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Anxious and nonanxious children's recall of a repeated or unique event

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Abstract

The current study examined 4- and 5-year-olds' memory for an event that was experienced once or was the first in a sequence of four similar events. The event was private swimming lessons for beginners that, because of natural variation in fear of water, were experienced as stressful for some children and not stressful for others. Consistent with much previous research, there was evidence that repeat-event children remembered less than did single-event children. There was some evidence for a beneficial influence of stress on resistance to suggestions. No other effects of stress were found in either the single- or repeat-event children. Implications for the debate on the influence of stress on memory and for children's testimony are discussed.

Keywords: Memory; Repeated events; Suggestibility; Stress

Introduction

Although there are many creative and highly informative naturalistic studies on children's reports of stressful[1] events (e.g., Goodman, Hirschman, Hepps, & Rudy, 1991; Vandermaas, Hess, & Baker-Ward, 1993), few have included a condition in which the

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[1] Much of the recent literature has used the term *emotional arousal* to describe experiences involving stress, anxiety, and fear. In the current article, to avoid the more cumbersome terminology of *negative emotional arousal*, the term *stress* is used to describe the research involving negatively emotionally arousing events.

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same controlled event that led to stress for some children was entirely nonstressful for others. Such controlled comparisons of memory for stressful and nonstressful events are essential for understanding whether we can expect the same quality of memory reports concerning stressful events and neutral or even enjoyable events. That is, studies of children's memory for stressful events can inform us about how children report stressful events but not about how those reports may differ from reports of entirely nonstressful events. Moreover, the number of times an event is experienced has been shown to influence children's memory reports for an instance of the event (e.g., Connolly & Lindsay, 2001; Powell, Roberts, Ceci, & Hembrooke, 1999), so the possible effect of stress on memory reports should be studied in the context of single and repeated events. The current study examined the influence of stress and event repetition, as well as the potential interaction between these two variables, on children's recall.

Stressful events

There is a long-standing debate over the impact, if any, of stress on memory (e.g., Christianson, 1992; Deffenbacher, Bornstein, Penrod, & McGorty, 2005). Based on studies with adults, some scholars suggest that stressful events may be remembered better than neutral events due to a rehearsal or rumination mechanism (e.g., Neisser et al., 1996). Others argue that stress may have a deleterious effect on memory due to repression or forgetting (e.g., Terr, 1991) or some variation on the narrowing-of-attention hypothesis (e.g., Christianson, 1992; Deffenbacher et al., 2005). Still others have found that memory for stressful events does not differ substantially from memory for nonstressful events (e.g., Geraerts et al., 2007). The extant research has not yet provided a clear picture of the influence of stress on children's ability to recall such events (Cordón, Pipe, Sayfan, Melinder, & Goodman, 2004; Pipe, Lamb, Orbach, & Esplin, 2004).

Important advances in the investigation of children's recall of stressful events came when researchers began examining children's memory for medical experiences, including inoculations, visits to the emergency room, and painful and frightening medical procedures such as the voiding cystourethrogram (VCUG) (e.g., Goodman et al., 1991; Merritt, Ornstein, & Spicker, 1994; Ornstein, Gordon, & Larus, 1992; Peterson & Bell, 1996; Quas et al., 1999). With medical events, researchers often are able to determine precisely what occurred during a stressful experience and can compare children's recall with an objective record. Unfortunately, beyond a finding that children's memory can be generally accurate for stressful events, no other clear pattern has materialized (Fivush, 2002).

In much of the medical events research, most children likely experienced some degree of stress during the procedure. Thus, this work cannot address the question of whether memory reports of stressful events differ from those of neutral events. In response, some scholars have made an effort to experimentally compare stressful events with neutral events. Shrimpton, Oates, and Hayes (1998) compared children's recall of receiving venipuncture (stressful) with their recall of viewing a demonstration of venipuncture (nonstressful). The authors found that children who experienced the stressful event were less suggestible and reported fewer errors than did the nonstressed children, suggesting a positive influence of stress on recall. However, the stressful and neutral events were different events that varied on several important dimensions, including degree of participation, leaving open the possibility that differences in memory were a function of the nature of the event itself. This possible confound was addressed in two studies by Peters (1997) where an event was interrupted by either a fire alarm and a concerned confederate or a loud radio and an unconcerned confederate. Children then completed a memory test for the interrupted event. Both studies found a negative impact of stress on recall. Although Peters was able to begin to address the methodological problem from prior studies that stressful and nonstressful events were different events, the events were still not identical and the target event occurred only once.

Overall, there is conflicting evidence on the effect of stress on children's memory. This may be partially due to differences in the events themselves or to low levels of stress experienced by the children in the studies. Another limiting concern addressed in the current research is that extant studies either involved a single event or did not manipulate event frequency experimentally.

Event frequency

From decades of research on children's memory for repeated events, we know that children's reports of repeated experiences differ from their reports of unique experiences (e.g., Nelson, 1986). However, there is much less research examining how children report one particular instance of a repeated event. In studying memory for repeated events, we must distinguish between two types of details: fixed and variable. Fixed details are experienced in exactly the same way during each encounter with the event (e.g., one always orders food before eating when at a restaurant). Variable details are expected to change between the instances of a repeated event (e.g., the particular food ordered). It is reasonable to anticipate, and indeed it is supported by research, that fixed details are strengthened in memory as they are repeated over time (e.g., Connolly & Lindsay, 2001). Because we know less about memory for variable details, and because most repeated events do not recur in exactly the same way, the focus of much of the extant work, including the current study, is on variable details.

