Subtest Short Form. Additionally, verbal comprehension was assessed as measured by the Vocabulary and Similarities subtests of the WISC-IV. Finally, working memory was measured using the Digit Span and Letter-Number Sequencing Subtests of the WISC-IV. IQ, verbal comprehension, and working memory were all scored according to the WISC-IV Technical and Interpretive Manual (Wechsler, 2003).

Faux Pas Task. A higher order Theory of Mind task, the Faux Pas Task, (Baron-Cohen, et al., 1999), was administered to all participants (see Appendix B). This task was designed for use with children between the ages of 9 and 11, especially those with Asperger syndrome or high-functioning autism. This measure was chosen because it is one of the few appropriate Theory of Mind measures for the age group in this study.

Each child was read a series of 10 vignettes, each of which involves two to three characters and at least two separate statements. In each vignette, one character says something that would be considered inappropriate given an understanding of the social context. The stories contain no explicit reference to the characters' reactions, so that the children had to detect the faux pas without explicit cues, just as in real life. After each story, the child was asked a series of four questions: A faux pas detection question ("In this story, did someone say something they should not have said?"); an identification question ("What did they say that should not have been said?"); a comprehension question to verify that the child understood the facts conveyed; and finally a false belief question to determine whether or not the child understand that the faux pas resulted from

a character's false belief rather than from malicious intent. Following the scoring procedures developed by Baron-Cohen et al. (1999), the children were given 1 point for each faux pas they identified correctly. To detect a faux pas, the child had to answer all the questions correctly, that is, identify that someone had said something that they should not have, identify what it was that they should not have said (or some approximation of it), answer a comprehension question, and recognize that the faux pas was a consequence of a false belief. Failure of any of these questions led to a score of zero for that story. Thus, each child received an overall score somewhere between 0 and 10, depending on their ability to identify the faux pas in each vignette.

Emotional Memory Interview. Based on procedure developed by Fivush, Haden, and Adam (1995) children were asked to provide narratives for a total of four autobiographical memories (see Appendix C for detailed protocol). Before this, parents were asked to nominate one positive and one negative event that the child should remember (see Appendix D for a full description). Children were then prompted to describe these two events, along with a positive and negative event of their own choosing ("Tell me the best/worst thing that ever happened to you."). The order that the children described these four events was counterbalanced across participants. Children's responses were followed up with empty prompts (e.g. "Can you tell me more about that?") until the child could provide no more information about the event. Afterwards, children were given more specific prompts for additional information that was not provided spontaneously ("who was there?", "when did this happen?", "where were you?", etc.). Children were also asked to identify on a six-point likert scale how each event made them feel, from "really unhappy" to "really happy."

Procedure

Written parental permission was received for all participants in the study. Children with Asperger syndrome attending the Canisius College/SUNY-Buffalo's Asperger Treatment Day Camp and typically developing children from the same geographical area were tested individually. All children were assessed by the same researcher, an experienced male examiner with a PhD in human development. Children with Asperger Syndrome were tested on the Canisius College campus in designated testing rooms found in a dormitory. Children's IQ, verbal comprehension, and working memory were assessed prior to the testing session as part of the treatment program. After providing their assent, children with Asperger Syndrome were asked to complete the Theory of Mind task (the Faux Pas task) and the Emotional Memory Interview. The order of these tasks was counterbalanced across participants. The testing session took approximately one hour for children with Asperger Syndrome. Once these tasks were completed, children were debriefed and returned to regular camp activities.

The typically developing children were tested at Summit Educational Resources, a school for Autistic Children located just a few miles from Canisius College. These children received a battery of tests on the test day that included the Emotional Memory Interview and the Faux Pas task, in addition to IQ assessment. IQ testing was always administered first, with the order of Emotional Memory Interview and the Faux Pas task counter-balanced across participants. The testing session took between four and five hours for typically developing children.

Coding of Autobiographical Memories

All narratives were transcribed verbatim. As suggested by Pennebaker (2001), interviewer comments, fillers ("um," "like," etc.), repetitions, and narrative information provided after specific prompts were removed. As mentioned above, IQ, verbal comprehension, and working memory were all scored according to the WISC-IV Technical and Interpretive Manual (Wechsler, 2003). Additionally, coding of the Faux Pas task followed the scoring procedures outlined Baron-Cohen et al. (1999).

Miscellaneous content and structure coding. All memory narratives were hand-coded for event type, overall emotional tone, social orientation, and structure (see Peterson, Grant, & Boland, 2005). Potential codes for event type included trauma, transition, play, and other. Trauma could be physical (e.g. breaking a bone) or emotional (e.g. getting teased at school). Transitions involved passing from one stage to another, (e.g. the birth of a sibling or starting elementary school). Play included descriptions of play sessions or any other events that occurred during play. Each memory narrative was coded as positive, negative, or neutral in overall emotional tone. For social orientation, each memory narrative was classified as either individually- or socially-focused. Finally, for structure, each narrative was categorized as a plotted story, a snapshot, or a repeated event. Plotted stories have clear beginnings, middles, and ends. Snapshots, or moments-in-time, describe multiple aspects of the same event. Finally, repeated events were habitual actions that would have taken place on multiple occasions.

All coding for event type, overall emotional tone, social orientation, and structure was completed by the researcher. Additionally one female undergraduate research assistant helped to establish inter-rater reliability. This assistant was supervised directly

by the researcher. Approximately twenty percent (n = 46) of the memory narratives were randomly selected as the basis for establishing inter-rater reliability. Percent agreement ranged from 89% for structure to 96% for emotional tone.

Internal States Language. Losh and Capps (2006) limited their examination of the content of memory reports to whether the narratives provided contained contextually appropriate content. This investigation examines the content of emotional autobiographical memories more thoroughly. The Linguistic Inquiry and Word Count (LIWC, Pennebaker, Francis, & Booth, 2001) program was used to analyze the narratives for their emotional, cognitive, perceptual, physiological, and social content. LIWC is a software program intended to analyze the text of narratives for the degree to which people use different categories of words. Of most interest to this study was the length of narrative, and the extent to which children include positive or negative emotion words and self-references.

Coherence. Losh and Capps (2006) used the findings from their "form" outcome measures (i.e. "use of narrative," "causal inferences," etc.) as the basis for characterizations of the overall coherence on the memory reports. As such, another productive method of quantifying these autobiographical memories may be through an established *coherence* coding scheme (Reese & Haden, in preparation; Baker-Ward, Bauer, Fivush, et al., 2007) More coherent reports place the event within a larger context, are temporally ordered, and have a running theme. A narrator who provides context allows the listener to locate the event in both space and time. Coherent narratives contain sufficient temporal information to allow a naïve listener to easily order events within a narrative on a timeline. Coherent narratives provide causal linkages between events

within the narrative. Fully coherent narratives contain a resolution, in which the individual relates this experience back to self-concept, identity, or other autobiographical experiences. Individuals providing autobiographical narratives with greater coherence should have more interconnected representations of the remembered event, leading to memory representations that should endure over time.

Coherence was coded using the Narrative Coherence Coding Scheme (NaCC: Reese & Haden, in preparation). This method is now widely used in memory research laboratories across the US and New Zealand. By conforming to this standard scheme, research findings are more easily comparable across labs. In this scheme, three dimensions of coherence are assessed: context, chronology, and theme. The context dimensions measures the provision of information about when and where an event occurred. The chronology dimension assesses whether the events can be placed on a timeline by a naive listener. Theme suggests that there is a clear focus to the narrative. Only children's spontaneous utterances were coded. Information provided in response to a specific *wh*- question was disregarded. Ratings from 0-3 were made for each narrative on all the three dimensions of narrative coherence (see Appendix E). Contextual information was sometimes provided to the child in the prompts for the mother nominated memories. In such situations, context was not coded and this was treated as missing data. Because logistic multilevel models were used to assess context and theme, these variables were split into dichotomous low/high variables by combining the lower two levels (0 and 1) and the higher two levels (2 and 3). For context, a high score would mean that the participant is including information locating the event in both time and location. For theme, a high score would indicate that the participant is including several

instances of causal linkages, interpretations, and elaborations of previously reported actions.

All coherence coding was completed by the author and one female research assistant, who is a master's degree student with an undergraduate degree in psychology. This assistant was supervised directly by the researcher. Coders were trained to an acceptable level of reliability (> .85 intraclass correlations for coherence) (Shrout & Fleiss, 1979) by the author using a practice set of transcripts not included in the present study. Intraclass correlations have been established as the standard way of assessing reliability between coders by the NaCCS and also used in previous research (Bohanek, Fivush, & Walker, 2005). This was deemed an appropriate method to judge inter-rater reliability of coherence because the ratings were made on an ordered scale. Approximately twenty-five percent (n = 56) of the memory narratives were randomly selected as the basis for establishing reliability in coding coherence. Child narratives that contained at least two units of information but did not contain two actions that were uninterrupted by the interviewer were deemed non-codable not used when calculating reliability for chronology. Child narratives that lacked even two propositions were not considered to be a memory, and were not used when calculating inter-rater reliability in context and theme. The intraclass correlations for the context, chronology, and theme dimensions were 0.92, 0.86 and 0.96 respectively.

Results

Overview

Multilevel modeling (MLM) is the most appropriate form of analysis for this data set because much of the data are nested within individual children (Raudenbush & Bryk,

2002). That is, all memories are not independent of each other, as each child provided four unique memory narratives. This resulted in variables at both the level of the memory (level 1) and the level of the child (level 2). Memories narrated by the same child may have more similarities to each other than those produced by other children. MLM allows for the analysis of this non-independence arising from each child supplying four memories. MLM also allows for partitioning of variability both between persons (e.g. diagnosis, age) and within persons (e.g. memory valence, source of memory nomination). Further, MLM allows the testing of hypotheses that predict changes in the slopes (rather than just the intercepts) of a variable. Additionally, MLM allows for analysis of incomplete data, not just complete cases, which is important because a few children were unable to generate memory narratives for all four prompts. In accordance with standards in the extant literature (Singer, 1998), all MLM analyses will be generated using PROC MIXED in SAS software, Version 9.1 of the SAS System for Windows (Copyright © 2002-2003, SAS Institute Inc., Cary, NC, USA).

For Aims 1 and 3, it was important to be able to make direct comparisons between outcome variables. This would have been impossible to do using typical MLM models with only one dependent variable. Instead, a series of MANOVAs were used to address these aims. In Aim 1, for example, it may by the case that the pattern of relationships between dimensions of ISL would be different for children with and without Asperger Syndrome. By including all of these dimensions of ISL in the MANOVA, this potential may be tested through an omnibus effect of diagnosis. The influence that diagnosis has on each dimension of ISL was then tested through post-hoc comparisons. Thus, the

primary goal of Aims 1 and 3 was to probe for differences by diagnosis in the content and structure of emotional memory narratives.

If differences emerged in the content of autobiographical memory narratives between children with and without Asperger syndrome, it would remain unclear what specific factors are driving these differences. Thus, the goal for Aims 2 and 4 was to investigate the possible factors that may explain any difference between children with and without Asperger syndrome in the content and structure of their autobiographical memories. These exploratory analyses were designed to determine if memory valence (positive or negative), memory source (nominated by mother or child), age, IQ, theory of mind skills, working memory, and/or verbal comprehension influenced the content and structure of children's memory narratives. See Table 2 for interrelationships among the potential between person predictors.

Table 2

Correlations Among Potential Between-Person Predictors of Autobiographical Memory

	Age (in Years)	Theory of Mind	IQ	Verbal Comprehension	Working Memory
Age (in Years)		.37*	.10	.30*	.06
Theory of Mind	.37*		.26*	.55*	.23*
IQ	.10	.26*		.75*	.58*
Verbal Comprehension	.30*	.55*	.75*		.51*
Working Memory	.06	.23*	.58*	.51*	

Note: * indicates a significant difference between diagnostic groups at the .01 level

The high correlations between IQ, verbal comprehension, and working memory are not surprising given that verbal comprehension and working memory are subtests of

the larger WISC-IV IQ test. If the addition of one of these predictors to the model caused diagnosis to no longer be significant, this may indicate that the predictor is contributing to the observed diagnostic differences.

Separate sets of MLM models were run for each dependent measure that displayed diagnostic differences in Aims 1 and 3. When using MLM, it is recommended to conduct a preliminary analysis to ensure that there is sufficient variability at Level 1 and Level 2 to warrant continuation with analyses (e.g. Nezlek, 2001; Raudenbush & Bryk, 2002). This preliminary analysis is termed a fully unconditional model (also referred to as a null model), in which no term other than the intercept is included at any level (Curran, 2000, Nezlek, 2001). When a preliminary analysis using a fully unconditional model indicated that there was sufficient variability at Level 1 and Level 2 in the dependent variable, further MLM analyses were conducted. In cases where there was only significant variability at one level, MANOVA served as the primary analytic tool.

Correlations between predictor variables at the child level and the dependent measures were run. Those variables most highly correlated with ISL were added to the model in the Level 2 equation for the intercept from Aims 1 and 3. Because there were 57 people in the final sample, MLM analyses were limited to only five predictors, including interaction terms, at Level 2 (Neupert, personal communication). Due to the number and exploratory nature of the analyses reported below, it is important to recognize the possibility of Type I errors. It is possible that significant differences may emerge that are simply attributable to chance. Thus, only theoretically grounded effects will be examined.

Preliminary Analyses

Each of the 57 participants in the study was asked to discuss four memories, resulting in a total 228 possible memories for analysis. Overall, children were able to generate memory narratives for 91.2% of the memory prompts, with a memory operationally defined as a narrative containing at least two propositions (Peterson & McCabe, 1983). Typically developing children were able to generate memory narratives 97.2% of the time, whereas children with Asperger syndrome were able to do it 87.5% of the time. Follow-up analyses examining the effects of memory source and memory valence relied on four separate Fisher's exact tests because some cells had an expected frequency of five or less. Children with Asperger Syndrome had a particularly difficult time generating memory narratives in the self-nominated negative memory condition compared to typically developing children ($p < .05$). No significant differences in ability to generate memory narratives emerged between groups in the child-nominated positive memory, mother-nominated positive memory, or mother-nominated negative memory conditions (see Figure 2).

Seven of the twenty-eight typically developing children in this study were female, whereas the entire sample of children with Asperger syndrome was male. Preliminary analyses (in the form of t-tests) probed for the presence of gender differences on the dependent narrative measures. It was not expected that differences would be observed, as previous investigations of children's memory narratives have failed to find significant gender differences (e.g. Peterson & McCabe, 1983; Fivush, Hazzard, Sales, Sarfati, & Brown, 2003). However, a few gender differences on narrative measures did emerge. Within the typically developing group, females provided memory narratives that

were over twice as long (M = 287.96 words, SD = 252.70) as those generated by their male counterparts (M = 116.01, SD = 120.56, t [224] = -5.95, $p < .001$). Additionally, females provided narratives that were scored as higher in the theme dimension of coherence (M = 0.96, SD = 0.19) than males did (M = 0.59, SD = 0.49, t [207] = -3.95, $p < .001$). When these gender differences were found, they were considered in the subsequent analyses, either as a factor in the ANOVA-based analyses or as a predictor in Level 2 equation for the intercept in the MLM equations.

As mentioned above, parents and children were each asked to nominate one positive and one negative event that the child should remember. The order in which the children described these four events was counterbalanced across participants. As counterbalancing cannot eliminate increases in within-person variability arising from order effects, preliminary analyses examined this possibility. Such analyses appear to eliminate the possibility of fatigue effects, as order did not affect any dependent measures, such as narrative length, inclusion of ISL, or coherence of narrative.

