1-1-2010

Children's memory for painful procedures: the relationship of pain intensity, anxiety, and adult behaviors to subsequent recall.

Melanie Noel
Dalhousie University

C. Meghan McMurtry
cmcmurtr@uoguelph.ca

Christine T. Chambers

Patrick J. McGrath

Children's Memory for Painful Procedures: The Relationship of Pain Intensity, Anxiety, and Adult Behaviors to Subsequent Recall

Melanie Noel,[1] MSc, C. Meghan McMurtry,[1] BA, Christine T. Chambers,[1,2,3] PhD, and Patrick J. McGrath,[1,2,3,4] PhD

[1]Departments of Psychology, [2]Department of Pediatrics, Dalhousie University, [3]Centre for Pediatric Pain Research, IWK Health Centre and [4]Department of Psychiatry, Dalhousie University

Objective To examine whether children's experience of pain intensity and anxiety, and adult behaviors during venepuncture, were related to children's memories of the procedure. **Methods** Participants were 48 children (24 males, 24 females) between the ages of 5 and 10 years who underwent venepuncture. The venepunctures were videotaped and adult behaviors were coded. Children self-reported their pain intensity and anxiety immediately and 2 weeks following venepuncture and answered contextual questions at follow-up. **Results** Children who initially reported higher levels of pain tended to over-estimate their anxiety at follow-up, whereas children who reported lower levels of pain accurately- or under-estimated their anxiety. Staff coping-promoting behaviors predicted the accuracy of children's contextual memories. Staff and parent behaviors did not predict children's recalled pain intensity and anxiety. **Conclusions** Results indicate that children's direct experience of pain intensity and staff behaviors during venepuncture are related to their memories. These data highlight the importance of effective pain management during medical procedures.

Memory is an active process that influences subsequent experience. The way that children remember painful medical procedures affects their experience of pain and distress during subsequent procedures. Children who develop exaggerated negative memories of pain and anxiety tend to experience more pain and distress at subsequent procedures than children who accurately recall their experience (Chen, Zeltzer, Craske, & Katz, 2000). These memories can be formed very early in life (Taddio, Katz, Ilersich, & Koren, 1997), have the potential to persist into adulthood, and are predictive of fear and avoidance of medical care later in life (Pate, Blount, Cohen, & Smith, 1996). It has been suggested that children's memories of early pain experiences may even initiate chronic pain syndromes and facilitate their persistence into adulthood (Sun-Ok & Carr, 1999). Simply put, children's memories for painful experiences may be as important to their health as their direct experience of the pain itself.

Memory representations of painful experiences are complex and involve somatosensory (e.g., pain intensity), affective (e.g., anxiety), and contextual aspects of the event (Ornstein, Manning, & Pelphrey, 1999). Research suggests that young children are fairly accurate when recalling contextual details of painful medical procedures, especially in the absence of specific or leading questions (Sjöberg & Lindholm, 2005). Similarly, their memories for somatosensory and affective aspects of painful experiences can be accurate (Badali, Pillai, Craig, Giesbrecht, & Chambers, 2000; Lander, Hodgins, & Fowler-Kerry, 1992; Zonneveld, McGrath, Reid, & Sorbi, 1997). However, memories are constructive and susceptible to distortion over time (Bruck, Ceci, Francoeur, & Barr, 1995) and the manner of distortion has important implications for children's coping during subsequent procedures. For example, children whose memories of lumbar punctures were reframed by therapists in positive ways (e.g., highlighting how children effectively

All correspondence concerning this article should be addressed to Melanie Noel, Psychology Department, Dalhousie University, Canada. E-mail: melanie.noel@dal.ca

Journal of Pediatric Psychology 35(6) pp. 626–636, 2010
doi:10.1093/jpepsy/jsp096
Advance Access publication November 4, 2009

coped during the procedure) experienced less pain and distress at subsequent procedures than children whose memories were not reframed (Chen, Zeltzer, Craske, & Katz, 1999).

