

ABSTRACT

MORRIS, S. GWYNN. Influences on Children's Narrative Coherence: Age, Memory Breadth, and Verbal Comprehension. (Under the direction of Lynne Baker-Ward.)

Narrative coherence, or the measure of how well a particular memory has been structurally organized and interpreted, is receiving increased attention from memory researchers, likely due to its presumed links with effective coping and long-term remembering. The current study shed light on this important but elusive construct by exploring factors that influenced coherence in children's personal memory narratives of events that occurred in both the recent and distant past. Specifically, 112 4- to 8-year-old children were asked to remember parent-nominated events that transpired within the past 4 months. One year later, when the children were 5- to 9-years-old, they were asked to remember both the previously discussed events that occurred over a year in the past and more recent events that occurred within the past 4 months. The research employed a recently devised standardized coding scheme to examine the chronology and theme dimensions of coherence in the children's memory narratives. Cross-sectional analyses revealed that 8-year-olds produced memory narratives that were significantly higher in both the theme and chronology dimensions of coherence than 4- and 6-year-olds. Multilevel modeling of children's recent memories indicated that verbal comprehension scores related positively to both theme and chronology, but only the theme dimension was affected by memory breadth. Further, a child's current reporting ability was found to be a significant influence on the theme and chronology of children's narratives of events that transpired over a year in the past, but these dimensions of coherence were no longer affected by the initial breadth of that memory. Overall, the influences on children's narrative coherence differ both between the

theme and chronology dimensions and between recent versus distant memories. Implications for memory research are discussed.

**INFLUENCES ON CHILDREN'S NARRATIVE COHERENCE:
AGE, MEMORY BREADTH, AND VERBAL COMPREHENSION**

by

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Influences on children's narrative coherence:

Age, memory breadth, and verbal comprehension

Narrative coherence is a measure of how well a particular memory has been structurally organized and interpreted. Event narratives that are highly coherent situate the event within a specific context (i.e. a particular place and time), are ordered chronologically, and have a consistent theme (Fivush, 2007). In short, a naïve listener of a highly coherent event narrative would know when and where the event took place, could temporally order the actions that make up the particular episode, and would understand how the episode affected the teller. In contrast, personal memory narratives that are lacking in these aspects are low in coherence.

Although narrative coherence is receiving increased attention in memory research as a predictor of various outcomes and is often central to theoretical conceptions of autobiographical narratives, very little is empirically known about what factors may influence coherence itself (Peterson & Biggs, 1998). Coherence has recently been described as “conceptually critical,” yet “an elusive construct” (Fivush, 2007). There is a lack of consensus in the extant literature for both the definition of coherence and the way coherence should be measured. Thus, the present research sought to expand the understanding of the construct of coherence in children's memory narratives. These narratives were provided by 112 4-8-year-old children over the course of two sessions, one year apart. The children reported on parent-nominated unique events, such as field trips, dance recitals, and family vacations. The investigation utilized a version of a recently developed coherence coding scheme which has been standardized across six different memory labs.

The study first described age-related differences in narrative coherence in 4-8 year-olds. Next, the research assessed the influences of age, memory breadth, and verbal comprehension on narrative coherence in children's memory reports for both recent and distant events. These variables were selected to test theoretical assumptions that coherence is a reflection of the organization and content of one's underlying event memory, rather than solely a reflection of a child's current verbal abilities (Fivush, Haden & Adam, 1995; Peterson & Biggs, 1998). Further, extant studies have shown that children talk about memories from the recent past and the distant past differently (Van Abbema, 2002; Van Abbema & Bauer, 2005). Thus, children's memories for events that occurred within the past four months and memories for events that transpired over a year in the past were examined. The current investigation constitutes an original and valuable contribution to the understanding of verbal memory reports in general and narrative coherence as a construct specifically.

Before proceeding to the specific aims and methods of the present research, the relevant background will be provided. First, the importance of coherence is outlined. Following that is an examination of the alternative approaches to the definition and measurement of coherence, as well a discussion as to what exactly coherence may be tapping into. Lastly, studies relating to age differences in coherence, the link between memory breadth and subsequent recall, and the relationship between verbal ability and memory reports will be reviewed, leading directly to the specific aims of the current study.

*Why is Coherence Important?**Association with Adjustment Following a Traumatic Experience*

During adulthood, a lack of coherence in trauma memories has been associated with posttraumatic stress disorder (PTSD). This is often termed the disintegration view or fragmentation of trauma memories (cf. the landmark view as presented by Berntsen, Willert, & Rubin, 2003). Ehlers and Clark (2000) support the disintegration view and stated, “We propose that in persistent PTSD one of the main problems is that the trauma memory is poorly elaborated and inadequately integrated into its context in time, place, subsequent and previous information and other autobiographical memories” (p.325). Treatments based on this paradigm seek to reduce PTSD symptoms by increasing the coherence of trauma memories. Foa, Molnar, and Cashman (1995) examined the rape narratives of 14 women before and after undergoing such a therapy for PTSD. After treatment, the participants’ narratives had increased in the proportion of organized thoughts. Organized thoughts were utterances that indicated realization, decision making, or planning. Pearson correlations indicated that an increase in organized thought was significantly related to a decrease in depression, as measured by the Beck Depression Inventory. Foa, Molnar, and Cashman’s work is consistent with the findings of Pennebaker and his colleagues, who have shown that adults have better health outcomes and immune functioning when they repeatedly write about negative memories, often resulting in a more coherent written narrative (i.e. Pennebaker, 1993; Pennebaker, Kiecolt-Glaser, & Glaser, 1988).

The disintegration framework has recently been applied in a study of children’s narratives of personal accidents. O’Kearney, Speyer, and Kenardy (in press) examined

the memory narratives from 80 children (between the ages of 7 and 16) four to seven weeks after they had been admitted to a hospital for treatment of an accidental injury. The majority of accidental injuries were caused by falling (26%), bike/scooter/skate accidents (16%) or tripping (15%) and all resulted in a hospital stay of 24 hours or more. To collect the narratives, interviewers visited the children in their own homes and asked the child to verbally report their injury. The interviewers used only the following prompt:

In a moment I will ask you to tell me about your accident, how you felt, what you saw, who was there with you, everything. I would like you to describe the accident to me as if it is happening right now. I would like you to tell me as many things that you can remember that happened during the accident. Things like what happened around you, how you were feeling, and what you were thinking during the accident (p. 5).

The authors used coherence, along with other narrative qualities, child factors (gender and age), and accident factors (trauma and injury severity) to predict variance in post-trauma intrusive and avoidant PTSD symptoms. These PTSD symptoms were measured using the CRIES-8, a child-friendly and reliable version of the Horowitz Impact of Event Scale. In the CRIES-8, the child self-reports the frequency of eight symptoms on a Likert scale ranging from 0 (*Not at all*) to 5 (*Often*). The use of hierarchical multiple regression analyses revealed that the narrative measures (including coherence) predicted 37% of the variance in the severity of intrusive symptoms over and above what could be predicted by the child and accident factors. However, upon closer examination of the standardized regression coefficients (β) predicted by this model, the

coherence measures were not significantly adding to the accurate prediction of intrusions. Causal markers (a measure of cohesion, defined as the relationship or connections between sentences and clauses) and negated conceptual references (i.e. “I forget,” “I don’t know”) did have significant standardized regression coefficients. It is difficult to draw conclusions from this study as the authors measured coherence in a slightly different way than in the present study (discussed below). Yet, it is evident from this carefully controlled study that certain narrative qualities do have the power to predict post-traumatic outcomes in children.

Thus, a deeper understanding of coherence in both adult and child narratives may be beneficial to the understanding of the causes and symptoms of PTSD. Further, increased knowledge about coherence may improve our ability to successfully treat those suffering from PTSD.

Theoretical Association with Long-term Remembering

The importance of coherence extends beyond PTSD and trauma memories. Coherence has also been examined in the realm of children’s everyday autobiographical memories. Coherence is often assumed to be an important predictor of which memories are remembered or forgotten through the period of childhood amnesia. According to Fivush, Haden, and Adam (1995), “memories of personally experienced events that are not organized as coherent narratives will be less likely to be integrated into the developing life story and therefore less likely to be recalled later in development than personal memories that are narratively organized”(p.34). Hence, because very young children cannot independently form rich narratives about their experiences, these

experiences may not be remembered into adulthood, resulting in childhood amnesia (Nelson & Fivush, 2004).

Surprisingly, few investigations to date have examined the relation between coherence and recall after a lengthy delay. A classic study by Pillemer, Picariello, and Pruitt (1994) is often cited as evidence of the role of coherence in the survival of early memories. For example, Peterson and Biggs (1998) stated, “In support of this hypothesis, Pillemar, Picariello and Pruitt (1994) found that the coherence of preschoolers’ narratives predicted their ability to recall those narrativized experiences 7 years later” (p. 52). Yet, in examining the original paper, it becomes clear that “coherence” was not actually measured. In the study, the authors asked 25 children to recall being evacuated from their preschool in response to a fire alarm triggered by burning popcorn. The participants were asked to recall the evacuation at two time points: two weeks after the event occurred and again seven years after the fire alarm. Eleven of the children were in the younger classroom at the time of the evacuation (mean age 3.5) and 14 were in the older classroom (mean age 4.5). All children were able to provide mnemonic information two weeks after the event and there were no age differences in the amount remembered. However, the older children provided more temporal and causal sequences than the younger children.

At the 7-year follow up, Pillemar et al. reported, “Only those preadolescents who had been in the older preschool group at the time of the alarm showed convincing evidence of long-term memory” (p. 95). Inspection of their data reveals that eight of the 14 children who were in the older preschool class at the time of the incident could produce an intact or fragmentary narrative about the evacuation that occurred seven years

in the past, whereas only two of the 11 children who were in the younger class produced fragmentary narratives. The authors themselves interpreted their results as suggesting that the increased causal reasoning and temporal sequencing in the older children's initial reports may be related to long-term memory. Yet, these conclusions are based on a small sample size and were only analyzed at the group level. That is, the authors used chi-squared analyses to demonstrate that the group of participants who had been in the older classroom at the time of the fire alarm more frequently produced intact narratives than the group of participants who had been in the younger classroom. The authors did not link each particular narrative collected immediately after the fire-alarm to the same child's narrative seven years later. Thus, while increases in causal and temporal reasoning may be associated with long-term memory in the study, it is not appropriate to conclude that these aspects actually predict long term memory. Further, although causal reasoning and temporal sequencing are often considered components of coherence, they do not represent the exact same thing as coherence (see discussion below). In short, while it is tempting to use the classic fire alarm study as evidence for the role of coherence in long term remembering, the actual data are inconclusive. Clearly, a more comprehensive approach should be taken to test the theory that coherence of early memories predicts their survival through the period of childhood amnesia.

Although many researchers are examining narrative coherence for the various reasons outlined above, there is presently no consensus in the extant literature about the definition and best method to quantify coherence.

How is Coherence Defined and Measured?

As Fivush (2007) recently articulated, “Whereas there is almost universal agreement that coherence is conceptually vital, there is as yet no agreed upon definition or measure of narrative coherence in the literature” (p. 1). Fivush goes on to state, “Across multiple theoretical formulations of coherence, three dimensions are consistently argued to contribute to overall coherence: 1) context, i.e., orienting the narrative in place and time, 2) chronology, i.e., relating the component actions along a comprehensible timeline, and 3) theme, i.e., maintaining topic and providing a sense of rising action with a resolution and/or final point to the story” (p.1). In the past, literature has either (a) used the term coherence as an adjective to describe one of these dimensions, (b) measured coherence on one overall rating scale that lumps all or some of these dimensions together, or (c) taken a multidimensional approach, as will the present research. Each of these major approaches will be reviewed below, culminating in an explanation of the conceptualization of coherence that guided the current investigation.

Coherence as an Adjective

As an adjective, coherence could mean that narratives are on-topic, make sense, are in chronological order, etc. The term coherence has also been used to describe only one dimension of the three that are used in a multidimensional approach: context, theme, and chronology. In these cases, coherence is not viewed as a construct in and of itself. Two representative examples of extant literature that use the term coherence without explicit definitions will be presented.

Berntsen, Willert, and Rubin (2003) do not explicitly define coherence in their work; however, they operationalize coherence as the lack of fragmentation in a memory.

The authors examined coherence in 113 adults' memories of traumatic events. Twenty-five of these adults had after-effects consistent with PTSD, whereas the others did not. The authors quantified coherence using self-report to a single question ("When you recall the traumatic event, do you then think of it as a continuous series of episodes or as some isolated incoherent fragments?") on a 1-5 Likert scale, anchored by "Totally Incoherent" and "Totally Coherent" (p. 693). They found that coherence ratings and trauma severity were correlated to a greater degree in the group suffering from PTSD symptoms (.51) than those that did not have PTSD symptoms (.01). However, the method used by Bernstein et al. would not be developmentally appropriate for use with young children due to its advanced wording.

In Van Abbema and Bauer's recent work (2005), coherence reflected only the chronology dimension. The authors examined 3-year-old children's narratives about mother-nominated positive events (i.e. trips to a zoo, first time on an airplane) during session 1. They then compared these narratives to narratives about the same events and more recent events produced by the same children when they were 7-, 8-, or 9-years old during session 2. Children's narratives were acquired using an interview method similar to many studies investigating children's memory (e.g. Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Fivush, Hazzard, Sales, Sarfati, & Brown, 2003; Kleinknecht & Beike, 2004). That is, interviewers first introduced the event, then used generic prompts and neutral affirmations to encourage the child to provide more information (e.g. "What else can you tell me about that?"; "Okay"), and finally used specific prompts to ask about specific aspects of the event (e.g. "It looks like you ...when you were there. What else can you tell me about that?"). Each proposition in the narratives produced by the 47

children in this study was given one of seven mutually exclusive content codes as follows: *what, who, where, when, why, how, or intensifier*. Three additional dependent variables were then formed from the content codes: total content, breadth, and ratio. Total content was simply the sum of all content codes and was used to assess the length of the narrative. Breadth was a count of the number of the traditional pieces of *wh-* information included in the narrative (*who, what, when, where, why, and how*). Thus, breadth ranged from 0-6 and was considered to be a marker of the global complexity of a narrative. Lastly, ratio was the average number of content codes per each proposition. Accordingly, ratio was used to indicate the local level complexity of a narrative.

The authors used these variables in a series of 2 (session: 1, 2) by 3 (age group: 7, 8, 9 years) ANOVAs, with session as a within-participant factor and age group as a between-participants factor. Although only a trend was found for changes in total content over sessions, main effects of session were found for both breadth and ratio, as well as for the when, why, and how variables. The authors reported, “In the present research, school-aged children’s reports of events from age 3 were more complex and more *coherent* than age 3 reports, and they included at least as much detail” (p. 843, italics added). Oddly, there was never a formal mention of how coherence was defined or coded in the study. However, the first author indicated via personal communication that coherence was used as a reflection of the “when” category, meaning highly coherent narratives contained more temporal markers and connectives than those narratives that were not deemed coherent (D. Van Abbema, personal communication, December 19, 2006).

Although studies that use the term coherence as an adjective may offer important insights about narrative properties, they do not present a complete picture of coherence as a construct and should not be directly compared to studies that define and utilize coherence in a different manner.

The Unidimensional Approach to Coherence

Researchers who take a unidimensional approach to coherence tend to view coherence as a construct in and of itself. They typically measure coherence on one global rating scale that considers a combination of any of the contextual information, thematic information, and chronological sequencing provided in a narrative. Peterson and McCabe set the stage for this type of analysis in their early program of research on children's narratives.

Peterson and McCabe's approach. Much of the more recent research on coherence has been greatly shaped by the early work of Peterson and her colleagues. Although Peterson and McCabe (1983) did not consider coherence as a construct, they still provided the basis for analyzing children's memory narratives by examining the structure of children's narratives in three different ways: high point analysis, episodic analysis, and dependency analysis. Each of these analyses resulted in a global classification of the narrative into a particular structural category. In their frequently cited book, they analyzed 1,124 memory narratives collected from 96 white, working-class children, evenly distributed over the ages 3 ½ to 9 ½. A minimum of three narratives were elicited from each child during conversations with the experimenter. During these conversations, the experimenter briefly told about an experience and asked the child if something similar had happened to them. The child was encouraged to

provide a narrative through empty prompts (i.e., “Tell me more,” “Yes,” and exact echoes of the child’s comments). Peterson and McCabe provide the following example of a memory prompt:

I took my cat to the vet last summer and when the vet was about to give him a shot, my cat took off and ran around the office. Do you have any cats or other pets? (If necessary: Did anything ever happen to your _____?) (p. 16).

Prompts were designed to elicit experiences that were unique for children and included events such as bee-stings, spilling accidents, vacations, pet adventures, and sibling squabbles.

The authors proceeded to analyze the structure of these child memory narratives using three different coding schemes. The first coding scheme they used was high point analysis. High point analysis is guided by the assumption that a narrative has both referential functions (to factually recount events) and evaluative function (to interpret events). For high point analysis, each narrative was examined at the level of each clause. The organization of these clauses resulted in the narratives being classified as representing a specific structure. The ideal structure of a narrative is termed the classic structure, in which the narrative builds to a high point, evaluatively dwells on the high point, and then resolves it.

The second type of analysis employed by Peterson and McCabe was episodic analysis. Episodic analysis is guided by the assumption that narratives are organized reports about purposeful behavior. In this coding scheme, each statement is classified into its functional category (i.e. event, motivating state, attempt, etc.). Then, the organization of these functional categories in a particular narrative is examined and

classified as falling into a particular structure. Seven structures are possible, ranging from the least complex (descriptive sequences) to the most complex (interactive episode). The episodic analysis is similar to Story Grammar analysis popularized by Trabasso and his colleagues (e.g. Trabasso & Nickels, 1992; Trabasso & Stein, 1997; Stein & Albro, 1997). Like the episodic analysis, Story Grammars examine the structure, rather than the coherence, of a narrative. Examining the structure of a narrative may reveal something about the chronological sequencing of events within the narrative, but does not consider other aspects that coherence includes, such as contextual information and personal meaning making.

The last analysis used by Peterson and McCabe was dependency analysis, which is primarily concerned with the syntax of a narrative. The analysis breaks each narrative into propositional units and then examines the relationships among the propositions to see how the narrative was told. “In short, the procedure of dependency analysis is to (1) isolate the most dominant proposition; (2) determine the propositions, if any, that are contrastive within that (dominant) proposition, break them out, and subordinated them into the dominant proposition so that they are parallel and coordinated with each other; and (3) repeat this process with every segment of the discourse until all contrastive propositions have been de-transformed” (p.114). Thus, dependency analysis views a narrative hierarchically. A narrative can be thought of graphically as a branching structure starting at level one and extending down through many layers. Again, the narratives can be classified into six structural categories based on the hierarchy of the discourse, ranging from a simple coordinate sequence to the ideal hierarchy (See Appendix A for a summary table of these three analyses).

