

# Stressing Memory: Long-Term Relations Among Children's Stress, Recall and Psychological Outcome Following Hurricane Andrew

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We examined relations among stress, children's recall, and psychological functioning following Hurricane Andrew. Thirty-five children from mixed socioeconomic backgrounds were divided into low-, moderate-, and high-stress groups and were interviewed about the hurricane immediately after the storm and 6 years later. Our primary interest, stemming from previous work, was in the emotional and cognitive content of their recall. At the initial interviews, children who were more stressed included less positive emotion and fewer cognitive processing words and provided less free recall and less information overall. In contrast, children who initially recalled more information showed better psychological outcome immediately following the hurricane. Six years later, children who had been more stressed initially included more negative emotion and more cognitive processing words, but provided less information during free recall. Children who had initially used more positive emotion words and recalled more information showed better psychological outcome 6 years later. Implications for children's remembering and coping with traumatic events are discussed.

Hurricane Andrew devastated the coast of Florida on August 24, 1992, in one of the most destructive natural disasters to occur on U.S. soil. The storm left over 175,000 residents without homes and basic services for extended periods (Slevin

& Filkins, 1992). Unfortunately, many victims of Hurricane Andrew were thousands of children who weathered the storm while remaining inside their collapsing homes. In the aftermath of the hurricane, parents and children struggled to adapt to their broken surroundings and the loss of homes, pets, toys, and displaced friends. Hurricane Andrew was a frightening, stressful event for all who lived through it. How stressful the event was may have varied considerably from child to child, along with the impact the event had on emotional well-being and psychological functioning.

Typically, research on how stressful events affect children has been divided into two lines of study. One line of research conducted by cognitive psychologists has focused on how stress affects the accuracy and amount of information children recall about a negative event. The other line of research, usually conducted by clinical psychologists, has examined the effects of stressful experiences on children's immediate and long-term psychological well-being. Their primary concern has been children's negative symptomatology following traumatic events. To date little attempt has been made to integrate these two lines of research by examining how children's memories of stressful life experiences relate to their psychological well-being either immediately or over time. Thus, the major objective of this study was to examine the relations among stress, emotional and cognitive content of children's memories, and their psychological functioning both immediately after living through Hurricane Andrew and 6 years later.

Research stemming from forensic interests has focused on the accuracy and overall amount of information children recall (Ceci & Bruck, 1993). One problem with this existing research on children's recall of stressful events is that researchers have used a variety of methods to assess children's stress levels, including self-report; subjective ratings by parents or doctors; objective stress ratings based on set criteria; behavioral indexes; and physiological measures such as heart rate, skin conductance, and hormonal levels. Different measures of stress have been differentially related to children's recall. Some studies have concluded that stress enhances children's memory for the event (Terr, 1979, 1988), whereas others have found that stress impairs children's memories (Bahrick, Parker, Fivush, & Levitt, 1998; Bugental, Blue, Cortez, Fleck, & Rodriguez, 1992; Merritt, Ornstein, & Spicker, 1994) or that stress has no effect on memory at all (Peterson & Bell, 1996). Despite the differing pattern of results concerning the stress-memory relation in these various studies, the overall conclusion is that children are able to recall a remarkable amount of information about various stressful procedures or events even after very long delays. In reviewing studies of children's recall of negative events, both Fivush (1998) and Pezdek and Taylor (2001) found that children recall more about stressful events than about emotionally neutral or possibly even positive events.

However, the relations between memory and stress are critical not only from a forensic perspective. How we remember and incorporate the negative events of our

lives has implications for future coping and well-being (Pennebaker, 1997). In this sense, what we remember and how we come to understand our experiences may be more important for our everyday functioning than whether our memories are a carbon copy of the actual event (Fivush, Sales, Goldberg, Bahrick, & Parker, 2004).