Importantly, there is a growing body of literature showing that children report repeated events differently from how they report unique events (e.g., Connolly & Price, 2006; Hudson, 1990; Powell & Roberts, 2002). Specifically, children who have experienced a repeated event tend to report fewer correct details from a target event, often report details from experienced but nontarget occurrences, and often are more suggestible (i.e., susceptible to report erroneous postevent information [Bruck & Ceci, 1999]) as compared with children who have experienced a single event (e.g., Connolly & Lindsay, 2001; Connolly & Price, 2006; Powell & Roberts, 2002; Powell et al., 1999; Price & Connolly, 2004).

Fuzzy-trace theory is often relied on to help guide the research on children's recall of an instance of a repeated event that contains variable details. According to fuzzy-trace theory (e.g., Brainerd & Reyna, 1995), two memory traces are formed when an event is encountered: verbatim and gist. A verbatim trace contains the precise event details, whereas a gist trace contains the event's general meaning. With repeated events, a verbatim trace is created during each instance, but each instance also activates the same gist trace. Whether or not the verbatim or gist trace is activated at retrieval is an important question; verbatim memory is supportive of recall of particular instance details, whereas gist memory is less so. If the verbatim trace is accessed, recall of instance details is much more likely and rejection of misinformation should increase, a process known as recollection rejection (Brainerd & Reyna, 2002). However, if the gist trace is accessed, recall of nontarget details, acceptance of gist-consistent suggestions, and reduced reporting of correct target details are likely to occur.

Event frequency and stress

There are some well-developed hypotheses regarding memory for repeated trauma based on clinical work with traumatized children, most notably that proposed by Terr (1991). Terr suggested that there are two types of trauma; Type I traumas are single experiences and are remembered vividly, whereas Type II traumas are repeated and predictable and are more likely to be denied or forgotten. Given that Terr's work is based on clinical observation and that a similar phenomenon has been observed in studies of memory for repeated neutral events, we turn to the experimental research on memory for repeated stressful events for theoretical guidance.

The evidence suggests that children's memory for variable details of repeated events may be less accurate than their memory for comparable details of a single event. However, we do not yet know the nature of a potential interaction between stress and event frequency. As part of their study on children's memory for stressful dental procedures, Vandermaas and colleagues (1993) collected parental reports of 4- and 5-year-olds' and 7- and 8-year-olds' prior experience with the participating dentist (see also Ornstein et al., 2006). When the amount of prior experience was statistically controlled, a previously significant interaction between age and stress (i.e., anxiety reduced correct responses for older children but not for younger children) disappeared. Thus, although the authors concluded that this finding was preliminary, given the nature of the data on prior experience with the dentist (parental reports), it indicates that there may be a complex influence of frequency of experience on recall of a stressful event. Goodman and colleagues examined children's recall of a stressful medical experience (VCUG), which some children had experienced for the first time and others had experienced one or more times previously (Goodman, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1994). Previous experience with the VCUG did not influence children's ability to recall the experience. Quas and colleagues (1999) conducted a similar study and found a positive correlation between the number of previously experienced VCUGs and the amount of correct information recalled. An important consideration in the above studies is that because medical procedures are likely to be highly similar across occurrences, many (perhaps most) details are fixed, and this is expected to enhance children's ability to report correct information (e.g., Connolly & Lindsay, 2001). As discussed above, an important focus of the current study is repeated events that are largely variable. And because research on children's memory for medical procedures likely involves at least some degree of stress for all children, such research does not address the question of whether memory reports of stressful events differ from those of nonstressful events.

The current study

The current research examined children's recall of unique and instances of repeated stressful and nonstressful events. We developed a paradigm that we believe is an effective and ethical way to study memory for repeated stressful and nonstressful events. The basic event was private swimming lessons for beginners that, because of natural variation in children's fear of water, were experienced as anxiety provoking for some children and not anxiety provoking for others. Children were then read suggestive information by a parent and participated in a recall test. As the most accurate description of children's experiences in the current study, we refer to the children as anxious or nonanxious.

Method

Participants and materials

A total of 81 4- and 5-year-olds ($M = 58.35$ months, $SD = 7.88$, 45 boys and 36 girls) were recruited by advertisement in newspapers, schools, preschools, and day care facilities. Research has consistently found that preschool children are more suggestible than older children (Bruck & Ceci, 1999); thus, 4- and 5-year-olds were chosen to maximize the size of the suggestibility effect and consequently our ability to detect differences in anxious and nonanxious children if they were present. Parents were interviewed by phone to determine children's eligibility and to make an initial placement into an anxiety condition. To be eligible, parents needed to indicate that their children had *some* to *no* water experience[2] and had previously participated in two or fewer sets of swimming lessons. Children were randomly assigned to receive either one or four private (one-on-one) swimming lessons. After completion of the study, children received passes to the recreation facility and a small prize. Age and gender distribution were equal in all conditions (with one exception noted below). Once children arrived at the swimming pool, no child withdrew from the study.

Anxiety measures

Most accessible physiological measures (e.g., heart rate, blood pressure) were inappropriate because children engaged in physical activity during the lessons. Instead, we relied on self-ratings and observer ratings to evaluate children's anxiety. Immediately following the first (or only) lesson, parents and instructors completed a scale of child anxiety ranging from *not at all anxious* (1) to *extremely anxious* (9). Children were asked how they felt before and during (retrospectively) the lesson by pointing to a picture of one of three koala faces that exhibited varying levels of anxiety (Koala Fear Questionnaire [Muris et al., 2003]).