Each of the types of analysis used by Peterson and McCabe incorporated parts of the context, theme, and chronology dimensions now associated with coherence. Further, each analysis combined aspects of each of these dimensions in their final structural classification of narratives. The work of Peterson and her colleagues were used as a basis to develop coherence coding schemes by many researchers who subsequently examined children's memory narratives. This section will focus on unidimensional schemes for examining coherence, although the Peterson and McCabe work also influenced the multidimensional schemes to be discussed in the next section.

Work from the Fivush laboratory. Fivush and her colleagues have taken a unidimensional approach to coherence in several of their studies (Fivush et al., 2003; Bohanek, Fivush, & Walker, 2005). For example, coherence was assessed globally on a 0-3 scale in their 2003 study. In this study, the authors interviewed 29 5-12-year-old children who were living in violent communities about events from their recent past. The participants were recruited from a waiting room in a clinic in the downtown of a large southeastern city. The children were asked to discuss two positive and two negative personally experienced events. Of these events, half were parent-nominated and half were child-nominated. The negative events that were discussed varied from traumatic to only mildly stressful events (e.g. violent interpersonal altercations, minor illness/injuries). Positive events were more homogeneous and included primarily family outings, vacations, holidays, and trips to an amusement park. For each event, interviewers first asked children to provide a narrative in response to open-ended questions and neutral prompts. After the child stopped responding to these prompts, the interviewer asked a series of *wh*-questions to elicit information that had not been spontaneously mentioned by

the child during free-recall. One of the goals of the study was to understand the impact of event valence (i.e. positive or negative) on children's coherence. Although Fivush et al. did not explicitly define coherence, their definition is implicit in their coding scheme. They made a global rating of the coherence of each narrative using a 4 point scale based on work by Peterson and McCabe (1982) as follows:

0 = Disorganized pattern: Narrative is too confused, disoriented or contradictory for the listener to understand.

1 = Chronological pattern: Narrative describes successive events that are sequentially and/or logically ordered.

2 = Ending-at-the-high-point: Narrative builds to a climactic high point, then ends; there is no "wrap-up" or resolution.

3 = Classic pattern: Narrative builds to a high point, evaluatively dwells on it, then resolves it. (p. 7)

Thus, Fivush et al. incorporated aspects of the chronology and theme dimensions of coherence, but did not address the context dimension. Further, although the authors used a 2 (event valence) by 2 (nomination) by 2 (gender) ANOVA on coherence scores to demonstrate that negatively valenced events were more coherent than positively valenced reports, it is impossible to examine whether certain dimensions of coherence are differentially affected by valence than others.

Thus, while the unidimensional approach provided an entry point into the study of coherence, there are limitations associated with operationalizing coherence in this way. As demonstrated in the example discussed above, a unidimensional approach to coherence precludes a fine-grained analysis of the different aspects of coherence.

Further, using such a broad scale may mask developmental trends in coherence that may be evident when examining the separate dimensions associated with coherence. For these reasons, many researchers have moved to the multidimensional approach to coherence, which will be discussed in the next section.

The Multidimensional Approach to Coherence

Researchers who take a multidimensional approach to coherence believe that coherence is composed of separate dimensions. However, these dimensions have been defined slightly differently by each researcher. Further, investigators have approached coherence coding in two different manners: through word counts or rating systems. In a word count approach, the researcher counts words that represent different dimensions of coherence. For example, temporal terms such as *then* and *next* may be counted to capture the chronology of a narrative. In the rating system approach to coding coherence, narratives are given a subjective rating for each dimension based on a set of criteria. A representative example from each of these traditions will be reviewed in the current section. In the following section, the multidimensional approach to coherence that was employed in the present study will be articulated.

Peterson and her colleagues have more recently conceptualized coherence as multidimensional and have taken a word-count approach to examine coherence. For example, in their 1998 study, Peterson and Biggs quantified coherence by counting the number of propositions in a child's narrative that were orientations (provided information about the context of an event), actions, or evaluations (evaluative or affective information). The frequency of each of these categories was then calculated (i.e. # of propositions in category/ narrative). The operational definition of coherence employed

by the authors was as follows: “It was assumed that narratives with more orientations and evaluations were more coherent because the narrated events were embedded within a richer descriptive and emotional context” (p. 68). Thus, the authors recognized two separate dimensions that compose overall coherence.

Peterson and Biggs used this method to examine children’s memories for a recent trip to the emergency room to treat a minor trauma, such as a laceration requiring stitches or a fracture requiring a cast. There were 90 participants in this study, 30 in each of three age groups: 2-3-year olds, 4-5-year-olds, and 9-13-year-olds. An interviewer asked the children to recount their injury and subsequent hospital visit in their homes during the two weeks following the event. The experimenter prompted the child with open-ended statements, such as “Tell me about when you hurt yourself. What happened?” The authors found that 2-3-year-olds provided almost no orientations or evaluations, 4-5-year-olds provided some evaluations but still few or no orientations, and 9-13-year-olds included significantly more actions, more orienting information (such as time, place, and background information), and more evaluations (such as affective or evaluative comments) than the children who were at the end of early childhood. Thus, using this method, it appears that there may be age-related improvements in coherence. However, it should be noted that because older children produced significantly longer narratives than the younger children in this study, their findings are confounded with narrative length.

A few limitations are associated with using methods of measuring coherence based on word counts. First, these methods often encounter the confound of narrative length. Fivush (2007) articulates another major limitation with the word count approach:

“[The word count approach] is problematic in that relations between the use of specific word types and overall narrative coherence are not always clear; for example, is a narrative more coherent just because the narrator uses a large number of “and then” connectives” (p.2). Due to these limitations, some researchers (including the present author) have turned to measuring coherence using rating scales rather than word counts.

One earlier-described study employed a multidimensional rating scale to examine children’s memories of recent accidents (O’Kearney et al., in press). This study of children’s accident narratives and post-trauma used a coding scheme that involved rating narrative coherence on an overall scale and several separate dimensions. Their coding scheme, again based on work by Peterson and McCabe (1983), consisted of a global rating of coherence as well as individual three-point ratings on three separate, ordinal scales: level of orientation, sequence of events, and level of evaluation (see Appendix B). Level of orientation was determined by rating how well the people, place, and time of the events were described in a narrative. Sequence of events was rated with regard to whether the events were narrated in chronological order or were temporally disorganized. Level of evaluation was a measure of the degree an event was interpreted for the listener through the use of explanations, judgments, emotional states, intentions, and inferences. However, O’Kearney et al.’s classification of coherence overlapped with narrative qualities they termed cohesion. In fact, the authors stated, “Coherence is constructed depending on cohesiveness of the narrative together with the skills and knowledge that the discourse participants bring to the situation” (p. 3). Specifically, usage of words such as *because* and *so*, would contribute to both the level of evaluation in coherence coding and to the causal marker measurement in cohesion coding. Thus, by entering the non-

independent measures of both cohesiveness and coherence into their hierarchical multiple regression, the independent effects of coherence may have been overshadowed by the effects of cohesion on their outcome measures of intrusive and avoidant symptoms. However, this study did allow for separate examination of the different dimensions of coherence.

The current study built on the work that has been reviewed in the above sections by taking a multidimensional approach to narrative coherence.

Operationalization of Coherence in the Present Research

In the current investigation, coherence was conceptualized as a multidimensional construct consisting of three separate dimensions: context, chronology, and theme. Context captures the time and location where a particular event occurs. Chronology refers to the ability of a naïve listener to successfully order all the actions within an event on a timeline. Theme attempts to measure how developed, evaluated, and tied to the self a particular event is. An attempt to succinctly capture this conceptualization of coherence was provided in the definition in the first sentence of this dissertation: Narrative coherence is a measure of how well a particular memory has been structurally organized and interpreted.

In the present research, coherence was measured using a slight modification to the Narrative Coherence Coding Scheme (NaCCS). This scheme was devised by a consortium of psychologists from six prominent labs studying memory development in the US and New Zealand (Reese & Haden, in preparation). In the NaCCS, each narrative receives a code from 0-3 on each dimension of coherence. The details of this scheme and the slight modification used for the present study are presented in Appendix C. As noted

in Appendix C, the modification was to add more specificity in defining the lower two levels of the chronology dimension. As originally defined, a score of 0 indicated that none of the events of an episode could be chronologically ordered, and a score of 1 indicated that some but not most of the events could be placed on a timeline. A precise definition was added for use in the present study, so that a score of 0 indicated that 0-25% of the events in a narrative could be chronologically ordered and a score of 1 indicated that 25-50% of the events could be placed on a timeline. Thus, the chronology scale is interval in nature. However, the theme and context dimensions are ordinal scales.

Although this coding method is similar to the one used by O’Kearney et al., the individual scales in the NaCCS use a four-point rating system rather than a three-point rating system. This allows for a wider range of variability and makes the present scale appropriate for use with both children and adult narratives. Further, the levels on the individual scales of the current scheme are more specifically defined than the broad, more subjective ratings used by O’Kearney et al. This feature makes it easier for others to become reliable users of the scale.

There are several advantages to using the NaCCS, which explain why this coding scheme was selected for the present research. First, using this multidimensional measure of coherence rather than a unidimensional measure is valuable because it allows for a more fine-grained assessment of the components of coherence. It also allows for a clearer understanding of coherence as a construct because we can examine the separate relationship of each dimension to development and cognitive and linguistic skills. Secondly, data can still be analyzed for the separate aspects of coherence using the NaCCS even when it would be inappropriate to consider all three dimensions

simultaneously. For example, in the current investigation, interviewers used contextual information to prompt children to remember and narrate events from their past (e.g., “Tell me about visiting Chuck E. Cheese on your 4th birthday”). This procedure precluded children from independently providing contextual information in their narratives; however, theme and chronology could still be assessed. Finally, using this standardized measure of coherence is a great asset that will allow studies that are published from all the labs that use it to be directly compared. An understanding of coherence based on multiple studies from multiple labs will greatly enhance our understanding of the role of coherence in memory.

It is important to realize that the way coherence is measured is a reflection of the underlying assumptions about what coherence is actually tapping into. Thus, the next section will examine whether coherence is a function of the underlying memory representation or simply a function of a child’s verbal ability to convey a personal memory.

Is Coherence a Function of the Underlying Memory Representation or a Function of a Child’s Reporting Ability?

One of the reasons that the field has lacked a consistent way of defining and measuring coherence for so long is lack of a consensus regarding the nature of the construct. For children’s event memories, is coherence a property of the underlying cognitive representation (i.e., the organization of the event in memory storage), a property of a child’s verbal reporting abilities, or both? Is it even possible to untangle these influences? (For a similar debate about story structure, see Peterson & McCabe, 1983, pp. 9-13). Because the measurement of coherence is typically derived from verbal

reports of encoded and stored experiences (although cf. the self-report measure used by Bernsten, Willert, & Rubin, 2003), it is difficult to determine whether coherence is being influenced by the mental representation of the memory, by the verbal abilities of the person creating the report, or a combination of these two forces. Indeed, this is a common concern that plagues all memory research examining verbal reports, but it is particularly salient when working with children due to their limited verbal abilities. Many researchers have suggested that for children six years of age or younger, verbal measures of memory recall underestimate children's mnemonic competence (e. g., Price & Goodman, 1990; Bauer, 1996). Therefore, questions remain concerning the effects of age, verbal ability, and underlying memory on children's narrative coherence.

It is important to address these questions to inform theoretical perspectives on children's narrative coherence. If coherence is primarily a property of the underlying memory representation established at encoding, it may indeed play an important role in childhood amnesia, as theorized above. However, if it is influenced more by a child's age and verbal abilities, it may not be an effective predictor of long-term memory, necessitating the revision of existing perspectives on narrative. Thus, it is worthwhile to assess the influences of the underlying representation versus verbal abilities on children's narrative coherence.

There are mixed ideas and evidence in the existing literature about the influences on children's narrative coherence. Some researchers assume that narrative coherence is primarily a reflection of the structure and interconnectedness of the underlying event representation (Fivush, Haden & Adam, 1995; Baker-Ward, Ornstein, & Principe, 1997), which is thought to be the cognitive basis for verbal reports. For example, in their

longitudinal examination of preschoolers' personal narratives to be reviewed in detail in the next section, Fivush et al. (1995) attributed the observed increase in coherence between ages 4 and 5 to the likelihood that children were reorganizing their earlier memories (i.e. underlying representations). In other words, it is possible that stored memory representations were changing over time, which subsequently affected the child's coherence.

Even though some investigators have theorized that coherence may be a property of an underlying memory representation, it must be acknowledged that examining coherence in verbal recall is only a proxy measure of the representation, as "no one has direct access to these underlying representations" (Baker-Ward et al., 1997, p. 82). Because coherence is only a proxy measure, it may be subject to outside influences, particularly verbal skills. Since memories are typically shared using words, the assessment of the representation is confounded with verbal skills. Coherence, therefore, may also be a reflection of linguistic ability. Supporting this proposition, "McCabe et al. (1991) found that the coherence of personal experience narratives matched the teller's current linguistic competence, not their competence at the time when the events occurred" (Peterson & Biggs, 1998, p.74).

Thus, the primary goal of the current research was to examine what factors were influencing children's coherence. If coherence is indeed a direct reflection of the underlying memory representation, one would expect that a child would be more likely to create a highly coherent narrative if the underlying memory encoded a wide breadth of information (i.e. who, what, when, where, why, how). Clearly, if a child doesn't have all of this information to draw from when reporting a narrative, the coherence dimensions of

theme, context, and chronology may suffer. However, a memory encoded with a wide breadth may be necessary, but not sufficient, for a child to form a highly coherent narrative. For instance, perhaps some children have all the canonical components of an event stored in their memory representation, but these components could still be stored and reported in an unorganized, non-coherent manner. If this is the case, does the child not take advantage of these components due to limited verbal skills or to other capacities that may vary with age? Alternatively, the child may have encoded a wide breadth of components of an episode, and then take advantage of this to tell a very coherent narrative.

In summary, it has been postulated that coherence predicts coping outcomes and the long-term survival of early memories. Yet, these suppositions rest on the assumption that coherence is a function of the underlying memory representation established at encoding and then stored, in contrast to the alternative possibility that coherence is simply a function of a child's ability to report a narrative. Presently, it is unclear if a non-coherent narrative corresponds to an impoverished or unorganized underlying memory representation, or merely to individual differences in the reporting child's age or verbal skills (or to both of these factors). The desire to empirically address these questions about the fundamental nature of coherence shaped the aims of the current research. The findings presented below will help elucidate what coherence actually reflects.

Specifically, this study aimed to examine the influences of age, memory breadth (a more direct measure of the underlying memory structure, to be discussed below), and verbal comprehension on two dimensions of coherence in children's recent and distant memory narratives. Because these questions involve effects on coherence at both the level of a

memory representation (breadth) and the level of the child (verbal skills and age), multilevel modeling was used in the present investigation to address these cross-level influences.

Despite the disagreements in the definition and measurement of coherence as outlined above, existing literature was used to inform and guide the hypotheses in the present study. This information is reviewed below.

Age-Related Differences in Coherence

Children are independently capable of providing narratives of their past experiences by age 3 (Bauer & Wewerka, 1997). Much research demonstrates age-related improvements in various aspects of children's narrative reports of personal memories. In the research reviewed above, Peterson and Biggs (1998) examined personal narratives from 96 children aged 3 ½ to 9 ½ about a trip to the emergency room. They found age-related differences in the amount of evaluations and orientations provided in each narrative, with older children using more evaluations and orientations than younger children. They also noted that a resolution was more often included in older children's narratives rather than younger children's narratives. Longitudinal examinations have resulted in findings consistent with this cross-sectional report.

Fivush, Haden, and Adam (1995) longitudinally examined personal narratives for recent events over time starting when children were 3 ½ and continuing until they were almost 6. In their study, fourteen children were asked open-ended questions about recently occurring, parent-nominated unique events (e.g. outing to a museum, first trip on an airplane) which transpired when the children were 40-, 46-, 58-, and 70-months-old. The authors reported that children's narrative accounts of these events became more

complex, more coherent and more detailed over time. It should be noted, however, that the authors used the term coherence synonymously with cohesion and measured this by counts of orientations and evaluations.

It is clear that children's overall narratives do change with age, but how does the construct of narrative coherence change with age? Presently, the extant literature cannot provide empirical answers to this question. Thus, the current research examined age-related differences in coherence in children's narratives about specific parent-nominated past events. Let us now examine research that informs hypotheses about possible age-related differences in the chronology and theme dimensions of narrative coherence. As will be discussed below, the context dimension of narrative coherence will not be assessed in the present study, as aspects of the interview procedure prohibited the collection of the relevant data.

Chronology

In the current research, the chronology dimension of narrative coherence is a rating of how well the events in a particular narrative are temporally sequenced. Thus, the cognitive understanding of sequence and the understanding that this information must be conveyed to a listener are prerequisite skills for producing a narrative high in this dimension of coherence.

According to Piaget's classic theory of cognitive development, children in the preoperational stage of development are egocentric, meaning that they typically believe that all others share their perspective and understanding. Piaget's preoperational stage generally corresponds to the early childhood years, or about ages 3-7. Thus, when reporting a personal past event to a person who was not present at the time,

preoperational children may not realize that a listener needs explicit indicators of event sequence in a story to understand the order in which the events occurred. Piaget stated, “before the age of 7 or 8, children’s narratives...remain purely egocentric, i.e. events are linked together on the basis of personal interest and not on the real order of time” (Piaget, 1969/1928, p. 272). There is evidence in the extant literature that both contradicts and supports this statement.

Peterson and McCabe (1983) pointed out that Piaget’s perspective was mostly shaped by studies of children’s narratives that were retellings of experiment-provided stories or arranging stimulus pictures in an order, rather than from the basis of their narratives of personal experiences. They conclude, “Children do understand temporal order and can accurately reproduce it in their stories, unless they are attempting to recall complex and poorly structured stories such as those used by Piaget” (p. 164). Classic work by Nelson (1978) indeed showed that young children could tell chronologically ordered stories about familiar, repeated personally experienced events, such as going to eat at a fast-food restaurant. However, this conclusion may depend on children’s knowledge of scripts about eating at fast food restaurant in general, and may not apply to their reports of less familiar experiences. Thus, young children may still have difficulties sequentially ordering events from novel personal events that lack scripts.