The second body of research on memory and stress has examined the impact of traumatic experiences on psychological functioning (Nader, Pynoos, Fairbanks, & Frederick, 1990; Pynoos, & Nader, 1988). This research has focused on children's psychological functioning following real-world traumatic events such as natural disasters, traumatic separations from caregivers, serious bodily injury, or other life-threatening experiences. There has been a particularly dramatic increase in the number of reports on children's psychological functioning after exposure to natural disasters (Lipovsky, 1991; Lonigan, Shannon, Finch, Daugherty, & Taylor, 1991; Lonigan, Shannon, Taylor, Finch, & Sallee, 1994; Vernberg, La Greca, Silverman, & Prinstein, 1996). Often this research has been conducted by clinicians who are especially interested in children's acute psychological responses to natural disaster, in particular the amount of posttraumatic stress symptomatology expressed by a given individual. The typical posttraumatic stress responses of children to natural disaster have included trauma-specific fears; fears of recurrence; regressive behavior; externalizing symptoms; behavioral reenactment; posttraumatic play; avoidance of traumatic reminders; detachment, anxiety, and depressive disorders; school problems; symptoms of physiological hyperarousal; and changed attitudes about the self, world, and future (Bloch, Silber, & Perry, 1956; Burke, Moccia, Borus, & Burns, 1986; Green et al., 1994; Green, Korol, & Grace, 1991; Newman, 1976; Pynoos, Frederick, & Nader, 1987; Terr, 1981, 1983). These symptoms cluster into what has been labeled posttraumatic stress disorder (PTSD).

Eight months after children experienced Hurricane Andrew, Shaw, Applegate, and Tanner (1995) examined the continuing psychological effects of exposure to the storm on a school-age population. They found that 89% of the children were rated in the *moderate* and *severe* to *very severe* categories on their PTSD index, which indicated high levels of continuing psychological distress and disruptions in normal functioning. When the same children were reexamined 21 months after the storm, researchers found that 70% of the children endorsed moderate to severe posttraumatic stress symptomatology (Shaw, Applegate, & Schorr, 1996). The authors speculated that the continuing high levels of posttraumatic stress symptomatology almost 2 years later were related to continued exposure to traumatic reminders. Thus, reminders of the storm triggered memories and feelings of the event, which suggests that what one remembers about an event influences psychological functioning of children.

In support of this interpretation, recent research with adults has consistently found that emotional disclosure during writing about traumas has significant health and psychological benefits to the writer (Francis & Pennebaker, 1992;

Pennebaker, Colder, & Sharp, 1990; Pennebaker, Kiecolt-Glaser, & Glaser, 1988; Petrie, Booth, Pennebaker, Davison, & Thomas, 1995). Pennebaker and colleagues found that the content of one's memories, especially the emotional and cognitive processing words used in recall, has a significant impact on well-being. The inclusion of more emotional and cognitive processing words in a narrative indicates of greater depth of processing and suggests that individuals are actively working to understand the event and the role it played in their lives. Thus, examining the emotional and cognitive content of recall following a stressful experience may be a useful index of how that individual is coping with the stress-inducing event. From this perspective, it is assumed that the narrative content both reflects previous processing of the event and simultaneously influences subsequent processing such that stress influences memory and memory influences stress in a dialectical relation.

Very little is known about the specific content of children's narratives of stressful experiences and how these memories relate to psychological functioning. In one of the only studies to directly examine the content of children's independent narratives for both positive and negative events, Fivush, Hazzard, Sales, Sarfati, and Brown (2003) found that children included more internal states language when narrating negative events than positive events. Moreover, children used more cognitive and emotion words when narrating more severely negative events (e.g., the arrest of a mother or murder of a family member) than less severely negative events (e.g., allergy shots or fighting with a sibling), which suggests that children may be working harder to process and understand highly negative events.