An independent coder rated the first lesson videotapes. First, children's level of apprehension prior to entering the water was rated on a scale ranging from *not at all apprehensive* (1) to *extremely apprehensive* (9). Next, for six different behaviors, the coder provided a frequency rating ranging from *never* (1) to *often* (5). Three behaviors were deemed to be representative of children's comfort in the lesson: engagement behaviors (e.g., initiating participation in activities), laughter/broad smiling, and brave activities (e.g., splashing, face in water). The remaining three behaviors were deemed to be indicative of anxiety in the water: physical avoidance (e.g., cringing, turning away), clinging (to stable items, e.g., wall, teacher, railing), and resistance/refusal to participate in activities. Finally, children's overall level of anxiety was rated on the same scale that parents and instructors used. Interrater reliability (intraclass correlations, ICC_1) between two independent coders on 16% of the sample (evenly distributed across frequency conditions) ranged from *good* to

[2] Fully 86% of children had *some* previous water experience. Children who had *some* versus *no* water experience did not differ in level of anxiety, $F(1,80) = 2.80$, $p = .10$, $\eta^2 = .03$.

excellent (Cicchetti & Sparrow, 1981): .92 for apprehension, .77 for engagement, .82 for laughter, .88 for brave activities, .71 for avoidance, .80 for clinging, .84 for resistance, and .94 for anxiety.

As a result of excellent reliability ($ICC_2 = .83$) between the instructor and video coder evaluations of children's anxiety on the 9-point scale and the hands-on nature of the instructor–child interaction, we relied exclusively on instructor evaluations to determine children's final assignment to an anxiety condition. Children's ratings of their own anxiety and parental ratings of children's anxiety were excluded from the determination of children's anxiety condition based on the limited range of children's own assessments (80% of children selected *not at all anxious* even if they were crying and refusing to get into the water) and a lack of attention to children on the part of many parents during the swimming lesson. Children who received a rating of 1 ($n = 26$) or 2 ($n = 15$) out of 9 from their instructor were placed in the *nonanxious* condition, whereas children who received a rating of 4 or higher (*n*s: 4 = 13, 5 = 9, 6 = 7, 7 = 4, 8 = 4, 9 = 3) were placed in the *anxious* condition. This resulted in removal from the study of 14 children who received a rating of 3 out of 9 on the anxiety scale. Thus, of the 95 children who participated fully in the study, 81 were included in the analyses. Children who received a 3 on the anxiety scale were removed based on discussion with instructors and video coders. It became apparent that children who received a 1 or a 2 were considered not only nonanxious but also generally happy, whereas children who received a 4 or higher were considered to have at least some anxiety (the midpoint on the scale, 5, was labeled as *moderately anxious*). Children who received a 3 were generally those who exhibited mixed emotions (e.g., crying before the lesson and smiling by the end). Given our belief that the children did not belong on a continuum of anxiety but rather comprised two distinct groups (and a mixed group), in retrospect an initial judgment by instructors as anxious or nonanxious followed by a rating of *how* anxious or nonanxious would have been a preferable method of determining anxiety condition.

Half of the children in each anxiety condition as initially assessed were randomly assigned to experience one lesson, and half were assigned to experience four similar lessons. After reassignment to the final anxiety condition, there were 25 nonanxious single-lesson children ($M = 60.58$ months, $SD = 6.49$), 16 anxious single-lesson children ($M = 57.61$ months, $SD = 7.64$), 18 nonanxious four-lesson children ($M = 60.57$ months, $SD = 9.65$), and 22 anxious four-lesson children ($M = 54.95$ months, $SD = 7.42$). To investigate whether anxiety levels varied as a function of age (in months), an Anxiety × Frequency analysis of variance (ANOVA) was conducted with age as the dependent variable, and there was a significant main effect of anxiety, $F(1, 76) = 5.83$, $\eta^2 = .07$; anxious children were younger ($M = 56.18$ months, $SD = 7.54$) than nonanxious children ($M = 60.58$ months, $SD = 7.68$). To address this age effect, we initially used an analysis of covariance (ANCOVA), with age as the covariate, to analyze the data. However, the conclusions from the ANCOVA did not differ from those without age as a covariate, so for ease of reporting, the ANOVA results are reported. Furthermore, although there was a statistically significant age difference, we believe that the actual difference (approximately 4 months) is not psychologically meaningful.

Temperament measures

We included two measures of temperament to determine whether emotional or behavioral characteristics discriminated children who were fearful of the water from those who were not. Parents were asked to complete the Strengths and Difficulties Questionnaire (Goodman, 1997) to assess the presence of children's social and emotional difficulties. The Strengths and Difficulties Questionnaire has five scales: hyperactivity, emotional symptoms, conduct problems, peer problems, and prosocial behavior. The instrument has been highly correlated with the well-established Rutter questionnaires (Elander & Rutter, 1996) for detection of emotional and behavioral disturbances (Goodman, 1997) and has demonstrated good agreement with behavioral observations (Hughes, White, Sharpen, & Dunn, 2000). Parents also completed the Children's Behavior Questionnaire–Very Short Form, which was designed for use with 3- to 7-year-olds and is available in various lengths (36–195 statements). The Children's Behavior Questionnaire–Very Short Form has demonstrated good internal consistency and validity (Putnam & Rothbart, 2006). Scores were summed to represent three broad measures of temperament: extraversion (surgency), negative affect, and effortful control.

Design and procedure

This was a 2 (Frequency: single vs. repeated) × 2 (Anxiety: anxious vs. nonanxious) × 2 (Suggestion: suggestion vs. no suggestion) mixed factorial design. Frequency and anxiety were between-participants variables, and suggestion was a within-participants variable.

Lessons

The instructor was one of five women qualified to teach swimming by the Red Cross. All sessions took place at the same facility. In the repeated condition, the four lessons took place over a period of 2 weeks. All lessons involved the same activities in the same order and contained 16 critical (to-be-remembered) details described below.[3] Details were brought to children's attention through repeated reference by the instructor. In the four-lesson condition, all details varied between lessons. Where possible, items for each activity were linked thematically and selected from the Price and Connolly (2006) category norms. Previous research has found that when variable details experienced across repeated events are thematically (or categorically) related, children are more suggestible to category-consistent false details (Connolly & Price, 2006). Children were encouraged to attempt all activities (and most often did), but if they were unable to perform an activity, the instructor demonstrated the activity twice.