Other research has found support for Piaget’s predictions about children’s increasing ability to sequence events within a narrative after the age of 7 or 8. Hudson and Shapiro (1991) stated, “Research generally shows that preschool children predominantly use the connective *and*, but with increasing age, children use more temporal, causal, and contrasting connectives, as well as intraclausal cohesion such as

subordinate conjunctions (e.g., *when, after*)” (p. 104). Thus, as children age past the preschool years, one would expect their ability to convey chronological sequences to increase. Further, their research findings support this. They examined personal narratives from preschoolers (mean age 4 years, 8 months; $n = 37$), first graders (mean age 6 years, 7 months; $n = 38$), and third graders (mean age 8 years, 7 months; $n = 34$). The narratives were about four personal, past events: a birthday party, a doctor’s visit, Halloween, and a trip. Their results indicated that explicit temporal sequencing was exhibited by approximately 40% of preschoolers, 40% of first graders, and 80% of third graders (notably, who were older than 7 or 8, an outcome consistent with Piagetian theory).

Although the theory and literature reviewed in this section strongly suggest that the skills (i.e. temporal sequencing, recognition of a listener’s needs) that contribute to the chronology dimension of coherence in 4-8-year-old children’s narratives may show age-related differences, actual age-related differences in the chronology dimension itself have yet to be reported.

Theme

In the present study, the theme dimension of narrative 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, the ability to evaluate and link information is needed to produce a narrative high in this dimension of coherence.

Hudson and Shapiro’s (1991) earlier-described work also examined two characteristics of 4- to 8-year-olds’ narratives that would influence the theme dimension

of coherence. They examined inclusions of explanations (descriptive information or why particular events were carried out) and high points (including emotional reactions).

Approximately twice as many narratives produced by 8-year-olds included explanations and high points as did the narratives produced by 4- and 6-year-olds. Further, Hudson and Shapiro also reported, “the inclusion of codas that tie a narrative together or to bring the narrative up to the present are only found in the narratives of children 8 years and above” (p. 99).

Consistent with the Hudson and Shapiro work, Peterson and Biggs (1998) also showed age-related differences in the frequency of evaluations included in children’s personal narratives about a past injury. However, Peterson and Biggs were comparing groups of children aged 2-3, 4-5, and 9-13. Thus, they lack data on children aged 6-8, which were included in the present study. It is important to study children of this age because of the important Piagetian cognitive shifts that children of this age typically experience (discussed above).

In Fivush and colleagues’ (1995) longitudinal examination of preschoolers’ memory narratives for moderately positive events, the same fourteen children participated when they were 40-, 46-, 58-, and 70-months-old. During each time point, an interviewer asked each child to discuss three parent-nominated events using only open-ended prompts. When the children were 40-months old, all three of the remembered events had occurred during the recent past. However, when the children were 46-, 58-, and 70-months old, two of the discussed events were from the recent past and the remaining event was one that had transpired in the distant past and that had been discussed at the previous session. Some children were not asked to recall a distant

memory at certain time points because a similar event had been experienced more recently, which negated the uniqueness of the distant event. The authors reported that 8 of the 11 children who were prompted to do so were able to remember and narrate the distant event during the 46-month time point, 7 of 9 children during the 58-month time point, and 9 of 10 children during the 70-month time point. Overall, 80% of the distant memories that were asked about were repeatedly recalled by the children. Fivush et al. reported that the almost-5-year-olds reported more evaluations in their repeated narratives of events than they had when describing these same events when they were almost 4. There was not a statistically significant increase in evaluations for events discussed at almost 5 and again when at almost 6. Thus, it seems that there was a shift in the quantity of evaluative information provided in narratives between ages 4 and 5, but not 5 and 6. However, Fivush et al. did not continue to follow these children beyond age 6, so one is unable to make conclusions about shifts beyond this point in the lifespan. Moreover, their conclusions were drawn from the analyses of a very small sample, only 24 repeated memories nested within 14 participating children. Finally, of course, they were only assessing evaluations, which is only one contributor to the theme dimension of coherence.

The dimension of theme in coherence is also influenced by the inclusion of causes in a narrative. Trabasso, Stein, and their colleagues have done a great deal of work in this area, specifically examining goals as causes of actions (e.g. Trabasso & Nickels, 1992; Trabasso & Stein, 1997; Stein & Albro, 1997). Trabasso and Nickels (1992) had 48 children aged 3, 4, 5, or 9 and a group of ten adults narrate a picture book called, "Frog, Where are You?" The book used 24 pictures to depict a boy who loses his frog, then

searches for it in many places, and finally finds his frog. Each clause in the children's narratives was then classified as belonging to a goal-attempt-outcome (GAO) unit or a non-GAO unit. Non-GAO units consisted of isolated descriptors, names, or identifications of items in the pictures. The authors found that 3- and 4-year-olds used primarily non-GAO units in their narratives. This pattern changed for the 5-year-olds who used more GAO units than their younger counterparts. The 9-year-olds and adults conveyed mostly GAO units in their narratives. Their findings suggest that as children age, they may be including an increasing number of goals as causal reasoning in their narratives. Although these interpretations are interesting, it is important to note that the narratives analyzed in this study were about pictures seen in the present and were not memories for personal events. As Trabasso and Stein (1997) point out, "The studies of Trabasso and his colleagues suggest that the spontaneous use of goals and purposes explicitly occurs at age 5 while tacit use may occur earlier. It is likely that in real-life situations where the stakes are high, children use knowledge of goals and plans as young as 2" (pp. 244-245).

Thus, while the literature suggests that there may be age-related differences in the components that contribute to theme dimension of coherence (i.e. use of evaluations and causal explanations in narratives), age-related differences in the theme dimension of coherence itself have yet to be empirically assessed.

The above sections have reviewed literature that guided current hypotheses about the age-related differences in narrative coherence. Now we will examine possible predictors of coherence itself.

Memory Breadth and Subsequent Recall

Breadth is a measure of the proportion of canonical components (who, what, when, where, why, how) recalled about a particular episode (Van Abbema, 2002). As stated above, if coherence is indeed a direct reflection of the underlying memory representation, one would expect that a child would be more likely to create a highly coherent narrative if the underlying memory contains a wide breadth of information. Clearly, if a child doesn't have a wide breadth of information to draw from when creating a narrative, the coherence dimensions of theme, context, and chronology may suffer. However, there may be both developmental changes and individual differences in the association between breadth and coherence, meaning that a wider breadth may be necessary, but not sufficient, to produce a highly coherent narrative. While this is a logical theoretical position, there is currently no empirical evidence that explicitly address it.

Van Abbema and Bauer (2005) examined 32 7- to 9-year-old children's memories for mother-nominated personal events that occurred when the children were aged 3 and that occurred within the past 3 months. Their data showed that the recent memories were recalled with a greater breadth than the distant memories. Further, they noted that the children's reports of the recent events were more coherent and included twice the detail than in the distant memories. However, the authors did not examine the relationship between breadth and other memory outcomes at the level of each individual memory. Moreover, in their study, breadth was coded from the same report that influenced their impressions of coherence and their count of the number of details (a confound that was avoided in the present investigation). Finally, as previously noted, the authors defined

coherence solely on the basis of the use of temporal connections. Thus, while this study does not preclude the possibility that the breadth of a memory may influence how coherently the past event is reported, Van Abbema and Bauer's investigation does not provide a firm basis for this conclusion. Overall, although theory may point to a relationship between memory breadth and coherence, this association has yet to be empirically investigated.

However, memory breadth is only one possible influence on children's narrative coherence. Verbal comprehension may also play a role and will now be discussed.

Verbal Ability and Memory Reports

Even children as young as age two are able to use words to describe past events that they have experienced (Morris & Baker-Ward, 2007). Nonetheless, there are questions about the relation of verbal comprehension and memory reports. Specifically, do children's age-related increases in verbal skills influence their ability to talk about the past? Is it necessary to measure verbal comprehension when considering narrative coherence in children's memory reports? Could age-related increases in children's narrative coherence merely be a reflection of their increasing verbal abilities?

Nelson and Fivush (2004) describe an unpublished dissertation (Walkenfeld, 2000) that examined 3- to 5-year-old children's memory for an experimenter-provided event: a treasure hunt at a pretend zoo. Children's language skills were also assessed using the standardized Test of Early Language Development (Hresko, Reid, & Hammill, 1981). This test provides a raw score, standardized score, and a "language age" for each child's receptive and expressive language capacities. Stepwise regressions across the entire sample revealed that while age and expressive language were not significant

predictors of item recall and narrative cohesion, receptive language (verbal comprehension) predicted both of these outcomes ($ps < .0001$). Although the to-be-remembered event in this study was experimenter-staged, it was a moderately pleasant event similar to many of the events nominated in the present study (e.g., a visit to science museum). Thus, at least for the youngest age group in the current study, it seemed important to consider receptive language as a possible predictor of narrative coherence.

The role of receptive language in older children's memory reports, however, is less clear. Burgwyn-Bailes, Baker-Ward, Gordon, and Ornstein (2001) examined 24 3- to 7-year-old children's memory for a facial laceration and subsequent treatment by a plastic surgeon. The children were interviewed about their experiences within a few days of the event, 6 weeks later, and again 1 year later. Interviews were based on a checklist of present features (i.e. the nurse applies a numbing agent, the doctor puts some medicine on the wound) that the surgeon completed at the time of the initial treatment. During the interviews, children were first asked open-ended questions about what had occurred when they were treated. These questions were followed up with a series of closed *wh*-questions and then forced choice yes/no questions about particular features of the event if they were not included in the child's free response. Total recall was calculated as the percentage of features about which a child provided information (at any level of specificity) in relation to the total number of present features. The authors of this study then used a series of hierarchical multiple regressions to examine if individual difference factors were predictive of total recall at delays of 6-weeks and 1-year. One of the factors examined was children's receptive vocabulary, which was assessed by the Peabody Picture Vocabulary Test- Revised (PPVT-R). The authors report that after age alone,

adding PPVT-R scores and PPVT-R x Age interactions significantly increased the amount of variance in total recall at 1-year that the model explained from 24% to 43%. However, simply adding PPVT-R scores (without the age interaction term) did not have an effect on the model. The authors explained, “increases in receptive language skills were associated with increased total recall only for the younger children; among the older children, receptive language skill was no longer helpful in predicting recall” (p. S38). Assuming that the amount of information recalled impacts narrative coherence, this study further indicates that verbal comprehension may be an important predictor of narrative coherence for the younger children in the present study, but not the older 6- and 8-year-old children.

In contrast, other studies have indicated that verbal comprehension is not an important predictor of recall. Ornstein et al. (2006) examined 4- to 7-year-old children’s memories over a 6-month interval for a well-child check up by a pediatrician. Children’s scores on the PPVT-R only explained about 1% of the variance in open-ended recall (i.e., children’s free responses to “Tell me what happened at your check-up”). Yet, in this study, open-ended recall was quantified as a percentage of present features that a child reported. There was no measure of qualities of the child’s narrative, such as coherence.

Fivush, Hazzard, Sales, Sarfati, and Brown (2003) did measure 5- to 12-year-old children’s narrative coherence (a global rating of 0-3) when discussing both positive and negative events. Positive events were much like the majority of events discussed in the current study and included occurrences such as trips to amusement parks, vacations, and parties. Negative events included events such as illnesses, injuries, and parental separations. Verbal ability was assessed in these children using the Peabody Picture

Vocabulary Test, Third Edition (PPVT-3). Vocabulary scores were not correlated with the amount of information recalled. The authors found that the coherence of negative events was correlated with both age ($r = .58, p < 0.01$) and PPVT-3 scores ($r = .53, p < 0.01$). Intriguingly, the coherence of positive events did not correlate with age or vocabulary. Thus, future research should most certainly address the relationship between emotional content of a memory and vocabulary scores, however such an examination is beyond the scope of the present study. Also, the Fivush et al. study was based on the memories of only 29 participants who were living in a violent community; hence, caution should be used when generalizing these findings. For the purposes of the current study, however, it is important to note that there may be a relationship between vocabulary comprehension and coherence in children beyond preschool age, at least in certain situations. Overall, the extant literature has not provided a clear picture of the relationship between children's verbal abilities and their subsequent memory reports.

In summary, the literature reviewed above has left many gaps in our understanding of children's narrative coherence. It has been demonstrated that older children include more orientations and evaluations in their personal narratives (Peterson & McCabe, 1983), and are more likely to use temporal markers than preschool children (Hudson & Shapiro, 1991). However, when coherence is conceptualized as a multidimensional construct, it is unclear whether there are age-related differences in the theme and chronology dimensions of coherence. Further, although it can be theorized that memory breadth (which corresponds to the underlying memory representation) is an important influence on coherence, there is presently no empirical evidence that addresses this supposition. Finally, some extant studies demonstrate a relationship between

children's verbal abilities and subsequent properties of memory narratives (Walkenfeld, 2000), yet others only find this relationship under specific circumstances (e.g., in older but not younger children [Burgwyn-Bailes et al., 2001]; in narratives of negative but not positive events [Fivush et al, 2003]). Therefore, the influence that a child's verbal ability may (or may not) exert on narrative coherence has not been firmly established. Thus, the present study attempted to fill the void of knowledge about coherence as presented below.

Rationale for the Present Study

Narrative coherence is often used as a predictor of other outcomes in the extant literature (e.g. coping with trauma [O'Kearney et. al, in press]; recalling memories of experiences that transpired during the period of childhood amnesia, [Fivush, Haden, & Adam, 1995]). Nonetheless, little work has actually empirically explored the factors that influence narrative coherence. It is important that coherence is fully understood as a construct in its own right in order for it to be most useful as a predictor in future research. Although narrative coherence has often been assumed to be a direct reflection of the underlying memory representation, it is necessary to consider outside influences on coherence (especially verbal ability) that may complicate otherwise straight-forward interpretations of coherence. Thus, the present study empirically examined age-related differences in two dimensions of coherence in children's memory narratives. The research also assessed the influences of age, memory breadth, and verbal comprehension on narrative coherence for both recent (from past 4 months) and distant (over one-year in the past) events. A clear understanding of these influences will help empirically inform the theoretical view of what it is that coherence is actually representing: the underlying

memory representation that is encoded and stored or simply the reporting ability of children upon retrieval.

A major asset of the current research is that it used a method for measuring coherence that was developed and is now in use by many memory researchers. Thus, the results found here are directly comparable to all future studies coming out of the six labs that have adopted this method thus far. This could potentially lead to great gains in our understanding of the role of coherence in memory.

Furthermore, the present study examined coherence in memory narratives provided by children when they were 4, 6, and 8 years of age, and again when they were 5, 7, and 9 years old. This age range is important as it offers a bridge between the many studies that include only preschoolers (i.e. Fivush, Haden, & Adam, 1995) and the few which include school-aged children (i.e. Van Abbema, 2005).

Lastly, this study involved the analysis of 2,144 memories collected from 112 children, resulting in more statistical power than found in any of the studies of children's coherence in the extant literature. Thus, the analyses of the data described here offers valuable insights that others could not.

In the data set analyzed in present study, 4-, 6-, and 8-year-old children were asked about their memories of specific parent-nominated events from the past four months of their lives. They were first asked about the event in general terms (i.e., Tell me about your fourth birthday party), and then were asked a series of specific *wh*-questions about the event (i.e., Who was there?). Thus, the participating children provided both a free narrative in response to the open-ended questions and gave answers to directed *wh*- probes. During the same session, children's verbal comprehension was

also assessed. One year later, the then 5-, 7-, and 9-year-olds were again asked about events from their recent past, as well as about events they had previously discussed during the initial session of the study. The cross-lagged design of this study allowed for both cross-sectional analyses and longitudinal analyses. Thus, we were able to examine the influence of variables over time. Additionally, asking each child about multiple memories allowed for the use of multilevel modeling, a powerful statistical tool for analyzing nested data. Further, by asking children about unique events in their lives, the design reduced the likelihood that children had repeatedly experienced the to-be-remembered event and thus had the opportunity to reorganize the memory representation between the two assessment points (Nelson, 1993).

Two dimensions of coherence were assessed in the children's free narratives about their recent and distant memories: chronology and theme. It would have been inappropriate to assess the context dimension because contextual information (when and where an event took place) was provided by the experimenter to the children in order to prompt for the specific memory. For example, in the prompt, "Tell me about the time you visited the fire station," the location of the event (fire station) was provided by the experimenter. Thus, the child had no need to restate the location of the event.

The breadth of children's memories was also assessed. In the previous studies that examined breadth (Van Abbema & Bauer, 2005; Kleinknecht & Beike, 2004), the assessment of memory breadth was confounded by narrative coherence, as these two measures were both based on children's free narratives. The current study avoided this confound by assessing breadth only from the children's answers to the specific *wh*-questions. Thus, the measurements of breadth and coherence did not come from the same

source. Further, by providing a framework for the provision of breadth information, the retrieval demands and the level of verbal skills needed was drastically reduced (Baker-Ward, Ornstein, & Principe, 1997). As Peterson and McCabe (1983) explained, “Whenever probes are used, there is more in memory than is linguistically represented when children tell of their personal or vicarious experiences” (p. 13). Given this, one can expect that memory breadth is closer to the actual underlying memory representation than is coherence. For these reasons, in the present study, breadth was considered to be a close proxy for the underlying memory representation.

These data were used to address the specific aims and hypotheses that guided the current study. These goals will be articulated in the following section.

Specific Aims and Hypotheses

Aim 1. To Describe the Age-Related Differences in Two Dimensions of 4-8-year-old Children's Narrative Coherence

At this point, it is still unclear whether there are age related differences in the theme and chronology dimensions of children's narratives about their personal past. Thus, the first aim of the present study was to empirically address this using a cross-sectional sample. Only memories for recent events were examined to exclude possible effects from the duration of time a particular memory has been stored.

Hypothesis 1A

I hypothesized that children's narratives would show an age-related difference in the chronology dimension of coherence. As reviewed above, Hudson and Shapiro (1991) examined narratives from children of the same age as were examined in the present study. They found that older children used more temporal connections than younger children. This could enable older children to better convey the chronological sequence of events that comprise a personal episode. The events the children discussed in Hudson and Shapiro's work are also very similar to the mother-nominated events children discussed in the current research. Based on these similarities and Piaget's perspective of the offset of egocentrism, I hypothesized that children's narratives would show an age-related difference in the chronology dimension of coherence. Specifically, I predicted that chronology would be greater for the 8-year-olds than the 4- and 6-year-olds.

Hypothesis 1B

I hypothesized that children's narratives would show an age-related difference in the theme dimension of coherence. This hypothesis was based on the research reviewed

above demonstrating that older children use evaluations to a greater extent than younger children, which could lead to a more developed theme. However, I was unable to make specific predictions about where in the age range the differences would appear, although in general I expected older children's narratives to be higher in theme than younger children's.

Aim 2: To Examine the Influences of Age, Memory Breadth, and Level of Verbal Comprehension on Two Dimensions of Children's Narrative Coherence in Recent Memories

A clear understanding of the influences of age, breadth, and verbal comprehension will help empirically inform the theoretical view of what it is that coherence is actually representing: the underlying memory representation that is encoded and stored or simply the reporting ability of children upon retrieval (or both). If breadth (a measure that is close to the underlying representation) exerts a strong influence on coherence, this would support the contention that coherence indeed taps into the underlying memory representation. However, if verbal comprehension has a strong influence on coherence, it would indicate that coherence is also influenced by reporting ability. Age influences on coherence could be a sign of developmental changes in both underlying memory representation and/or verbal abilities. Unfortunately, there was not enough strong empirical evidence in the extant literature to make specific predictions about each of the influences of each of these factors, thus these examinations were exploratory in nature.