In this study, we bring together the research on memory and psychological outcome by examining the relations among stress, the content of children's recall of Hurricane Andrew, and their psychological functioning both immediately following the hurricane and 6 years later. In published analyses of this same data set, we had examined how stress related to the overall amount of recall of Hurricane Andrew in the months following the storm and again 6 years later (Bahrack et al., 1998; Fivush et al., 2004). Briefly, we found that all children recalled this event in a highly vivid and detailed fashion even 6 years later but those children who experienced higher stress during the hurricane, as assessed by amount of property damage, recalled less information in free recall than children experiencing lower stress. In this study, we explicitly examined the emotional and cognitive content of children's recall. Further, given the mixed findings in the previous research on stress and memory, we related multiple measurements of stress that were collected at the initial interview to children's initial and long-term recall of the hurricane. Stress measurements included both objective measures of property damage and subjective Likert-type scale ratings completed by the mother and the child. Additionally, we related children's recall to their psychological functioning assessed at both time points by a PTSD symptomatology scale.

Previous research on the stress–memory relation has focused on accuracy and amount of recall, rather than on the content of recall. Thus we could make few specific predictions. However, we reasoned that children who were less stressed about the hurricane might talk more, and talk more freely, about the event and also might indicate a deeper understanding of the event through the use of more emotion and cognitive processing words than would children who were more stressed. Furthermore, based on research with adults (Pennebaker, 1997) we predicted that children who included more mention of emotion and cognitive processing words in their recall would show better psychological outcome after the hurricane both immediately and 6 years later. Thus, stress should predict narrative content, and narrative content should predict psychological outcome above and beyond the direct influence of stress on outcome. Finally, we predicted that initial PTSD symptoms would be related to symptoms expressed 6 years later, although such relations could possibly be mediated by narrative content.

## METHOD

### Participants

Of the original 100 participants in the Bahrick et al. (1998) study, 41 families with 42 children (one set of siblings) were located, and all agreed to participate in the follow-up study. The children were 3 to 4 years old ( $M$  age = 4 years, 3 months,  $SD$  = 7 months) at the time of the initial interview and were 9 to 10 years old ( $M$  age = 9 years, 9 months,  $SD$  = 7 months) at the time of the follow-up interview. Children were from diverse socioeconomic and racial backgrounds. Of the 42 children who participated in both the initial and follow-up studies, we are missing 4 children's Time 1 stress data and 7 children's Time 2 stress data. Thus, the analyses include only the 35 children (21 boys and 14 girls) with complete data. These 35 children did not differ either demographically or on overall amount of recall at the first interview from the full sample.

### Interview

At each visit, one of several trained, female research assistants conducted a structured interview with the child at a neutral location, such as a local library or a public park. In certain cases, the interview was conducted at the child's home if it was not the same structure in which the family experienced Hurricane Andrew.

The initial and follow-up interviews were identical. All interviews began with a warm-up period to establish rapport. Each interview began with the open-ended prompt: "Tell me everything you can remember about Hurricane Andrew." After

exhausting their free-recall to this question, children were asked three additional open-ended questions about preparing for the storm (e.g., “What did you do to get ready for the storm?”), the storm itself (e.g., “What happened during the storm?”), and the aftermath (e.g., “What happened after the storm?”). Responses to these open-ended prompts were counted as free recall. These questions were followed by a series of more specific questions such as, “Did anything happen to the windows?” and, if *yes*, “What?” or “What did the inside of your house look like after the hurricane?” Responses to these follow-up questions were counted as cued recall. The initial interviews were conducted between 2 and 5 months after the hurricane. The follow-up interviews were conducted approximately 6 years later (range: 5 years, 6 months to 5 years, 11 months, after the first interview). All interviews were audiotaped and transcribed verbatim. There were no differences in amount of recall as a function of retention interval at either interview time (see Bahrick et al., 1998; Fivush et al., 2004, for details). In addition, the mothers also completed a questionnaire about the amount of family discussion of hurricane events at the initial interview and again at the follow-up interview. This questionnaire asked mothers to rate on a 7-point Likert-type scale ranging from 1 to 7 the amount of family discussion immediately after the hurricane, in the intervening years, and during the past year about preparing for the storm, the storm itself, and the aftermath.