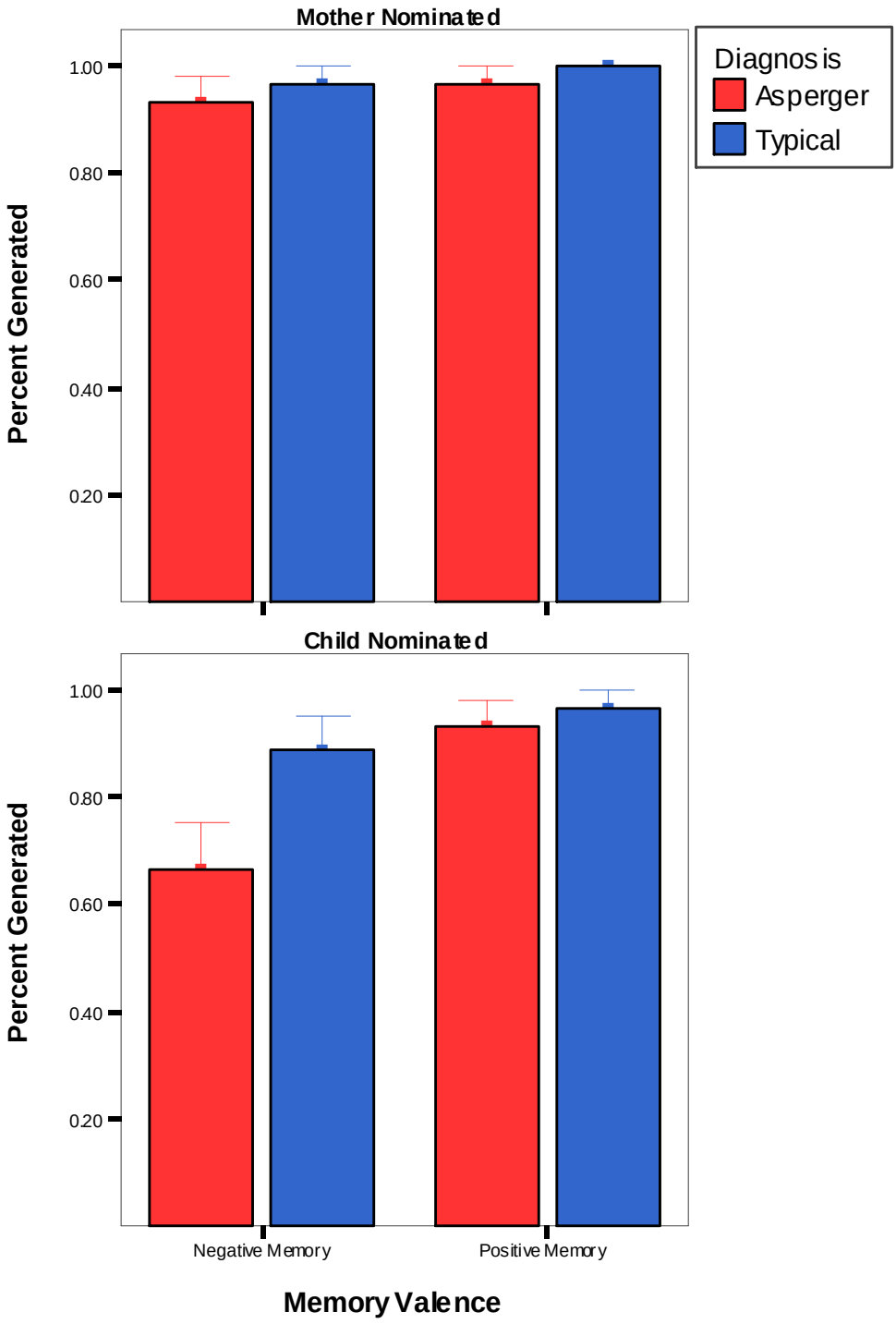

Figure 2. Three-way interaction between diagnosis, memory valence, and memory source on the percentage of memories successfully generated.

Because it is possible that any group differences in ISL or coherence observed in children with and without Asperger Syndrome might be the product of the types of events these children are talking about, preliminary analyses examined group differences in the topics that the children discussed. Unfortunately, the majority of both groups provided memory narratives that were coded as "other." This event type coding followed the guidelines of Peterson et al. (2005), which only allowed for coding narratives as trauma, transition, play, and other. This other category encompassed a wide range of narrative topics, such as vacations, pets, school-related activities, and punishments. This category of other was retained in this study in order to maintain consistency with previous research. Children with Asperger Syndrome were more likely to provide memory narratives that were categorized as play (16%) than were typically developing children (4%, $X^2 = 9.20$, $p < .05$) (see Figure 3).

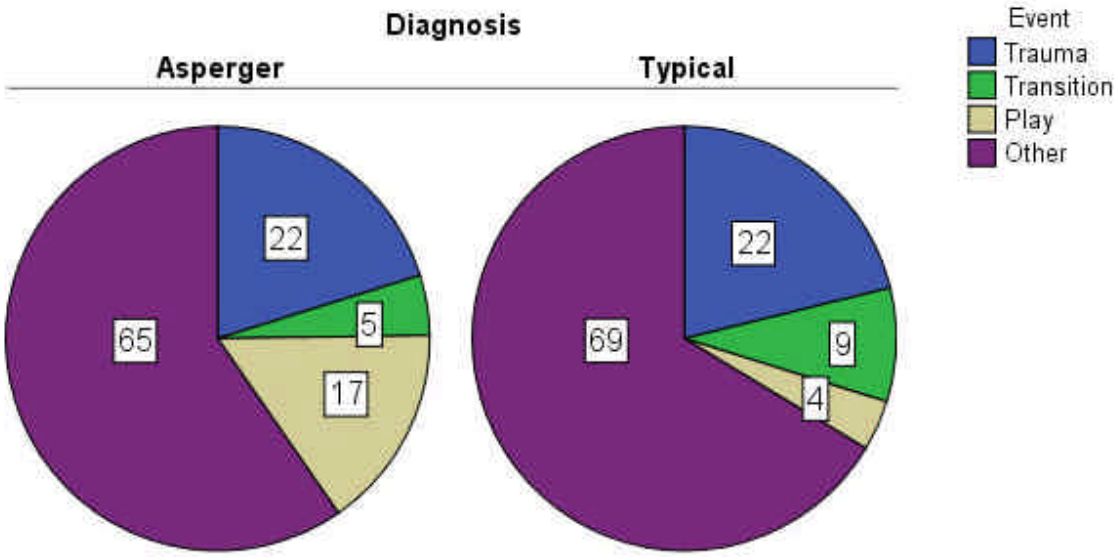

Figure 3. Frequencies of memories that are categorized as trauma, transition, play, and other by diagnosis.

Children with Asperger Syndrome were also less likely to provide memory narratives that were rated by coders as negative in tone (25%) than were typically developing children (40%, $X^2 = 11.85$, $p < .005$) (see Figure 4). The group differences for event type and emotion held true for all conditions, regardless of memory source (child versus mother nominated) or valence referenced in the instructions. Despite the fact that children with Asperger Syndrome provided narratives that were less negative in tone than did the typically developing children, the groups did not differ in their average self-ratings of how happy or unhappy the remembered events made them feel. This lack of group differences held true for all conditions, regardless of memory source or valence.

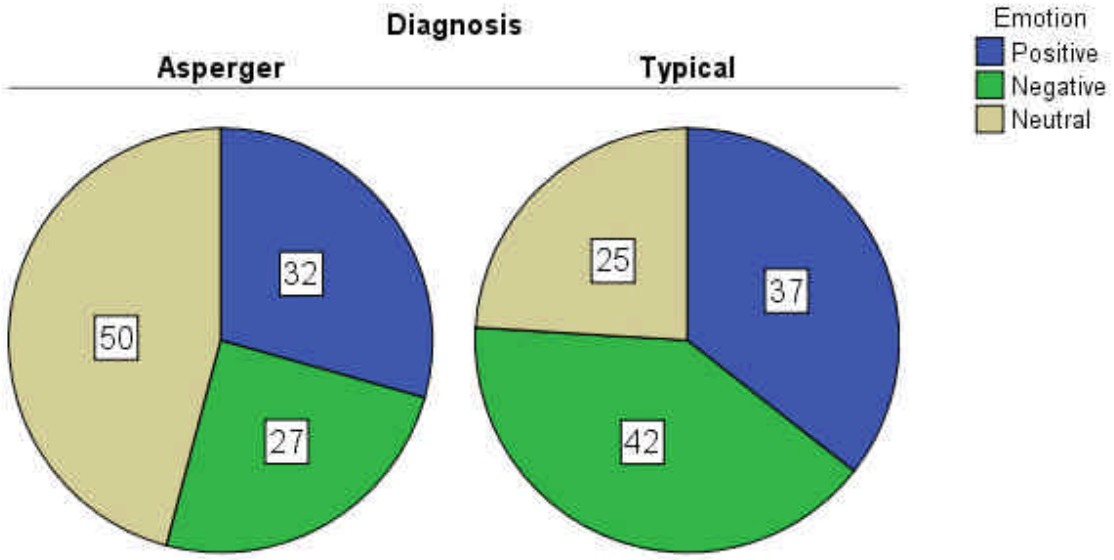

Figure 4. Frequencies of memories that are positive, negative, or neutral in tone by diagnosis.

Children with Asperger Syndrome were on average less likely to provide socially-oriented memory narratives (55%) than typically developing children (78%, t [211] = -3.61, $p < .001$). Children with Asperger Syndrome were particularly unlikely to generate socially-oriented memory narratives in the child-nominated negative memory

(X^2 = 3.88, p < .05) and the mother-nominated positive memory conditions (X^2 = 7.39, p < .01). No significant differences in ability to generate socially-oriented memory narratives emerged in the mother-nominated negative memory or child-nominated positive memory conditions (see Figure 5).

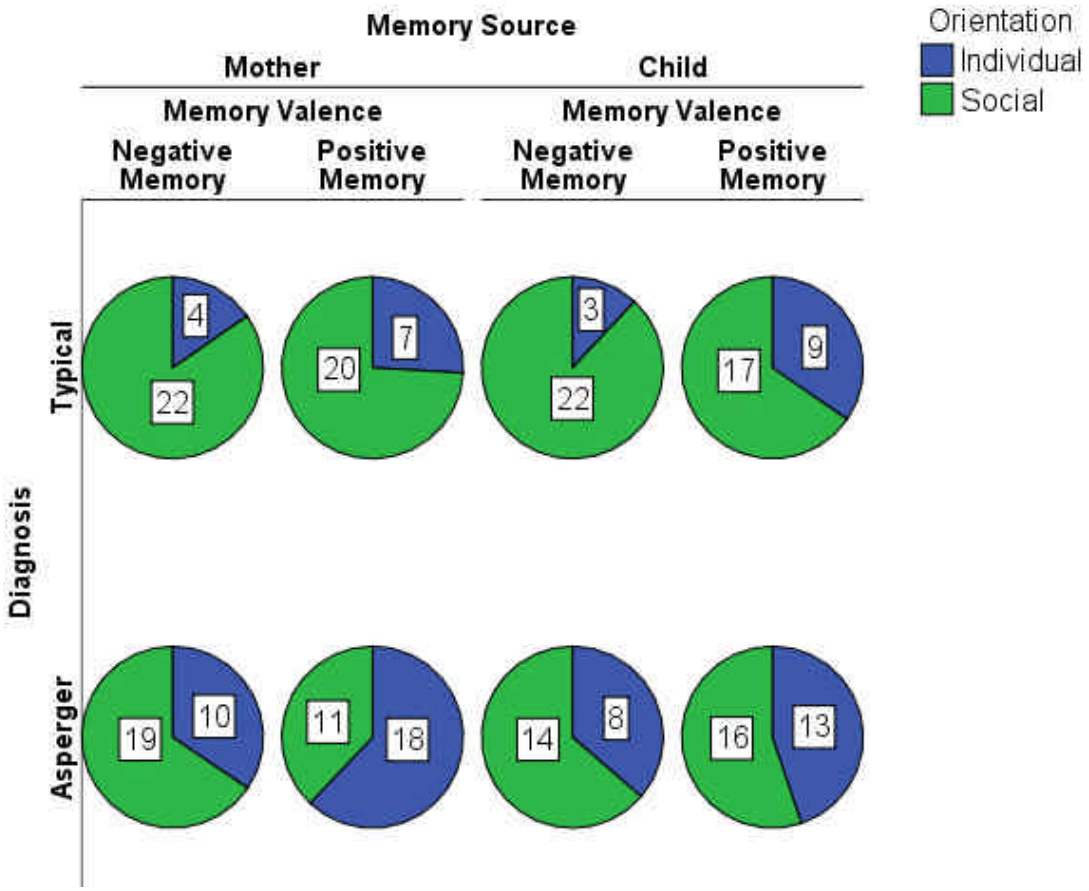

Figure 5. Frequencies of memories that are individually- and socially-based by diagnosis, memory source, and memory valence.

Typically developing children were on average more likely to structure their memory narratives as a plotted story (74%) than children with Asperger Syndrome (45%, t [211] = 4.72, p < .001). Children with Asperger Syndrome were particularly unlikely to generate a plotted story in the child-nominated negative memory (X^2 = 7.40, p < .05) and the mother-nominated positive memory conditions (X^2 = 9.80, p < .01). No significant

differences in ability to generate socially-oriented memory narratives emerged in the mother-nominated negative memory or child-nominated positive memory conditions (see Figure 6).

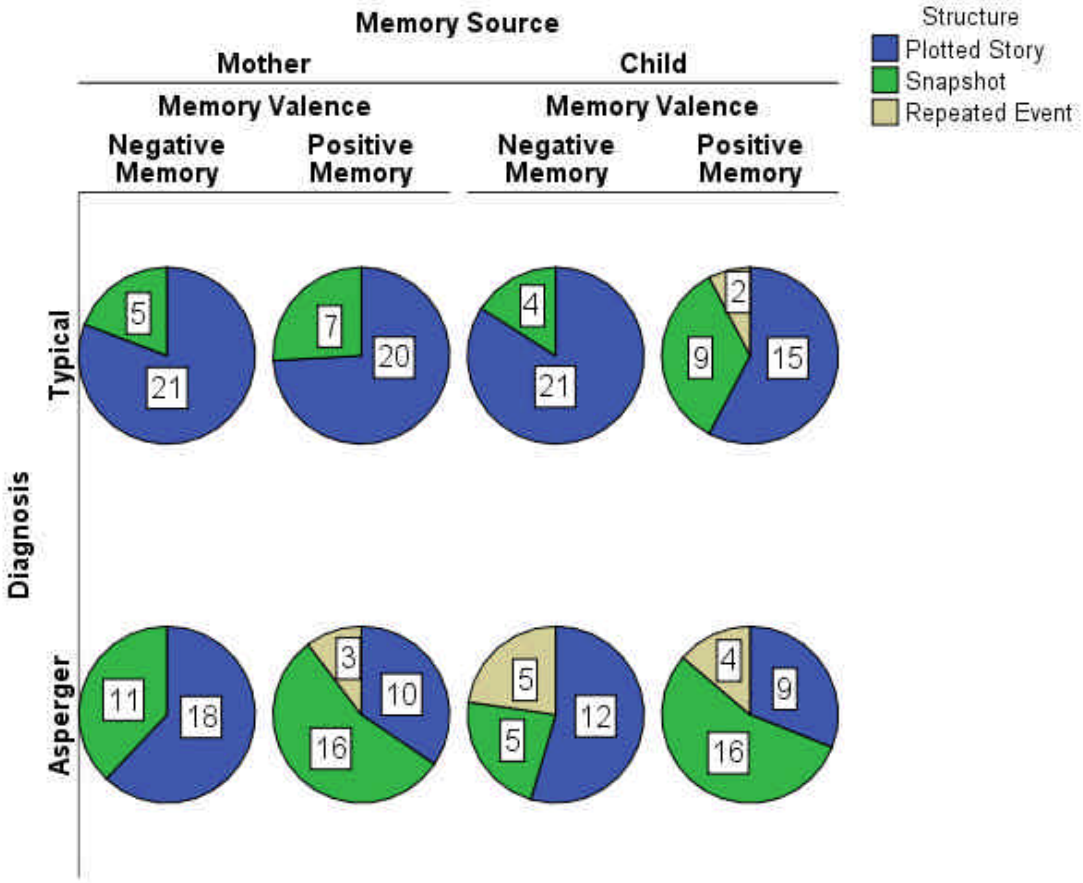

Figure 6. Frequencies of memories that are plotted stories, snapshots, and repeated events by diagnosis, memory source, and memory valence.

Analyses of Specifics Aims

Internal States Content of Autobiographical Memories

Aim 1. Examine the Content of Autobiographical Memory Narratives (i.e. Narrative Length, Use of Internal States Language, References to Social World) in Children With and Without Asperger Syndrome.

Hypothesis 1A. It was hypothesized that children with Asperger syndrome would provide memory narratives than are shorter in length than will their typically developing peers.

This hypothesis was supported; typically developing children did in fact generate memory narratives that were almost twice as long (M = 184.85 words, SD = 185.64) as those provided by children with Asperger syndrome (M = 95.32, SD = 102.22), as reflected in the significant main effect of diagnosis (t [224] = -4.41, $p < .001$). As mentioned above, analyses found in Aim 2 will probe for the factors driving the differences observed here in Aim 1. These disparate lengths of narrative necessitate that in the subsequent analyses a consideration of percentages of content rather than raw frequencies should be used.

Hypothesis 1B. It was hypothesized that children with Asperger syndrome would include less ISL than will their typically developing peers.

The hypothesis that children with Asperger syndrome will include less references to internal states (such as emotional, cognitive, perceptual, and physiological states) in their memory narratives than will their typically developing peers was tested using a MANOVA with percentage of emotional, cognitive, perceptual, and physiological words as the dependent measures. The omnibus test of the relationship between diagnosis and inclusion of ISL was close to significant (F [4, 221] = 2.15, $p < .08$, $?^2 = .04$). Examining the univariate tests revealed that children with Asperger Syndrome included less perceptual information (M = 1.34%, SD = 1.89) than typically developing children (M = 1.93%, SD = 2.13, F [1, 224] = 5.06, $p < .05$, $?^2 = .02$). Additionally, there was a trend for children with Asperger syndrome to include a smaller percentage of emotional

information in their narratives (*M* = 3.34%, *SD* = 4.36) than did typically developing children (*M* = 4.40%, *SD* = 2.60, *F* [1, 224] = 3.15, *p* < .08, ?^{2} = .01). No other significant differences emerged between groups in use of ISL (see Figure 7).