I conducted two exploratory analyses to determine if age, breadth, and verbal comprehension did indeed influence the (a) theme and (b) chronology dimensions of

coherence in children's memory narratives. Again, only memories for recent events were examined to preclude possible effects from the duration of time a particular memory has been stored.

Based on the studies reviewed above, it was a possibility that verbal comprehension could have exerted a stronger influence on the narrative coherence of younger, but not older, children. Therefore, an Age X Verbal comprehension term was also included in the models.

Aim 3: To Examine Whether Two Dimensions of Children's Narrative Coherence for a Distant Memory Depends on a Child's Initial Breadth and Coherence of the Memory and/or the Child's Narrative Ability at Time of Retrieval.

It has been speculated that childhood memories that are highly coherent are more likely to survive into adulthood than those memories that are not coherent (Fivush, Haden, & Adam, 1995). This would make sense if coherence represented something about a memory's underlying representation, but not if coherence only tapped into a child's ability to narrate. Thus, it is important to examine what factors may predict coherence over a long duration of time. Therefore, I examined the influences of the initial breadth and coherence of a memory, as well as a child's current reporting ability, on the coherence of the same memory reported one year later.

If coherence is directly tied to the underlying memory representation, the breadth of a particular memory (a more direct measure of the representation than coherence, see discussion above) should have an effect on theme and chronology above and beyond a child's current reporting ability and the coherence of the initial report of the memory. If coherence is merely a reflection of a child's reporting ability, the initial breadth of the

memory will no longer be an influence on coherence one year later. Since the influences on coherence of distant memories have not been empirically explored in the extant literature, no specific hypotheses were made.

I conducted two exploratory analyses to determine the influences of the initial breadth and coherence of a memory, as well as a child's current reporting ability, on the (a) theme and (b) chronology dimensions of coherence in children's distant memory narratives.

Method

This study was part of a larger, ongoing project being conducted at the University of Minnesota investigating the development of autobiographical memory under the direction of Patricia Bauer, Ph.D.ⁱ. The data used in the present investigation were obtained through a collaborative agreement with the principal investigator and were not previously analyzed to answer the current questions. All memory data were obtained in the form of written transcripts, and coding was completed by the first author and her research assistants. All data collection procedures were approved by the University of Minnesota's Internal Review Board (#1313) and the current investigation was reviewed by the Internal Review Board at North Carolina State University and classified as exempt (#155-06-5). Only those aspects of the larger project relevant to this study are described here.

Participants

Participants were recruited via phone calls from the Minneapolis/St. Paul metropolitan area from a database of families who had indicated at the time of their children's births that they would be interested in becoming involved in later research. Initially, 198 families agreed to participate in the current study via telephone and were mailed information. Of these families, 135 (68%) subsequently completed participation in the first wave of data collection. Both the parent and child received a \$10 gift card to a local merchant in appreciation of their participation. At wave 1, the sample consisted of 48 4-year-olds (Mean age = 4.19, $SD = 0.07$, 21 girls), 44 6-year-olds (Mean age = 6.19, $SD = 0.05$, 25 girls), and 43 8-year-olds (Mean age = 8.20, $SD = 0.05$, 27 girls).

ⁱ Although Dr. Bauer is now in the Department of Psychology and Neuroscience at Duke University in Durham, North Carolina, she is continuing to oversee her research at the University of Minnesota.

Retention was high, with 84% returning for wave 2 one year later. Thus, the final sample consisted of 40 5-year-olds (Mean age = 5.21, $SD = 0.09$, 18 girls), 40 7-year-olds (Mean age = 7.18, $SD = 0.11$, 23 girls), and 33 9-year-olds (Mean age = 9.19, $SD = 0.10$, 20 girls). The data from one 4-year-old boy was excluded from analyses in the present investigation due to maternal reporting of developmental delays for which the child was receiving therapeutic assistance. Thus, the data for this study came from a total of 112 children. The sample, based on mothers' reports for the child participants, consisted primarily of Caucasian individuals. In addition to the 104 Caucasian participants, 5 Caucasian/Asian, 2 American Indian/Caucasian, and 1 Hawaiian individual also contributed data.

Procedures

Participants visited the lab at the University of Minnesota for two hour-and-a-half sessions separated by one week at wave 1, and again one year later at wave 2. (See Table 1 for a timeline of the study). Four months prior to their visit to the lab each year, parents of the participants were sent a blank calendar and asked to record one or two unique events that occurred each week. Specifically, the parent instructions read:

Good examples of the types of events that we hope you will record on your child's calendar are going to the zoo, a trip to the science museum or a special school event, and "first time" events that have happened (perhaps a first airplane ride, the birth of a sibling, or the first time to a carwash). Please try to avoid recording routine events, such as going to the grocery store (unless something especially interesting happened on a recent trip, that is!), going to the doctor for a routine check-up or a birthday party. We hope that you will identify events that

were of interest to your child at the time, and that you think are likely to be remembered (often small, but uncommon, events are remembered better than holiday experiences or vacations, for example). Please bring the calendar along at the time of your first visit. We will use it as a guide to help us select events to talk about. Between now and your visits to the laboratory, please do not initiate conversations about these events with your child.

During the first wave of this study, the child participants discussed a minimum of nine of these randomly selected events with an experimenter. During the second wave of this study, participants were asked to discuss at least three of the events discussed the previous year, and at least six recent events with an experimenter.

Table 1. Procedural Timeline.

Wave 1		Wave 2 (+1 year)	
Session 1	Session 2 (+1 week)	Session 1	Session 2 (+1 week)
Parental Calendar of Events for the last 4 months collected		Parental Calendar of Events for the last 4 months collected	
ECI (4-5 recent events)	ECI (4+ recent events for 9 total)	ECI (4-5 recent or past events)	ECI (4+ recent or past events for 9 total (3 past, 6 recent))
	Verbal Comprehension Assessment (WJ-III)		

Each wave was separated by one year, and within each wave, each session was separated by one week. ECI = experimenter-child interview

Experimenter-Child Interview (ECI)

During the first wave, at least nine events were randomly selected by a research assistant from the parental event calendar. During the second wave, a minimum of six

recent events were randomly selected by a research assistant from the parental event calendar for the four months preceding the present laboratory visit. Additionally, three events that had been discussed during wave 1 were randomly selected. The titles of these events were written on an information sheet and then given to the parent. The parent was asked to provide a brief description about each event. This information was then used by the experimenter in an interview with the child. In total, the child was asked about at least nine events in each wave. Half of the events were discussed in the first session, and half were discussed in the second session. Each child was interviewed by the same female experimenter across each session, but a different female researcher across each wave.

During the memory interviews, the research assistant gave the child the following instructions:

Your mom wrote down some things you've done and it's my turn to talk with you about them. Some of the things happened more recently, and some of them happened a long time ago. Since I wasn't with you during these times, it's up to you to tell me everything you can about each one. When you're done, I'll ask you a few questions. During this, your mom is going to fill out some paperwork, so she won't be able to help you out. We're just trying to find out what you remember all by yourself. Let's talk about the first one.

The experimenter started each event at the most general level possible, using the bare minimum of the event title that will allow the child to identify the event: "What can you tell me about X?" If the child was unable to identify the event or started talking about the wrong event, the experimenter provided ONE descriptive cue from the

mother's description to clarify the event. For example, if the event title was "Trip to the zoo", an additional cue may be "you saw animals." The experimenter encouraged the child to continue with his or her spontaneous report by using empty prompts for more information, such as, "Tell me one more thing," "Do you remember anything else?" and "I see." After the child's independent narrative had been exhausted, the experimenter said:

"You told me a lot/little about all that. I'm going to ask you some questions...(some of which you already talked about). Just answer the best you can."

The experimenter then asked a series of seven specific wh-questions about the event: What else did you do, who was there, where did you X, when did you X, why did you X, how did you X, and how did you feel about X.

These interviews were videotaped and later transcribed verbatim. All coding took place from the written transcripts.

Verbal Comprehension Assessment

During the second session of the first wave of data collection, a trained experimenter administered a verbal comprehension assessment to all children who were still engaged in the experiment, remained cooperative, and had time left in their sessions. Thus, complete scores are available for 29 (of 40) 4-year-olds, 39 (of 40) 6-year-olds, and 32 (of 33) 8-year-olds. As noted earlier, this study was part of a larger study. As part of the larger study, the children were completing many more cognitive and memory tasks than those described here. The 4-year-olds had a greater number of tasks to complete before the verbal assessment than the older children. Thus, due to the additional task

requirements and time restraints, fewer 4-year-olds than older children completed the verbal assessment task used in the present study.

The verbal comprehension assessment includes four subtests from the Woodcock-Johnson III (WJ-III) Test of Cognitive Abilities (Woodcock, McGrew & Mather, 2001): Picture vocabulary (test 1A), synonyms (test 1B), antonyms (test 1C), and verbal analogies (test 1D). The WJ-III is an assessment tool that is appropriate for use with individuals aged 2 to 90+ years old and is often used by clinicians and school psychologists to measure general intellectual ability, specific cognitive abilities, scholastic aptitude, oral language, and achievement. The test was normed using data from over 8,800 participants in more than 100 diverse locations in the US. Moreover, the verbal comprehension test has a median reliability of .90 in the 5 to 19 age range. Thus, the WJ-III was an appropriate choice for the present sample.

All subtests were administered and scored according to the standardized instructions as specified in the WJ-III Examiner's Manual (Mather & Woodcock, 2001). Raw scores were converted to the *W* scores for analyses in the present study using the WJ-III computer software, the Compuscore and Profile Program (Schrank & Woodcock, 2001). The *W* score is a special transformation of the Rasch ability scale and was chosen for its mathematical properties that make it advantageous for many statistical procedures. Specifically, the *W* scores are more easily interpreted than raw scores and they are set on an equal-interval measurement scale. The *W* scale for the verbal comprehension test is centered on a value of 500, which is set to the approximate average performance of a 10-year-old child. Thus, the *W* score is norm-referenced and conveys information about the level of development of a child's verbal comprehension abilities. Studies have shown

that in typically developing preschoolers (ages 2-6), scores on the WJIII verbal comprehension correlate (.70) with verbal IQ scores derived from the *Wechsler Preschool and Primary Scale of Intelligence-Revised* (McGrew & Woodcock, 2001). Studies have also confirmed that in typically developing 8- to 12-year-olds, scores on the WJIII verbal comprehension correlate (.71) to scores on the Verbal Comprehension Index from the *Wechsler Intelligence Scale for Children-Third Edition* (WISC-III) (McGrew & Woodcock, 2001).

Coding

General Procedures

All coding was completed by the first author and her two female research assistants, who were a master's degree student in developmental psychology and an advanced undergraduate student in psychology. These assistants were supervised directly by the first author and her graduate advisor. All memories were coded for coherence, and memories collected during wave 1 were coded for breadth using the schemes described below. One research assistant helped with each coding scheme.

Coders were trained to an acceptable level of reliability ($>.85$ intraclass correlations for coherence, $>.70$ kappas for breadth categories) by the first 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 have also been 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 and every narrative

receives a code or designation as not a memory, meaning that there are no cases of non-occurrence.

Coherence

Coherence was coded by the first author and one graduate research assistant using the Narrative Coherence Coding Scheme (Reese & Haden, in preparation [see Appendix C]). This is the method now used in six memory research labs across the US and New Zealand. By conforming to this standard scheme, research produced by all six of these labs will be comparable. Thus, broader conclusions and implications can be deduced than was previously possible when using various coding schemes.

In this scheme, three dimensions of coherence are assessed: Context, chronology, and theme. 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 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 as described in the Dataset Specific Coherence Coding Rules (see Appendix D). Ratings from 0-3 were made for each narrative on two of the three dimensions of narrative coherence: Chronology and Theme. The chronology scale was interval in nature, making it appropriate for analysis using multilevel modeling. However, the theme scale was ordinal in nature. For statistical purposes, the ordinal theme scores were collapsed into a dichotomous low/high measure, such that ratings of 0 or 1 on the ordinal scale were considered low, and ratings of 2 or 3 on the ordinal scale was considered high. It was inappropriate to assess the third dimension of coherence (context) in this particular dataset because the experimenters

often provided information about the location and time the event occurred in their prompting. Thus, the prompts precluded the child's independent provision of contextual information.

Examples of how this coding scheme was applied to narratives from 4-, 6-, and 8-year-olds are provided in Appendix E.

Approximately ten percent ($n= 223$) of the transcripts were randomly selected as the basis for establishing reliability in coding coherence. For the chronology dimension, memories were coded from 0-3 as described above (Appendix C). Further, 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 as specified according to the procedures described in Appendix D. These memories were assigned the numerical value of -1 for the purposes of calculating intraclass correlations. Child narratives that lacked even two units of information were not considered to be a memory (see Appendix D), and were assigned a numerical value of -2 for the purposes of calculating inter-rater reliability. It is important to include these codes when assessing reliability to insure that both coders were using the criteria to classifying memories in the same way. The intraclass correlation for the chronology dimension was 0.86. Similar to the procedure with chronology, in the case of theme, child narratives that lacked even two units of information were not considered to be memories (see Appendix D), and were assigned a numerical value of -1 for the purposes of calculating inter-rater reliability. The intraclass correlation for the theme dimension was 0.90.

Breadth

In this investigation, breadth is considered to be a close proxy for the underlying memory representation. It is typically measured as a simple 0-6 count of the number of traditional narrative components included in the participant's memory (e.g. Van Abbema & Bauer, 2005). The six traditional narrative components are information about (a) how, (b) when, (c) what, (d) who, (e) where, and (f) why the event occurred. In the present study, the *what* component was not included because that information was used by the experimenter to prompt the child for the specific memory. Narrative breadth was assessed as a percentage of *wh*-information provided to the *wh*-questions that were asked. The percentage system was used rather than a simple count to account for the rare cases when an interviewer failed to ask all 5 of the traditional *wh*-questions.

Only unique information that the child provided in response to a closed *wh*-question was coded. Thus, the portion of the memory coded for narrative breadth did not overlap with the portion of the memory coded for narrative coherence, providing an independent data stream for these two measurements. Further, because the information coded for breadth was supported by the framework of *wh*-questions, the retrieval demands and the level of verbal skills needed for the child to report this information was drastically reduced as compared to the information provided to open-ended prompts that was coded for coherence. Therefore, one can expect that memory breadth is closer to the actual underlying memory representation than is coherence. For these reasons, in the present study, breadth was considered to be a close proxy for the underlying memory representation (although see discussion below).

The scheme developed by Van Abbema (2002) and based on work by Kleinknecht (2000) was adapted for use in this investigation with slight modification (See Appendix F). All memories collected during wave 1 ($n = 1095$) were coded for breadth. Coding was completed by the first author and one undergraduate research assistant. Approximately ten percent ($n = 102$) were randomly selected to establish inter-rater reliability. Inter-rater reliability was judged to be at acceptable levels based on Cohen's kappas for the five categories, which ranged from 0.79 to 0.92 (Cohen, 1960). Examples of how this coding scheme was applied to narratives from 4-, 6-, and 8-year-olds are provided in Appendix E.

Results

Descriptive Analyses

Each of the 112 participants in this study was asked to discuss at least nine memories at each wave of data collection, resulting in a sum of 2,144 possible memories for analysis. Of these, 333 of the same memories were introduced at wave 1 (T1) and again at wave 2 (T1ⁱ). The remaining 1,478 introduced memories were from the recent past (within the past 4 months) and discussed only once, either at wave 1 (T1) or wave 2 (T2). Overall, children were able to remember 81.4% of the memories that were introduced, where remembering was defined as being able to provide a mnemonic narrative containing at least two propositions (see Table 2). There were no differences in frequency of remembering across the two waves of this study, $X^2(1, N= 2,144) = 0.11$, $p = .16$. Not surprisingly, during wave 2, recent memories were remembered more frequently than distant memories, $X^2(1, N= 1,049) = 18.01$, $p < .01$. Consistent with findings in the extant literature (Van Abbema & Bauer, 2005), age differences in the frequency of remembering were found, $X^2(2, N= 2,144) = 159.53$, $p < .01$, such that 4-year-olds remembered fewer memories than 6-year-olds, who remembered fewer memories than 8-year-olds (see Figure 1).

ⁱ Although memories described by T1ⁱ and T2 were both actually reported during wave 2, the different notations are used to distinguish memories of distant and recent events. The T1ⁱ notation was used to describe memories that were reported at wave 2, but transpired over one year in the past and that were also discussed at wave 1. The T2 notation was used to describe memories for events that transpired within the past 4 months at wave 2.

Table 2

Number of Memories Introduced and Remembered

	<i>Memories Introduced</i>	<i>Memories Remembered</i>	<i>Memories for which a child provided breadth information in the absence of a narrative</i>
Wave 1 Recent (T1)	1095	879	108
Wave 2 Recent (T2)	716	616	NA
Distant (T1')	333	215	NA
Total	2144	1746	

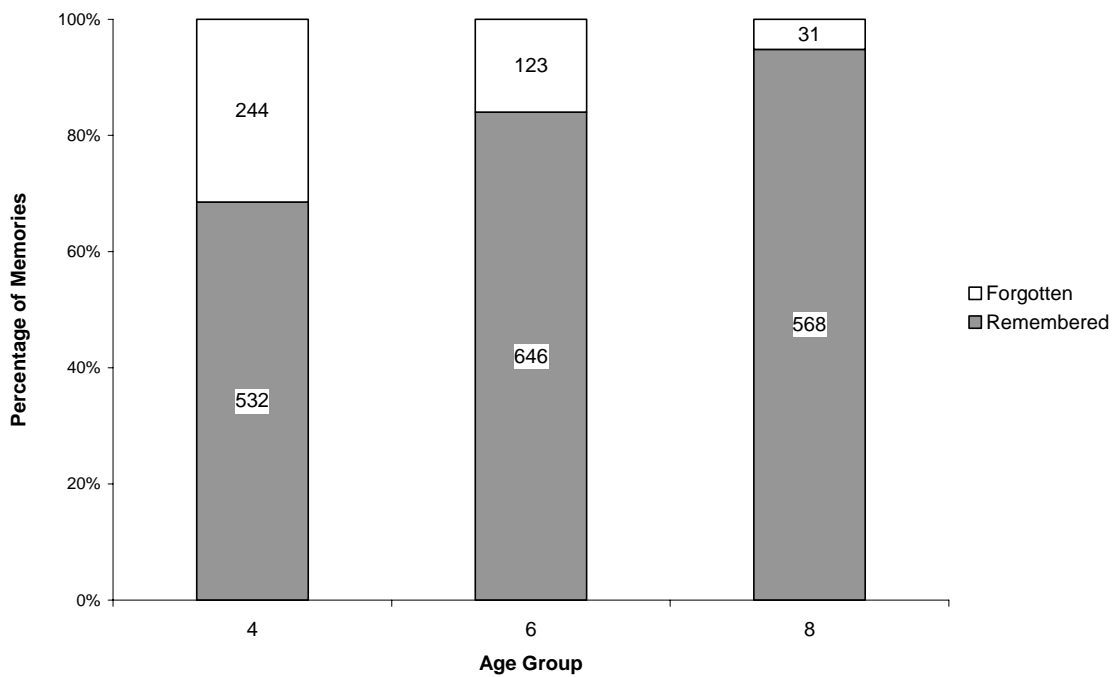


Figure 1

Percentage of memories that were remembered or forgotten by age group

*Results Addressing the Specifics Aims**Overview*

Although the data analysis for aim 1 used traditional multivariate statistical techniques, the analyses for aims 2 and 3 took advantage of multilevel modeling (MLM). MLM was most appropriate for the current data set because much of the data are nested within individual children (Raudenbush & Bryk, 2002). MLM allows partitioning of variability both between persons (i.e. age, verbal comprehension) and within persons (i.e. narrative characteristics). Further, MLM allows for the analyses of observations that are not fully independent. For example, in the current study, memories produced by the same child are likely more similar than memories produced by different children. Additionally, MLM allows for analysis of complete data, not just complete cases. Because many children did not give enough information to allow for the coding of the chronology dimension, but still received scores for the theme dimension, being able to analyze all the existing data was a plus for this study. In accordance with standards in the extant literature (Singer, 1998), all MLM analyses were 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).