The way that children's memories are emotionally framed is influenced by the level of pain and distress that they experience. Children who experienced higher levels of pain and distress during lumbar punctures tended to develop negatively exaggerated memories and recalled fewer details overall as compared to children who showed more effective coping (Chen et al., 2000). Similarly, children who received standard care for vaccinations tended to form more negatively exaggerated memories of pain intensity than children who received distraction or local anesthetic (Cohen et al., 2001). These children were also less accurate at recalling anxiety than children who received local anesthetic. Accordingly, children's experiences of pain intensity and emotional distress (e.g., anxiety) in the context of less invasive, albeit painful and highly feared procedures, may also be related to how exaggerated their memories become over time. It is likely that the relationship between pain and memory is mediated through attention. Children who experience more pain during medical procedures are less likely to have the attentional resources necessary to encode the event (Chen et al., 2000), which leads to poorly organized memories (Eysenck, 1982). Furthermore, increased distress may be associated with increased production of cortisol, which has been linked to impairments in memory, possibly due to its negative effects on the hippocampus (Newcomer, Craft, Hershey, & Askins, 1994). Identifying factors that affect children's pain and distress is important as they may impact children's memories and coping during subsequent procedures.

Adult behaviors during medical procedures may play an important role in the development of children's pain memories. Adults are influential in children's ability to cope with stress by influencing children's exposure to and appraisal of stressors as well as their individual coping styles (Power, 2004). Adult behaviors during medical procedures are strongly related to children's distress and coping in the immediate medical context (Blount et al., 1997). Certain adult behaviors are related to increased child coping whereas others are related to increased levels of pain and distress. Given that adult behaviors during medical procedures are related to children's pain and distress, and the level of pain and distress is related to how children recall the procedure, it is likely that adult behaviors are related to children's memories for painful procedures. The present study examined whether children's initial levels of pain intensity and anxiety and adult behaviors were related to children's subsequent recall. It extends previous research by examining the role of psychosocial factors (i.e., adult behaviors) in children's memories for painful procedures and the relationship between children's distress and subsequent recall in the context of a relatively minor episode of acute pain. It was expected that children who reported higher levels of pain intensity and anxiety would form negatively exaggerated memories and recall fewer contextual details than children who reported lower levels of pain intensity and anxiety. Secondly, it was expected that children exposed to more distress-promoting adult behaviors would form more negatively exaggerated memories and recall fewer contextual details than children exposed to more coping-promoting adult behaviors.

Methods

Participants

Participants were 48 children (24 males; 24 females) aged 5–10 years ($M = 7.50$, $SD = 1.41$) who underwent venepuncture in a blood drawing laboratory at a tertiary care pediatric hospital and their parents. Participants were recruited to participate in a larger study (McMurtry, 2009) and were later invited to take part in a follow-up memory study. In the larger study, the children viewed and responded to brief video clips of specific parental behaviors during their procedure as well as vignettes of a pretend mother. The type and amount of exposure to the video clips was kept consistent across children. The memory study occurred after the larger study began, enabling collection of initial pain and anxiety ratings without the children's knowledge that they would later be asked to recall this information. The larger study included 102 participants. Recruitment for the current study began after 32 participants had taken part in the larger study. A total of 70 participants were approached and 63 indicated interest in participating in the memory study. Of these, 15 children were excluded because they received an intervening needle prior to the memory interview ($n = 8$) or they were not available at follow-up ($n = 7$).

The majority of children were Caucasian (78.3%). Parents included 85.4% mothers and 14.6% fathers with ages ranging from 25 to 56 years ($M = 38.19$, $SD = 7.26$). On average, parents had completed some post-secondary education. Three children received a parent-applied local anesthetic (e.g., EMLA—Eutectic Mixture of Local

Table I. Children's Recall of Contextual Details

Questions	Correct answers (%)
During what season did you have your blood drawn?	66
During what month did you have your blood drawn?	61.7
What time of day did you get your blood drawn (e.g., morning-time, lunch-time or supper-time)?	51.1
Who was in the room with you when you got your blood drawn?	66
Was the person that gave you the needle a man or a woman?	97.9
Where on your body did they put the needle?	83
What color hair did the person that videotaped your needle have?	48.9
What color was the chair in the room that you had your blood drawn?	40.4
What color was the counter top in the room that you had your blood drawn?	0
What color were the cupboards in the room that you had your blood drawn?	23.4
Where was your mom/dad when you got your blood drawn?	89.4
What could you pick out of a drawer immediately after you got your needle?	80.9