### Coding

*Amount of recall.* Each transcript was divided into propositional units to assess the overall length of recall. A *proposition* was defined as a unit of information about the hurricane (e.g., “the windows shattered,” “it was scary,” “we boarded the windows,” “we cleaned up,” “I thought we were going to die”). Lists of nouns were considered as one proposition. *Yes* and *no* responses were not counted as recall. Two independent coders compared their divisions into propositions on 25% of the transcripts and achieved an intercoder reliability of 88.6% (range = 73–97%). We then calculated the total number of propositions as a measure of overall length. Total number of propositions was determined by adding the number of propositions provided to the open-ended prompts to the number of propositions recalled in response to the specific questions. Furthermore, we calculated the percentage of information provided during free recall by dividing the number of propositions provided to the open-ended questions by the total number of propositions.

*Content of recall.* Coding focused on the amount and type of internal state language children used in their reports. We were particularly interested in children’s emotion and cognitive processing language. In contrast to coding for amount of recall, which focused on propositions, this coding scheme focused on

counting occurrences of specific types of words embedded within propositions. Specifically, all transcripts were coded for the following types of words.

*Positive emotion words.* Any mention of positive emotion, such as happy or glad, during the narrative was considered as belonging to this category (e.g., “I was *glad* when it was all over”). Any mention of having fun, being excited, smiling, and laughing were also coded as positive emotion.

*Negative emotion words.* Any mention of a negative emotion such as sadness, fear, or anger was coded in this category (e.g., “We were all so *scared*”). Crying and screaming were also coded as negative emotion.

*Cognition words.* Any mention of cognitive states such as thinking, knowing, and wondering. Only references to cognitive states during the hurricane itself were coded (e.g., “I *thought* the window was going to smash”). Thoughts in the present were not included (e.g., “I think two trees fell down”).

Two independent coders compared their coding for 25% of the transcripts and achieved intercoder reliability of 96% (range = 92–100%) for positive and negative emotion and 92% (range = 89–97%) for cognition words.

## Stress Measures

At the time of the initial interview three distinct measures of child stress were gathered. These measures included an assessment of the amount of damage to the families’ homes, a subjective stress rating where children reported on their own stress, and a subjective stress rating where mothers reported on their children’s stress.

*Damage assessment.* All mothers were given a hurricane severity questionnaire designed to objectively determine the degree of storm exposure. This measure allowed the participants to be classified into high, moderate, or low storm damage groups. Eighteen children were classified in the high-damage group, 11 in the moderate-damage group, and 6 in the low-damage group. The high-damage families’ lives were in danger during the storm while they witnessed the complete destruction of their property during the hurricane. They were forced to relocate or have their homes rebuilt after the storm and lived for extended periods after the storm without basic services such as electricity, water, and telephone. The moderate-damage group experienced some exterior damage to their homes and water damage to the interiors of their homes. They also experienced basic service outages. This group also had to cope with the major cleanup of their homes and neighborhoods but not to the extent of the high-damage group. The low-damage group consisted of families who experienced no property damage from the storm and little or no time without basic services. However, they prepared for the hurricane in

the same manner as the moderate- and high-damage groups (see Bahrack et al., 1998, for full details on stress groupings, amount of damage to the homes, and repairs).

*Child subjective stress rating.* All children were asked to complete a brief subjective stress rating about how they felt during the hurricane. They were asked to rate how scared and upset or happy and good they felt during each phase of the hurricane (i.e., preparation, storm, and aftermath). To facilitate their understanding of the scale, the children were asked to indicate which of two puppets, a relaxed or a frightened one, felt more like they did. Once the children picked the puppet that felt closest to how they did, the experimenter asked them if they “just sort of felt like that” or “felt like that a lot.” Children’s stress was rated on a 4-point scale ranging from 1 (*extremely happy and good*) to 4 (*extremely frightened and upset*). A total score was computed by taking the average stress score across all phases.

*Mother subjective rating of child stress.* Mothers were asked to indicate on a 4-point scale, ranging from 1 (*extremely happy and relaxed*) to 4 (*extremely frightened and upset*), how stressed their children were during the hurricane.