One of the primary assumptions of traditional MLM is that the dependent variable is quantified on an interval scale. When the dependent variable is indeed measured on an interval scale, as was the case for chronology in the present study, it is plausible to assume linear models and normality at the most micro level of analysis (Raudenbush & Bryk, 2002). Thus, for analyses involving the outcome variable of chronology, traditional MLM was employed. However, the assumptions of linear models and

normality at the micro level become implausible when the outcome variable is measured on an ordinal scale, as was the case of theme in the present study. Thus, traditional MLM would be inappropriate for examining the theme dimension.

The solution to this problem was to employ logistic multilevel models to assess theme. An examination of the distribution of theme scores in the present data revealed that 96.2% of remembered memories were coded as a 1 or 2 on the ordinal scale described above (see Figure 2). This is an expected outcome considering the ages of the participants in this study. Therefore, for the purpose of achieving the aims of this study, theme was analyzed using a dichotomous low/high scale by combining the lower two levels (i.e., 0 and 1) and the higher two levels (i.e., 2 and 3) of the ordinal theme scale. Using this dichotomous scale resulted in only a 3.8% loss of the initial variance, confirming that this was an appropriate analytic strategy for the present sample. Thus, logistic multilevel models were used to assess theme, which is an appropriate method for analyzing dependent variables that are dichotomous in nature. 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). The results will be presented below in terms of each specific aim.

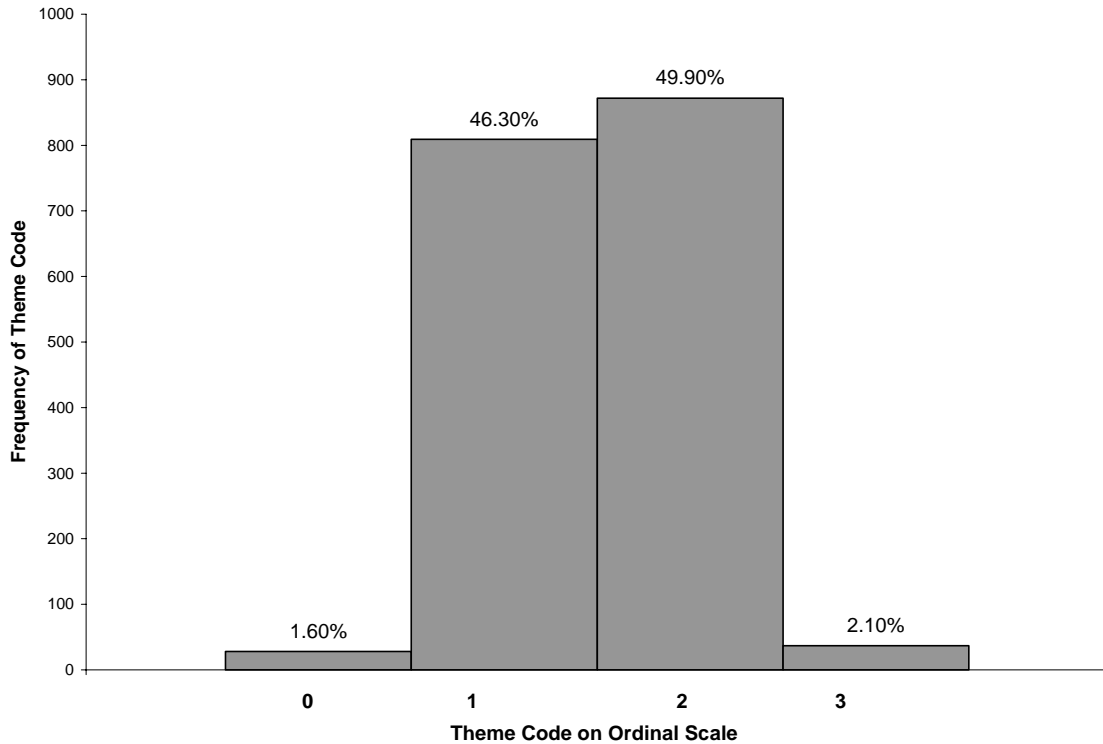


Figure 2

Frequency of levels of theme coded on the ordinal scale across all memories

Results addressing Aim 1

The first aim of this study was to describe the age-related differences in two dimensions of 4-8-year-old children's narrative coherence. Aim 1 was achieved by conducting a cross-sectional comparison of the theme and chronology dimensions of coherence in recent narratives from 4-, 6-, and 8-year-olds. An average score from each child's 8-12 codable recent narratives from only wave1 was calculated for both theme and chronology (see Figure 1 and Figure 2). Thus, although each child provided multiple memory narratives, the average scores were used so that each child contributed only one score for this analysis. As all of the events discussed were moderately positive events from the recent past, it was appropriate to combine the data from each child. Because

each child contributed only one score, independence of observations can be assumed. One 6-year-old child did not provide any narrative information that could be coded for coherence during wave 1 (although she did provide answers to some specific *Wh*-questions). Thus, this child did not contribute data for this particular analysis.

A multivariate analysis of variance (MANOVA) was used to determine age group differences in the two dimensions of coherence: chronology and theme. Omnibus results from this analysis revealed a significant main effect of age group, $F(4, 214) = 11.95, p < .01, \eta^2 = 0.33$. Follow up univariate ANOVAs confirmed that the three age groups did significantly vary across means for both the chronology ($F(2, 108) = 24.26, p < .01, \eta^2 = 0.31$) and theme ($F(2, 108) = 9.11, p < .01, \eta^2 = 0.14$) dimensions of coherence.

In support of hypothesis 1A, a planned difference contrast confirmed that chronology scores of the 8-year-olds were significantly different than the overall mean of those of the 4- and 6-year olds ($p < .01$). Further examination of the effect of age group on chronology using Bonferroni's post hoc test revealed that the 4-year-old group and the 6-year-old group did not significantly differ in their mean level of chronology ($p = .06$), whereas the 8-year-old group had a significantly higher mean level of chronology than both the 4-year-old group ($p < .01$) and the 6-year-old group ($p < .01$) (see Figure 3).

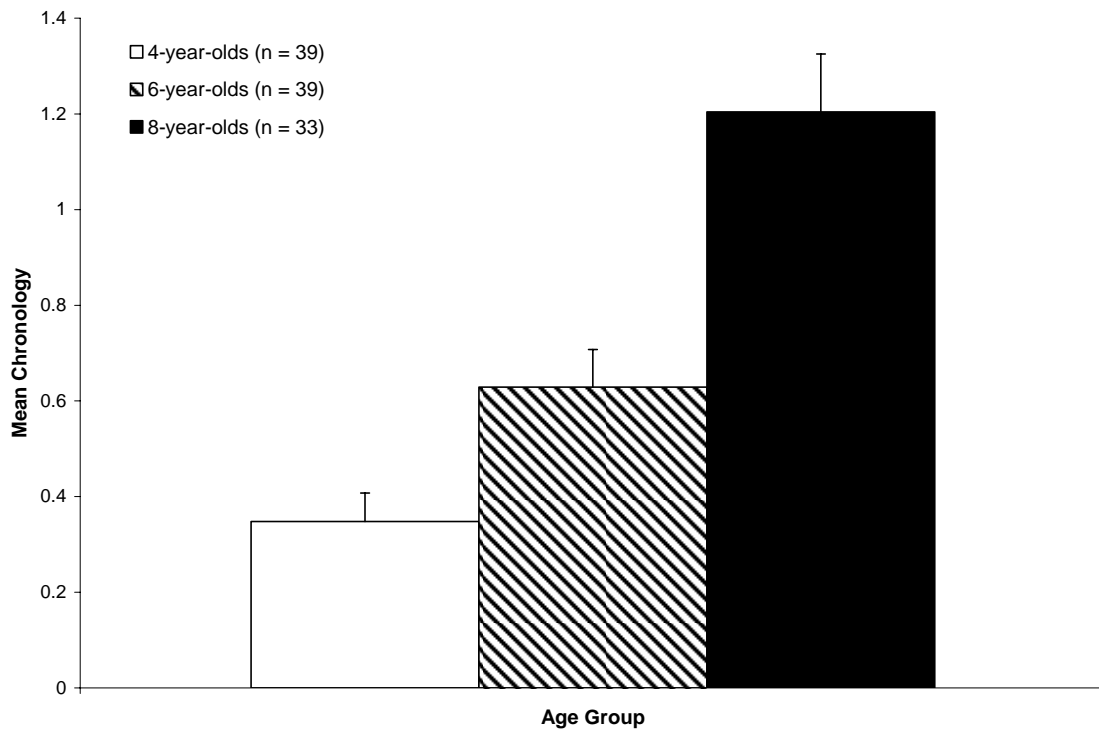


Figure 3

Mean levels of chronology in recent memories for 4-, 6-, and 8-year-olds

A similar pattern of age group differences was found for the theme dimension. Bonferroni's post hoc test demonstrated that the 4-year-old group and the 6-year-old group did not significantly differ in their mean level of theme ($p = 1.00$), whereas the 8-year-old group had a significantly higher mean level of chronology than both the 4-year-old group ($p < .01$) and the 6-year-old group ($p < .01$) (see Figure 4).

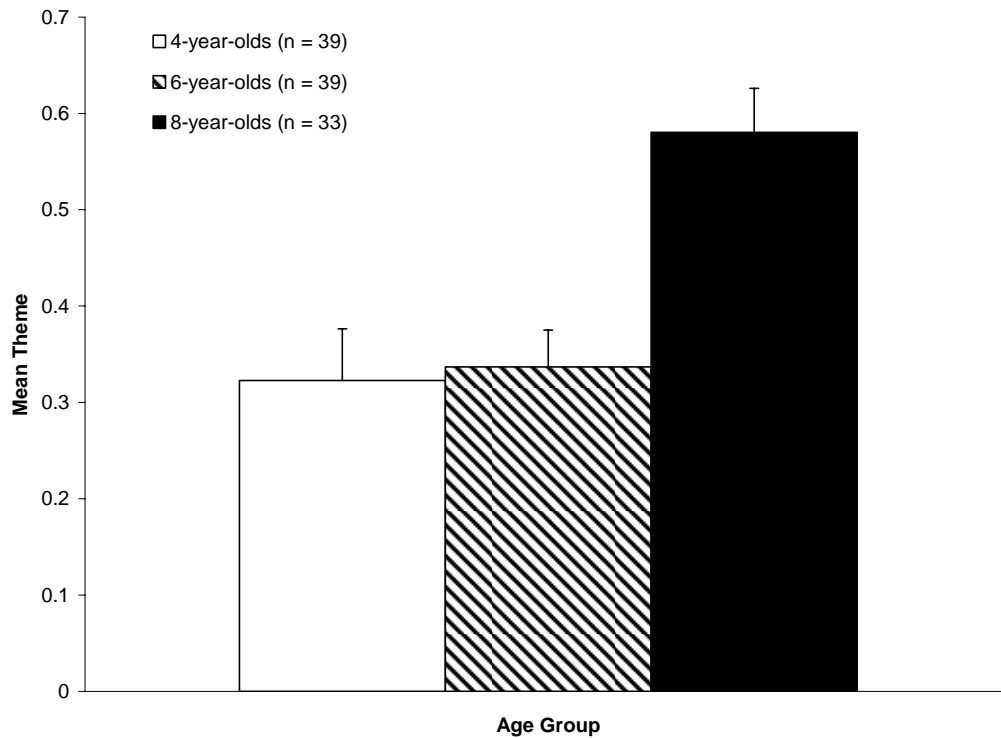


Figure 4

Mean levels of theme in recent memories for 4-, 6-, and 8-year-olds

Results addressing Aim 2

The second aim of the present investigation was to examine the influences of age, memory breadth, and level of verbal comprehension on two dimensions of children's narrative coherence in recent memories. Two exploratory analyses were conducted to determine if age, breadth, and verbal comprehension did indeed influence the (a) chronology and (b) theme dimensions of coherence. Based on the studies reviewed above, it was possible that verbal comprehension may have exerted a stronger influence on the narrative coherence of the younger than the older children. Therefore, an Age X Verbal comprehension term was included in the models. Analyses involving chronology will be presented first, followed by results examining theme.

Chronology. As in the analysis for aim 1, only the narratives for recent memories (data from wave 1) were considered. However, MLM was used for this analysis because each of 6-9 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).

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). Results from this analysis indicated that 15% of the variability in chronology scores was between people ($\tau_{00} = 0.21$, $z = 4.07$, $p < .001$) and 85% was within people ($\sigma^2 = 1.20$, $z = 18.88$, $p < .001$). Therefore, the fully unconditional model indicated that there was sufficient variability for further analyses of the chronology dimension.

In the next step, age, breadth, verbal comprehension scores, and an Age X Verbal Comprehension score interaction term were used to predict the chronology scores at wave 1 only. In other words, this model addressed the within-person association between memory breadth and the chronology of that memory, controlling for between-person differences in age and verbal comprehension and also addressed the Age X Verbal interaction. The equations for this model are as follows (Model 1):

$$\text{Level 1: CHRONOLOGY } T_{1ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{AGE}) + \gamma_{02}(\text{VERBAL}) + \gamma_{03}(\text{AGE*VERBAL}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

where

CHRONOLOGY T1 = chronology score of each memory at wave 1 (range 0-3)

BREADTH = breadth for each memory (a percentage expressed in terms of a fraction, range 0-1)

AGE = child's age in years at wave 1

VERBAL = WJIII verbal comprehension score (*W* score)

In Level 1, the intercept, β_{0ij} is defined as the expected level of chronology for memory *j* of person *i*. The slope, β_{1ij} , is the expected change in chronology associated with breadth. The error term, r_{ij} , represents a unique effect associated with person *i* (i.e. how much an individual fluctuates in chronology over multiple memories). The individual intercepts (β_{0i}) and slopes (β_{1i}) become the outcome variables in the Level 2 equations, where the average chronology level for the entire sample (i.e. the grand mean) is represented by γ_{00} . The extent to which people vary from the sample average of chronology is represented by u_{0i} . γ_{10} represents the average change in chronology over multiple memories when breadth = 0, whereas u_{1i} represents participants' interindividual variability in the slope characterizing the relationship between breadth and chronology. Further, γ_{01} represents the age differences in chronology, above and beyond the effects of breadth. γ_{02} corresponds to the effects of verbal comprehension on chronology, above and beyond breadth. Finally, γ_{03} represents the influences of the Age X Verbal comprehension interaction on chronology, which was included to account for the possibility that the predictive value of verbal comprehension differed by age.

Results from the model above indicated that breadth was not significantly related to chronology (see Model 1 of Table 3) when examining average trends in the sample. Further, neither age nor verbal comprehension affected chronology scores for recent memories. The Age x Verbal comprehension interaction also had no influences on chronology. Thus, it seems that none of the expected influences on chronology scores had an effect. In spite of this, this model accounted for 81% of the between person variance and 0% of the within person variance. Perhaps this is due to the significant amount of within-person fluctuation in chronology. One further consideration could explain these null findings. It is expected that age would be highly correlated with the independent variables in this model, and this may introduce problems of multicollinearity. Indeed, results indicated that age is significantly and strongly correlated with verbal comprehension scores, and moderately correlated with breadth (see Table 4). Age may be a marker for changes in breadth and vocabulary, but the changes in breadth and vocabulary may be the true mechanisms that affect developmental change in coherence. Thus, a second model was conducted to examine influences on narrative chronology, with age removed from the model (Model 2):

$$\text{Level 1: CHRONOLOGY } T_{1ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{VERBAL}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

The results from Model 2 still indicated that breadth was not significantly related to chronology (see Model 2 of Table 3) when examining average trends in the sample. Importantly, verbal comprehension was found to have a significant positive effect on chronology scores for recent memories, such that children with better verbal

comprehension scores produced memory narratives that were higher in chronology. This model accounted for 59% of the between person variance and 0% of the within person variance.

Table 3

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Chronology in Recent Memories

Fixed Effects	Model 1	Model 2
Level of Chronology, β_0		
Intercept, γ_{00}	6.60 (6.57)	-6.67* (1.50)
Age, γ_{01}	-1.87 (1.12)	-
Verbal Comprehension, γ_{02}	-0.01 (0.01)	0.01* (0.00)
Age X Verbal Comprehension, γ_{03}	-0.00 (0.00)	-
Breadth Slope, β_1		
Intercept, γ_{10}	0.31 (.22)	0.34 (0.22)
Random Effects		
Between-person variability in level of chronology (τ_{00})	0.04 (0.18)	.09 (0.18)
Between-person variability around breadth slope (τ_{11})	0.13 (.44)	0.9 (0.47)
Within-person fluctuation in chronology (σ^2)	1.21* (0.07)	1.21* (0.07)

Note: $n = 98$ participants, 709 memories; * $p < .0001$

Table 4

Correlations between age, breadth, and verbal comprehension

	1.	2.	3.
1. Age	-	0.40*	0.83*
2. Breadth	-	-	0.45*
3. Verbal Comprehension	-	-	-

Note: * $p < .0001$

Theme. As in the analysis examining chronology described above, only the narratives for recent memories (data from wave 1) were considered when examining theme. Although the models that were tested for theme are conceptually similar to the models examined when considering chronology, logistical MLM was used for this analysis because theme is a dichotomous outcome measure (low or high). Thus, results are expressed in terms of odds ratios. For example, for memories that children remember with 100% breadth, what are the odds that their memory narrative will be high in theme? Again, each of 6-9 recent memories were nested within each child, resulting in variables at both the level of the memory (level 1) and the level of the child (level 2).