Anesthetics) prior to venepuncture.[1] On average, children had previously had blood work done at least three times, received at least three prior immunizations, and had been hospitalized 1–2 times. The majority of children were described as having minor health conditions (60.4%), which most commonly included allergies and asthma. Preliminary analyses revealed no differences between children on the basis of having a minor health condition, sex, or age on study variables (e.g., pain intensity, anxiety, adult behaviors, child distress, and coping).

Measures

Pain Intensity

Pain intensity was measured using the one-item Faces Pain Scale-Revised (FPS-R; Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001). The FPS-R consists of six gender-neutral faces depicting ''no pain'' (neutral face) to ''most pain possible'' expressions. Children select a face that represents how much pain she/he feels and the faces are scored: 0, 2, 4, 6, 8, and 10. The FPS-R is the most psychometrically sound self-report measure of pain in children between 4 and 12 years of age (Stinson, Kavanagh, Yamada, Gill, & Stevens, 2006).

Emotional Distress/Anxiety

Given that there is no agreed upon ''gold standard'' self-report measure of anxiety for use with children, anxiety was measured using two one-item measures of anxiety: The anxiety scale of the Children's Anxiety and Pain Scales (CAPS; Kuttner & LePage, 1989) and the Faces Anxiety Scale (FAS; McKinley, Coote, & Stein-Parbury, 2003). Both anxiety scales consist of five faces representing varying degrees of anxiety. Children are instructed to select a face that represents how scared she/he feels and the ordered faces are scored from 0 to 4. The anxiety scale of the CAPS is intended for use with children between the ages of 4 and 10 years and has shown good evidence of validity (Kuttner & LePage, 1989). The FAS has also shown good evidence of validity, rank order, and equality between scale points (McKinley et al., 2003).

Context

Children's contextual memories were assessed through 12 open-ended questions (Table I). These questions were similar to those used with children between 5 and 10 years of age in a previous study on children's memory for pain during the cold pressor task (Badali et al., 2000) but were modified for the context of venepuncture. Correct answers to the questions were predefined by a researcher who watched the videos of the procedures and recorded the correct answers for each child. To ensure that younger children were not penalized for their cognitive level, many of the predefined answers were broad and developmentally appropriate. For example, in response to the question, ''What time of day did you get your blood drawn?,'' acceptable responses could include the general time of day (e.g., morning-time, lunch-time, or supper-time) as opposed to exact times of day. Preliminary analyses revealed that there was not a significant relationship between contextual recall and the age of the children.

[1]Preliminary analyses revealed no differences between children who received a parent-applied local anesthetic prior to venepuncture and the other children on any outcome variables.

Adult and Child Behaviors

Parent, medical staff, and child behaviors during venepuncture were videotaped, transcribed, and later coded using the CAMPIS-Revised (CAMPIS-R; Blount et al., 1997). In the CAMPIS-R, 35 individual codes are collapsed into six categories: three child codes (i.e., coping, distress, and neutral behaviors) and three adult codes (i.e., coping-promoting, distress-promoting, and neutral behaviors). The categorization of the behaviors in the CAMPIS-R was made on both theoretical and empirical grounds. With the exception of neutral behaviors, each of the adult codes consists of specific adult behaviors that have been found to be associated with either child coping (i.e., humor directed to child, nonprocedural talk to child, and command to engage in coping strategy) or child distress (i.e., apology, criticism, empathy, reassurance, giving control to child). The CAMPIS-R has been found to have high interrater reliability and good concurrent validity with both observational and self-report measures (Blount et al., 1997).