### Psychological Functioning Measure

At both the initial interview and the follow-up interview, psychological functioning was measured using the Child Frederick PTSD Reaction Index Form C (Frederick, 1985). This 20-item questionnaire was designed to assess PTSD symptomatology in children. Slight modifications were made to assess symptoms specific to the hurricane and to allow for children to respond to eight items on their own. At the initial visit, mothers administered eight questions from the PTSD Index to their children (e.g., “Do thoughts about the hurricane make you feel afraid or upset?”) and then completed the remaining questions according to their judgment about their children (e.g., “Feels as good about things he or she likes to do as he or she did before”). At the follow-up visit, children completed the entire questionnaire on their own. Each question is responded to on a 3-point scale, thus scores can range from 0 (*no PTSD symptoms present*) to 60 (*extremely high levels of PTSD symptoms present*). Frederick (1985) labeled the severity of PTSD symptoms for the total score on the Reaction Index: 0 to 11 (*doubtful*), 12 to 24 (*mild*), 25 to 39 (*moderate*), and 40 to 60 (*severe*).

## RESULTS

Analyses addressed the relations among stress, content of children’s narratives, and psychological functioning concurrently and over time. We first provide descriptive statistics on the narrative and psychological outcome variables. We then

examine the relations among the various stress measures. Turning to our critical analyses, we first examine the concurrent relations among stress, recall, and psychological outcome at Time 1, and then explore the concurrent relations between content of the narratives and psychological functioning at Time 2. Finally, we examine the relations among stress, recall, and psychological functioning over time. Initial analyses included gender and amount of family discussion about the hurricane, but these variables were unrelated to either content of recall, stress, or psychological outcome and are therefore not discussed further.

### Comparison of Content and Psychological Functioning Over Time

Table 1 shows the means and standard deviations for the narrative and psychological outcome variables at each time point. Children's overall PTSD scores tended to be higher immediately after the storm than 6 years later,  $t(34) = 1.75, p = .09$ , although it should be noted that at both time points, mean scores were in the mild range. Overall, children recalled more 6 years later when they were 9- and 10-year-olds than when they were first interviewed at 3 to 4 years of age,  $t(34) = 5.10, p < .001$ ; they provided more information during free recall at Time 2 than at Time 1,  $t(34) = 5.59, p < .001$ ; and included more cognitive words in their Time 2 recall than Time 1 recall,  $t(33) = 4.91, p < .001$ . There were no significant differences over time in their use of emotion words.

### Relations Among Stress Measures

The first analytic question was whether the stress measures were related to one another. A series of Pearson correlations were conducted among the measures of stress based on amount of property damage, the mother ratings of the children's stress, and child rating of his or her own stress. The only significant correlation was

TABLE 1  
Means and Standard Deviations of Content and Psychological  
Functioning Variables at Each Time Point

| Variables        | Time 1 |       | Time 2 |       |
|------------------|--------|-------|--------|-------|
|                  | M      | SD    | M      | SD    |
| PTSD score       | 20.59  | 9.15  | 16.91  | 10.79 |
| Total recall     | 53.80  | 25.73 | 110.49 | 60.27 |
| % free recall    | 0.46   | 0.15  | 0.60   | 0.14  |
| Cognitive words  | 0.59   | 1.16  | 3.79   | 3.26  |
| Positive emotion | 1.27   | 1.76  | 2.00   | 1.89  |
| Negative emotion | 1.82   | 1.80  | 2.59   | 2.54  |

between amount of damage and maternal ratings of child stress, such that families who sustained a greater amount of property damage had children with higher maternal ratings of child stress,  $r(34) = .53, p < .001$ . No significant correlations were obtained between the children's own stress ratings and either the damage assessment,  $r(34) = .03$ , or maternal ratings of stress,  $r(34) = .09$ .

### Concurrent Relations Among Stress, Content of Recall, and Psychological Functioning

The second set of analyses examined whether there were concurrent relations among stress, the content of children's recall at Time 1, and psychological functioning at Time 1. To explore this issue we first conducted Pearson correlations among the three measures of stress, all of our narrative variables (total number of propositions, percent of information provided during free recall, positive emotion, negative emotion, and cognition words) from the initial interview and PTSD symptomatology scores obtained during the initial interview.