When using logistic MLM, it is also 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). Results from the fully unconditional model indicated that 65% of the variability in chronology scores was between people ($\tau_{00} = 1.56$) and 35% was within people ($\sigma^2 = 0.85$). Therefore, the fully unconditional model indicated that there was sufficient variability for further analyses of the theme dimension.

Similar to the analysis for chronology above, age, breadth, verbal comprehension scores, and an Age X Verbal Comprehension score interaction term were first used to predict the theme scores at wave 1 only. The equations for this model were as follows (Model 1):

$$\text{Level 1: THEME T1}_{ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{AGE}) + \gamma_{02}(\text{VERBAL}) + \gamma_{03}(\text{AGE*VERBAL}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

where the only change to the model from the previous equations is

THEME T1 = dichotomous theme score of each memory at wave 1 (range 0-1)

The results from Model 1 are presented in Table 5. As seen in the table, memories for which children can provide all the breadth information (who, when, where, why, and how) are over 4 times as likely to be narrated with high breadth than memories for which children do not provide any breadth information. Further, there was a non-significant trend such that older children were slightly more likely to provide narratives that are higher in theme. Calculating the amount of variance explained by this model using the same method as for the chronology MLM models produced negative estimates for R^2 . Thus, the method proposed by Snijders and Boskers (2003) was used to estimate the amount of variance explained in the logistic multilevel model. This method requires that the slope is constrained to make the R^2_{between} estimate, which produced new estimates for the random effects ($\tau_{00} = 1.12$, $\sigma^2 = 0.87$). It was found that 27% of the between person variance was accounted for in Model 1. However, a negative value (-13%) was still estimated for R^2_{within} , indicating that there may be chance fluctuation in the model, or that there is some model misspecification.

A second model was conducted to investigate the influences of breadth and verbal comprehension on theme in the absence of age, since age has been determined to present a problem of multicollinearity (see Table 4). Thus, the equations for this model were as follows (Model 2):

$$\text{Level 1: THEME } T_{1ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{VERBAL}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

The results from Model 2 confirmed the finding from Model 1: Memories for which children can provide all the breadth information (who, when, where, why, and how) are over 4 times as likely to be narrated with high theme than memories for which children do not provide any breadth information (see Model 2 of Table 6). Interestingly, there was a significant effect such that with each one point increase of children's verbal comprehension scores, they are 2% more likely to provide narratives that are high in theme. This model suggests that both the underlying memory representation and children's verbal ability influence the theme dimension of narrative coherence. The Snijders and Boskers (2003) method was again used to estimate the amount of variance explained in the logistic multilevel model. The new estimates for the random effects when the slope was constrained to make the R^2_{between} estimate were $\tau_{00} = 1.17$ and $\sigma^2 = 0.86$. It was found that 24% of the between person variance was accounted for in Model 2. However, a negative value (-27%) was still estimated for R^2_{within} , indicating that there also may be chance fluctuation in this model, or that there is some model misspecification.

Table 5

Odds Ratios of Fixed Effects and Random Effects in Multilevel Model of Theme in Recent Memories

Fixed Effects	Model 1	Model 2
Level of Theme, β_0		
Intercept, γ_{00}	231548520	0.00
Age, γ_{01}	0.01*	-
Verbal Comprehension, γ_{02}	0.96	1.02**
Age X Verbal Comprehension, γ_{03}	1.01*	-
Breadth Slope, β_1		
Intercept, γ_{10}	4.14**	4.37**
Random Effects		
Between-person variability in level of theme (τ_{00})	1.85	2.23
Between-person variability around breadth slope (τ_{11})	0.92	1.31
Within-person fluctuation in theme (σ^2)	0.86	0.85

Note: $n = 98$ participants, 761 memories; * $p < .10$, ** $p < .05$. Intercepts cannot be interpreted in these models.

In sum, results have indicated that the theme dimension, but not the chronology dimension, of narratives about recent memories told by 4-to 8-year-old children was influenced by breadth, an indicator of the underlying memory representation. Both the chronology and theme dimensions were influenced by children verbal comprehension.

Results addressing Aim 3

The final aim that guided the current research was to examine whether two dimensions of children's narrative coherence for a distant memory depended on a child's initial breadth and coherence of the memory and/or the child's narrative ability at time of retrieval. This aim was achieved by conducting two exploratory analyses to determine the influences of the initial breadth and coherence of a memory, as well as a child's current reporting ability, on the (a) chronology and (b) theme dimension of coherence in children's distant memory narratives. Cross level interactions between breadth and reporting ability were also examined to test for the possibility that a child's current reporting ability influenced the within-person relationship between initial breadth and coherence. As in the previous section, analyses involving chronology will be presented first, followed by results examining theme.

Chronology. Children's memories for events that transpired over a year in the past were considered in this set of analyses, meaning these analyses used data from 333 possible memories. Of these memories, 251 (76%) were remembered (see Table 2). MLM was again used because each of 2-4 distant 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). Similar to the methods undertaken for Aim 2, a preliminary analysis using a fully unconditional model was used to verify that there was sufficient variability at Level 1 and Level 2 in the dependent variable to warrant further analyses. For these distant memories, 26% of the variability in chronology scores was between people ($\tau_{00} = 0.33$, $z = 3.06$, $p = .001$) and 74% was within people ($\sigma^2 = 0.92$, $z = 8.49$, $p < .001$).

The first model in this exploratory analysis was constructed based on the ideas discussed above. The equations for the model are as follows (Model 1):

$$\text{Level 1: CHRONOLGY T1}'_{ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{CHRONOLGY T1}) + \Gamma_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{REPORT T2}) + u_{1i}$$

$$\beta_{2i} = \gamma_{20} + u_{2i}$$

where

CHRONOLGY T1' = chronology coherence score of distant memories at wave 2

BREADTH T1= breadth for each memory at time 1, (0-1)

CHRONOLGY T1= chronology coherence score of memories at wave 1

AGE T2= child's age in years at wave 2

REPORT T2 = child's current reporting capacity at wave 2, (maximum chronology score earned when describing recent memories at time 2)

Similar to the equations used in aim 2, in Level 1, the intercept, β_{0ij} is defined as the person-level mean of chronology for a distant memory when both breadth and chronology at wave 1 are 0. The first slope, β_{1ij} , is the within-person relationship between initial breadth and chronology for a distant memory. The second slope, β_{2ij} , is the stability or change of chronology over one year (from wave 1 (T1) to wave 2 (T1')). The error term, Γ_{ij} , represents a unique effect associated with person i (i.e. how much an individual fluctuates in chronology over multiple memories). The individual intercepts (β_{0i}) and slopes (β_1 and β_2) become the outcome variables in the Level 2 equations, where the average chronology of distant memories for the entire sample (i.e. the grand mean), is

represented by γ_{00} . γ_{10} represents the average change in chronology of distant memories when breadth and initial chronology = 0. The extent to which people vary from the sample average of chronology is represented by u_{0i} . In addition, γ_{01} represents the effects of current reporting ability on chronology of a distant memory, above and beyond the effects of breadth and initial chronology. γ_{02} represents the influence of age on chronology to distant memories, above and beyond breadth and initial chronology. γ_{11} represents the cross-level interaction, meaning the effects of current reporting ability on the relationship between initial breadth and chronology to a distant memory. γ_{20} indicates the relationship between the initial chronology of a memory at wave 1 and the chronology of a memory one year later at wave 2. Lastly, the interindividual variability in each slope is represented by u_{1i} and u_{2i} .

Model 1 failed to converge, likely due to the complexity of the model. A typical solution when MLM models do not converge is to constrain the slopes to be equal across persons (Raudenbush & Bryk, 2002; Neupert, 2003). Thus, model 2 was identical to model 1, except that u_{1i} and u_{2i} have been removed to constrain the slopes. The equations for the model 2 are below (Model 2):

$$\text{Level 1: } \text{CHRONOLOGY T1}'_{ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{CHRONOLOGY T1}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{REPORT T2})$$

$$\beta_{2i} = \gamma_{20}$$

Model 2 did converge, and indeed accounted for 17% of the between person variance and 5% of the within person variance in chronology scores of distant memories. However, this model produced no significant fixed effects (see Model 2 of Table 6). Therefore, it was necessary to create a simpler, better-fitting model. Model 3 was identical to model 2 except that the cross level interaction between breadth and reporting ability was removed. The equations for this model are below (Model 3):

$$\text{Level 1: CHRONOLOGY T1}_{ij}' = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{CHRONOLOGY T1}) + \epsilon_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10}$$

$$\beta_{2i} = \gamma_{20}$$

The results from model 3 indicated that children with higher levels of current reporting ability tended to report distant memories with higher levels of chronology, even when accounting for the initial levels of chronology and breadth of that distant memory (see Model 3 of Table 6). However, the initial breadth of a memory had no effect on T1' chronology scores, suggesting that the underlying memory representation may not be reflected in the child's chronology of distant memories. Model 3 was able to account for 18% of the between person variance and 4% of the within person variance in chronology scores of distant memories.

Although Model 3 was able to provide a great deal of information, there were remaining questions about the validity of the measure of a child's current reporting ability. In Model 3, a child's current reporting ability was quantified as a child's highest chronology score of any recent memory discussed during wave 2. However, there is

concern that one high score could be a “fluke”, and falsely inflate this measure. Thus, in model 4, a child’s current reporting ability was quantified differently. In this model, it was quantified as a child’s most frequent (mode) chronology score of all recent memories that were remembered during wave 2. Therefore, the equations for model 4 were the same as those for model 3. However, the measure used to quantify REPORT T2 was changed.

The pattern of findings from model 4 was similar to that of model 3 (see Model 4 of Table 6). The results from model 4, like model 3, indicated that children report distant memories with higher levels of chronology when they have higher levels of current reporting ability, even when accounting for the initial levels of chronology and breadth when reporting that memory. Importantly, the same finding occurred with two different methods of quantifying a child’s current reporting ability. Model 4 accounted for 60% of the between person variance, but only 2% of the within person variance in chronology scores of distant memories.

Table 6

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Chronology in Distant Memories

Fixed Effects	Model 2 _a	Model 3	Model 4
Level of Chronology in Distant Memories, β_0			
Intercept, γ_{00}	-0.27 (0.68)	-0.68 (0.44)	-0.09 (0.40)
Current Reporting Ability, γ_{01}	0.15 (0.25)	0.33** (0.09) _b	0.48*** (0.08) _c
Age, γ_{02}	0.08 (0.06)	0.08 (0.06)	0.07 (0.06)
Initial Breadth Slope, β_1			
Intercept, γ_{10}	-0.67 (0.89)	-0.02 (0.37)	0.09 (0.35)
Current Reporting Ability, γ_{11}	0.28 (0.35)	-	-
Initial Chronology Slope, β_1			
Intercept, γ_{10}	0.06 (0.06)	0.06 (0.06)	0.04 (0.06)
Random Effects			
Chronology level (τ_{00})	0.28** (0.11)	0.27** (0.11)	0.13 (0.10)
Within-person fluctuation (σ^2)	0.88*** (0.11)	0.88*** (0.11)	0.90*** (0.12)

Note: $n = 105$ participants, 205 memories; * $p < .05$, ** $p < .01$, *** $p < .001$; _a Model 1 failed to converge and is thus absent from this table, _b = quantified as maximum chronology score during wave 2, _c = quantified as the mode of chronology scores during wave 2

Theme. As in the analysis examining chronology described above, only the narratives for distant memories (data from wave 1) were considered when examining theme. Although the models that were tested for theme are conceptually similar to the models examined when considering chronology, logistical MLM was used for this analysis because theme is a dichotomous outcome measure (low or high). Results from the fully unconditional model indicated that 68% of the variability in chronology scores was between people ($\tau_{00} = 1.66$) and 32% was within people ($\sigma^2 = 0.76$). Therefore, the fully unconditional model indicated that there was sufficient variability for further analyses. Thus, the four models used to assess chronology were used to assess theme, only where

THEME T1' = theme coherence score of distant memories at wave 2 (0-1).

The equations for Model 1 were:

$$\text{Level 1: THEME T1}'_{ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{THEME T1}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{REPORT T2}) + u_{1i}$$

$$\beta_{2i} = \gamma_{20} + u_{2i}$$

The equations for Model 2, where both slopes were constrained, were:

$$\text{Level 1: THEME T1}'_{ij} = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{THEME T1}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{REPORT T2})$$

$$\beta_{2i} = \gamma_{20}$$

The equations for Model 3 and Model 4, where the cross level interaction between breadth and reporting ability was removed for parsimony, were:

$$\text{Level 1: THEME T1}_{ij}' = \beta_{0ij} + \beta_{1ij}(\text{BREADTH T1}) + \beta_{2ij}(\text{THEME T1}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{REPORT T2}) + \gamma_{02}(\text{AGE T2}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10}$$

$$\beta_{2i} = \gamma_{20}$$

Note that in Model 3, REPORT T2= child's maximum theme score earned for recent memories during wave 2. In Model 4, REPORT T2= child's most frequent (mode) theme score earned for recent memories during wave 2.

Models 1, 2, and 3 all failed to converge. However, Model 4 indicated that children who most frequently report recent memories using narratives that are high in theme are almost 8 times as likely to report their distant memories using narratives that are high in theme than children who do not frequently report current memories with high theme (see Table 7). According to the Snijders and Boskers (2003) method, 26% of the between person variance and 21% of the within person variance was accounted for by Model 4.

Table 7

Odds Ratios of Fixed Effects and Random Effects in Multilevel Model of Theme in Distant Memories

Fixed Effects	Model 4 _a
Level of Theme in Distant Memories, β_0	
Intercept, γ_{00}	0.15*
Current Reporting Ability, γ_{01}	7.91**
Age, γ_{02}	1.15
Initial Breadth Slope, β_1	
Intercept, γ_{10}	0.56
Initial Theme Slope, β_2	
Intercept, γ_{20}	1.26
Random Effects	
Between-person variability in level of theme (τ_{00})	1.15
Within-person fluctuation in theme (σ^2)	0.76

Note: $n = 106$ participants, 224 memories; * $p < .05$, ** $p < .0001$; _a Models 1, 2, and 3 failed to converge

Overall, results indicated that both the chronology and theme dimensions of narrative coherence in children's distant memories were influenced by a child's current reporting ability, but were no longer affected by the initial breadth of that memory. Thus, coherence for memories of the distant past may no longer reflect the initial underlying memory representation.

Additional Analyses

All of the analyses reported above examined the dimensions of theme and chronology separately. However, questions still remain about the relationship between the two dimensions. Thus, MLM was used to assess the influences of theme on chronology scores in recent memories only (Model 1), distant memories only (Model 2), and in all memories reported in this study (Model 3) using the following equations:

$$\text{Level 1: CHRONOLOGY}_{ij} = \beta_{0ij} + \beta_{1ij}(\text{THEME}) + r_{ij}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + u_{1i}$$

Similar to the MLM analyses described above, the intercept, β_{0ij} is defined as the person-level mean of chronology for a memory when theme is 0. The slope, β_{1ij} , is the within-person relationship between theme and chronology for a memory. The level 1 error term, r_{ij} , represents a unique effect associated with person i (i.e. how much an individual fluctuates in chronology over multiple memories). The individual intercepts (β_{0i}) and slope (β_{1i}) become the outcome variables in the Level 2 equations, where the average chronology of memories for the entire sample (i.e. the grand mean), is represented by γ_{00} . γ_{10} represents the influence of theme on the chronology of memories. The extent to which people vary from the sample average of chronology is represented by u_{0i} . Lastly, the interindividual variability in the relationship between chronology and theme is represented by u_{1i} .

Fully unconditional models were used to verify that there was sufficient variability at Level 1 and Level 2 in the dependent variable to warrant the further analyses of Model 1,

Model 2, and Model 3. For the recent memories to be further explored in Model 1, 15% of the variability in chronology scores was between people ($\tau_{00} = 0.21, z = 4.07, p < .001$) and 85% was within people ($\sigma^2 = 1.20, z = 18.88, p < .001$). For the distant memories to be further explored in Model 2, 26% of the variability in chronology scores was between people ($\tau_{00} = 0.33, z = 3.06, p = .001$) and 74% was within people ($\sigma^2 = 0.92, z = 8.49, p < .001$). Finally, for all memories to be further explored in Model 3, 15% of the variability in chronology scores was between people ($\tau_{00} = 0.20, z = 5.25, p < .001$) and 85% was within people ($\sigma^2 = 1.17, z = 27.66, p < .001$). Thus, there was significant variability to continue.

All three models indicated that theme scores significantly accounted for variance in chronology scores (see Table 8). However, the amount of within-person variance explained by the models was small. Specifically, Models 1 and 2 each accounted for 4% of the within-person variance in chronology scores, and Model 3 accounted for only 2% of the within-person variance in chronology scores in all memories in this study. Therefore, there appears to be some degree of relatedness between the two dimensions of theme and chronology in children's narratives for both recent and distant memories. However, there is not a perfect overlap between the two dimensions.

Table 8

Unstandardized Coefficients (and Standard Errors) of Multilevel Models of Chronology predicted by Theme

Fixed Effects	Model 1 ^a (Recent Memories)	Model 2 ^b (Distant Memories)	Model 3 ^c (All Memories)
Level of Chronology, β_0			
Intercept, γ_{00}	0.58 ** (0.06)	0.39** (0.09)	0.54** (0.05)
Theme Slope, β_1			
Intercept, γ_{10}	0.38** (0.10)	0.50* (0.15)	0.38** (0.07)
Random Effects			
Between-person variability in level of chronology (τ_{00})	0.08* (0.04)	0.00(0)	0.06* (0.03)
Between-person variability around theme slope (τ_{11})	0.29* (0.11)	0.56* (0.18)	0.16* (0.06)
Within-person fluctuation in chronology (σ^2)	1.15** (0.06)	0.88**(0.10)	1.14** (0.04)

Notes: ^aRecent memories only from wave 1, $n = 111$ participants, 818 memories; ^bDistant memories only from waves 2, $n = 107$ participants, 236 memories; ^cAll memories from both waves, $n = 112$ participants, 1640 memories;

** $p < .001$, * $p < .05$

Summary of Results

In review, the analyses described above provided support for hypotheses 1A and 1B; as predicted, 8-year-olds produced memory narratives that were significantly higher in both the theme and chronology dimensions of coherence than 4- and 6-year-olds. Moreover, the exploratory MLM analyses used to address the second and third aims of this investigation yielded significant findings. Notably, verbal comprehension scores related positively to both theme and chronology in children's narratives of recent events, but only the theme dimension was affected by memory breadth. A different pattern of influences on coherence was revealed in children's narratives of distant events: a child's current reporting ability was found to be a significant influence on theme and chronology, but the initial breadth of the memory did not affect levels of theme and chronology.