To begin, the instructor pointed out her bathing cap color and the insect badge she wore. Next, the instructor and children discussed a pool safety issue and played a game to enter the water while a "friend" floated nearby. Children warmed up by painting a body part with water while a lucky number floated nearby. Children then played a game while wearing a special wristband, splashed their instructor to get her wet, and hunted for treasure at the pool bottom while their instructor played a musical instrument. Children moved through the water in a special way and performed a trick. Finally, children stood on a foam mat of a particular shape and received a sticker with a picture of fruit on it. The order of activities always was the same, but the order of presentation of options was

[3] Initially, critical details were designated as either "central" or "peripheral." However, this variable was collapsed when it was determined that our definition of centrality did not represent the details children perceived as central and that peripheral details generally were recalled better than central details.

Table 1
Sample set of experienced details

Activity	Day 1	Day 2	Day 3	Day 4	Suggested
Safety	Orientation	Call for help	PFD use	Safe entries	
Bathing cap	Red	White	Black	Blue	Green
Picture	Ant	Ladybug	Spider	Bee	
Entry game	Tree Game	Crab Walk	Alligator Crawl	Simon Says	Speckled Frogs
Float friend	Shark	Whale	Ducky	Fishy	
Paint body	Face	Bum	Legs	Arms	Tummy
Treasure	Ring	Ball	Dice	Puck	
Game	Motorboat	Mr. Shark	Hokey-Pokey	Purple Soup	
Wristband	Bugs Bunny	Tweety	Daffy Duck	Scooby-Doo	
Get teacher wet	Hands	Squirty frog	Sponge	Kicking	Bucket
Lucky number	2	8	7	3	5
Music maker	Guitar	Tambourine	Maraca	Cymbals	Drums
Move in water	Run	Float on back	Front float	Creep	
Water trick	Spin	Jump in water	Hand on bottom	Sit on bottom	Bubbles
Foam mat	Triangle	Octagon	Circle	Rectangle	Square
Sticker	Orange	Banana	Grapes	Pear	

partially counterbalanced; that is, two random orders of options were created, and half of the children received each order (for a sample order, see Table 1).

In an attempt to account for the likely decline in anxiety over the lessons in the repeat-event group, the first lesson was the target (to-be-remembered) lesson. The target lesson was the same for single- and repeat-event children and was tagged by having the instructor wear a large flower on her bathing suit so that the instance could be referred to as "Flower Day." Parents were asked not to take their children swimming until the entire study concluded.

Biasing

Parents read their children a story that contained suggestive information about the target lesson on three separate occasions: 2.5 weeks following the target lesson, 1 week following the first reading, and 1 week following the second reading. Parents were told that the information in the book may or may not have been experienced by their children but that at least some of it was experienced (as per Poole & Lindsay, 1995, 2001). Children were told that they would be reading a book about a swimming lesson. The book contained a personal story about the children participating in a swimming lesson and used the children's names. Of the critical experienced details, half were misrepresented in the book (i.e., suggested) and half were not misrepresented (i.e., the activity was mentioned without specific detail information). Suggestions were specific details that the children did not experience during any lesson (e.g., "While they painted, Mary had a *floating dolphin friend* in the pool"). Details that were not suggested were presented at a more general level in the book (e.g., "While they painted, Mary had a *floating friend* in the pool"). Each suggestive detail was presented three times in the story. Assignment of details as suggested/not suggested was counterbalanced such that a particular item was suggested for half of the children and was not suggested for the other children. The details that were not suggested to the children served as a control for chance guessing of corresponding suggested details.

Memory interview

Two days following the final presentation of the biasing information, a female interviewer (blind to children's condition) conducted the memory test. After establishing rapport with the children, the interviewer ensured that children correctly identified the target lesson and understood that all questions were about Flower Day only. The interviewer explained that a range of responses may be appropriate (e.g., "It's okay to say 'I don't know'"). The interviewer instructed children that even though she might ask questions about things that had already been discussed, this was not an indication that children's previous responses were incorrect.

The interview began with free recall, progressed to cued recall, and ended with recognition questions. Free recall consisted of an open-ended request that children describe everything they remembered about the target lesson, followed by three nondirective prompts (e.g., "What else happened?"). Next, the interviewer asked one follow-up prompt for each piece of information mentioned in free recall (e.g., "You said you played a game; can you tell me more about that?"). In cued recall, a specific question was asked regarding each of the critical details (e.g., "On Flower Day you wore a wristband; what was the picture on your wristband?"). If children did not answer a cued recall question, one prompt was asked. Finally, for each critical detail, 2 recognition questions were asked (for a total of 32): one regarding the experienced detail and the other regarding the suggested/not suggested detail (e.g., "Did you wear a wristband with a picture of Scooby-Doo?"). The correct answer to one question was *yes*, and the correct answer to the other one was *no*. Two random orders of recognition questions were created, and half of the children received each order. The interview was audio- and videorecorded.

Interviews were transcribed, and each critical detail was coded as one of three responses:

Correct response: Critical detail was experienced.
False suggestion: Reported detail was a suggested detail.
Internal intrusion error: Detail was experienced, but not in the target session.

Intercoder agreement was 85% based on 20% of the transcripts.

The maximum possible number of correct responses was 16 (there were 16 critical details), the maximum number of suggested responses was 8 (half of the critical details were suggested, and half were not suggested), and there was no maximum number of internal intrusion errors due to the potential for multiple responses to a single question. Only children's reports of specific details were coded. For example, if children reported that there was a "floating friend" in the pool, this was not coded; however, if children reported that there was a "shark" that floated with them in the pool, this was coded.