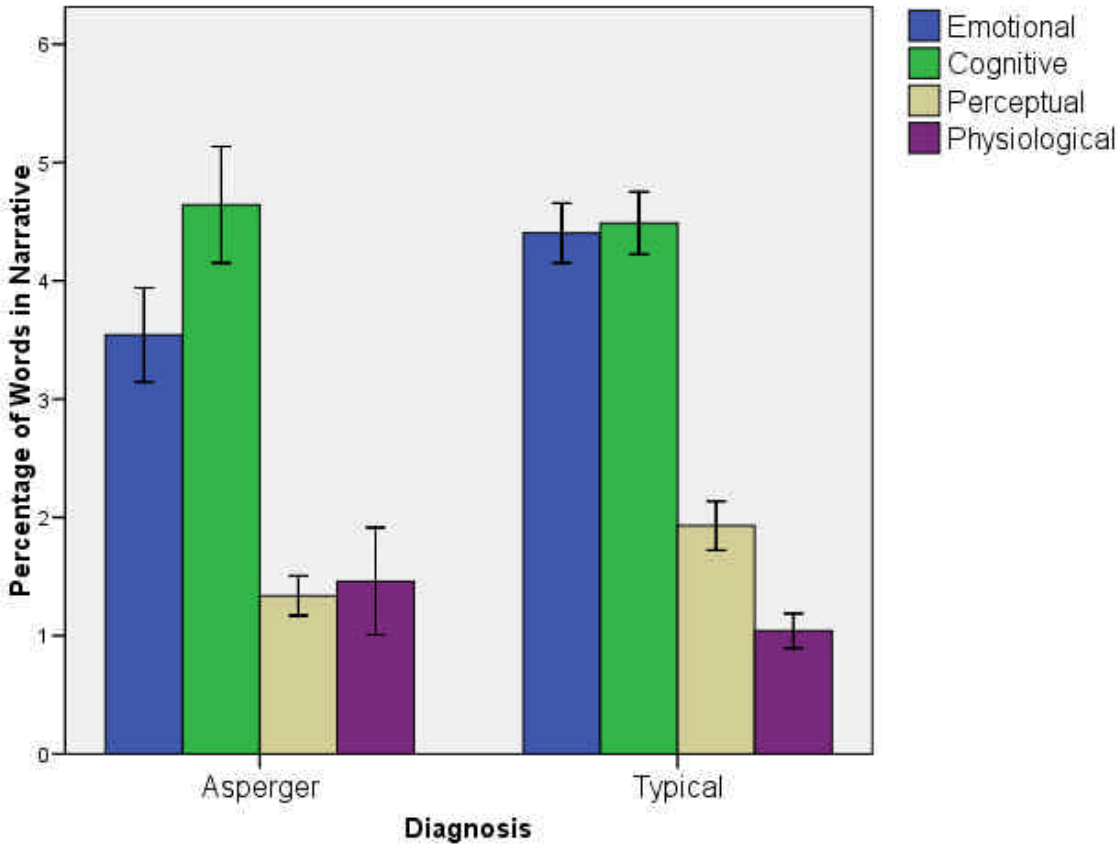

Figure 7. Percentage of ISL words included in the narratives of children with and without Asperger Syndrome.

Probing further, a MANOVA (with positive feelings, optimism and energy, anxiety and fear, anger, and sadness or depression as the dependent measures) revealed a significant omnibus effect of diagnosis on percentage of affective information (*F* [5, 220] = 5.95, *p* < .001, ?^{2} = .12). Specifically, children with Asperger Syndrome included a lower percentage of positive feelings (e.g. happy, joy, and love) (*F* [1, 224] = 26.01, *p* < .001, ?^{2} = .10) and a higher percentage of references to anxiety and fear (e.g. nervous,

afraid, and tense) (F [1, 224] = 5.12, $p < .05$, $?^2 = .02$) than did the typically developing children (see Figure 8). Additionally, there was a trend for children with Asperger Syndrome to include more anger in their narratives than did typically developing children (F [1, 224] = 3.16, $p < .08$, $?^2 = .01$).

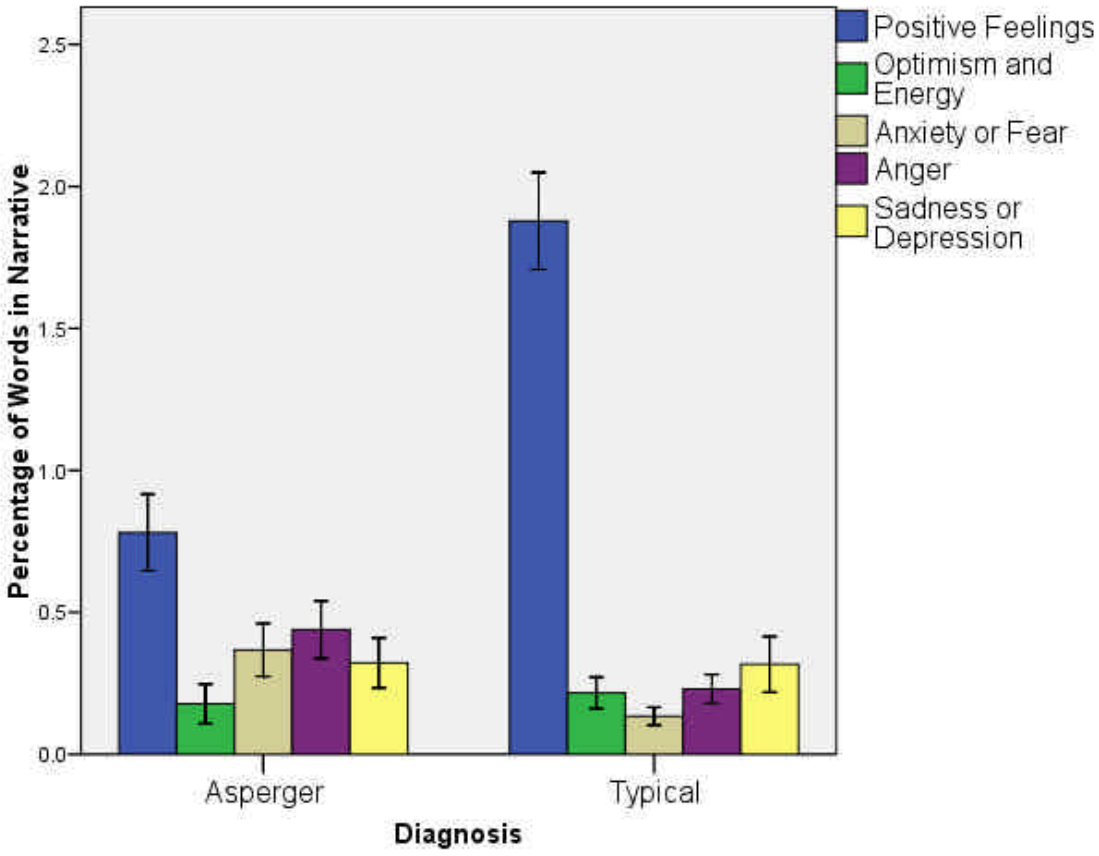

Figure 8. Percentage of emotional words included in the narratives of children with and without Asperger Syndrome.

Hypothesis 1C. It was hypothesized that children with Asperger syndrome would include fewer references to the social world (and more references to self) than will their typically developing peers.

The hypothesis that children with Asperger syndrome would include less social and more egocentric information in their memory narratives than would their typically

developing peers was tested using two individual t-tests. Children with Asperger Syndrome included fewer references to others (t [224] = -2.15, $p < .05$) and that there was a trend for them to include more references to self (t [224] = 1.89, $p < .07$) than did the typically developing children (see Figure 9).

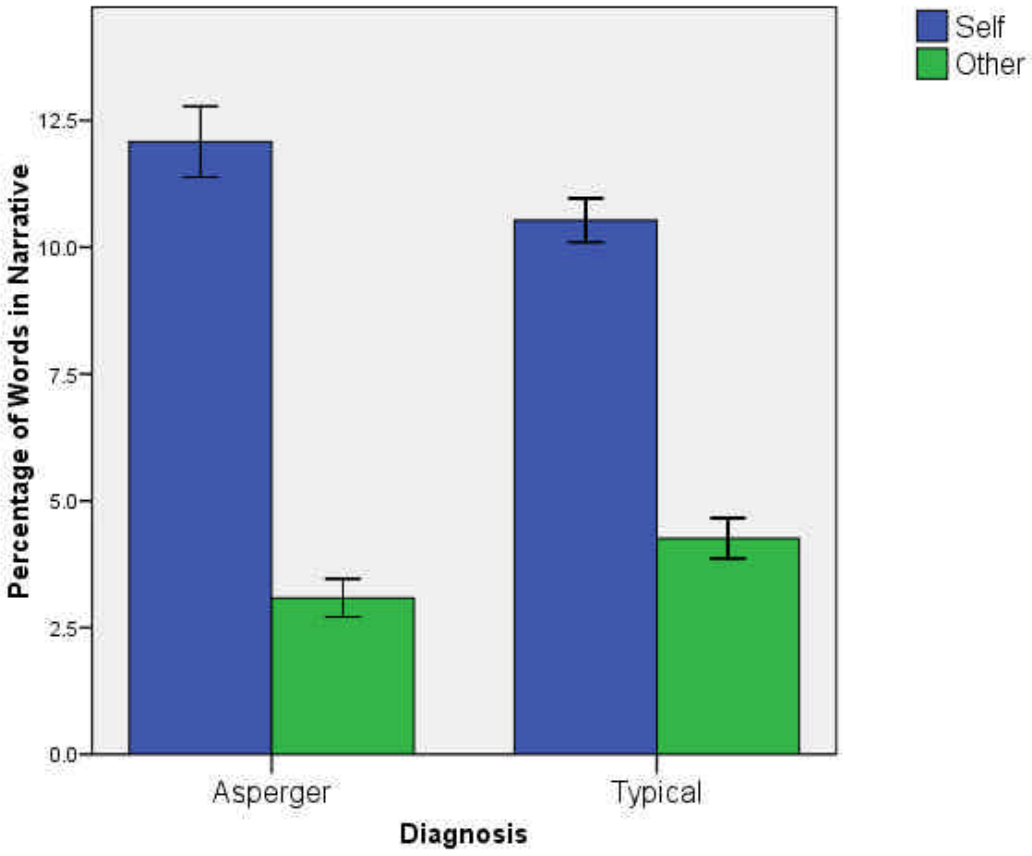

Figure 9. Percentage of social words included in the narratives of children with and without Asperger Syndrome.

Aim 2. Examine the Influences of Age, Memory Valence, Memory Source, IQ, Theory of Mind, Working Memory, and Verbal Comprehension on the Content of Emotional Memory Reports in Children With and Without Asperger Syndrome.

Research question 2. As addressed in the first aim, differences emerged in the content of autobiographical memory narratives between children with and without

Asperger syndrome. It remains unclear, however, what specific factors are driving these differences. Thus, the second aim is to investigate the possible factors that may explain any difference between children with and without Asperger syndrome in the content of their autobiographical memories. The following section presents exploratory analyses to determine if age, memory valence (positive or negative), memory source (nominated by mother or child), IQ, theory of mind skills, working memory, and/or verbal comprehension influenced the length and use of ISL in children's memory narratives. If the addition of one of these alternate predictors to the model causes diagnosis to no longer be significant, this may indicate that the predictor is contributing to the observed diagnostic differences.

Word Count

A fully unconditional model with word count as the dependent measure indicated that 54% of the variability in length of narrative was between people ($t_{00} = 12743$, $z = 4.33$, $p < .0001$) and 46% was within people ($s^2 = 10984$, $z = 9.2$, $p < .0001$). Therefore, the fully unconditional model indicated that there was sufficient variability for further analyses of word count. As mentioned above, gender differences in narrative length were observed. Because the all females were found in the typically developing group, gender will be among the first predictors added to the MLM model.

Thus, in the next step, gender and diagnosis were used to predict word count. In other words, the model addressed the between-person association between diagnosis and length of memory reports, controlling for gender. The equations for this model are as follows (Model 1):

Level 1: LENGTH = $ß_{0ij} + r_{ij}$

Level 2: $ß_{0i} = ?_{00} + ?_{01}$(DIAGNOSIS) + $?_{02}$(GENDER) + u_{0i}

where

LENGTH = word count of memory narratives

DIAGNOSIS = child's diagnostic category (Asperger or typically developing)

GENDER = gender of the child (male or female)

In Level 1, the intercept, $ß_{0ij}$ is the expected length of narrative for memory j in person i. The error term, r_{ij}, represents a unique effect associated with person i (i.e. how much an individual fluctuates in length over multiple memories). The intercept ($ß_{0i}$) becomes the outcome variable in the Level 2 equations, where the average length of narrative for emotional memories for the entire sample (i.e. the grand mean), is represented by $?_{00.}$ $?_{01}$ represents the average relationship between diagnosis and memory length and $?_{02}$ represents the average relationship between gender and memory length. The extent to which people vary from the sample average of narrative length is represented by u_{0i}.

Results from the model above indicated that diagnosis was not a significant predictor of memory length after controlling for gender (see Table 3). Thus, further analyses regarding word length will not be conducted as diagnostic differences appear to be an artifact of the gender composition of the groups. This model accounted for 27% of the between person variance and 0% of the within person variance in word length.

Table 3

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Word Count in Emotional Memories

Fixed Effects	Model 1
Word Count, ß$_0$	
Intercept, ?$_{00}$	95.32** (20.08)
Diagnosis, ?$_{01}$	51.81 (31.82)
Gender, ?$_{02}$	140.84* (48.35)
Random Effects	
Between-person variability in level of chronology (t_{00})	9353.33** (2350.87)
Within-person fluctuation in chronology (s^2)	10984** (1194.53)

Note: * $p < .01$, $^{**}p < .0001$

Inclusion of Positive Feelings

A fully unconditional model with percentage of positive feelings as the dependent measure indicated that 19% of the variability in positive affect was between people (t_{00} = 0.56, $z = 2.49$, $p < .005$) and 81% was within people ($s^2 = 2.34$, $z = 9.21$, $p < .0001$). Therefore, the fully unconditional model indicated that there was sufficient variability at both levels for further analyses of percentage of positive feelings.

The within person predictors of memory valence and memory source were considered in this first model of percentage of positive feelings. Interactions between memory source and memory valence, diagnosis and memory source, diagnosis and memory valence, and a three-way interaction between memory source, memory valence, and diagnosis are also included in the model. The equations for this model are as follows (Model 1):

Level 1: $POSFEEL = ß_{0ij} + ß_{1ij}(SOURCE) + ß_{2ij}(VALENCE) + ß_{3ij}(SOURCE*VALENCE) + r_{ij}$

Level 2: $ß_{0i} = ?_{00} + ?_{01}(DIAGNOSIS) + u_{0i}$

$ß_{1i} = ?_{10} + ?_{11}(DIAGNOSIS) + u_{1i}$

$ß_{2i} = ?_{20} + ?_{21}(DIAGNOSIS) + u_{2i}$

$ß_{3i} = ?_{30} + ?_{31}(DIAGNOSIS) + u_{3i}$

where

POSFEEL = percentage of words in narrative referring to positive feelings

VALENCE = emotional valence of the memory (positive or negative)

SOURCE = who nominated the topic of the narrative (child or mother)

In Level 1, the intercept, $ß_{0ij}$ is the expected percentage of positive feelings for memory j in person i. The first slope, $ß_{1ij}$, is the within-person relationship between memory source and positive feeling word usage for an emotional memory. The second slope, $ß_{2ij}$, is the within-person relationship between memory valence and positive feeling word usage for an emotional memory. The final slope, $ß_{3ij}$, is the within-person interaction between memory source and memory valence on sensory information. The error term, r_{ij}, represents a unique effect associated with person i (i.e. how much an individual fluctuates in positive feelings over multiple memories). The individual intercepts ($ß_{0i}$) and slopes ($ß_{1i}$, $ß_{2i,}$ and $ß_{3i}$) become the outcome variables in the Level 2 equations, where the average percentage of positive feelings in emotional memories for the entire sample (i.e. the grand mean), is represented by $?_{00.}$ $?_{01}$ represents the average relationship between diagnosis and percentage of positive feelings. $?_{10}$ represents the

average relationship between memory source and positive feelings, $?_{20}$ represents the average relationship between memory valence and positive feelings, and $?_{30}$ represents the influences of the memory valence X memory source interaction, which was included to account for the possibility that the predictive value of memory source differed by memory valence. $?_{11}$ represents the influences of the memory source X diagnosis interaction on positive feeling word usage, which was included to account for the possibility that the predictive value of diagnosis differed by memory source. $?_{21}$ represents the influences of the memory valence X diagnosis interaction on positive feeling word usage, which was included to account for the possibility that the predictive value of diagnosis differed by memory valence. $?_{31}$ represents the influences of the memory valence X memory source X diagnosis three-way interaction on positive feeling word usage. The extent to which people vary from the sample average percentage of positive feelings is represented by u_{0i}. The interindividual variability in the slope between memory source and positive feelings is represented by u_{1i}. The interindividual variability in the slope between memory valence and positive feelings is represented by u_{2i}. The interindividual variability in the three-way interaction between memory source, memory valence, and diagnosis on positive feelings is represented by u_{3i}.