The correlations between stress and PTSD and between stress and narrative content at Time 1 are presented in Table 2. First, we found a direct relation between stress and PTSD symptoms, such that children living in homes which sustained more damage exhibited more PTSD symptoms at Time 1. Turning to relations between stress and children's recall at Time 1, children who sustained more damage to their homes recalled less overall, provided less information during free recall, and included fewer positive emotion words and fewer cognitive processing words in their initial recall of the hurricane. Neither the mothers' nor children's stress ratings were related to narrative content or PTSD at Time 1.

Relations between narrative content and psychological outcome are shown in the upper left column of Table 3. Children who recalled more information overall and who provided more information in free recall exhibited fewer PTSD symptoms immediately after the hurricane.

TABLE 2  
Correlations Among Stress, Content of Recall at Time 1,  
and PTSD Scores at Time 1

|                  | <i>PTSD</i> | <i>Total Recall</i> | <i>% Free Recall</i> | <i>Positive Emotion</i> | <i>Negative Emotion</i> | <i>Cognition Words</i> |
|------------------|-------------|---------------------|----------------------|-------------------------|-------------------------|------------------------|
| Stress at Time 1 |             |                     |                      |                         |                         |                        |
| Damage rating    | .43**       | -.37*               | -.38*                | -.37*                   | -.06                    | -.53**                 |
| Mother rating    | .19         | -.25                | -.19                 | -.24                    | -.12                    | -.19                   |
| Child rating     | -.07        | -.18                | -.20                 | .07                     | .02                     | -.09                   |

*Note.* Degrees of freedom for all correlations was 34.

\* $p < .05$ . \*\* $p < .01$ .

TABLE 3  
Correlations Between Content of Recall and  
PTSD Scores by Time Point

|                  | <i>PTSD by Time Point</i> |                    |
|------------------|---------------------------|--------------------|
|                  | <i>Time 1 PTSD</i>        | <i>Time 2 PTSD</i> |
| Concurrent       |                           |                    |
| Total recall     | -.38*                     | .14                |
| % free recall    | -.51**                    | .03                |
| Positive emotion | -.17                      | .14                |
| Negative emotion | -.30                      | .26                |
| Cognitive        | -.09                      | .26                |
| Cross-lagged     |                           |                    |
| Total recall     |                           | -.37*              |
| % free recall    |                           | -.26               |
| Positive emotion |                           | -.37*              |
| Negative emotion |                           | -.11               |
| Cognitive        |                           | -.01               |

*Note.* Degrees of freedom for all correlations was 34.

\* $p < .05$ . \*\* $p < .01$ .

Given that stress, amount of information provided during free recall, and overall recall all were significantly correlated with PTSD at Time 1, a hierarchical regression was performed to determine which of these factors best predicted the child's PTSD score at Time 1. The overall model was significant,  $F(3, 34) = 3.59, p < .01$ . Only the amount of information provided during free recall was a significant predictor of PTSD scores at Time 1,  $t = 2.12, p < .05$ , such that children who included more information during free recall had lower PTSD immediately after the storm.

Next, a series of Pearson correlations were conducted to examine the concurrent relations between the content of children's recall at Time 2 and their psychological functioning at Time 2, as shown in the top right column of Table 3. No significant relations were found between the content of children's narratives about the hurricane and the amount of PTSD symptoms still expressed 6 years later.

### Relations Among Stress, Content of Children's Narratives, and Psychological Functioning Over Time

The final set of analyses examined relations among stress, content of children's recall, and psychological functioning over time. First, we conducted Pearson correlations between the stress measures collected at Time 1 and the content of children's recall at Time 2, as well as their PTSD scores at Time 2, as shown in Table 4. Stress at time of experience was significantly related to how children talked about

TABLE 4  
Correlations Among Stress, Content of Recall at Time 2,  
and PTSD Scores at Time 2

|                  | <i>PTSD</i> | <i>Total Recall</i> | <i>% Free Recall</i> | <i>Positive Emotion</i> | <i>Negative Emotion</i> | <i>Cognition Words</i> |
|------------------|-------------|---------------------|----------------------|-------------------------|-------------------------|------------------------|
| Stress at Time 1 |             |                     |                      |                         |                         |                        |
| Damage rating    | .13         | .02                 | -.34*                | .21                     | .46*                    | .45*                   |
| Mother rating    | .16         | -.29                | -.36*                | .03                     | .01                     | .06                    |
| Child rating     | .21         | -.26                | -.35*                | .06                     | .04                     | -.18                   |

*Note.* Degrees of freedom for all correlations was 34.