Only critical details were coded for three reasons. First, noncritical details were reported infrequently; children reported an average of 1.47 specific noncritical details in free recall, of which 51.3% were theoretically verifiable with our videotapes of the target lesson (verifiable: "I walked into the water," "I put my head under water," etc.; not verifiable: "I heard tapping under water," "I wore my bathing suit under my clothes," etc.). Second, because only the target lesson was videotaped, it was not possible to corroborate children's reports of noncritical details that may have occurred during one of the nontarget lessons. Finally, because a primary objective of the videotaping was to be unobtrusive, there often were camera obstructions for short periods of time throughout the lesson. For example, it was not uncommon for an unsuspecting pool patron to stand between our camera and participants, leaving us unable to see the children until we were able to reposition the camera. Therefore, even noncritical details that were theoretically verifiable may have been present, but we were unable to determine their occurrence conclusively. All tests were two-tailed, and alpha levels were set to .05.

Results

Anxiety conditions

Temperament measures

To examine whether anxious and nonanxious children differed on specific personality measures, we compared children's scores on each of the dimensions of the Children's Behavior Questionnaire–Very Short Form and the Strengths and Difficulties Questionnaire for each anxiety condition. There were no significant differences between anxious and nonanxious children on any of the scales. That is, children in the anxious and nonanxious conditions did not differ on the measured personality traits and appeared to differ only in their fear of the water.

Behavioral coding

To explore children's specific behaviors during the lesson, a more detailed coding of children's behavior was conducted by a video coder (for descriptive information, see Table 2). Two children's videos were not codeable due to technical problems (apprehension ratings were possible). Children in the anxious condition engaged in the following behaviors more often than did children in the nonanxious condition (each category was rated out of 5, all *p*s $< .05$): avoidance, $t(77) = 7.25$, $\eta^2 = .40$, clinging, $t(77) = 5.36$, $\eta^2 = .26$, and resistance or refusal to engage in activities, $t(77) = 8.28$, $\eta^2 = .46$. Anxious children were also less likely than nonanxious children to engage in activities generally, $t(77) = 3.44$, $\eta^2 = .12$,

Table 2
Means and standard deviations of behavioral coding measures

	Anxious	Nonanxious
Overall anxiety[a]	5.65 (1.63)	1.37 (0.49)
Apprehension[a]	5.50 (2.33)	2.78 (1.98)
Avoidance	3.63 (1.10)	2.00 (0.89)
Clinging	3.66 (1.32)	2.12 (1.23)
Resistance/refusal	3.39 (0.75)	2.00 (0.74)
General engagement[b]	3.45 (0.80)	4.07 (0.82)
Brave activities[b]	2.16 (0.49)	2.63 (1.18)
Laughter/broad smiling[b]	2.32 (1.00)	2.17 (1.02)

Note. Standard deviations are in parentheses.
[a] These items were rated from 1 to 9, whereas the other items were rated from 1 to 5.
[b] These items were expected to indicate neutral/positive arousal, whereas the other items were expected to indicate negative arousal. All differences are significant except for laughter/broad smiling.

and to engage in brave activities, $t(77) = 7.16$, $\eta^2 = .46$. Anxious children were rated (from 1 to 9) as more apprehensive at the beginning of the lesson than were nonanxious children, $t(79) = 5.66$, $\eta^2 = .29$.

Interview analyses

In the analyses of recognition responses, only children's correct and incorrect *yes* responses were analyzed because also analyzing correct and incorrect *no* responses would have been redundant. That is, a single question about an experienced detail can have only either a correct *yes* or an incorrect *no* response. Likewise, a question about a control or suggested detail can have only either an incorrect *yes* or a correct *no* response.

Correct responses

Overall, 52% of children reported at least one correct detail in free recall, 95% reported at least one correct detail in cued recall, and 62% responded correctly to at least half of the questions in recognition. Table 3 displays the descriptive information across conditions for free recall, cued recall, and recognition. Children's reports of details experienced during the target lesson (of a possible total of 16) were analyzed in a 2 (Frequency) × 2 (Anxiety) × 2 (Suggestion) ANOVA for each of free recall, cued recall, and recognition.

In free recall, single-lesson children reported more correct details ($M = 1.28$, $SD = 1.47$) than did repeat-lesson children ($M = 0.37$, $SD = 0.49$), $F(1, 77) = 12.05$, $\eta^2 = .14$. Similarly, in cued recall, single-lesson children reported more correct details

Table 3
Means and standard deviations of correct and suggested responses in free and cued recall