Results from the model above indicated that diagnosis does in fact influence usage of positive words (see Model 1 of Table 4). There is a significant three-way interaction between diagnosis, memory source, and memory valence on the usage of positive feelings in emotional narratives (see Figure 10). Typical children were much

more likely to include positive feelings in their self-generated negative memories than were children with Asperger Syndrome.

This model accounted for 47% of the between person variance and 6% of the within person variance in word length. The goals of subsequent models examining word count were two-fold. First, 53% of the between person and 94% of the within person variance were still left to explain. Second, if adding another predictor to the model reduced the predictive power of diagnosis, it may be inferred that the shared variance between diagnosis and that predictor is predictive of word count. This would likely be indicative of factors that are driving observed diagnostic differences.

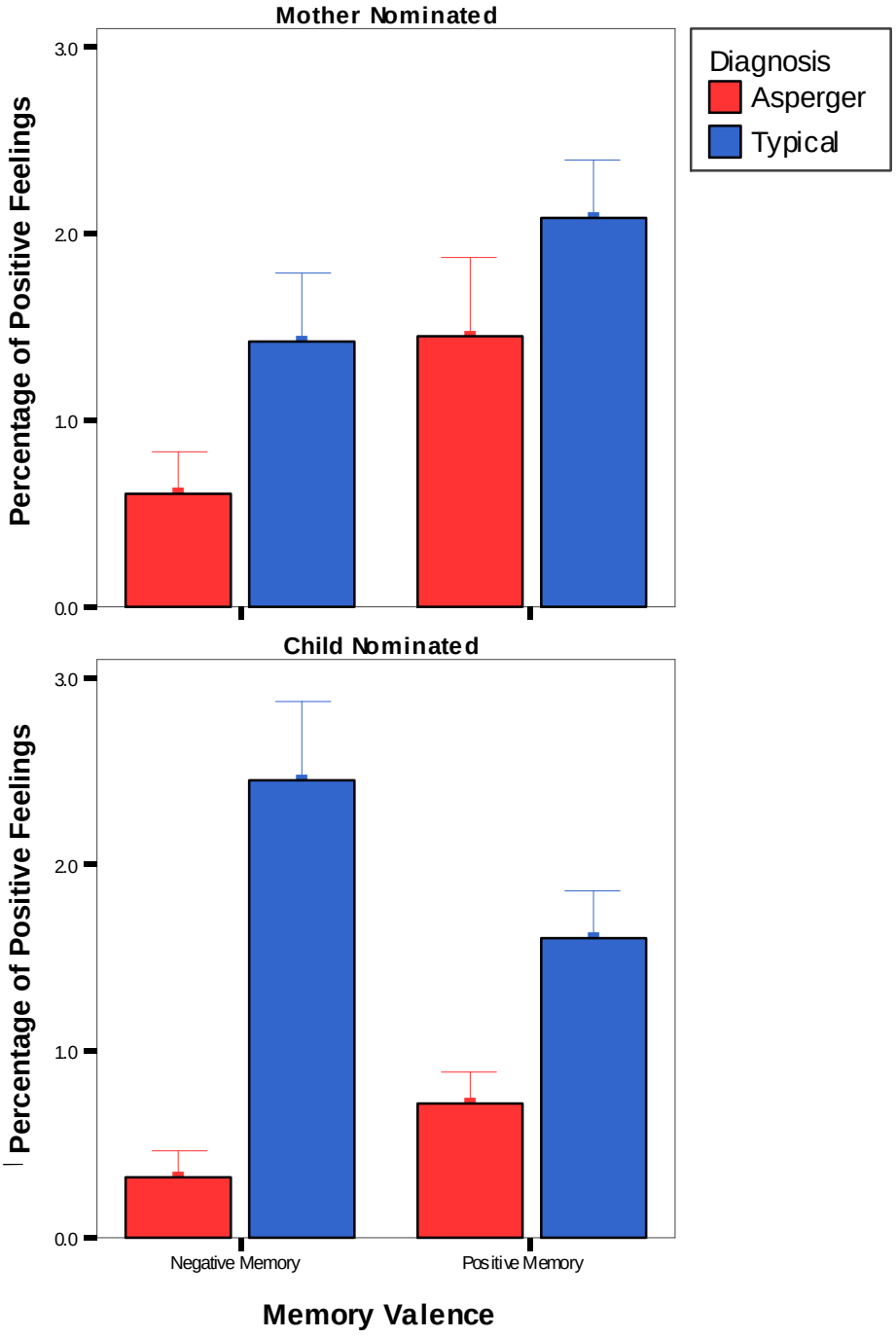

Figure 10. Three-way interaction between memory source, memory valence, and diagnosis on the percentage of positive emotion words included in the narratives of children with and without Asperger Syndrome.

Correlations again determined the order in which predictor variables were entered into the MLM models. Correlations between potential predictors of narrative content and percentage of positive words can been seen in Table 4.

Table 4

Correlations Between Potential Predictors of Narrative and Positive Feelings

Predictors of Narrative	Correlation with Positive Feelings	Significance (1-tailed)
Theory of Mind (Faux Pas)	.09	.17
Verbal Comprehension	.09	.20
Working Memory	.08	.22
IQ	.06	.39
Age	-.02	.78

As can be seen above, none of the predictor variables shared much variance with usage of positive feelings in these emotional personal narratives. Given that Theory of Mind had the largest correlation with percentage of positive feelings, it was the between-person predictor entered into the MLM model first. Not surprisingly, given their lack of correlation with the outcome variable, Theory of Mind and the rest of the potential between-person predictors of narrative did not account for a significant amount of variance in when added to the model. Thus, Model 1 was chosen as the final model (see Table 5). In sum, typically developing children appear to include more positive emotion in their self-nominated negative memory narratives than children with Asperger Syndrome.

Table 5

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Positive Feelings in Emotional Memories

Fixed Effects	Model 1
Positive Feelings, ß$_0$	
Intercept, ?$_{00}$	0.72** (0.25)
Diagnosis, ?$_{01}$	0.70 (0.40)
Memory Source Slope, ß$_1$	
Intercept, ?$_{10}$	-0.51 (0.27)
Diagnosis, ?$_{11}$	1.52** (0.49)
Memory Valence Slope, ß$_2$	
Intercept, ?$_{20}$	0.62* (0.27)
Diagnosis, ?$_{21}$	0.04 (0.49)
Memory Source X Memory Valence, ß$_3$	
Diagnosis, ?$_{21}$	-1.49* (0.58)
Random Effects	
Between-person variability in level of chronology (t_{00})	0.30* (0.17)
Within-person fluctuation in chronology (s^2)	2.20*** (0.24)

Note: $^{*}p< .05$, $^{**}p< .01$, $^{****}p< .0001$

Inclusion of Anxiety and Fear Words

A fully unconditional model with percentage of anxiety of fear words as the dependent measure indicated that 4% of the variability in length of narrative was between people ($t_{00} = 0.03$, $z = 0.69$, $p = .24$) and 96% was within people ($s^2 = 0.59$, $z = 9.21$, $p < .0001$). Therefore, the fully unconditional model indicated that there was not sufficient

variability between people. This lack of significant variability at both levels makes ANOVA-based analyses equally appropriate as MLM for further analyses, so ANOVA-based analyses were used instead.

A 2 (diagnosis) X 2 (memory source) X 2 (memory valence) ANCOVA with IQ as a covariate and inclusion of anxiety and fear words as the dependent variable revealed only a significant main effect of diagnosis (F [1, 217] = 4.19, $p < .05$, $?^2 = .02$). Children with Asperger syndrome ($M = 0.37$, $SD = 1.02$) included more references to anxiety and fear than their typically developing peers ($M = 0.13$, $SD = 0.33$), over and above the effects of IQ.

Correlations determined which variables would be considered in the ANOVAs. Correlations between potential predictors of narrative content and usage of anxiety and fear words can be seen in Table 6.

Table 6

Correlations Between Potential Predictors of Narrative and Anxiety and Fear Words

Predictors of Narrative	Correlation with Anxiety and Fear Words	Significance (1-tailed)
Working Memory	-.17	< .005
IQ	-.11	< .05
Verbal Comprehension	-.10	< .05
Theory of Mind (Faux Pas)	-.07	.13
Age	-.02	.35

Controlling for working memory reduced the relationship between diagnosis and usage of anxiety/fear words to nonsignificance (F [1, 216] = 2.95, $p = .09$, $?^2 = .01$). This is suggestive that perhaps children with higher levels of working memory are more likely

to be able to scaffold the event for themselves and/or apply guidance and direction from adults.

Inclusion of Anger Words

A fully unconditional model with percentage of anxiety of fear words as the dependent measure indicated that 6% of the variability in length of narrative was between people ($t_{00} = 0.05$, $z = 0.99$, $p = .16$) and 94% was within people ($s^2 = 0.74$ $z = 9.21$, $p < .0001$). Therefore, the fully unconditional model indicated that there was not sufficient variability between people. This lack of significant variability at both levels makes ANOVA-based analyses equally appropriate as MLM for further analyses, so ANOVA-based analyses were used instead.

A 2 (diagnosis) X 2 (memory source) X 2 (memory valence) ANCOVA with IQ as a covariate and inclusion of anger words as the dependent variable revealed did not even reveal a main effect of diagnosis. Thus, controlling for IQ reduced the relationship between diagnosis and use of anger words to nonsignificance. Thus, the observed group difference between children with and without Asperger Syndrome in use of anger words in emotional memory narratives appears to be an artifact of the IQ differences between groups.

Inclusion of Perceptual Words

A fully unconditional model with percentage of perceptual words as the dependent measure indicated that 14% of the variability in perceptual words was between people ($t_{00} = 0.55$, $z = 1.94$, $p < .05$) and 86% was within people ($s^2 = 3.44$, $z = 9.20$, $p < .0001$). Therefore, the fully unconditional model indicated that there was sufficient variability at both levels for further analyses of percentage of perceptual words.

Unlike the results of the ANOVA-based analyses, diagnosis is not a significant predictor of inclusion of perceptual words when this is examined using MLM. This is likely because MLM is generally more conservative than ANOVA-based analyses (see Quené & van den Bergh, 2004). Thus, there appear to be no diagnostic differences left to explain using MLM techniques.

Inclusion of References to Others

A fully unconditional model with percentage of references too others as the dependent measure indicated that 17% of the variability was between people ($t_{00} = 7.65$, $z = 2.24$, $p < .05$) and 83% was within people ($s^2 = 37.86$, $z = 9.20$, $p < .0001$). Therefore, the fully unconditional model indicated that there was sufficient variability at both levels for further analyses of percentage of references to others.

Similar to the analyses regarding the perceptual words, diagnosis was no longer a significant predictor of inclusion of references to others when this is examined using MLM. The more conservative nature of MLM protects against the Type I error of concluding that there are differences between children with and without Asperger Syndrome in their use of references to others in memory narratives. Given this, it appears that there are no significant differences between groups in their inclusion of references to others in emotional memory narratives.

Inclusion of References to Self

A fully unconditional model with percentage of references too self as the dependent measure indicated that 2% of the variability was between people ($t_{00} = 0.73$, $z = 0.32$, $p = .38$) and 98% was within people ($s^2 = 40.02$, $z = 9.21$, $p < .0001$). Therefore, the fully unconditional model indicated that there was not sufficient variability between

people. This lack of significant variability at both levels makes ANOVA-based analyses equally appropriate as MLM for further analyses, so ANOVA-based analyses were used instead.

A 2 (diagnosis) X 2 (memory source) X 2 (memory valence) ANCOVA with IQ as a covariate and inclusion of references to self as the dependent variable revealed an interaction between diagnosis and memory source on the inclusion of self words that approached significance (F [1, 217] = 2.84, $p < .10$, $?^2 = .01$). Whereas there is no difference between groups in the references to self in the mother-nominated memories, children with Asperger Syndrome may be including more references to themselves in their self-generated memories than typically developing children (see Figure 11).

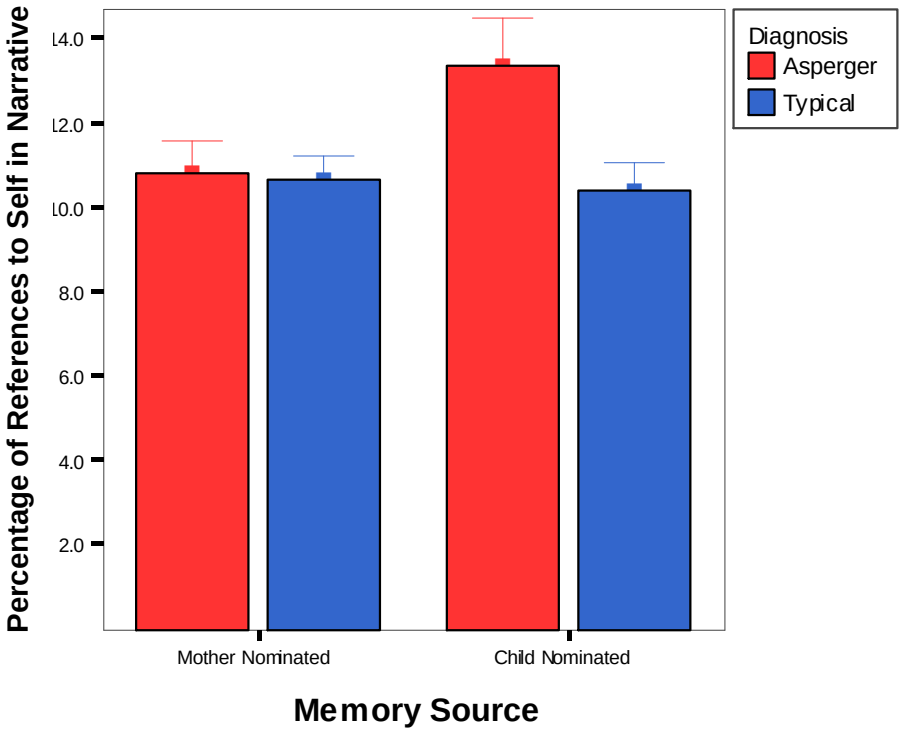

Figure 11. Two-way interaction between memory source and diagnosis on the percentage of references to self included in the narratives of children with and without Asperger Syndrome.

Correlations determined which variables would be considered in the ANOVAs. Correlations between potential predictors of narrative content and usage of anxiety and fear words can been seen in Table 7.

Table 7

Correlations Between Potential Predictors of Narrative and References to Self

Predictors of Narrative	Correlation with References to Self	Significance (1-tailed)
Working Memory	-.10	.14
Age	-.04	.53
Verbal Comprehension	-.03	.71
Theory of Mind (Faux Pas)	.01	.86
IQ	-.01	.90

As can be seen above, none of the predictor variables shared much variance with usage of references to self in these emotional personal narratives. Not surprisingly, given their lack of correlation with the outcome variable, these potential between-person predictors of narrative were not found to be related to percentage of references to self. Thus, the factors that drive the differences in references to self between children with and without Asperger Syndrome remain to be revealed.

Coherence of Autobiographical Memories

Aim 3. Examine the Coherence of Autobiographical Memory Narratives in Children With and Without Asperger Syndrome.

Coherence was assessed using the Narrative Coherence Coding Scheme (NaCC: Reese & Haden, in preparation), a standardized coding scheme that assesses three

dimensions of coherence: context, chronology, and theme. See Table 8 for interrelationships among these dimension of coherence.

Table 8

Correlations Among Dimensions of Coherence

	Context	Chronology	Theme
Context		.12	.39*
Chronology	.12		.26*
Theme	.39*	.26*	

Note: * indicates a significant difference between diagnostic groups at the .01 level

Hypotheses 3A, 3B, and 3C. It was hypothesized that children with Asperger syndrome would be less likely to generate narratives high in the dimensions of context, chronology, and theme than typically developing children.

Children with Asperger Syndrome on average had significantly lower Context scores (M = 0.22, SD = 0.42) than did typically developing children (M = 0.44, SD = 0.50, t [146] = -3.00, $p < .005$). Typically developing children are providing both time and location information almost half of the time, whereas children with Asperger syndrome are doing so less that a quarter of the time. Thus, children with Asperger syndrome were less likely than typically developing children to provide information that would locate the memory in both time and space.