\* $p < .05$ . \*\* $p < .01$

the event 6 years later. Specifically, children who had experienced more damage provided less information during free recall, but included more cognitive processing words and negative emotion words in their narratives of Hurricane Andrew 6 years after the event. Furthermore, children rated by both self and mother to have experienced higher levels of stress during the hurricane provided less information during free recall at the 6 year follow-up interview. However, we did not find a significant relation between stress at time of experience and PTSD symptomatology 6 years later.

Second, as presented in the bottom portion of Table 3, we conducted Pearson correlations between the content of children's narratives at Time 1 and their PTSD symptoms at Time 2. Children who produced longer narratives and used more positive emotion words in their recall at Time 1 had lower overall PTSD scores at Time 2.

To control for the influence of children's PTSD scores at Time 1 on their subsequent PTSD scores at Time 2, as well as to more thoroughly explore which correlated factors best predicted PTSD scores at Time 2, a hierarchical regression model was constructed. PTSD scores at Time 1, total recall at Time 1, and positive emotion talk at Time 1 were entered as predictor variables, and PTSD scores at Time 2 was the outcome variable. The overall model was significant,  $F(3, 34) = 3.08$ ,  $p < .05$ . Only positive emotion talk at Time 1 was a marginally significant predictor of PTSD scores at Time 2,  $t = 1.79$ ,  $p < .08$ .

## DISCUSSION

In this study our major objective was to examine the interrelations among stress at time of experience, the content of children's narratives, and psychological functioning both immediately following Hurricane Andrew and 6 years later. We were particularly interested in how the content of children's recall related to their

long-term psychological functioning. Our results provide evidence that level of stress experienced during a real-life traumatic event, Hurricane Andrew, is related to the content of children's recall of the hurricane immediately following the storm and up to 6 years later. Intriguingly, the relations between the content of children's recall and their psychological functioning change over time.

First, on a methodological note, although living through a devastating hurricane is clearly a stressful experience, the various measures of stress employed in this study were not highly intercorrelated with each other and were differentially related to narrative content and psychological outcome. Specifically, whereas maternal ratings of children's stress were related to the objective damage assessment, these subjective ratings were not related to either children's narratives or outcome at either time point. Further, children's ratings of their own stress were not related to either of the other stress measures or to their own concurrent narrative content or outcome. Likert ratings of stress may not be a good method for assessing stress levels in 3- and 4-year-old children, who may have difficulty describing their global levels of stress. At this age, other indexes of stress, including objective measures, may be needed to assess the psychological impact of stressful events on children's short- and long-term functioning.

More important, we found that stress at time of experience, which was operationalized as property damage, was related to the content of children's recall. We were particularly interested in the emotional and cognitive processing language because prior work with adults has suggested that greater depth of emotional processing and understanding is indicated by the presence of emotion and cognitive processing words. Adults who include more emotion words and cognitive processing words in their narratives show better physical and psychological outcomes following traumatic events (see Pennebaker, 1997, for a review). In this study, at the initial interviews, children with the highest levels of stress included less positive emotion, fewer cognitive processing words, provided less information during free recall, and reported less information overall in their narratives. Additionally, how children initially recalled the hurricane was related to their psychological functioning such that children who provided more information during free recall and reported more information overall showed better psychological functioning in the months immediately following the hurricane. Importantly, children's ability or willingness to provide information during free recall appeared to be the best predictor of their psychological well-being immediately after the storm.