Discussion

This investigation examined the influences of age, verbal comprehension skills, breadth, and narrative ability on two dimensions of children's narrative coherence for recent and distant autobiographical memories. Three major findings emerged from this study. First, as expected, cross-sectional analyses revealed that 8-year-olds, in comparison with 4- and 6-year-old children, produced memory narratives that were significantly higher in both the theme and chronology dimensions of coherence. Secondly, more sophisticated analyses of children's recent memories indicated that verbal comprehension scores related positively to both theme and chronology, but only the theme dimension was affected by memory breadth. That is, the breadth of a particular memory, which is arguably a proxy for the underlying memory representation, was reflected only in the theme dimension of coherence such that higher levels of breadth corresponded to higher levels of theme. There was no relationship between the underlying memory representation and the chronology dimension for recent memories. Importantly, a different pattern of influences was found when examining the coherence of children's distant rather than their recent memories, leading to the last major finding of this study: A child's current reporting ability was a significant influence on the theme and chronology of children's narratives of events that transpired over a year in the past, but these dimensions of coherence were no longer affected by the initial breadth of that memory. Thus, coherence in distant memories may no longer be reflecting the initial underlying memory representation. Overall, the results demonstrate that the influences on children's narrative coherence differ both between the theme and chronology dimensions and between recent versus distant memories. Each of the three major findings will be discussed in turn. Following that, both the limitations associated with breadth in

particular and the study overall will be presented. Finally, recommendations will be made to guide future research on children's coherence in memory narratives.

Age-Related Differences in Theme and Chronology

The first finding of this study demonstrated age-related differences in mean levels of theme and chronology for recent memories. The significantly higher levels of theme and chronology seen in 8-year-olds as compared to the younger 4- and 6-year-olds are not surprising. Indeed, the age-related increases in levels are consistent with findings from research conducted by Hudson and Shapiro (1991), who reported that 8-year-olds produced personal memory narratives with significantly more explicit temporal sequencing, explanations, and high points than did either 4- or 6-year-olds. Although some work by Fivush et al. (1995) reported an increase in use of evaluations in memory narratives from ages 4 to 5, results from the present study showed no significant difference in levels of theme and chronology between 4-year-olds and 6-year-olds. This discrepant finding may be attributable to the measurement of theme in the present study, in which theme was operationalized as a rating of how well the events in a particular narrative were described, elaborated, evaluated, causally-linked, and related to other autobiographical memories or to the self. Thus, evaluation, as measured by Fivush et al. (1995), was only one component of a total theme score in the present research. Further, the mean levels of theme and chronology found in this study were similar to findings from studies that have actually employed the same coding scheme, NaCCS. A comparison of several different memory investigations using the NaCCS across multiple laboratories to be presented at an upcoming conference showed that the 4- to 8-year-olds in the present study were generating memory narratives with similar means as is being found in other studies (Fivush, 2007). Overall, reports from

the present study suggest a developmental shift in theme and chronology between the ages of 6 and 8. These ages are concurrent with the Piagetian shift from the preoperational to concrete operational stage, meaning children are less egocentric (Piaget, 1969/1928). Thus, 8-year-olds may be able to take into account the perspective of a naïve listener, and therefore realize they need to provide more theme and chronology information than younger children.

This description of the developmental trajectory of theme and chronology is a good starting point for understanding coherence as a construct, but it is important to explore the mechanisms that drive the suggested developmental changes. One source of the developmental shift may be the disappearance of childhood egocentrism, as discussed above. However, the present study suggests that there may be other mechanisms influencing developmental increases in coherence. Thus, we turn to the second major finding of this study: Levels of verbal comprehension and memory breadth (which both tend to increase with age) influence some dimensions of coherence, at least for recent memory narratives.

Coherence in Children's Recent Memory Narratives

In recent memories, theme was influenced by a child's verbal comprehension and by memory breadth. Assuming that breadth is a proxy for the underlying memory representation as previously argued, theme appears to be reflecting aspects of both the underlying memory representation and a child's verbal skills. However, the chronology of recent memories was not influenced by memory breadth, suggesting that chronology may be a better indication of how well a child can tell a story rather than how well a child remembers a particular event. These important findings should be taken into account by researchers who are interested in using coherence as a predictor variable for other outcomes. For example, several researchers have postulated that coherence should predict long-term remembering

(Fivush, Haden & Adam, 1995; Peterson & Biggs, 1998). However, this theoretical perspective presumes that coherence is a reflection of the organization of the underlying memory representation. The present findings suggest that the theorized relationship between coherence and long-term remembering should be refined such that the theme of a recent memory, but not necessarily chronology, would be expected to predict long-term remembering.

It was interesting that age did not have a significant effect on children's coherence for recent memories, especially since cross-sectional analyses demonstrated age group difference in both the theme and chronology dimensions. However, in the MLM analyses, age was competing against several other variables (i.e., verbal comprehension scores, Age x Verbal comprehension scores, and breadth) to account for the variance in theme and chronology scores. All of these other variables were significantly related to age, meaning these variables were not independent. It is likely that breadth and verbal comprehension have a more proximal influence on coherence than age per se. Thus, although age may be a marker for changes in breadth and vocabulary, the changes in breadth and vocabulary may be the true mechanisms that affect developmental change in coherence.

Furthermore, because there are different influences on the alternative dimensions of coherence for recent events, it is even more important for researchers to use a multidimensional scale rather than a simpler unidimensional assessment. The use of a unidimensional assessment may mask relationships that would be evident when taking a more fine-grained approach.

It remains unclear whether the theme and chronology dimensions of coherence are truly independent. The creators of the NaCCS asserted that each of the three dimensions

(context, theme, and chronology), “is empirically independent, develops at different rates and relates differently to other measures of language and cognition” (Fivush, 2007, p.1). Results from the current investigation provide evidence that both supports and repudiates this assertion. In support of Fivush’s claim that theme and chronology are independent dimensions, the findings indicated a different pattern of influences on each dimension. Specifically, findings demonstrated that breadth influenced the theme dimension, but not the chronology dimension, in recent memories. In contrast, MLM analyses demonstrated that theme was able to account for a small, but significant portion of variance in chronology scores in both recent and distant memories (see Table 8). Thus, more work should be conducted before a firm conclusion can be drawn regarding the independence of the various dimensions of coherence in children’s memory narratives.

Coherence in Children’s Distant Memory Narratives

The final finding of this study is related to the influences on children’s narratives of distant memories. When examining the coherence of children’s reports of events that took place over a year in the past, the initial levels of breadth were not predictive. Because the measurement of the initial breadth of a memory occurred when the memory was still from the recent past (within 4 months), initial breadth may serve as a proxy for the underlying memory representation at encoding (Baker-Ward et al., 1993). Thus, the coherence of distant memories reported by 5- to 9-year-olds was not a reflection of the initial underlying memory representation; rather, it was purely a reflection of the child’s current ability to tell a good story. (Although it is possible that the underlying memory representation itself is changing, see discussion below). This finding also has important implications for researchers interested in coherence.

These findings suggest that if coherence (particularly theme) is indeed going to be used to predict long-term remembering of a particular event in young children, it should be measured soon after the event transpires. Results from this study suggest that the coherence of children's distant memories is no longer providing any information about the initial underlying memory. Changes in a child's narrative ability seem to overshadow the effects of the underlying memory as initially encoded. Perhaps once children reach a high level of verbal and narrative skills, coherence would be more indicative of underlying memory. Future studies should investigate these relationships in older children with more advanced narrative skills.

Breadth as a Proxy for Underlying Memory Representation

Although the interpretations of the results presented above are quite informative, they rest strongly on the assumption that breadth is a valid measure of a child's underlying memory representation for a particular event. Concerns about the measurement of breadth will be discussed below.

One possible problem with the measurement of breadth is that breadth may have been artificially inflated by reports of schematic, rather than mnemonic, information in response to the specific *wh*-questions. In fact, studies have shown that when children have well-established scripts due to repeated experience, they may confuse memory of a specific event with their memories for similar events, especially when the events are very similar (e.g. Powell & Thompson, 1996). Much research has indicated that as children get older and experience more events, they acquire more script information (Bauer & Fivush, 1992; Fivush, 1984). If the older children in the present study had more script-information in their repertoire than the younger children, older children may have relied on this to answer the *wh*-

questions used to assess breadth more frequently than younger children. This may have led to an overestimation of age-related increases in breadth. Alternatively, the younger children may have relied on scripts to answer questions to a greater degree than the older children in this study, who were able to distinguish their script-knowledge from their specific event memories (Hudson, 1986; Farrar & Boyer-Pennington, 1999). This may have led to an underestimation of age-related increases in breadth.

It should be noted, however, that attempts were made to prevent these possible errors in the measurement of breadth in the design of this study. Parents were instructed to nominate specific one-time events to reduce the likelihood that children were remembering repeated events for which they had existing script information. In spite of that, what may have been a unique event at during the first wave (e.g. first trip on an airplane), may have become a repeated event by the second wave (e.g. child goes on several more airplane trips). However, for the purposed of the present study, breadth was only assessed in memories reported at wave 1, when all memories were recent (occurring within the past 4 months). Further, evidence in the extant literature indicates that young children are able to rely on their episodic memories (rather than script knowledge) to answer open-ended questions about recent events (Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993). Specifically, Baker-Ward and her colleagues examined 3-, 5-, and 7-year-olds memories for a well check-up by their pediatrician after a delay of 1, 3, and 6-weeks. During the check-ups, some events that would be expected based on script knowledge of check-ups (i.e. getting an inoculation) did not occur. In subsequent recall in response to open-ended prompts, no child reported the occurrence of any of these expected-but-absent events suggesting that the children were not relying on their script knowledge. Thus, because in the current investigation breadth was

assessed in children's reports of recent events in response to non-leading *wh*-questions, it is probable that breadth is really assessing children's episodic memory, rather than script knowledge.

Another potential problem with the measurement of breadth is the possibility that the measure was falsely inflated through the provision of highly-probable answers that, although plausible, actually conveyed false information. For example, children in this study often answered the breadth question, "Who was there?" with Mommy and/or Daddy. While this is often true, children may have also used this answer in cases in which they were making a guess or it was not true. As we did not verify the veracity of the child's responses, all reasonable answers were accepted. Further, children may have attempted to answer a breadth question to satisfy the social demands of the situation, even if they did not have the mnemonic information requested in their memory of the event in question.

Careful interviewing and coding attempted to prevent these problems from occurring. Several aspects of the method are particularly relevant. The interviewers provided a warm atmosphere in which the child was told that it is okay to reply with "I don't remember." Interviewers also used only non-leading, open-ended questions and specific *wh*-prompts. Many studies have shown that young children are capable of providing detailed, accurate information in these neutral interviews containing many open-ended prompts (see Perona, Bottoms, & Sorenson, 2006 for a recent review; Sternberg, Lamb, Orbach, Esplin, & Mitchell, 2001; Bruck, Ceci, & Hembrooke, 1998). Thus, it is likely that false information was only very rarely provided by the children in this study. In coding, only information that provided actual information above and beyond what was mentioned by the interviewer was deemed correct. For example, if the interviewer asked the child about "Picture Day at

School”, the answer “at school” to *where* was not accepted, but “on the bleachers in the gym” was accepted. Further, empty answers such as “Because I wanted to” to *why* were not accepted. These coding conventions would clearly minimize the instances in which the measure of breadth would include lucky guesses or inferential processing. Therefore, it is most likely that the coding of breadth reflected accurate information from a child’s underlying memory representation.

Moreover, some breadth questions may not have had meaning in the context of a particular event. This problem may have led to an underestimation of breadth in the current study. For example, for the event “Birthday”, *why* has little meaning. This was a common event discussed in this study, and most children tended to answer “Why was it your birthday?” with either “I don’t know” or “because it was my birthday” neither of which provide any information. Thus, breadth may not be a pure proxy of the true underlying event representation. Further, breadth is only one possible aspect of the memory representation. Whereas breadth addresses the extent to which the traditional elements of a narrative are available (and presumably represented) in memory, the measure does not assess the organization of these components (Baker-Ward et. al, 1997). In summary, although I acknowledge that breadth is not a perfect measure, the measurement of breadth in this study was still useful in measuring the underlying memory representation. Breadth was measured from a different data source than was coherence, suggesting that these measures are likely tapping into the underlying memory representation in different ways. Additionally, breadth did produce significant variability and age-related changes in the current investigation. Furthermore, as pointed out by Baker-Ward, Ornstein, and Principe, “Given that a widely held conceptual analysis of remembering begins with the establishment of a representation

which is then used as the basis for subsequent recall, it seems justified to keep representation in the equation by the use of proxy measures, while, at the same time, searching for better indicators” (1997, p.83). The authors go on to suggest three alternative approaches to access an underlying memory representation: (a) exploring cues that elicit the memory, (b) examining information that interferes with memory performance, and (c) investigating experiences that can reinstate a memory (pp.89-91). These approaches should be considered for future studies examining children’s coherence.

Limitations of Current Study

In addition to the problems involving the measure of breadth, another limitation of the current study is the selection of event memories. In the present research, mothers selected the events for their child to remember. These events tended to be mostly moderately positive events, such as field trips and family outings. Although this is a standard practice in research on children’s memories (e.g. Fivush & Schwarzmuller, 1988; Van Abbema & Bauer 2005), it is unclear whether the events selected by a parent are significant and personally meaningful to the child (Bauer, in press). It may be that children have more coherent memories of events which are personally significant or are negatively valenced (see Fivush et al., 2003). However, the fact that over 80% of the parent-nominated memories in this study were recalled by the children suggests that these events were actually fairly memorable to the children.

One more possible limitation to the present investigation has to do with narrative coherence as a whole. Narrative coherence is comprised of three dimensions: context, chronology, and theme (Fivush, 2007). The current study was unable to test predictions about the context dimension of coherence. This dimension is particularly difficult to assess

in longitudinal research tracking specific memories through time, as contextual information is typically needed to cue a particular memory. Thus, the benefits of examining specific memories over time outweighed the loss of contextual information in the present study.

A final complication to consider in relation to the current research is the conceptualization of an underlying memory representation. This study suggested that the coherence of children's distant memories was not a reflection of the initial underlying memory representation. However, it may be that the underlying memory representation is actually changing over time (Marsh, 2007; Baker-Ward, Ornstein, & Principe, 1997; Fivush, Haden, & Adam, 1995). It is possible that children's narrative coherence of distant memories is actually influenced by the current state of the underlying representation, rather than the initial content of the representation. Changes in a child's memory representation of a particular event could occur for several reasons: (a) the representation may change over time as constructivist processes replace forgotten information, (b) the child may have been exposed to information that was misleading or suggestive after the event either through discussion or re-experiencing a similar event, or lastly, (c) the child may learn new information that is relevant to the original event (Baker-Ward, Ornstein, & Principe, 1997). The first of these processes has been demonstrated in preschool aged children. Myles-Worsley, Cromer, and Dodd (1986) found that as young children's memory for a particular day at preschool faded, they increasingly used their script knowledge of routines to construct their reports. Thus, in the present study, it is feasible that by the second wave, children's representation of distant events consisted partially of script information, as the original episodic information had faded over the year delay. Thus, the coherence of their narratives

to distant events was no longer reflecting the initial representation of the memory because aspects of the initial representation had faded away.

The second process leading to changes in memory representations, often termed the misinformation effect, has been demonstrated in both children and adults (for reviews, see Ceci & Bruck, 1993; Wright & Loftus, 1998). In cases of misinformation, incorrect information about a particular event overwrites the correct information. This is an unlikely scenario in the present study. In the present study, the events that were remembered and reported by children were parent-nominated events such as field trips, dentist visits, holidays, and birthday parties. It is improbable that any misinformation would be provided to the child about these innocuous events.

The final process that may lead to changes in memory representation over time is the augmentation of the original representation with new, relevant information. This information may be acquired through discussions or experiences. For example, suppose a child was asked to remember a family trip to the beach at wave 1 in the current investigation. Subsequently, the child viewed pictures of the beach trip in the family photo album while discussing the details of the trip with her mother. The new details provided by the mother while looking at the photos may be interwoven into the child's initial memory representation of the beach trip. Thus, at wave 2, the initial memory representation would have changed, possibly becoming higher in breadth. This could also occur if a child re-experiences an event. For example, if the child is asked to discuss a recent trip to the Mall of America at wave 1, and subsequently visits the mall again and on this visit, sees more of the mall, the new information may be added to the memory representation of the original visit. Attempts were made to prevent this from occurring by asking parents to nominate specific one-time events for their child to

remember. In all of the three cases of changes in memory representation described above, it is possible that the coherence of the distant memories would actually be predicted by the breadth of the memory at wave 2, which would be a measure of the current representation rather than the initial representation. This would be an interesting analysis for future studies.

Strengths of Current Study

Despite the limitations to the current investigation, it is worthwhile to revisit the many strengths of this study. First, this study used the NaCCS, meaning the results found here are directly comparable to all studies employing this same method. This study also examined coherence in memory narratives provided by 4-, 5-, 6-, 7-, 8-, and 9-year-olds. This age range is important because it includes both preschool and school-aged children in the same study. Thus, direct comparisons can be made amongst these ages. This is an advantage over the many studies that include only preschoolers (i.e. Fivush, Haden, and Adam, 1995) and the few that include school-aged children (i.e. Van Abbema, 2005). Further, this study involved the analysis of a large data set (2,144 memories collected from 112 children), resulting in more statistical power than any of the studies of children's coherence in the extant literature. Lastly, the design in the present study, which obtained multiple memories from each child over time, allowed for 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. 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. Further, MLM allowed for the disentangling of effects on coherence at the level of the memory and the level of the child.

Above and beyond the strengths of the study, the study was able to shed light on the elusive construct of coherence. Results indicate that the underlying memory representation is being reflected in children's narrative coherence for recent memory, but it is still unclear whether the same holds true for distant memories. Thus, more research needs to be conducted to further explore these findings. In fact, many avenues of future research can be recommended based on the findings discussed above. First, methodological suggestions for future research will be presented, followed by propositions for future studies.

Recommendations for Future Research

Three methodological recommendations can be derived from the current study. First, this study has provided initial evidence that the influences on coherence may be changing as a function of time since the event occurred and a child's current age. Thus, it is important for researchers to realize that when coherence is examined cross-sectionally for only recent memories, their findings these may not be indicative of what is actually occurring over time. Thus, the importance of future longitudinal studies is evident. Secondly, this study further demonstrated the independence of the dimensions of theme and chronology within narrative coherence. Memory researchers would be advised to use a multidimensional scale when examining coherence in the future. Lastly, the present investigation employed multilevel modeling (MLM), which is the most appropriate analytical technique when examining nested data. Most studies in the past have relied on regression techniques, and ignored the nested structure of memories within persons. Thus, MLM may better reveal the true relationship between the variables of interest when examining children's memories. Future studies should take advantage of MLM.