Condition	Correct responses			Suggested responses		
	Free recall	Cued recall	Correct yes	Free recall	Cued recall	Incorrect yes
Single event, Anxious						
Suggested (max. = 8)	0.50 (0.79)	2.89 (1.49)	5.11 (2.08)	0.50 (0.79)	2.28 (1.93)	4.78 (1.99)
Not suggested (max. = 8)	0.61 (0.70)	3.50 (1.47)	6.17 (1.20)	0.33 (0.69)	0.28 (0.57)	2.94 (2.18)
Single event, Nonanxious						
Suggested (max. = 8)	0.68 (1.25)	3.12 (1.54)	5.12 (1.62)	0.72 (0.79)	1.92 (1.41)	3.80 (1.73)
Not suggested (max. = 8)	0.72 (0.94)	3.44 (1.87)	5.29 (1.55)	0.00 (0.00)	0.20 (0.50)	2.12 (1.39)
Repeat event, anxious						
Suggested (max. = 8)	0.14 (0.35)	1.00 (1.02)	4.64 (2.32)	0.27 (0.46)	2.27 (1.93)	5.41 (2.40)
Not suggested (max. = 8)	0.23 (0.43)	1.55 (1.50)	5.18 (2.22)	0.10 (0.29)	0.41 (0.67)	3.77 (2.52)
Repeat event, Nonanxious						
Suggested (max. = 8)	0.06 (0.25)	1.19 (1.17)	5.88 (2.50)	0.69 (1.14)	1.18 (2.23)	5.25 (2.62)
Not suggested (max. = 8)	0.31 (0.48)	0.38 (0.62)	5.56 (2.76)	0.06 (0.25)	2.19 (1.94)	4.19 (3.13)
Overall (max. = 16)						
Single event	1.28 (1.47)	6.49 (2.45)	10.81 (2.51)	0.77 (0.87)	2.30 (1.70)	6.67 (3.18)
Repeat event	0.37 (0.49)	2.89 (2.26)	10.50 (4.27)	0.53 (0.89)	2.47 (2.02)	9.29 (4.80)
Anxious	0.70 (0.97)	4.28 (2.97)	10.48 (3.51)	0.58 (0.84)	2.63 (1.96)	8.53 (4.18)
Nonanxious	1.00 (1.40)	5.32 (2.90)	10.85 (3.40)	0.73 (0.92)	2.15 (1.73)	7.29 (4.19)

Note. Standard deviations are in parentheses. max., maximum.

($M = 6.49$, $SD = 2.45$) than did repeat-lesson children ($M = 2.89$, $SD = 2.26$), $F(1, 77) = 42.90$, $\eta^2 = .36$. There was also a main effect of suggestion in cued recall, $F(1, 77) = 8.08$, $\eta^2 = .10$; children reported more correct responses regarding details that were not the subject of a false suggestion ($M = 2.69$, $SD = 1.64$) than regarding details about which suggestions were presented ($M = 2.11$, $SD = 1.88$). There were no significant differences in children's correct *yes* responses.

In sum, single-lesson children reported more correct information than did repeat-lesson children in both free and cued recall, and in cued recall children reported more correct details that had not previously been the subject of a false suggestion than those that had. There were no significant effects related to children's anxiety.

Suggested responses

Overall, 38% of children reported a suggested detail in free recall, 78% did so in cued recall, and 98% responded with at least one incorrect *yes* in recognition. Table 3 displays the descriptive information for free recall, cued recall, and recognition. Children's reports of details that were only read to them (not experienced, of a possible total of 8) in the biasing book were analyzed in a 2 (Frequency) $\times$ 2 (Anxiety) $\times$ 2 (Suggestion) ANOVA for each of free recall, cued recall, and recognition. It is possible that children will guess a suggested detail even if it had not been presented in the biasing book. For instance, if a child spontaneously forgot that she painted her face with water during the target lesson and was asked which body part she painted, she might guess *tummy* even if *tummy* was not suggested to her. To measure this, we analyzed suggested responses to details about which suggestions had not been presented. A suggestibility effect is obtained when children's false reports contain more false suggestions than nonsuggested errors.

In free recall, there was a main effect of suggestion, $F(1, 77) = 17.92$, $\eta^2 = .19$, that was qualified by a Suggestion $\times$ Anxiety interaction, $F(1, 77) = 6.20$, $\eta^2 = .08$ (Fig. 1). To explore this interaction, we examined the difference between suggested and not suggested details (i.e., the suggestibility effect) in each anxiety condition. Nonanxious children

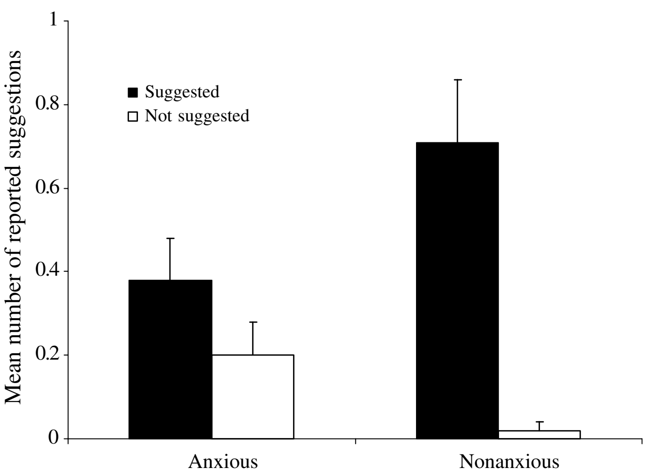

Fig. 1. Mean numbers of reported suggestions in free recall.

evinced a significant suggestibility effect, $t(40) = 4.55$, by reporting more suggestions that had been falsely presented to them ($M = 0.71$, $SD = 0.93$) than details that had not ($M = 0.02$, $SD = 0.16$). Conversely, anxious children evinced no differences in suggestibility in their responses about details that had previously been suggested ($M = 0.38$, $SD = 0.63$) and about details that had not ($M = 0.20$, $SD = 0.52$), $t(39) = 1.42$, $p = .16$. In cued recall, there was a main effect of suggestion, $F(1,77) = 59.48$, $\eta^2 = .44$; children reported more suggestions about details that were falsely suggested ($M = 2.07$, $SD = 1.86$) than about details that were not ($M = 0.31$, $SD = 0.58$).

Recall that there was a corresponding suggestion for each target detail, although only half of the suggestions were presented to children. For children to report a suggested response in recognition, they would reply with an incorrect *yes* to a question that contained the suggested detail. Children responded with an incorrect *yes* more often about suggested details ($M = 4.74$, $SD = 2.23$) than about not suggested details ($M = 3.16$, $SD = 2.40$), $F(1,77) = 49.00$, $\eta^2 = .39$. Furthermore, children in the repeat-lesson condition responded with an incorrect *yes* more often ($M = 9.29$, $SD = 4.80$) than did children in the single-lesson condition ($M = 6.67$, $SD = 3.18$), $F(1,77) = 7.55$, $\eta^2 = .09$.