This pattern of results is consistent with Peterson and Biggs (1998), who found that children who were highly stressed over sustaining an injury requiring hospital treatment provided little emotional information in their accounts but children who were less distressed included more evaluative and emotional information in their reports. These results, along with our findings, suggest that children who experience extremely high levels of stress may have difficulty processing the event immediately following the traumatic experience or avoid thinking about the event al-

together as a way to cope, thereby including less language indicative of emotional and cognitive processing as well as providing less information during free recall and lower recall overall. Children who openly provided more information during free recall and recalled more information overall about the experience initially after the hurricane may have a more complete understanding of the event. A better understanding of the event might facilitate better psychological functioning after this traumatic experience.

Most intriguing are the relations over time. First, the level of stress at time of experience relates to the content of children's recall 6 years later. Specifically, children who were more stressed initially, as indicated by high property damage, included more negative emotions and cognitive processing words in their recall 6 years later, suggesting that they are still trying to make sense of the event. But they also provided less information during free recall. That they need more prompts and cues to recall information suggests that these children are still reluctant, or unable, to openly communicate about the event. Thus, as indicated by the presence of more negative emotion words, more cognitive words, and a smaller percentage of information provided during free recall, these highly stressed children may still be trying to process and understand the stressful event they experienced when they were only 3 and 4 years old to a greater extent than children who initially experienced less stress, but they may also be avoidant or ambivalent about dealing with the stressful experience.

It is interesting to note that PTSD scores immediately following the hurricane were not predictive of PTSD scores 6 years later. Rather, we found relations between the content of immediate recall and amount of PTSD symptoms still expressed 6 years later. Specifically, children who used more positive emotion words and included more information overall in their initial recall had lower overall PTSD scores 6 years later. This finding is consistent with recent research suggesting that children and adults who can find the positive in negative situations handle stressors better and have better psychological outcome following trauma (Aldwin & Sutton, 1998). Perhaps children who include more information at the initial interview are exhibiting less avoidance and are more willing to disclose information about the event, thereby reducing the anxiety surrounding the event. Seeking social support and emotional disclosure have been found to be effective methods of reducing stress for both children and adults (Lazarus & Folkman, 1984; Sandler, Tein, & West, 1994).

Unfortunately, our sample size was rather small and thus limited the type of analyses we could conduct. Nonetheless, although small, this sample is unique for several reasons. Hurricane Andrew was without question a highly stressful, real-life event that these children experienced at a very young age. Furthermore, it was a completely novel event, unlike any other stressor they may have encountered before, and there were no additional hurricanes or hurricane warnings between the two interviews, making Hurricane Andrew the only hurricane they had ever pre-

pared for and experienced. Finally, we were able to follow these children over a longer period than previous research on natural disasters. Of course, this was a public, highly discussed event, and we are assuming that the memory of this event, not unlike all autobiographical memories, was reconstructed over time. However, it is precisely this process of reconstructing memory over time that allows for individuals to work through and make meaning from the stressful experiences of their lives, and this meaning-making process is reflected in the types of language people use when recalling such events (Pennebaker, 1997).

According to some commonsense beliefs about early childhood memories, these children who were only 3 to 4 years old when they lived through Hurricane Andrew should not be able to easily remember or to be psychologically affected by this event in later life. Amazingly, not only do these children remember the hurricane, they continue to be emotionally affected by the hurricane even years later as indicated by their scores on the PTSD scale. This suggests that highly traumatic events experienced early in childhood may have long-term consequences for later psychological well-being. Most striking, as implied by their narratives of the hurricane event given years later, those children who experienced the highest levels of stress were still trying to process and understand the stressful event. Just as impressive, children whose immediate recall was suggestive of more emotional processing and better understanding exhibited better psychological functioning in the years following the event. Given that early childhood trauma has such far reaching repercussions, future research should concentrate on the role memory plays in children's understanding and coping with stressful events. For adults, how an event is remembered and reported by an individual affects how they cope with trauma and ultimately affects their physical and psychological well-being (Pennebaker, 1997). Our results suggest the same may be true for young children.

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