Children with Asperger Syndrome also scored lower in Chronology (M = 1.91, SD = 1.38) than did the typically developing children (M = 2.59, SD = 0.89, t [172] = -3.79, $p < .001$). Most typically developing children are providing enough information that at least 75% of the events in the narrative can be chronologically ordered. On the

other hand, only about 50% of the events in a narrative provided by a child with Asperger Syndrome can be ordered chronologically ordered. Thus, a naïve listener would have a more difficult time placing the events of a memory report on a timeline if that memory was generated by a child with Asperger Syndrome than if the memory came from a typically developing child.

Finally, children with Asperger Syndrome on average had lower Theme scores (M = 0.51, SD = 0.50) than typically developing children (M = 0.77, SD = 0.42, t [207] = -3.97, $p < .001$). Typically developing children are including several instances of causal linkages, and/or interpretations, and/or elaborations of previously reported actions over 75% of the time, whereas children with Asperger syndrome are doing a little over half of the time. Thus, compared to their typically developing peers, children with Asperger syndrome were less likely to substantially develop their autobiographical memory narrative.

Aim 4. Examine the Influences of Age, Memory Valence, Memory Source, IQ, Theory of Mind, Working Memory, and Verbal Comprehension on the Coherence of Emotional Memory Reports in Children With and Without Asperger Syndrome.

Research question 4. As seen in the third aim, differences in coherence were found between children with and without Asperger syndrome. It remains unclear, however, what specific factors are driving these differences. Thus, this last aim was intended to investigate the possible factors that may explain any difference between children with and without Asperger syndrome in the coherence of their emotional autobiographical memories. The following exploratory analyses were designed to examine whether age, memory valence (positive or negative), memory source (nominated

by mother or child), IQ, theory of mind skills, working memory, and/or verbal comprehension did indeed influence the coherence of children's memory narratives. If the addition of one of these alternate predictors to the model caused diagnosis to no longer be significant, one would be able to deduce that this predictor is contributing to the observed diagnostic differences in coherence.

Analyses for Aim 4. MLM will again be used because each of the four memories are nested within each child, resulting in variables at both the level of the memory (level 1) and the level of the child (level 2). Three separate sets of MLM models will be run for the three individual dimensions of coherence: Context, Chronology, and Theme. Two of the dependent measures (context and theme) violate one of the primary assumptions of linear MLM, namely that the dependent variable is measured on an interval scale. Given this, logistic multilevel models will again be used to assess context and theme. In accordance with standards in the extant literature (Guo & Zho, 2000), all logistic multilevel model analyses were generated using the macro %GLIMMIX in SAS software, Version 9.1 of the SAS System for Windows (Copyright © 2002-2003, SAS Institute Inc., Cary, NC, USA). Typical linear MLM models will be used to assess chronology, which is on an interval scale of measurement.

Context

A fully unconditional model with the context dimension of coherence as the dependent measure indicated that 2% of the variability in length of narrative was between people ($t_{00} = 0.02$) and 98% was within people ($s^2 = 1.00$). Therefore, the fully unconditional model indicated that there was not sufficient variability between people.

This lack of significant variability makes ANOVA-based analyses equally appropriate as logistic MLM analyses, so further analyses used ANOVA-based analyses.

A 2 (diagnosis) X 2 (memory source) X 2 (memory valence) ANCOVA with IQ as a covariate and scores on the context dimension of coherence as the dependent variable revealed only a significant main effect of diagnosis (F [1, 139] = 10.27, $p < .005$, $?^2$ = .07). Children with Asperger syndrome (M = 0.22, SD = 0.42) generated narratives that scored lower in the context dimension of coherence than their typically developing peers (M = 0.44, SD = 0.50), over and above the effects of IQ.

Correlations determined which other variables would be considered in the ANOVAs. Correlations between potential predictors of narrative content and context scores can be seen in Table 9.

Table 9

Correlations Between Potential Predictors of Narrative and Context Scores

Predictors of Narrative	Correlation with Context Scores	Significance (1-tailed)
Theory of Mind (Faux Pas)	.18	< .05
Age	.15	< .05
Verbal Comprehension	.12	.07
IQ	-.08	.18
Working Memory	.02	.43

Theory of Mind emerged as the predictor most associated with context scores. This is not surprising given that understanding the perspectives and mental states of others is necessary for the realization that these others were not there at the time of the remembered event, and thus require that you provide contextual information to them.

Controlling for both Theory of Mind and age failed to reduce the significance of the relationship between diagnosis and context scores. Attempts to control for verbal comprehension and working memory were similarly ineffective. Because of this, it is still unclear what factors may be driving the observed differences in context scores between children with and without Asperger Syndrome.

Chronology

A fully unconditional model with the chronology dimension of coherence as the dependent measure indicated that 7% of the variability in length of narrative was between people ($t_{00} = 0.10$, $z = 0.88$, $p = .19$) and 93% was within people ($s^2 = 1.32$, $z = 7.77$, $p < .0001$). Therefore, the fully unconditional model indicated that there was not sufficient variability between people. This lack of significant variability makes ANOVA-based analyses equally appropriate as MLM analyses, so further analyses used ANOVA-based analyses.

A 2 (diagnosis) X 2 (memory source) X 2 (memory valence) ANCOVA with IQ as a covariate and scores on the chronology dimension of coherence as the dependent variable revealed a significant main effect of diagnosis (F [1, 165] = 10.30, $p < .005$, $?^2 = .06$), a significant main effect of memory valence (F [1, 165] = 18.86, $p < .001$, $?^2 = .10$), and an interaction between diagnosis and memory source that approached significance (F [1, 165] = 3.39, $p < .07$, $?^2 = .02$), even after controlling for IQ. Children with Asperger Syndrome provided less coherent reports of positive, but not negative, events than typically developing children in the dimension of chronology (see Figure 12).

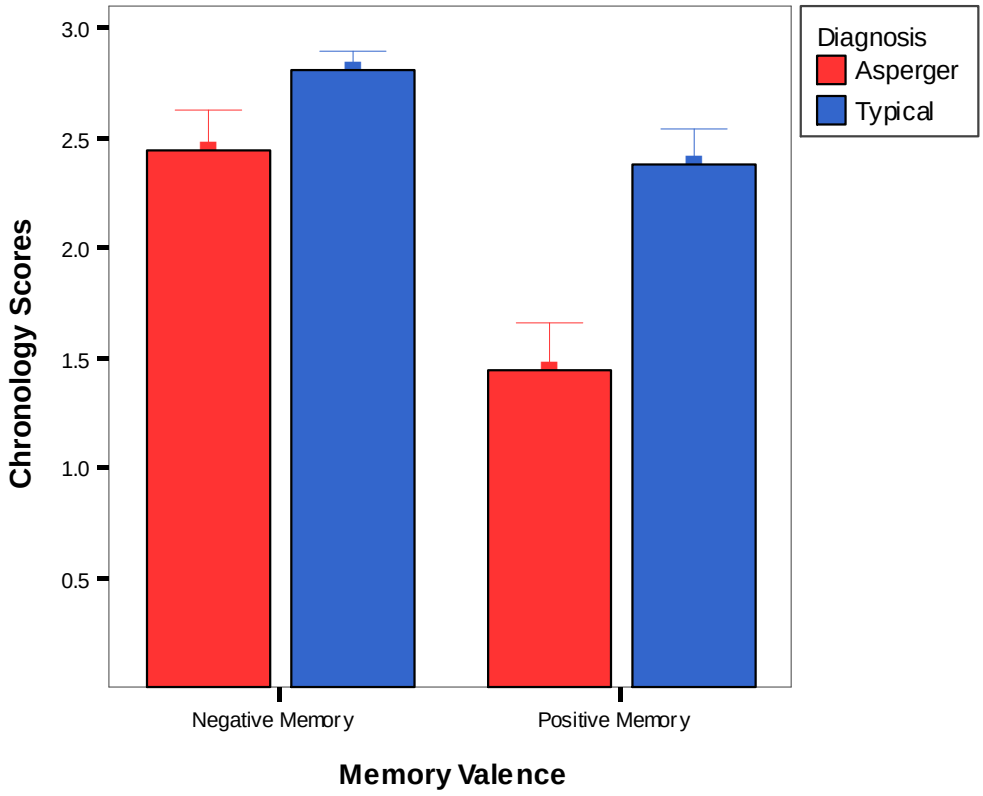

Figure 12. Interaction between memory valence and diagnosis on the chronology scores of emotional narratives generated by children with and without Asperger Syndrome.

Correlations determined which other variables would be considered in the ANOVAs. Correlations between potential predictors of narrative content and context scores can be seen in Table 10.

Table 10

Correlations Between Potential Predictors of Narrative and Chronology Scores

Predictors of Narrative	Correlation with Chronology Scores	Significance (1-tailed)
Working Memory	.25	< .001
Verbal Comprehension	.15	< .05
IQ	.15	< .05
Theory of Mind (Faux Pas)	.12	.06
Age	.00	.48

It is not surprising that working memory was the most predictive of chronology scores. When providing a chronologically-ordered memory narrative, one must hold the actions within the remembered event in working memory until it is the appropriate time to discuss those actions. Despite the significant correlations between chronology scores and the predictors of working memory and verbal comprehension (IQ was already controlled for in the above analyses), the addition of these variables as covariates did nothing to lessen the relationships described above. Attempts to control for Theory of Mind and age were similarly ineffective. Because of this, it remains to be determined what specific factors may be driving the observed interaction between memory valence and diagnosis on chronology scores.

Theme

A fully unconditional model with the theme dimension of coherence as the dependent measure indicated that 49% of the variability in theme scores was between people ($t_{00} = 0.82$) and 51% was within people ($s^2 = 0.85$). Therefore, the fully

unconditional model indicated that there was sufficient variability at both levels for further analyses of theme using MLM analyses.

The within person predictors of memory valence and memory source were considered in this first model of percentage of positive feelings. Diagnosis is the between person predictor of primary interest in this model. Finally, gender is included in the model to control for the gender differences in theme scores observed in this data set. The equations for this model are as follows (Model 1):

Level 1: $THEME = ß_{0ij} + ß_{1ij}(SOURCE) + ß_{2ij}(VALENCE) + r_{ij}$

Level 2: $ß_{0i} = ?_{00} + ?_{01}(DIAGNOSIS) + ?_{01}(GENDER) + u_{0i}$

$ß_{1i} = ?_{10} + u_{1i}$

$ß_{2i} = ?_{20} + u_{2i}$

where

THEME = rating of the theme dimension of coherence (0=low, 1=high)

Results from the model above indicated that diagnosis does in fact influence rating of theme for emotional memory reports (see Model 1 of Table 8), above and beyond the effects of gender. Memory source and memory valence, however, appear to be unrelated to theme scores. This model accounted for 61% of the between person variance and 11% of the within person variance in theme scores. The goals of subsequent models examining word count were two-fold. First, 39% of the between person and 89% of the within person variance were still left to explain. Second, if the adding another predictor to the model reduces the predictive power of diagnosis, it may be inferred that the shared variance between diagnosis and that predictor is predictive of theme scores.

This would likely be indicative of factors that are driving observed diagnostic differences.

Correlations again determined the order in which predictor variables were entered into the MLM models. Correlations between potential predictors of narrative content and theme scores can be seen in Table 11.

Table 11

Correlations Between Potential Predictors of Narrative and Theme Scores

Predictors of Narrative	Correlation with Theme Scores	Significance (1-tailed)
Verbal Comprehension	.21	< .001
Theory of Mind (Faux Pas)	.20	< .005
Working Memory	.12	< .05
Age	.11	.06
IQ	.07	.15

It is probably not surprising that out of the potential predictors, verbal comprehension shares the most variance with ratings of theme. In order to receive a high rating in the dimension of theme, the narrative must be substantially developed through several instances of causal linkages, interpretations, and elaborations. Including these in narrative devices would seem highly dependent upon having the verbal ability to do so. Given that verbal comprehension had the largest correlation with ratings of theme, it was the between-person predictor entered into the MLM model first. Surprisingly, given their correlation with theme scores, the addition of the variables of verbal comprehension, Theory of Mind, and working memory did not add help to explain the relationship between diagnosis and theme scores. Thus, Model 1 was chosen as the final model (see

Table 12). It remains unclear what specific factors may be driving the differences seen in the theme ratings for emotional autobiographical memories for children with and without Asperger Syndrome.

Table 12

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Theme Scores in Emotional Memories

Fixed Effects	Model 1
Theme, $ß_0$	
Intercept, $?_{00}$	-0.09 (0.30)
Diagnosis, $?_{01}$	0.80* (0.35)
Gender, $?_{02}$	2.46* (1.05)
Memory Source Slope, $ß_1$	
Intercept, $?_{10}$	0.17 (0.30)
Memory Valence Slope, $ß_2$	
Intercept, $?_{20}$	0.11 (0.30)
Random Effects	
Between-person variability in level of chronology (t_{00})	0.32
Within-person fluctuation in chronology (s^2)	0.94

Note: *$p < .05$

Discussion

This investigation examined the content and structure of the emotional autobiographical memories of children with and without Asperger Syndrome. Four major findings emerged from this study. First, in comparison to their typically developing peers, children with Asperger Syndrome were less able to generate memory

narratives, particularly in the self-nominated negative memory condition. Second, children with Asperger Syndrome were more likely to include negative emotions such as fear and anxiety and less likely to include positive feelings in their memory narratives than were typically developing children. Third, children with Asperger Syndrome were more likely to include references to themselves in their memory narratives than were their unimpaired peers in the memories they themselves generated. Finally, children with Asperger Syndrome generated memory narratives that were less coherent than narratives generated by typically developing children. Each of these major findings will be discussed in turn.

Differences in Generation of Emotional Memories

In contrast to their typically developing peers, the participants with Asperger Syndrome failed to nominate an emotion event for discussion with some frequency. This difference was most pronounced in the self-nominated negative memory condition. Without the extra scaffolding provided by their mothers' selections of memories, children with Asperger Syndrome were only able to generate memory narratives for negative events 67% of the time, whereas they were able to generate narratives for positive events 93% of the time. Typically developing children, on the other hand, did not show this same difficulty in generating their self-nominated negative memory narratives. Thus, it appears that the extra scaffolding provided by mother nomination of memory topics may help to minimize group differences seen in the ability to generate self-nominated memory narratives.

It is possible that children with Asperger Syndrome may simply be more reluctant to disclose their negative memories than typically developing children. The memories

that children with Asperger Syndrome did disclose were more infused with negative emotions (such as fear and anger) than those provided by typically developing children. Given this, it may be that the events the children did not disclose would have contained an even higher percentage of negative emotion words. Thus, children with Asperger Syndrome may be less likely to generate self-nominated negative memory narratives because they are uncomfortable in talking about such negative emotional experiences. The children's self-ratings of how the events made them feel, however, provide some evidence against this possible explanation. If the effect were simply a disclosure issue, one would expect the children with Asperger Syndrome would rate their experiences as more negative in valence than their typically developing counterparts. Instead, the two groups did not differ in their ratings of their self-nominated negative experiences. Of course, we only have ratings for the events the children did disclose, and it is impossible to know if these ratings would apply for the events the nondisclosed events.

Another possible conclusion is that children with Asperger Syndrome have reduced accessibility to their memories of the negative events in their lives. Given their lack of social skills, perhaps children with Asperger Syndrome did not seek out help from others in making sense of their negative experiences to the same extent that typically developing children did. When parents provide the scaffolding necessary for children to explain and resolve their negative emotion, they create a framework for understanding and organizing negative life events (Bird & Reese, 2006). If the parents of children with Asperger Syndrome are not able to provide the scaffolding necessary for children to explain and resolve their negative emotion, this might lead to less consolidation and fewer opportunities for reinstatement of their memories of negative experience. The

mother nominated negative events have presumably been discussed between the mother and child, providing both typically developing children and those with Asperger Syndrome an opportunity to make sense of these negative experiences through parental scaffolding. Because of their inherent difficulties with social interactions, children with Asperger Syndrome may be less likely to seek out the scaffolding necessary to make sense of negative events, which may then explain their reduced ability to generate negative memory narratives without social support. As discussed below, the content of the negative memory narratives also differs between diagnostic groups.

Differences in Use of Internal State Language

It was hypothesized that children with Asperger Syndrome would include fewer references to emotional, cognitive, perceptual, and physiological states than would their typically developing peers. This hypothesis was only partially supported. Children with Asperger Syndrome included fewer references to positive feelings in their memory narratives. In fact, a significant three-way interaction revealed that typical children were much more likely to include positive feelings in their self-nominated negative memories than were children with Asperger Syndrome. Typically developing children may be bringing positive emotion into their self-nominated negative memories as a mechanism for resolving and making sense of these negative experiences. Children with Asperger Syndrome, on the other hand, do not appear to put this same positive spin when narrating their negative experiences.