In sum, there was a significant suggestibility effect in the current study; children reported more suggestions about suggested details than about not suggested details in cued recall and in recognition. In free recall, children who were nonanxious evinced a significant suggestibility effect, whereas children who were anxious did not. Finally, in response to recognition questions, children who experienced four lessons were more suggestible than children who experienced only one lesson.

Internal intrusion errors

Overall, 22% of children reported at least one internal intrusion in free recall and 57% did so in cued recall. Recognition questions were structured such that we were not able to access reports of nontarget details. Children's reports of lesson details that were experienced, but on a nontarget day, were analyzed with a 2 (Frequency) × 2 (Anxiety) × 2 (Suggestion) ANOVA for each of free recall and cued recall. Although internal intrusions are truly possible only in the repeat-lesson condition, the single-lesson condition was included in these analyses as a measure of children's chance reporting of the particular internal intrusions (see explanation in "Suggested Responses" section above).

In free recall, there were no significant effects. In cued recall, there was a main effect of frequency, $F(1,77) = 49.88$, $\eta^2 = .39$; repeat-lesson children reported more internal intrusions ($M = 2.94$, $SD = 2.05$) than did single-lesson children ($M = 0.44$, $SD = 1.01$). Mean differences in reports of internal intrusions by anxious children ($M = 1.18$, $SD = 1.82$) and nonanxious children ($M = 1.14$, $SD = 2.20$) were not significant, $F(1,77) = 0.12$, $p = .73$.

Discussion

This study examined children's recall of variable details of an instance of a repeated versus single stressful or nonstressful event. We draw three important conclusions from these data. First, the presence or absence of anxiety did not substantially influence most measures of children's recall. Second, anxious children were less suggestible than nonanxious children in free recall only. Third, the memory reports of repeat-event children were inferior to the memory reports of single-event children. Each conclusion is discussed in turn.

Aside from one result in free recall (discussed below), there were no differences in correct responses, suggestibility, or internal intrusion errors between anxious and nonanxious children. In contrast to one prior study that found that stress and frequency of experience may interact (Vandermaas et al., 1993), in the current study there was no indication that single- and repeat-event children responded differently to anxiety; in both conditions, there was only one effect of anxiety on memory reports. Thus, the current results indicate that the literature on children's memory for neutral or positive events may indeed apply to children's memory for stressful events.

Given that anxiety had very little effect on children's memory reports, it is important to first address the possibility that this study simply did not detect differences. First, with respect to level of anxiety, there is evidence that anxious children differed behaviorally from nonanxious children. Furthermore, only children who were classified as anxious or nonanxious were included in the analyses; children for whom emotions were more ambiguous were excluded. The effect of this separation should be to maximize the chance of finding an anxiety difference if one existed. Second, an a priori power analysis using the fpower macro for SAS (Friendly, 2005) indicated that in a 2×2 between-participants factorial ANOVA, a cell size of 16 would be sufficient to detect a medium effect of anxiety if it was present. With a minimum of 16 children in our between-participants cells, if there was a medium effect of anxiety, it is likely we would have found it. Third, we measured child characteristics that might have differentiated anxious children from nonanxious children and also may have affected their memory. Specifically, the anxious and nonanxious groups did not differ on any of the personality characteristics or temperament measures, as measured by the Strengths and Difficulties Questionnaire and the Child Behavior Questionnaire–Very Short Form. Thus, we are reasonably confident that the two groups of children were comparable on characteristics that could affect memory and differed only in their fear of the water.

Consistent with the findings of many scholars (e.g., Goodman et al., 1991; Ridley, Clifford, & Keogh, 2002; Shrimpton et al., 1998), children who were anxious sometimes were less suggestible than children who were not anxious. Specifically, in free recall, nonanxious children evinced a significant suggestibility effect, whereas anxious children did not. Ridley and colleagues (2002) proposed that anxious children may be more likely than nonanxious children to find suggestive information threatening because it differs from their recall of the event. This may lead to more effortful processing of suggestive information and, thus, a reduction in suggestibility. In future work, it may be helpful to measure children's reactions to the suggestion presentations to explore this possibility.

The findings regarding the effects of event frequency are generally consistent with a large body of research suggesting that recall of an instance from a series of similar instances is difficult for children. Repeat-lesson children were less likely than single-lesson children to report correct information in free and cued recall, were more likely to report incorrect information in cued recall (internal intrusions), and were more suggestible in response to recognition questions. That single-lesson children reported more correct information than repeat-lesson children was anticipated given previous research finding that unique events are better recalled than instances of repeated events that vary across experiences (e.g., Hudson, 1990). This finding is also consistent with theoretical expectations. As discussed in the Introduction, fuzzy-trace theory predicts difficulty in precise recall of a particular instance when it is embedded among several other similar instances. Although children who received four lessons were not as accurate as children who received one lesson, many errors reported by repeat-lesson children were reports of details that had occurred but not in the target lesson. It is evident that a substantial challenge faced by children who experience repeated events is discriminating between experienced instances (e.g., Connolly & Price, 2006; Powell et al., 1999).

Finally, children who experienced repeated lessons were more likely than children who experienced a single lesson to report suggestions in response to recognition questions. As discussed in the Introduction, increased suggestibility after experiencing repeated events compared with experiencing a unique event is consistent with expectations developed from fuzzy-trace theory as well as with previous research; suggestions that are gist consistent are more likely to be accepted by repeat-event children than are comparable details experienced by single-event children.