Current theories relating coherence to PTSD may need to be revised based on the findings of the present study. Specifically, the finding that breadth predicts theme, but not chronology, of recent memories has implications for the study of PTSD. Researchers interested in further exploring the relationship between narratives of recent traumas and coping outcomes should focus on the theme dimension, rather than the chronology dimension of coherence as theme may be a better indication of the true memory representation, and is thus more likely to affect the individual. Further, the pattern of influences on children's coherence for distant memories is also informative for those interested in PTSD. Although O'Kearney and his colleagues (in press) demonstrated a relationship between the qualities of a child's accident memory narrative and the PTSD symptoms after the event, these memories were only from 4-7 weeks in the past. Thus, these memories may have been a better reflection of the underlying memory representation than they would have if the accidents had occurred over a year in the past. The findings from the present study suggest, at least for young children talking about old memories, narrative coherence as operationalized through use of the NaCCS may not be able to predict PTSD symptoms. Thus, the interpretation of coherence in children's memory narratives must take into consideration the age of the memory.

The findings of this study also have implications for the theorized relationship between coherence and the long-term retention of childhood memories. As discussed above, it seems plausible that high levels of the theme dimension in recent event memories may lead to long-term remembering of the event in question. Further, it is possible that higher levels of coherence in recent memories may be reflecting a more consolidated memory, and that in turn may actually lead to more information being remembered at a later date (breadth) rather

than simply remaining a highly coherent memory. Longitudinal studies tracking the survival or disappearance of children's memories over time should be conducted to empirically test these hypotheses.

At a more specific level, discussion of the present findings suggests immediate directions for future investigations that would provide further exploration of the results. The current study showed that breadth influenced the theme dimension of coherence in children's recent memories. It would be informative to examine this relationship in more detail. For instance, is one particular aspect of breadth (such as knowing the *why* information) driving the association with coherence? Or, are all breadth elements equally influencing theme? Finally, as previously discussed, it is possible that children's narrative coherence of distant memories is actually influenced by the current state of the underlying representation, rather than the initial content of the representation. Thus, it would be interesting to explore the relationships between initial breadth and the breadth of the memory at subsequent time points, and to examine the relationship between breadth and coherence over time.

In all, the current study has illuminated the relations between children's narrative coherence and their verbal abilities, narrative skills, and underlying memory representations. These relationships have sparked the beginning of an exciting program of research.

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Appendices

Appendix A

Summary table of Peterson and McCabe's three types of analysis examining narrative structure in children's memory narratives (Peterson & McCabe, 1983, pp. 6-7)

<i>Analysis:</i>	<i>High Point</i>	<i>Episodic</i>	<i>Dependency</i>
Elements	Independent Clauses: Orientation Evaluation Complicating Actions Resolutions Appendages	Statements of Important Distinctions: Events Motivating States Attempts Consequences Reactions Settings Judgments Appendages Others: External states Internal states Actions Natural occurrences	Functional Syntactic Propositions: Most dominant propositions Level 2 propositions Subordinate propositions (Levels 3-9 in our data)
Bonds	Intersection of time line of discourse with time line of experience	Relations between Elements: Temporal Causal Relations between Stuc- tures in Multiple- Structure Narratives: Temporal Enable Causal Allow Repetition	Syntactic Dependency: Coordination Subordination
Structures (Generally from most to least complex, ideal structure is starred)	*Classic End-at-High-Point Leapfrog Impoverished Disoriented	Interactive Episode Complex Episode *Complete Episode Abbreviated Episode Action Sequence Descriptive Sequence	*Ideal Hierarchy Mixed Subordinate Sequence Mixed Coordinate Sequence Combination of Simple Subordinate with Simple Coordinate Sequence Simple Subordinate Sequence Simple Coordinate Sequence
Alternatives:	Chronology	Reactive Sequence	

Appendix B

Coherence coding scheme published by O’Keraney, Speyer & Kenardy (in press)

Global coherence ratings were given according to the following scale:

1. Disoriented pattern—The narrative is too confused or disoriented for the listener to understand.
2. Impoverished pattern—The narrative consists of too few sentences for any high point pattern to be recognized.
3. Chronological pattern—The narrative is a simple description of successive events.
4. Leap-frogging pattern—The narrative jumps from one event to another within an integrated experience, leaving out major events that must be inferred by the listener.
5. Ending-at-the-high-point pattern—The narrative builds up to a high point and then ends; there is no resolution.
6. Classic Pattern—The narrative builds to a high point, evaluatively dwells on it, and then resolves it.

Coherence ratings were also made on 3-point individual scales as follows:

Level of orientation. Certain clauses serve as orientation to the people, place(s), time(s) and ongoing behavior of the narrative. They set the stage for the narrated events. Narratives were rated in the following way:

0. The narrative includes no orientation comments or only minimal information such as one statement referring to the setting or context of the events.
1. The narrative provides enough orientation information to gain a general sense of who, when and where the events took place (or at least two of these pieces of information).

2. The narrative provides precise information about the time of day, location, people involved, general conditions, etc.

Sequence of events. Narratives were rated according to whether the events were narrated in chronological order or whether there was repetition or disorganization of the sequence.

0. The narrative contained no apparent sequence of events or the events appeared so disorganized that the order of events in the narrative was difficult to follow.
1. The narrative appeared to be structured in chronological order but there was some evidence of disorganization or repetition of events.
2. The events of the narrative were organized in chronological order.

Level of evaluation. Evaluation clauses are clauses that give the point of the narrative: why it was told or what to think about a person, place, thing, event or entire experience. Some examples include: explanations, judgments, exaggeration, emotional states, intentions and inferences.

0. The narrative contained none or very little evaluation and consisted mainly of facts or a series of actions.
1. The narrative contained some evaluative comments usually in the form of internal emotional states or intentions.
2. The narrative contained detailed evaluative comments telling the reader what to think about the event being narrated.

Appendix C

NARRATIVE COHERENCE CODING SCHEME (NaCCS)

(Reese & Haden, in preparation)

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

*Minor Modifications for Present Study

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)	
<i>Level</i>	<i>Description</i>
Level 0*	Narrative consists of a list of actions with minimal or no information about temporal order. (* 0-25% of events can be ordered)
Level 1*	Naïve listener can place some but not most (*defined as 25-50%) 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	
<i>Level</i>	<i>Description</i>
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	<u>All of the above are present.</u> The narrative includes a resolution to story (problem solved) or links to other autobiographical experiences including future occurrences of the event (<i>I can't wait to do it again,</i>) or self-concept or identity. The resolution brings closure to the experience and provides new information. Resolution may not be positive. <i>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.</i>

- 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	
<i>Level</i>	<i>Description</i>
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 <u>or</u> 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 where 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
- 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 determined 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 rationale is that if we actually 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).

Appendix D

Dataset Specific Coherence Coding Rules

- Only code memories in which the child provides 2 or more propositions in response to initial or empty prompts. (So it doesn't count if information is in response to wh-question and yes/no doesn't provide information.)
- Do not code context (because this information is typically included in the prompts).
- What sections to code for theme:
 - Include:
 - All of the child's responses to the interviewer's initial and follow-up prompts about the event (i.e. You Mom also said you ate cake. Can you tell me about that?)
 - All of the child's responses to the interviewer's empty prompts (echoing what the child just said, tell me more, what else, OK, etc.)
 - Children's spontaneous comments about related events in the past (i.e. I had cake at my friend's birthday party too).
 - Exclude:
 - All child responses to specific wh- questions (typically stop coding when the interviewer starts with the wh- questions)
 - Child's comments about a wrong event (if the child is confused about which event is being asked about)
 - Child's off-topic comments about the present (i.e. playing with a slinky, what is that noise, etc.)

- What sections to code for chronology:
 - Pick the longest section that was used for theme coding. (Longest = the most propositions. If two sections seem about equal in length, take the first).
 - A section DOES NOT END if the interviewer makes empty comments that do not interrupt the child's flow (i.e. echoing child, yes, ok).
 - A section does end if the interviewer makes a prompt that interrupts the flow (tell me more, what else can you tell me, etc)
- Code the included sections using the standard rules for Coherence Coding (NaCCS).

Appendix E

Four Sample Coded Narratives

Example 1. A non-codable narrative by a 6-year-old girl (The child fails to provide at least two propositions during the free recall period. Thus this memory would not be included in the present study)

Went to Watch Uncle's Josh's Hockey Game

E: What can you tell me about going to watch Uncle Josh's hockey game or hockey team?

C: Umm...umm...

E: Do you remember that?

(C nods)

E: Yes, what can you remember about it?

C: Umm

E: Do you need a hint?

C: Yes

E: Yes you doing ok? Okay.

E: Let's see it looks like you sat with Aunt Melissa

C: Yes

E: Yes what else can you tell me about that?

C: I-

E: What

C: I don't know

E: Ok let's see if you can answer some questions then. Where was this? Where did you go?

C: Umm I forgot.

E: You forgot that ok umm and who was there with you when you went to watch?

C: Aunt Melissa, mom, dad, Ethan, Grace and Me

E: Oh wow all sorts of people, and why did you go watch the hockey team?

C: Umm just for fun.

E: Just for fun, that sounds like a good reason. How did you feel about that?

C: Good

E: Good alright and what did you do while you were there?

C: Umm just sit and watch the game.

E: Just sit and watch the game, anything else?

(C shakes head no)

E: Alright and when was this?

C: Long time ago.

E: A long time ago, that works. And let's see. How did you know where your Uncle Josh was?

C: Umm Aunt Melissa pointed him out to me.

E: Yes.

C: To us.

E: That's nice; Aunt Melissa pointed him out, good job. Alright anything else you want to tell me about going to watch the hockey team?

C: No

Example 2: 4-year-old boy (Information that is italicized was used to code theme =1, information that is underlined is used to code chronology = 0. The child's responses to the wh- questions were used to code breadth (who-1, when- 1, where-1, why-0, how-1, Total= 80%)

Early Childhood Screening

E: What can you tell me about when you...this is a hard one...do you remember when you went for your early childhood screening? What can you tell me about that? Do you remember anything about that?

C: I take the pictures

E: Yeah?

C: And that's all

E: That's all

E: Can you think of anything else?

C: No

E: Let's see... I have down that you went to your old school

C: Hmm...no

E: Yeah

C: Don't remember that

E: Don't remember that?

C: (C shakes head no)

E: I also have that you hmm did some testing and played some games with your ears and your eyes, playing ear and eye games.

C: Yeah

E: Can you tell me about that?

C: *I played the rock in the bucket*

E: Yes, okay

C: *And I...I point to letters for my eyes*

E: Yes

C: *And that's all I remember*

E: That's all you remember, anything else that you remember about that day?

C: (C shakes head no)

E: No, okay

E: Let's see...

C: Why do you have the eyes to these?

E: Why do I have what?

C: The eye check cards

E: Cause it's important, we have to do those once in a while

E: Okay, let's see...was there anything else that you did while you were there...anything else?

C: Yeah but I don't remember that

E: That's okay

E: Alright and...**who** was with you went to have all this testing done, when you played those games

C: Mom and that's all

E: Mom and that's all, good

E: And where did you go for this? Do you remember where you were?

C: My old school

E: Your old school, do you remember where in your old school?

C: Yeah

E: **Where?**

C: They had a drinking fountain there

E: Yes

C: And...gym and a school

E: Yes

C: And a door

E: Oh my goodness, all sorts of stuff

E: And **why** did you go do that? Why did you go those games for your ears and your eyes?

E: Do you know why?

C: (C shakes head no)

E: No

C: No

E: Okay

E: Lets see...how did you feel about that day? How did you feel about doing all that stuff?

C: Good

E: You felt good?

C: (C nods yes)

E: Alright

C: And bad

E: Good and bad?

C: (C giggles)

E: Oh, why both?

C: Because I was good

E: Oh...

E: (C giggles)

E: Alright

E: Do you remember **when** you did this? Do you remember when it was?

C: No

E: No

E: Was it a long time ago or was it fairly recently?

C: Long time ago

E: Long time ago, okay

E: And let's see... **how** did you...you said that you played a bucket game, how did you play that game?

C: Hmm they had a bucket

E: Yes

C: And rocks, but they dumped the rocks out

C: And they had a machine

E: Yes

C: And that's all I remember

E: That's all you remember

E: That's a lot, you remembered all sorts of stuff about that one.

C: Yeah

Example 3: 6-year-old girl (Information that is italicized was used to code theme = 2, information that is underlined is used to code chronology = 1. The child's responses to the wh- questions were used to code breadth (who-1, when-1, where-0, why-1, how-1, Total= 80%)

Portfolio night at School

E: *****START HERE***** Alright tell me about portfolio night at school.

C: Umm I had some slide shows

E: Yeah?

C: and we got to look at all the books we made

E: Yes.

C: and we got to bring home lots of pictures.

E: You got to bring home lots of pictures

C: Yes

E: Ok

C: and then but not all of our things we did we made just the pictures we got to bring home, computer pictures.

E: Ok

C: Umm and after and after that we went out to eat a Snuffy's.

E: Oh ok

C: Snuffy's malt shop.

E: Yes

C: We had malts to drink instead of milk

E: Oh fun. What else can you tell me about portfolio night?

C: My we went my grandma went

E: Your grandma went

C: Yes. And my and my brother and sister, and my dad went and mom went.

E: Ok

C: My teacher was there

E: Yes

C: Umm that's all I can remember about that.

E: Ok you did a great job. Let's see and your mom also said that you also showed them the newly hatched chicks.

C: Yes.

E: Yes?

C: And we got to hold chicks too.

E: You go to hold chicks too?

C: Yes

E: Wow, anything else you can tell me about portfolio night?

C: No

E: No ok, how did you feel about that night?

C: Good.

E: Good and **why** did you have a portfolio night? Why did that all happen?

C: To show to show to tell the moms and dads and brothers and sisters all about what you did at school.

E: Okay, to show them everything you did at school very cool.

E: And **where** exactly was it?

C: At the school

E: At the school, and can list off again **who** was there for me?

C: My mom, my dad, my sister, my brother, and my grandma.

E: Aright excellent job. And let's see so you showed the chicks, and the slide show and the pictures what else did you do? Anything you haven't mentioned yet?

(C: shakes head no)

E: No ok, and **when** was this?

C: Almost, almost at the end of school.

E: Ok and umm **how** did you hold the chicks?

(C holds out hands)

E: Just like that?

C: Yes some of the chicks jumped out of our hands.

E: Oh really

C: Yes

E: Wow ok, anything else you can tell me about portfolio day?

C: No

Example 4: 8-year-old girl (Information that is italicized was used to code theme = 2, information that is underlined is used to code chronology = 3. The child's responses to the

wh- questions were used to code breadth (who-1, when-1, where-1, why-1, how-1, Total=100%)

Project Fair at school

E: Okay. Let's see the last one. It is the project fair at your school.

C: Oh yes! I got a blue ribbon.

E: You got the blue ribbon?

C: Yes.

E: Okay. So you remember about this.

C: Yes.

E: Okay. Can you tell me a little more about this?

C: At first like I went on this bouncy thing and we were in there for like- well, not a bouncy thing but a thing where you blow up and go inside. We were in there for about twenty- like a half hour. And then we had to get out to answer questions because so like we saw people that they were at our stations, you know? And, um, the girl was kind of mean, she said, "You guys stay in there! I'm not letting anyone out until I'm done!" In like a snotty voice. I did not like that one bit! And there were a bunch of people in the class.

E: and your dad actually put here that you popped microwave popcorn?

C: Yes, that was my pop- that was my project.

E: Can you tell me about your project?

C: Okay, you like pop popcorn and we pounded the seeds to see which one was the best and this one we put it in for three minutes and it was all- it had three hundred thirty three seeds left over so we didn't do that, we like did another because that-

another bag of popcorn because three hundred and thirty seeds wouldn't be good because then people will think XXX.

E: Okay. And I also have here that a few people, um, asked you about your project.

C: *Yes, there was this one guy, he didn't understand English I don't think because I kept telling him and he was like, "Um...? XXX."*

E: Like me?

C: Not like you, you understand me, don't you?

E: I understand you, yes. Perfectly.

E: Okay, so let's see. We're almost finished with this question. **Who** was with you when you did your project? When you did this?

C: Um, well, basically no one because I was the only one at my station and then there were a few people coming around because Mom and Dad and Brian were just walking around and then they weren't with me so...

E: Okay. And, um, **why** did you decide to do this project?

C: It was the only project I could think of.

E: **How** did you find this project?

C: My mom told me about it.

E: Okay. XXX. Let's see. Um, and **where** was the station?

C: Um, at the end of the tables. I was at the very end, can you believe it?

E: It's weird?

C: Yes

E: And **when** it was?

C: No idea.

E: Any kind.

C: I think maybe in March.

E: March. Okay. And, let's see, what else did you do there? You did your project...

C: We got free samples of bread; French bread, my favorite.

E: Okay. And the last one, how did you feel about this?

C: Happy!

E: Okay, I can tell. You was happy. Good job Molly.

Appendix F

Narrative Breadth Coding Scheme

(Modified from Van Abbema, 2002)

Narrative breadth is usually operationalized as a raw count of the six traditional narrative components (who, what, when, where, why, how) used by the participant in their memory narrative. In the present study, *what* was not included because that information was often given to the child in the experimenters' prompts. Narrative breadth was rated as the percentage of *wh*-information provided to the *wh*-questions that were asked. For example, if an interviewer prompted for 4 of the 5 *wh*-questions (described below) and a child provided information to 3 of these, the child would receive a score of $3/5 = 60\%$. The percentage system was used rather than a simple count to account for the rare cases where an interviewer failed to ask all 5 of the traditional *wh*-questions.

Only information provided by the child in response to a closed *wh*-question was counted. Thus, this coding scheme did not include information coded in the coherence coding scheme.

Information that simply restates the prompt was not accepted. However, any statements that augmented information provided in the prompt was accepted. For example, if the prompt was, "Christmas program at school", the child would NOT receive credit for "at school", but would receive credit for "at my school, Lakeview Elementary." Furthermore, scripted, empty statements that did not actually answer the *wh*-question were not counted. For example, "Because I wanted to" would not be an acceptable answer to "why did you watch the changing of the guards", but, "Because we were on a trip and we wanted to see what it would be like" would be accepted.

How	Objective descriptions, subjective descriptions, mention of dialogue, internal state references (cognition words, emotions, likes/dislikes, desires)
When	Time, temporal connections
Who	Character introductions
Where	Place
Why	Rationalizations (causal relations, if/then statements)