There was not much other support for the hypothesis that children with Asperger Syndrome would use less ISL in their narratives, as these children did not differ from typically developing children in their use of cognitive, perceptual, or physiological

words. Unexpectedly, children with Asperger Syndrome actually included more references to negative emotions such as fear and anxiety than did their typically developing peers. This relationship between diagnosis and usage of anxiety and fear words disappears when controlling for working memory. In conjunction with the findings reported above, this pattern of results is consistent with the possibility that children who are able to keep guidance and direction from previous interactions with adults active in their working memory are better able to resolve their feelings of fear and anxiety.

Differences in References to Self

Hurlburt, Happé, and Frith (1994) found that although individuals with Asperger syndrome are able to reflect on their own mental states, they are not interested in comparing their reflections with others' self-reports. Thus, individuals with Asperger syndrome may lack an understanding of self in relation to others. Instead, they may experience an intense egocentrism (Frith & De Vignemont, 2005), which is likely a precursor to their observed deficits in Theory of Mind. Given this, it was not surprising that in the present study, there was a trend for children with Asperger Syndrome to include more references to themselves in their self-nominated memory narratives in comparison to both their mother-nominated memory narratives and those generated by typically developing children. Thus, when given the opportunity to choose their own topic for discussion, they may be providing more egocentric memory narratives. This pattern may not be particularly surprising as children with Asperger Syndrome are less aware of and involved in the social world. Because of this, these individuals are more likely to have memories that center on individual experiences. Mothers of children with

Asperger Syndrome appear to be compensating for this tendency in their children and by nominating memories that they know involve other people.

Differences in Coherence of Emotional Memories

It was hypothesized that children with Asperger syndrome would be less likely to generate narratives high in coherence than would typically developing children. This hypothesis was supported as children with Asperger Syndrome provided memory narratives that were rated lower on all dimensions of coherence (context, chronology, and theme) than were the reports of typically developing children. Only a main effect of diagnosis on coherence was revealed for the context and theme dimensions, with typically developing children providing more coherent memory narratives than children with Asperger Syndrome. For the dimension of chronology, children with Asperger Syndrome provided less coherent reports of positive, but not negative, events than did typically developing children. These relationships between diagnosis and coherence did not vary by the source of the memory nomination. Nor were these relationships partially explained through the potential predictors of Theory of Mind, working memory, verbal comprehension, IQ, or age. Because of this, it is still unclear what factors may be driving the observed differences in coherence scores between children with and without Asperger Syndrome.

It is possible that children with Asperger Syndrome provide less coherent narratives overall because the memories they do talk about are more likely to be repeated events than are those generated by typically developing children (see Figure 6). A generic memory that has been repeated on many occasions would be very hard to locate in a specific time and place, meaning a high score in context would be unlikely. These

repeated events would additionally be unlikely to contain a resolution, preventing the highest possible score for theme. Finally, because the order of actions within an event could vary considerably for different instances of a repeated event, children may not be able to temporally order their memory narratives for these repeated events.

Typically developing children, on the other hand, were much more likely to provide plotted story memory narratives. Plotted stories by definition contain actions that are causally and temporally linked, which would lead to higher scores in the theme and chronology dimensions of coherence. Additionally, plotted stories would be more likely to be located within a specific time and place. Thus, differences in coherence between children with and without Asperger Syndrome may arise from the types of narratives they are likely to provide.

Post-hoc analyses seem to lend some credence to these hypotheses. In comparison to snapshots ($M = 0.13$, $SD = 0.34$), both plotted stories ($M = 0.43$, $SD = 0.50$) and repeated events ($M = 0.40$, $SD = 0.52$) were rated higher in the dimension of context ($X^2 = 12.13$, $p < .005$). In comparison to both snapshots ($M = 1.53$, $SD = 1.41$) and repeated events ($M = 1.00$, $SD = 1.50$), plotted stories ($M = 2.65$, $SD = 0.84$) were rated higher in the dimension of chronology ($F = 25.52$, $p < .001$). Finally, in comparison to both snapshots ($M = 0.44$, $SD = 0.50$) and repeated events ($M = 0.42$, $SD = 0.51$), plotted stories ($M = 0.77$, $SD = 0.42$) were rated higher in the dimension of theme ($X^2 = 23.61$, $p < .001$). Thus, plotted stories were consistently rated highest in all dimensions of coherence. As typically developing children were much more likely than were children with Asperger Syndrome to narrate their emotional memories using these

plotted stories, it is not surprising that typically developing children are also more likely than those with Asperger Syndrome to provide highly coherent memory reports.

Emotion, Memory Narratives, and Asperger Syndrome

Children with Asperger Syndrome provided memory narratives that were globally rated by the researchers as more neutral and less negatively valenced memory narratives than did typically developing children. Despite this, the groups did not differ in their own perceptions of how the event made them feel. This may indicate that there is a disconnect between objective ratings of the emotional valence of an event and the subjective feelings that children with Asperger Syndrome have towards that same event. Given their difficulty with social interactions, it is certainly possible that children with Asperger Syndrome fail to differentiate themselves from typically developing children in their ratings of happiness because they are uncomfortable disclosing such information. Another possibility is that children with Asperger Syndrome do not experience the same extremes in negative emotions as typically developing children do.

Surprisingly, given that children with Asperger Syndrome provided memory narratives that were rated as less negative than those from their typically developing peers, children with Asperger Syndrome included a higher percentage of anxiety and fear words in their narratives than typically developing children. This pattern suggests that when children with Asperger Syndrome do discuss an event that is objectively negative, these narratives may be more densely infused with words related to anxiety and fear. A 2 (Diagnosis: Asperger or Typically Developing) X 3 (Emotion: Positive, Negative, or Neutral) ANOVA did not detect an interaction between diagnosis and emotion, but only a main effect of diagnosis. Thus, it appears that children with Asperger Syndrome were

more likely to include fear and anxiety in their emotional memory narratives, regardless of their overall tone. Additionally, there was a lack of correlation between self-ratings of happiness and use of anxiety and fear words. Together, these findings highlight a disconnect between subjective reports of emotion experience from children with Asperger Syndrome and more objective indicators of their emotional experience. These children appear to have a less developed understanding of emotional experience, a finding consistent with Losh and Capps' (2006) findings.

Bringing Meaning to Memory

Children with Asperger Syndrome had a particularly difficult time self-generating negative memory narratives compared to their typically developing peers. This group difference was not observed in the mother nominated positive memories, the mother-nominated negative memories, or in the child-generated positive memories. Perhaps because of their social difficulties, children with Asperger Syndrome did not seek out help from parents and peers in making sense of the negative experiences in their lives. This would likely lead to a lesser consolidation of negative experiences, making memories of these events less accessible over time.

This possible explanation was supported by the finding that typically developing children infused a good deal of positive emotion in their self-generated negative memories, whereas children with Asperger syndrome did not. Typically developing may be including a positive spin in their negative memory narratives, indicating that they are actively working to make sense of these experiences. Another possibility is that this inclusion of positive emotion may simply reflect typically developing children's subjective reality. The fact that typically developing children include even more positive

emotion in their self-generated negative memory narratives than their positive memory narratives would seem in conflict with this explanation, however. If inclusion of positive emotion words did reflect the child's subjective reality, one would expect that their self-nominated positive events would contain the largest percentage of positive emotion words. Instead, it is their self-nominated negative memories that contain the largest percentage of these words.

Additionally, the fact that typically developing children did not differ from children with Asperger Syndrome in their self-ratings of emotional experience would also seem to suggest that there are no differences in the children's subjective emotional experiences regarding these negative memories. Instead, there seems to be evidence that typically developing children are including a positive spin in their self-nominated negative memory narratives. Children with Asperger Syndrome, on the other hand, may be doing very little to make sense of the negative experiences of their lives. Children with Asperger Syndrome were also more likely to include negative emotions such as fear and anxiety in their narratives, regardless of memory type, than typically developing children. This group difference disappears when controlling for working memory, suggesting that children with higher levels of working memory are more likely to be able to scaffold the event for themselves and apply guidance and meaning-making strategies from adults.

Finally, children with Asperger Syndrome provided less coherent memory narratives than their typically developing peers. This may provide further support for the speculation that these children may be engaging less frequently in meaning-making activities, leading to less structured memory narratives. Given their difficulties with

social interactions, children with Asperger syndrome are less likely to talk about their memories with their parents and peers. Without these interactions, children with Asperger Syndrome may lack the framework to bring meaning to their emotional experiences.

Limitations of the Current Study

Perhaps the biggest limitation of the current study is that it did not directly measure episodic memory separate from autobiographical memory. Thus, it is possible that any differences seen between groups could result from differences in overall episodic memory functioning, rather than anything specific to autobiographical memory. It would have been nice to demonstrate little difference between groups in episodic memory functioning (as seen in Bolwer, Gardiner, & Grice, 2000), while at the same time presenting differences between groups specifically for autobiographical memory measures. It is worth noting, however, that there were no differences between diagnostic groups in their working memory. And whereas controlling for working memory did reduce the relationship between diagnosis and inclusion of anxiety and fear words to nonsignificance, it was not able to explain any other differences between diagnostic groups. Finally, and perhaps most importantly, the fact that many of the results are interactions rather than main effects of diagnosis argues against a basic memory deficit in Asperger Syndrome. Thus, provides some tenuous evidence that differences between children with Asperger Syndrome and typically developing children on measures of autobiographical memory are not simply the result of overall memory deficits.

An additional limitation is that children were not asked to provide memory reports for events that were not infused with emotion. It would have been potentially

informative to have directly compared emotional and nonemotional memory narratives in children with and without Asperger Syndrome. Losh and Capps (2006) did not find differences between children with and without autism spectrum disorders in their nonemotional memory narrative. The clinical samples in Losh and Capps (2006) and the present investigation were of similar age and cognitive development. Additionally, the children with Asperger Syndrome in the present investigation did not display delays in language development. Thus, these children with Asperger Syndrome were more similar to typically developing children than were the children with autism spectrum disorders in Losh and Capps (2006). For this reason, one would not expect to find differences between children with Asperger Syndrome and typically developing peers for nonemotional memories in the current sample either.

Demonstrating diagnostic differences for emotional, but not nonemotional, memories would have presented one important advantage. This would have highlighted that children with Asperger Syndrome have the capacity to remember events just as well as do typically developing children in some domains but not others. Still, one can find evidence that children with Asperger Syndrome do not have general memory deficits in the present investigation. Children with Asperger Syndrome seem to be just as able to generate memory narratives as typically developing children when given maternal scaffolding. These memory narratives do not differ in length or use of cognitive, perceptual, or physiological terms. Additionally, children with Asperger Syndrome only provided egocentric memory narratives when they did not have the support of mother nomination of memory topics. In many respects, children with Asperger Syndrome provide memory narratives that are similar to those provided by typically developing

children when given appropriate scaffolding. Thus, there is some reason to suspect that children with Asperger Syndrome have specific difficulties narrating some of their autobiographical memories.

Additionally, the Faux Pas task may not represent the best measure of Theory of Mind. While age appropriate and developed specifically for use with children with Asperger Syndrome (Baron-Cohen et al., 1999), detection of faux pas represents only one small part of Theory of Mind abilities. Additionally, the ability to detect faux pas may not be a particularly helpful in remembering events and generating narratives. Perhaps a measure of Theory of Mind that encompassed more dimensions of perspective-taking skills would be more predictive of narrative measures. Additionally, Losh and Capps (2003) found that emotional understanding, not Theory of Mind, was predictive of narrative measures in individuals with high-functioning autism. Thus, another limitation of the present investigation is the lack of any measure of emotional understanding.

Another potential weakness of the study was that the clinical and comparison samples were not perfectly matched. There were seven females in the typically developing sample, and no females with Asperger Syndrome. Additionally, the two groups were not equated for IQ or verbal comprehension. These variables were considered when they were significantly related to the outcome measures, however.

Finally, because of the number and exploratory nature of the analyses reported above, there is the risk of Type I errors. Given this, it is important to interpret the significant differences reported here with caution. Future investigations will aim to provide support for these findings.

Strengths of the Current Study

Despite the limitations to the current investigation, it is worthwhile to revisit the many strengths of this study. Perhaps the most significant strength of this study was the stringent criteria used for inclusion in the sample of children with Asperger Syndrome. In the Losh and Capps (2003, 2006) work, the clinical samples included children with both autism and Asperger Syndrome. Narrative differences between groups with autism spectrum disorders and typically developing children may arise from delays in social, cognitive, or language development. In the present investigation, only children whose characteristics were consistent with the Asperger Syndrome diagnosis at all three stages of the screening process (as described in the method) were included in the final sample of children with Asperger syndrome. By comparing typically developing children to those with Asperger syndrome (and not those with autism spectrum disorders more broadly), we are more certain that social factors may be driving the observed differences between the groups.

Unlike previous studies of autobiographical memory in populations with autism spectrum disorders, the present investigation examined the effect of prompting for positive and negative emotional memories. Losh and Capps (2006) found that children with autism spectrum disorders provided impoverished narratives for emotional, but not nonemotional, memories compared to typically developing children. They did not, however, consider the valence of the prompts in their report. Children with Asperger syndrome had a particularly difficult time narrating autobiographical narratives of negative events, possibly because of their fewer opportunities to consolidate such

memories through social interactions. This important finding was not examined in previous experiments.

Additionally, the children in the Losh and Capps (2006) study nominated all of the events that they then narrated. The present investigation found that additional scaffolding provided through maternal nomination of events helped to minimize differences between groups. Children with Asperger Syndrome had a difficult time generating narratives of negative experience, but only when they were required to self-nominate the remembered event. Additionally, children with Asperger Syndrome appear to include less of a positive spin on their self-nominated negative memories compared to typically developing children. Such observations would not have been possible using previous methodology.

Also, Losh and Capps (2006) were primarily concerned with the structuring of emotional narratives. Their findings suggested that individuals with autism spectrum disorders may have less coherent memory representations of emotional events than their typically developing peers. The present investigation applied a standardized coherence coding scheme (Reese & Haden, in preparation) to examine this directly and found that children with Asperger Syndrome do indeed provide less coherent emotional memory narratives. Additionally, the present investigation moved beyond the structuring of these memories and also examined their content. This study revealed that children with Asperger Syndrome were more likely to include negative emotions such as fear and anxiety and less likely to include positive feelings than typically developing children. Additionally, children with Asperger Syndrome provided more egocentric emotional memory narratives than their typically developing peers. Thus, such closer examinations

of the content of these narratives helped to differentiate the emotional memory reports of children with and without Asperger Syndrome.

Finally, the multiple memories obtained from each participant were examined using multilevel modeling (MLM). MLM is the statistical technique that is most appropriate for the nested data often analyzed in memory research, but unfortunately, it is seldom used at present. It accounts for the fact that the multiple memories examined in this study are not fully independent, such that memories produced by the same child are expected to be more similar than memories produced by different children.

Recommendations for Future Research

Obviously, additional research is needed to better understand autobiographical memory functioning in autism spectrum disorders. Examinations of first/early memories in these atypical populations could highlight what factors are most important in the onset of autobiographical memory. Experiments comparing autobiographical memory functioning in high-functioning autism and Asperger syndrome would be particularly informative. Autistic individuals display the same difficulty with social interactions seen in Asperger Syndrome. However, a diagnosis of autism requires that the individual also have language delays. Comparing autistic individuals with mentally aged-matched individuals with Asperger Syndrome would provide an opportunity to examine the unique contribution of language to the emergence of autobiographical memory (Nelson & Fivush, 2004). Finally, the data in this present investigation suggests that parents discuss emotional experiences with children with Asperger Syndrome differently than they do with typically developing children. This speculation has yet to be directly examined,

however. We still need to know more about how parents discuss emotional experiences with children with Asperger Syndrome across development.

Implications for Understanding Development

There was an overall absence of age effects in the present investigation. Age was correlated with the context dimension of coherence, with greater age associated with greater contextual coherence. Age was not able to explain any differences between children with and without Asperger Syndrome on any narrative measures, however. Because the groups were similar in age and in their cognitive and language development, this may not be particularly surprising. The children in the present investigation were between the ages of 6 and 13. Perhaps age effects would be more prominent at younger ages. By the time children reach the ages used in the present study, children with Asperger Syndrome may have had an opportunity to compensate for any earlier delays. Future investigations should address this possibility.

The Nelson and Fivush (2004) model outlines a number of cognitive social factors that contribute to the emergence of autobiographical memory. This model can be further evaluated using the data in the present investigation. As highlighted above, children with Asperger Syndrome and their typically developing peers differ from each other in their abilities in understand the mental states of other and in engaging in conversations about the past and future. Nelson and Fivush (2004) propose that both of these factors (Theory of Mind and social interactions) contribute to the development of autobiographical memory. Despite differences in Theory of Mind skills (as measured by the Faux Pas Task) between children with and without Asperger Syndrome, this difference did not help to explain any group differences on narrative measures. This is not surprising, as Losh

and Capps (2003) did not find that Theory of Mind skills predicted any measures of narrative. Instead, emotional understanding emerged as a strong predictor of narrative skills. It may be that the Nelson and Fivush (2004) model may need to consider the role of emotional understanding in the development of autobiographical memory.