It is important to note, however, that there was evidence of heightened suggestibility for repeat-lesson children versus single-lesson children only in response to recognition questions, not in free or cued recall. This effect is similar to that reported by Powell and Roberts (2002), who argued that the process of retrieving experienced details from a repeated event and attributing each to its source is a cognitively challenging process. When tested with a recognition question, children can respond to the question without engaging in this difficult process because a plausible response is provided in the question. When the plausible response is a suggested detail, a suggestibility effect will be observed. Conversely, when memory is tested with free or cued recall, memory for the event is more likely to be retrieved and can be used to reject suggestions.

There are at least two other explanations for our failure to find greater suggestibility in free and cued recall for children who experienced four lessons as compared with one lesson. First, because the readings of the biasing book were consistently spaced in both frequency conditions, the delay from the final (or only) lesson to the first reading of the biasing book was 2.5 weeks in the single-lesson condition and only 0.5 week in the repeat-lesson condition. This difference may have served to increase the relative suggestibility of the single-event children to levels observed in repeat-event children because the memory trace for the target lesson was not as strong when single-event children received the misinformation (Melnyk & Bruck, 2004). The second explanation relates to the temporal position of the target instance. In general, recall of a first instance from a series is superior to that of other instances, that is, a primacy effect (e.g., Hudson, 1990; Powell, Thomson, & Ceci, 2003). However, much of the previous repeat-event research has focused on recall of the final instance. In the current study, we targeted the first instance, and this may have resulted in stronger memory for repeat-lesson children than was observed in comparable studies and, thus, heightened resistance to suggestion. Despite some methodological challenges associated with recall of the first instance (i.e., differential delay between the target instance and recall), the potentially unique patterns of recall of the first instance should lead to further research that considers variable temporal positions of the target instance.

Forensic implications

When memory experts are called to testify in court, a criticism that may be leveled against them is that the research they cite is based on laboratory experiments that do not involve stressful events, whereas the experiences they propose to generalize do. To study the validity of this concern, one of the primary objectives of the current study was to examine whether or not children's memory for a stressful event differed substantially from their memory for a neutral event. We found only one effect of anxiety, and it related to suggestibility and not to correct responses. These data provide unique support for the argument that memory for stressful events is similar to memory for neutral events. Accordingly, our understanding of memory processes, well established over many years of research, may be used to understand reports of those who provide testimony to the court.

A further concern for children who participate in the legal system is that they often have been abused repeatedly (Connolly & Read, 2006; Sas, Hurley, Hatch, Malla, & Dick, 1993). These children often are required by the legal system to recall a particular instance of abuse for the accused to defend himself or herself. The current study provides further evidence that this may be a very challenging request that might not elicit the best and most accurate information from children.

Finally, there was a relatively high level of suggestibility in the current study; most children reported at least one suggestion in the memory interview. Given that a report of even one incorrect detail could be used to discredit a child's allegation, this finding has potentially concerning implications for fair assessments of children's reports. The suggestibility manipulation in the current study was particularly strong, perhaps more so than that which may normally be encountered in a forensic setting, that is, repeated, highly similar experiences, with each containing categorically related details (Connolly & Price, 2006). Nonetheless, these results highlight the need for educating interviewers about questioning children who have experienced a highly similar, but variable, repeated event. Many children are simply not able to respond consistently and accurately to questions about highly related details that vary from experience to experience. Asking such questions is likely to lead to reduced accuracy even when the incidents were truly experienced by the children. Such reporting errors may lead to an unjustified skepticism in reports of children's true experiences.

Limitations

Of course, there are a number of limitations to the current study. First, the levels of attained anxiety might not have been high enough to observe an effect on memory. For instance, Deffenbacher and colleagues (2005) argued that a deleterious effect of anxiety on memory is observable only when levels of anxiety are very high—much higher than would be observed in most laboratory-based studies. Although what constitutes a high level of anxiety was not defined in their report, we believe that some of our anxious children in fact did experience very high levels of stress. For example, many of the children in our anxious condition cried when approaching the swimming pool, and our instructors reported that many of the anxious children also trembled. Second, our measure of anxiety was imperfect. Perhaps in the future physiological measures of anxiety, as well as a more precise self-assessment of anxiety by the children themselves, could be implemented. However, most accessible physiological measures were not possible due to the physical nature of the event, and such measures might actually be inappropriate when comparing anxious children with those experiencing the same level of another emotion such as happiness (both may show elevated physiological arousal). Third, as discussed above, children who received four lessons were presented with the biasing information nearer the time of their last lesson experience than were children in the single-lesson condition. Unfortunately, it was not logistically possible to have the first lesson as the target lesson, have a consistent delay from the target lesson to the memory interview, and have a consistent delay from the target lesson to the initial presentation of the misinformation. Finally, anxious children in the current study might not have actively participated in as many of the lesson activities as did children who were nonanxious. Participation in an event has been found to lead to more complete, accurate, and organized reports than has observing an event (Murchaver, Pipe, Gordon, Owens, & Fivush, 1996) and may also reduce children's susceptibility to suggestion (Rudy & Goodman, 1991). However, if degree of participation had affected the results in this way, anxious children would have recalled less and been more suggestible than nonanxious children. We did not observe these patterns.

Conclusion

The current findings indicate that research on memory for nonemotional events may generalize to children's recall of stressful experiences. The findings related to anxiety are consistent with research that has found few differences when comparing children's recall of stressful events with their recall of nonstressful events (e.g., Ornstein et al., 1992). This research also highlights the importance of considering frequency of experience when researching children's autobiographical memory. Multiple experiences are very common in children's daily lives, and research into children's recall abilities must reflect this prevalence. Finally, this research takes an important step in the study of the impact of stress on children's memory. We have developed a paradigm that, although intensive, can be used to compare children's recall of the same event experienced as either stressful or nonstressful.

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