The present investigation examined the role of conversations about the past and future on the development of autobiographical memory indirectly by examining memories selected by both the child and the mother. It is probably a safe assumption that a memory selected by a mother for their child to discuss is one that the child and mother have discussed in the past. The memories nominated by the child, however, are less likely to have been discussed. The additional scaffolding provided through maternal nomination of events did appear to help to minimize differences between children with and without Asperger Syndrome. Thus, the overall pattern of results does provide support for Nelson and Fivush's (2004) inclusion of social interactions (in the form of conversations about the past and future) in their model of the emergence of autobiographical memory.

Fivush and Nelson (2004) note that "early culture- and gender-differentiated patterns of maternal reminiscing seem to be related to later culture- and gender-differentiated patterns of autobiographical memory" (p. 576). This present investigation extends these findings, highlighting the ways in which patterns of maternal reminiscing for children with typical and atypical development is related to later patterns of autobiographical memory.

Implications for Children with Asperger Syndrome

This study provided a better understanding of the strengths and weaknesses in autobiographical memory found in children with Asperger syndrome. This will likely help future intervention efforts. Children with Asperger syndrome appear to have difficulty narrating their emotional autobiographical memories. This could very well put them at a disadvantage, as autobiographical memory aids in planning for the present and future, establishing a continuous sense of self, and forming and maintaining relationships (Pillemer, 2003). Because of this, successful intervention efforts for children with Asperger Syndrome may need to specifically address the autobiographical memory system.

The findings of this study suggest that children with Asperger Syndrome have some difficulty bringing meaning to emotional experiences. Unlike their typically developing peers, children with Asperger Syndrome have particular difficulty in generating negatively valenced memory narratives without maternal scaffolding. Additionally, when they are able to provide self-nominated negative memory narratives, children with Asperger Syndrome include less positive feelings than typically developing children do. This suggests that these children are not able to understand these negative events on their own. Parents and teachers of children with Asperger Syndrome may need to do more in teaching strategies to children that can help them bring meaning to the negative events in their lives.

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Appendix

Appendix A

ASPERGER SYNDROME DIAGNOSTIC SCALE

ASDS

Asperger Syndrome Diagnostic Scale

Summary/Response Form

Section I. Identifying Information

Student's Name _____

Address _____

_____

	Year	Month	Day
Date Tested	____	____	____
Date of Birth	____	____	____
Age	____	____	____

School _____

Parents'/Guardians' Names _____

Examiner's Name _____

Examiner's Title _____

Rater's Name _____

Section II. Score Summary

Subscales	Raw Score	Standard Score	%ile
Language	____	____	____
Social	____	____	____
Maladaptive	____	____	____
Cognitive	____	____	____
Sensorimotor	____	____	____
Total Raw Score	____		
Asperger Syndrome Quotient		____	____

Section III. ASQ Interpretation Guide

Asperger Syndrome Quotient	Probability of Asperger Syndrome
>110	Very Likely
90–110	Likely
80–89	Possibly
70–79	Unlikely
≤69	Very Unlikely

Section IV. Profile of Scores

Quotients	ASQ	Quotients	ASDS Subscales: Standard Scores	Language	Social	Maladaptive	Cognitive	Sensorimotor	Standard Scores
130		130	16						16
125		125	15						15
120		120	14						14
115		115	13						13
110		110	12						12
105		105	11						11
100		100	10						10
95		95	9						9
90		90	8						8
85		85	7						7
80		80	6						6
75		75	5						5
70		70	4						4
65		65	3						3
60		60	2						2
55		55	1						1

6 7 8 9 10 09 08 07 06 05

Additional copies of this form (#9352) may be purchased from
PRO-ED, 8700 Shoal Creek Blvd., Austin, TX 78757-6897
800/897-3202, Fax 800/397-7633, www.proedinc.com

Section V. Response Form

Directions: The *Asperger Syndrome Diagnostic Scale* contains a series of statements that are rated as observed or not observed. Read each statement and circle 1 when you have observed the behavior that is described in the statement. If you have not observed the behavior described in the statement, circle 0. Remember to rate every behavior based upon your observations. If you are uncertain about how to rate an item, delay the rating and observe the person for a 6-hour period to determine your rating or seek information from a reliable reporter familiar with the individual.

Language Subscale	Observed	Not Observed
1. Speaks like an adult in an academic or "bookish" manner and/or overly uses correct grammar	1	0
2. Talks excessively about favorite topics that hold limited interest for others	1	0
3. Uses words or phrases repetitively	1	0
4. Does not understand subtle jokes (e.g., sarcasm)	1	0
5. Interprets conversations literally (i.e., has difficulty understanding metaphors, idioms)	1	0
6. Has peculiar voice characteristics (i.e., sing-song, monotone)	1	0
7. Acts as though he or she understands more than he or she does	1	0
8. Frequently asks inappropriate questions	1	0
9. Experiences difficulty in beginning and continuing a conversation	1	0
Total Language Raw Score	☐	

Social Subscale	Observed	Not Observed
1. Uses few gestures	1	0
2. Avoids or limits eye contact	1	0
3. Has difficulty in relating to others that cannot be explained by shyness, attention, or lack of experience	1	0
4. Exhibits few or inappropriate facial expressions	1	0
5. Shows little or no interest in other children	1	0
6. Prefers to be in the company of adults more than peers	1	0
7. Has few or no friends in spite of a desire to have them	1	0
8. Has little or no ability to make or keep friends	1	0
9. Does not respect others' personal space	1	0
10. Displays limited interest in what other people say or what others find interesting	1	0
11. Has difficulty understanding the feelings of others	1	0
12. Does not understand or use rules governing social behavior	1	0
13. Has difficulty understanding social cues (i.e., turn-taking in conversation, politeness)	1	0
Total Social Raw Score	☐	

Maladaptive Subscale	Observed	Not Observed
1. Does not change behavior to match the environment (i.e., uses loud outside voice in the library)	1	0
2. Engages in inappropriate behavior related to obsessive or favorite interest	1	0
3. Displays antisocial behavior	1	0
4. Exhibits a strong reaction to a change in his or her routine	1	0
5. Frequently becomes anxious or panics when unscheduled events occur	1	0
6. Appears depressed or has suicidal tendencies	1	0
7. Engages in repeated, obsessive, and/or ritualistic behavior	1	0
8. Displays behaviors that are immature and similar to those of a much younger child	1	0

9. Frequently loses temper or has tantrums	1	0
10. Frequently feels overwhelmed or bewildered, especially in crowds or demanding situations	1	0
11. Attempts to impose narrow interests, routines, or structures on others	1	0
Total Maladaptive Raw Score	☐	

Cognitive Subscale	Observed	Not Observed
1. Displays superior ability in restricted area of interest, while having average to above average skills in other areas	1	0
2. Displays an extreme or obsessive interest in a narrow subject	1	0
3. Functions best when engaged in familiar and repeated tasks	1	0
4. Has excellent rote memory	1	0
5. Learns best when pictures or written words are present	1	0
6. Has average to above average intelligence	1	0
7. Appears to be aware that he or she is different from others	1	0
8. Is oversensitive to criticism	1	0
9. Lacks organizational skills	1	0
10. Lacks common sense	1	0
Total Cognitive Raw Score	☐	

Sensorimotor Subscale	Observed	Not Observed
1. Displays an unusual reaction to loud, unpredictable noise (e.g., screams, has tantrums, or withdraws)	1	0
2. Frequently stiffens, flinches, or pulls away when hugged	1	0
3. Overreacts to smells that are hardly recognizable to those around him or her	1	0
4. Prefers to wear clothes made of only certain fabrics	1	0
5. Has a restricted diet consisting of the same foods cooked and presented in the same way	1	0
6. Exhibits difficulties with handwriting or other tasks (i.e., buttoning, typing) that require fine motor skills	1	0
7. Appears clumsy or uncoordinated	1	0
Total Sensorimotor Raw Score	☐	

Section VI. Key Questions

1. At what age did the unusual behavior first occur? _____
2. Does the unusual behavior occur in all settings? _____
3. Could the unusual behavior be the result of another handicapping condition? _____
4. Who has evaluated the person and what were the results? _____
5. What assessments and evaluations have been conducted? _____
6. Are disturbances noted in the areas of the DSM–IV or ICD–I0 definitions? _____
7. What areas are most affected? What are the symptoms? _____
8. How severe are the symptoms? How do the symptoms interfere with everyday functioning? _____
   _____
9. What information needs to be collected? _____
   Who can supply the information? _____
10. What resources are available for further evaluation? _____

Note. Section VI was adapted from *Gilliam Autism Rating Scale,* Summary/Response Form (p. 6), by J. Gilliam, 1995, Austin, TX: PRO-ED. Copyright 1995 by PRO-ED, Inc. Adapted with permission.

Section VII. Interpretation and Recommendations

Section VIII. ASDS Characteristics

Description: *The Asperger Syndrome Diagnostic Scale* (ASDS) is a standardized test designed to aid in the identification of individuals ages 5 through 18 who manifest the characteristics of Asperger syndrome (AS). The ASDS provides norm-referenced information that can assist in the diagnosis of AS.

Item Selection: Items on the ASDS are based on the diagnostic criteria of AS published in the *Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition* (DSM–IV; American Psychiatric Association, 1994) and in the *International Classification of Diseases–Tenth Edition* (ICD–10; World Health Organization, 1992), a review of all literature published in the ERIC and PsychInfo databases from 1975 through 1999 on AS, and Hans Asperger's (1944) original research.

Normative Data: The ASDS was standardized on a sample of 115 individuals with Asperger syndrome residing in 21 states.

Reliability: Internal consistency of the ASDS was determined using Cronbach's coefficient alpha technique. Studies revealed a coefficient alpha of .83 for the Asperger Syndrome Quotient (ASQ). This reliability coefficient is strong and indicates that the items in the test are strong and are measuring Asperger syndrome behaviors. The ASQ is sufficiently reliable for inclusion in important diagnostic decisions.

Validity: The validity of the ASDS was demonstrated through several research studies. Item analysis of the ASQ established that the items have strong discriminating power. Concurrent criterion-related validity studies demonstrated that scores from the ASDS can be used to identify students who are likely to have Asperger syndrome.

Appendix B

FAUX PAS TASK INTERVIEW PROTOCOL

Child ID Number: _____ Date: _____ Tape Number: _____

Location: Buffalo Raleigh Interviewer: _____

Introduction. *If this is the interviewer's first interaction with the participant, interview provides his/her name*: "***Hi,[child's name], I'm [interviewer's name]. I'm going to use this tape-recorder to play some stories for you. I want you to listen very carefully because afterwards I am going to ask you some questions to see what you think of them. Are you ready for the first story?"***

Practice Story.

0. It was time for lunch at school. Everyone was supposed to bring lunch from home. "Oh, no!" said Ben. I left my lunch box in my mom's car today." "Don't worry," said his friend Bob. I have two sandwiches in my lunch box. I'll give you one." "Thank you," said Ben.

   In the story did Ben forget to bring something to school?

   ____yes

   ___no

   What did he forget to bring?

   Who gave Ben a sandwich?

   Did Bob know that Ben left his lunch in his mom's car?

   [Interviewer checks tape-recorder to make sure that levels are appropriate. Interviewer continues with task if child correctly answers comprehension questions above. If not, interviewer provides correct answers and administers second practice story. Second practice story is administered only if child has difficulty with first practice story.]

0. It was free play time at school. Gwynn wanted to play basketball. She asked her friend Jason if he wanted to play with her. Jason said, "I would like to play but I can't because I hurt my foot." Gwynn said, "We can play a board game instead." They decided to play Monopoly.

In the story, did someone have a hurt foot?

___yes

___no

Who had a hurt foot?

What did Gwynn want to do during free play time?

Why did she plan Connect 4 instead of basketball?

If child does not correctly answer above questions after prompting, discontinue task and thank child for participation. If child answers correctly indicating comprehension of task, move on to next story.

Here's another story. Let's listen:

1. All of the class took part in a story competition. Emma really wanted to win. While she was away from school, the results of the competition were announced: Alice was the winner. The next day, Alice saw Emma and said "I'm sorry about your story." "What do you mean?" said Emma. "Oh nothing," said Alice.

   In the story did someone say something that they should not have said?

   ____ yes

   ____ no

   What did they say that they should not have said?

   Who won the story competition?

Did Alice realize that Emma hadn't heard the results of the competition*?*

OK, let's try another one.

2. Robert had just started at a new school. He said to his new friend, Andrew, "My Mom is a lunch lady at this school." Then Claire came over and said, "I hate lunch ladies. They're horrible." "Do you want to come and play hide-and-seek?" Andrew asked Claire. "No" she replied "I'm not feeling very well."

   In the story did someone say something that they should not have said?

   ____ yes

   ____ no

   What did they say that they should not have said?

   What job does Robert's Mom do?

   Did Claire know that Robert's Mom was a lunch lady?

You're really doing some good listening today. Here's the next story:

3. Mike was in one of the stalls in the bathroom at school. Joe and Peter were at the sinks nearby. Joe said "You know that new boy in the class, his name is Mike. Doesn't he look really weird!" Mike then came out of the stall. Peter said "Oh hello Mike, are you going to play football now?"

   In the story did someone say something that they should not have said?

   ____ yes

   ____ no

   What did they say that they should not have said?

   Where were Joe and Peter when they were talking?

Did Joe know that Mike was in the stalls?

OK. I think you'll like this one.

4. Kim helped her Mom make apple pie for her uncle when he came to visit. She carried it out of the kitchen. "I made it just for you," said Kim. "Mmm," replied Uncle Tom, "That looks lovely. I love pies, except for apple, of course!"

   In the story did someone say something that they should not have said?

   ____ yes

   ____ no

   What did they say that they should not have said?

   What kind of pie had Kim made?

   Did Uncle Tom know that the pie was an apple pie?

Let's keep going. Here's the next story.

5. James bought Richard a toy airplane for his birthday. A few months later, they were playing with it, and James accidentally dropped it. "Don't worry," said Richard, "I never liked it anyway. Someone gave it to me for my birthday."

   In the story did someone say something that they should not have said?

   ____ yes

   ____ no

   What did they say that they should not have said?

   What did James give Richard for his birthday?

Did Richard remember James had given him the toy airplane for his birthday?

OK. Ready to hear another one?

6. Sally has short blonde hair. She was at her Aunt Carol's house. The doorbell rang. It was Mary, a neighbor. Mary said "Hello," then looked at Sally and said, "Oh, I don't think I have met this little boy. What's your name?" Aunt Carol said, "Who'd like a cup of tea?"

   In the story did someone say something that they should not have said?

   ____ ***yes***

   ____ ***no***

   What did they say that they should not have said?

   Whose house was Sally at?

   Did Mary know that Sally was a little girl?

You're working hard! We have just a few more to finish. Here's the next story.

7. Ms. West, the teacher, had something to tell her class, "One of the boys in our class, Simon, is very seriously ill" she said. The class was very sad and was sitting quietly when a little girl, Becky, arrived late. "Have you heard the joke about sick people?" she asked. The teacher said to her "Sit down and get on with your work."

   In the story did someone say something that they should not have said?

   ____ ***yes***

   ____ ***no***

   What did they say that they should not have said?

   What did the teacher tell the class at the beginning of the story?

Did Becky know Simon was sick?

Thanks so much for helping me today. Here's the next one.

8. Tim was in a restaurant. He spilt his milk on the floor by accident. Jack was another person in the restaurant, standing by the desk waiting to pay. Tim went up to Jack and said, "I'm terribly sorry, but I have spilt my milk. Would you be able to mop it up?

   In the story did someone say something that they should not have said?

   ____ ***yes***

   ____ ***no***

   What did they say that they should not have said?

   Where did the story take place?

   Did Tom know Jack was a customer?

Would you believe we're almost done? This is the next-to-last story.

9. Jill had just moved into a new house. She went shopping with her Mom and bought some new curtains. When Jill had just put them up, her best friend Lisa came around and said, "Oh, those curtains are horrible, I hope you're going to get some new ones." Jill asked, "Do you like the rest of my bedroom?"

   In the story did someone say something that they should not have said?
   ____ ***no***

   ____ ***yes***

   What did they say that they should not have said?

   What had Lisa just bought?

Did Lisa know the curtains were new?

OK, listen to my very last story. Then I'll ask a few questions, and we'll be finished.

10. Helen's mom was having a surprise party for Helen's birthday. She invited Nicky and said, "Don't tell anyone, especially Helen!" The day before the party Nicky and Helen were playing together and Nicky ripped her new dress. "Oh!" said Nicky, "I was going to wear this dress to your party." "What party?" said Helen. "Come on," said Nicky. "Let's go and see if my mom can mend the tear."

    In the story did someone say something that they should not have said?

    ____ no

    ____ yes

    What did they say that they should not have said?

    Who was the surprise party for?

    Did Nicky remember the party was a surprise?

Thank you so much for doing such a good job today! Do you have any questions for me about what we did? . . . We're going to do something else now.

Appendix C

EMOTIONAL MEMORY INTERVIEW PROTOCOL

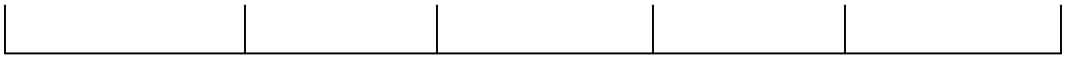
Child's ID _____ Location: Buffalo Raleigh Date _____

Interviewer _____ Tape _____

I'm going to talk with you about something your mother told me happened one time. But first I want to show you about our rating scale. We'll use this in a little while. Let's do a practice rating together.

OK, tell me what your very favorite thing to do is. What is the thing that you like to do best in the whole world? . . . . [Comment on child's choice . . . oh, I like that , too! . . . I bet that's fun . . .]

Now, think about how you feel when you are doing [activity mentioned above]. How does doing . . . make you feel? . . . OK, you said it makes you feel happy. Would you say it makes you very happy, pretty happy, or just a little happy? . . . You said ""pretty happy, so I'm going to put an X on the line above pretty happy on this scale. See? OK, now you know how to use my scale. "



Very Unhappy Pretty Unhappy A Little Unhappy A Little Happy Pretty Happy Very Happy

[Interviewer clarifies instructions as necessary.]

Mother Nominated Positive Event

Now let's talk about something that happened to you. Your mother told me about the time you . . . . Can you tell me more about that?

What else happened?

Tell me something else about that.

Is that all you remember?

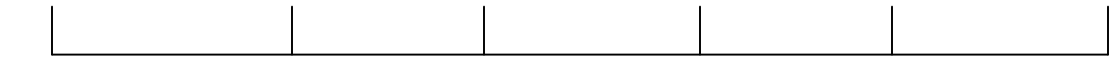
Now I'm going to ask you some things about the time you . . . Tell me everything you remember. If you don't remember something I ask, , just tell me you don't know. OK? We're still talking about the time you . . . .

Who was there? . . . Was anyone else with you? Who else was there?

When did this happen? . . . Do you remember how old you were or what grade you were in? . . . Do you know what time of the year it was?

Where were you?

How did you feel? Show me on my scale. *[If child has difficulty, ask for verbal response by saying, Did that make you feel happy or unhappy? Then ask for degree of emotion experienced. Would you say that made you feel just a little happy or pretty happy or really happy?]*



Really Unhappy Pretty Unhappy A Little Unhappy A Little Happy Pretty Happy Really Happy

Child Nominated Positive Event

Now tell me about the very best thing that ever happened to you in your whole life. What was the every best thing that ever happened to you? . . . . Tell me all about that.

What else happened?

Tell me something else about that.

Is that all you remember?

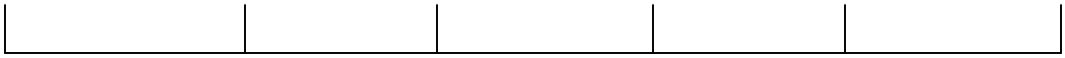
Now I'm going to ask you some things about the time you . . . Tell me everything you remember. If you don't remember something I ask, just tell me you don't know. OK? We're still talking about the time you . . . .

Who was there? . . . Was anyone else with you? Who else was there?

When did this happen? . . . Do you remember how old you were or what grade you were in? . . . Do you know what time of the year it was?

Where were you?

How did you feel? Show me on my scale. *[If child has difficulty, ask for verbal response by saying, Did that make you feel happy or unhappy? Then ask for degree of emotion experienced. Would you say that made you feel just a little happy or pretty happy or really happy?]*



Really Unhappy Pretty Unhappy A Little Unhappy A Little Happy Pretty Happy Really Happy

Mother Nominated Negative Event

Now let's talk about something that happened to you. Your mother told me about the time you . . . . Can you tell me more about that?

What else happened?

Tell me something else about that.

Is that all you remember?

Now I'm going to ask you some things about the time you . . . Tell me everything you remember. If you don't remember something I ask, , just tell me you don't know. OK?

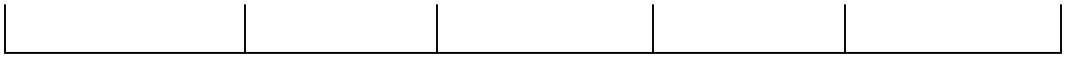
We're still talking about the time you . . . .

Who was there? . . . Was anyone else with you? Who else was there?

When did this happen? . . . Do you remember how old you were or what grade you were in? . . . Do you know what time of the year it was?

Where were you?

How did you feel? Show me on my scale. *[If child has difficulty, ask for verbal response by saying, Did that make you feel happy or unhappy? Then ask for degree of emotion experienced. Would you say that made you feel just a little unhappy or pretty unhappy or really unhappy?]*



Very Unhappy Pretty Unhappy A Little Unhappy A Little Happy Pretty Happy Very Happy

Child Nominated Negative Event

Now tell me about the worst thing that ever happened to you in your whole life. The worst thing that you want to talk about. What was the very worst thing that ever happened to you? . . . . Tell me all about that.

What else happened?

Tell me something else about that.

Is that all you remember?

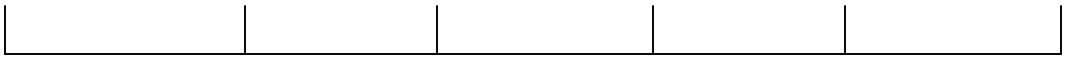
Now I'm going to ask you some things about the time you . . . Tell me everything you remember. If you don't remember something I ask, just tell me you don't know. OK? We're still talking about the time you . . . .

Who was there? . . . Was anyone else with you? Who else was there?

When did this happen? . . . Do you remember how old you were or what grade you were in? . . . Do you know what time of the year it was?

Where were you?

How did you feel? Show me on my scale. *[If child has difficulty, ask for verbal response by saying, Did that make you feel happy or unhappy? Then ask for degree of emotion experienced. Would you say that made you feel just a little unhappy or pretty unhappy or really unhappy?]*



Really Unhappy Pretty Unhappy A Little Unhappy A Little Happy Pretty Happy Really Happy

Additional Report

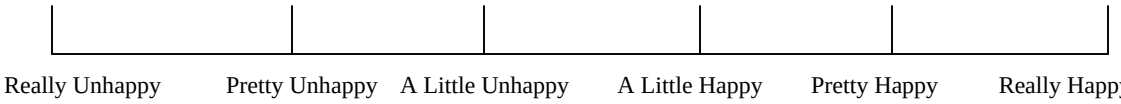
Included to avoid ending interview on a negative note.

OK, now let's talk about something you're really looking forward to doing. You know, something like a trip or a visit to a really interesting place or playing with a new toy. Tell me about something you're really looking forward do.

Tell me more about that . . .

What else?

How do you think . . . will make you feel?



That should be a really great time!

Thank you for talking with me today.

Appendix D

PARENT NOMINATIONS OF POSITIVE AND NEGATIVE EVENTS

Parent Nominations of Positive and Negative Events
Connections – Summer Asperger's Treatment Program (2005)

Child's Name: _____

Parent's Name: _____

Today's Date: _____

Research members of the Connections -- Summer Asperger's Treatment Program are interested in learning more about children's abilities to remember certain types of events that they experience. Below, please record two events that were fun or exciting for your child in the last year (such as a trip to an amusement park or family outing, receiving an award, bring home a pet) and two events or experiences that were frightening or stressful to your child (such as an injury, illness, being bullied, or witnessing violence).

Positive event (1): _____

Please briefly describe what happened and include who was present:

When did this happen (please estimate date)?

Approximately, how many times have you talked about this event with your child in the past:

week _____

month _____

year _____

How would you rate your child's excitement/stress on the following scale?

Extremely unhappy	Very unhappy	Somewhat unhappy	Neutral	Somewhat happy	Very Happy	Extremely happy
1	2	3	4	5	6	7

Event Protocol (page 2)

Positive event (2):_____

Please briefly describe what happened and who was present:

When did this happen?

Approximately, how many times have you talked about this event with your child in the past:

week _____

month _____

year _____

How would you rate your child's excitement/stress on the following scale?

Extremely unhappy	Very unhappy	Somewhat unhappy	Neutral	Somewhat happy	Very happy	Extremely happy
1	2	3	4	5	6	7

Event Protocol (page 3)

Please note: Below, please record two events that were negative and/or stressful.

Negative event (1) _____

Please briefly describe what happened and who was present:

When did this happen?

Approximately, how many times have you talked about this event with your child in the past:

week _____

month _____

year _____

How would you rate your child's excitement/stress on the following scale?

Extremely nonstressful	Very nonstressful	Somewhat nonstressful	Neutral	Somewhat stressful	Very stressful	Extremely stressful
1	2	3	4	5	6	7

Event Protocol (page 4)

Negative event (2) _____

Please briefly describe what happened and who was present:

When did this happen?

Approximately, how many times have you talked about this event with your child in the past:

week _____

month _____

year _____

How would you rate your child's excitement/stress on the following scale?

Extremely nnonstressful	Very nonstressful	Somewhat nonstressful	Neutral	Somewhat stressful	Very stressful	Extremely stressful
1	2	3	4	5	6	7

Appendix E

NARRATIVE COHERENCE CODING SCHEME (NaCCS)

(Baker-Ward, Bauer, Fivush, Haden, Ornstein, & Reese, in preparation)

***Updated Nov. 2006 with new rules, M&ND lab**

General Notes on Coding

- Code one dimension at a time for increased ease.
- Reliability calculated via intra-class correlations.
- The narrative must have two propositions to code. In the case of prompted narratives the two propositions may be interspaced by conversational fillers (okay) and non-specific (can you tell me more) prompts; however, the narrative can only be coded for Context and Theme, but not Chronology. To code for Chronology, use the first section that has two actions, end when the child is prompted again. Fillers such as "okay" are not considered a new prompt. If there is no section that contains two actions you do not code for chronology.
    - Example: Would code from **Context** and **Theme** but not **Chronology**
        - C: "I went to the park"
        - I: "Can you tell me more?"
        - C: "I played on the swing."
    - If the participant is prompted for a time or place, Context cannot be coded.
- Although the previous statement is our general rule, we recognize the utility of varying this procedure for some data sets, especially those involving young children. We think it makes sense to let the researcher make this decision so long as it is clearly specified in reports. However, we would be uncomfortable with coding the section that is most temporally ordered when selected on that basis as it could introduce bias.

Chronology (formerly known as Temporal)

Level	***Description***
Level 0	Narrative consists of a list of actions with minimal or no information about temporal order.
Level 1	Naïve listener can place some but not most of the events on a timeline. Fewer than half of the temporally relevant actions can be ordered on a timeline with confidence
Level 2	Can place between 50-75% of the relevant actions on a timeline but cannot reliably order the entire story from start to finish with confidence.
Level 3	Naïve listener can order almost all (> 75%) of the temporally relevant actions. This includes cases in which the speaker marks deviations from temporal order or repairs a violated timeline.

- For purposes of coding this dimension, only actions that occur within the defined event parameters are placed on the timeline. A misplaced evaluation is not penalized. Clear digressions are not penalized.

Theme

Level	***Description***
Level 0	The narrative is substantially off topic and/or characterized by multiple digressions that make the topic difficult to identify. There is no attempt to repair digressions.
Level 1	A topic is identifiable and most of the statements relate to the topic in a consistent manner. The narrative may include minimal development of the topic through reasonable causal linkages, or personal evaluations and reactions, or elaborations of actions.
Level 2	In addition to level 1, the narrative substantially develops the topic. There are several instances of causal linkages, and/or interpretations, and/or elaborations of previously reported actions.
Level 3	All of the above are present. The narrative includes a resolution to story (problem solved) or links to other autobiographical experiences including future occurrences of the event (*I can't wait to do it again,")* or self-concept or identity. The resolution brings closure to the experience and provides new information. Resolution may not be positive. *Notes: 1) Resolution goes beyond a simple wrap-up, e.g. " . . . and then we went home" is not a resolution. 2) Even if a resolution is present, narrative cannot be coded at this level unless conditions for a Level 2 are fulfilled.*

- If a speaker references the event to themselves, or to self, or identity, or self-concept, or other autobiographical memories, then he/she would get a 3. However, it is not necessary, and a "simple" resolution to an event would also qualify (it can't just be, "And then I was okay!" there has to be some sort of action or mechanism that allows the event to resolve itself).
    - "And that's when it became clear that the relationship was over." → no resolution just a wrap-up statement; therefore, this would not qualify for a rating of 3
    - "I was sick and now I am okay." → resolution, but no mechanism of resolution; therefore, this would not qualify for a rating of 3
    - "I was sick and my dad gave me medicine. Now I am okay" → resolution with a mechanism of resolution; therefore, this would qualify for a rating of a 3

Any mention of comparisons to other autobiographical experiences ("it was the best birthday ever").

Context

Level	***Description***
Level 0	No information about time or location is provided. The only mention of character is a reference to the narrator ("I").
Level 1	Partial information is provided; there is mention of time or place at any level of specificity.
Level 2	Both time and place are mentioned but no more than one dimension is specific. ("Last week I went to McDonald's.")
Level 3	Both time and place are mentioned and both are specific.

Is narrator providing enough information to listener to locate event in space and time? What does the listener need to understand the narrative?
This version provides only three levels of coding for context.

- One reference can be used for both time and location.
    - "When I was in kindergarten, I sat next to a girl…" → specific time and location
        - If it was daycare or elementary school instead of kindergarten the it would be coded as a would be general place, but "sixth grade" would be specific.

Location

- Setting is defined only on the basis of references to spatial location. Event or activity information in and of itself is not sufficient to define location.
- Information about location that does not identify a unique referent is coded as general: *at school, at work, at the hospital, at the museum, in the library, the park, at the beach, at a restaurant, at McDonald's* (because there are multiple locations).
- Examples of specific location include: *my school*, *the Chuck E. Cheese's near my house, Highland Mall, Grandmom's house, my house, my room*.
- *Giving a lecture, at a conference, at a party, flying a kite, deep-sea fishing* and similar phrases do not provide any location information.
- *On vacation in Italy* provides specific information, whereas *on vacation* provides no location information.
- Note that only temporal and spatial context is assessed in this version; other types of context (e. g. background) could be added as individual studies require to augment the scheme.
- "It was my first night working at Perkins" – Specific Time, General Place = 2
    - Look in the component in isolation of other contextual factors; "at Perkins" in isolation of other contextual indicators is general
- Always consider were the action of the narrative happened. Always code location and time based on the "title" theme or focus of the narrative.
    - "We were in my car when he proposed" → specific location; the focus of the narrative (the proposal) happened in the car
    - "I was in my car when I got into an accident" → not a location; the location would be where the accident happened

CONTEXT: Location (continued)

- If the action of the narrative takes place on or at a piece of furniture or in a portion of a home a code of at least **general** should be given. If the piece of furniture or the house related location is identified with a possessive pronoun then the location is **specific**.
    - "the dresser" "the front porch" → no location
    - "at the dresser" "on the front porch" → general location
    - "at her dresser" "on my grandma's front porch" → specific location
- "Went to…" does not always dictate a location. Additional context must be look at for clarification. This is especially important in the case of medical related locations.
    - "I went to the doctor for a check-up" → If the speaker went to the doctor for a procedure than it can be ascertained that the speaker went to a location and in this case a general location
    - "I went to the doctor for advice" → Location cannot be determined because "advice" does not dictate a location. This would also apply to "I went to my mother for advice"
    - "I went to the doctor's" → Location can be detemined because the possessive doctor's implies a place or location, the same would be true for "I went to my mother's"

Time

- We are revising the context dimension to be much more inclusive because we have decided it is important to capture portions of a lifespan, autobiographical time, rather than calendar time.
- Autobiographical time can refer to age-related transitions to roles that are not clearly associated with age (*When I became a grandmother, when my parents got divorced, when I was diagnosed with asthma).*
- When autobiographical time is referenced, references to a life period convey specific time information (as defined by Martin Conway). A life period implies boundaries on the portion of the lifespan. In addition, it is assumed that there are cultural conventions for reasonably clear boundaries on that time period. Hence, *when I was a child* was general; *when I was in elementary school* is a specific reference.
- In determining whether a referent is to a general or specific time, consider whether or not there are discrete boundaries. Hence, *several months ago* is now a specific reference.
- "In the morning" "One morning" "A long time ago"
    - Any temporal information or unit of time will count for at least **general** time if it narrows or restricts when an event can be pinpointed.
    - The rational is that if we actually to look at coherence developmentally it must reflect how the concept of time develops.

Remember if the time point can be placed within a specific boundary then the time will be coded as **specific** (e.g. when I was in kindergarten, when my parents got divorced).