Procedure

The study was approved by the hospital's Research Ethics Board and consisted of two phases. The first phase took place during, and immediately following, the children's venepunctures. Procedures were videotaped and pain and anxiety ratings were obtained from children immediately following the procedure. The administration order of the pain and anxiety scales was counterbalanced across children. Children then completed a laboratory-based study in which they viewed and responded to brief video clips of specific parental behaviors during their procedure as well as vignettes of a pretend mother (McMurtry, 2009). During their participation in the first phase of the study, children and parents were not aware of the memory study. As such, baseline pain and anxiety ratings and child and adult behaviors during venepunctures were not affected by knowledge that children's memories for the procedures would later be assessed. After the first phase of the study was completed, parents were given an information sheet that briefly outlined the second (memory) phase of the study. Interested participants were asked for permission to be contacted on the telephone and were given a sealed envelope containing a consent form and copies of the pain and anxiety scales which were individually contained in sealed and numbered envelopes. Parents were asked to refrain from opening the sealed envelopes until a researcher called them. Approximately 2 weeks after venepuncture ($M = 14.71$ days, $SD = 4.20$ days, range = 12–36 days), parents were contacted over the telephone at which time a researcher described the study and requested their participation. Telephone interviews for research on children's memory for pain have been effectively conducted with children as young as 5 years of age (Badali et al., 2000, Lander et al., 1992).

When the researcher initially contacted the parent, they either conducted the interview at that time or set up an alternate time to conduct the second phase of the study. The majority of interviews were conducted between 12 and 19 days after children's venepunctures ($n = 45$); however a minority of children were interviewed 25 ($n = 2$) and 36 days ($n = 1$) following the procedures due to their lack of availability during the initial interview attempts. Preliminary analyses revealed no differences between both groups of children on any of the outcome variables. Previous memory research has used time frames ranging from 1 week to 1 year (e.g., Badali et al., 2000; Chen et al., 2000). The present study employed a 2-week time frame to limit exclusions as a result of intervening needles and attrition.

At the beginning of the memory interview, the researcher obtained verbal consent from the parents and assent from the children. Parents were asked to refrain from helping or influencing their children's responses so as to not bias their recall. The memory assessment followed a similar protocol to what was used with children aged 5–10 years in a previous study on children's memory for a novel pain stimulus (Badali et al., 2000). During the telephone memory interview, children were unable to physically point to the faces in front of the researcher as they had done immediately following their venepunctures. Therefore, for ease of telephone communication and in order to avoid introducing a confounding numerical scale, letters of the alphabet were placed in random order under the faces on each scale that was used during the follow-up telephone interview. Children were reinstructed in the use of each rating scale and oriented to the placement of letters under each face. The order of scale presentation was counterbalanced and randomly numbered from 1 to 3 for ease of telephone communication. Children were asked to recall when they had their venepuncture and complete the pain and anxiety measures based on their memories of the procedure. Children were also asked a series of open-ended questions to assess their recall of the context in which the venepuncture took place (Table I).

Transcription and CAMPIS Coding

The videotaped procedures were transcribed on a word-by-word basis by one of two research assistants. Each participant's videotape was coded from the beginning of the recording (shortly after the child entered the room) until the child was out of the procedure chair. Each of the CAMPIS-R behavior categories was calculated as proportions.[2] Each proportion was calculated separately for each speaker as the number of instances of each type of behavior divided by the total number of behaviors summed across coping, distress, and neutral categories. There were two coders: one was the primary CAMPIS coder and the second coded 20% of the transcripts for reliability. Prior to coding the videotaped procedures for the current study, both coders attended a CAMPIS coding training workshop and subsequently coded five test tapes demonstrating overall reliability >80% (range = 82–98%). Both coders were blind to the children's memory interview responses at the time of coding. The kappa for the parent codes was .91 (standard error [*SE*] of .015), the kappa for staff codes was .93 (*SE* of .013), and the kappa for child codes was .93 (*SE* of .018) representing excellent reliability (Fleiss, 2003).

Table II. Children's Mean Pain Intensity and Anxiety Ratings, Behavioral Distress and Coping, and Correctly Answered Contextual Questions at Each Time Point ($N = 48$)

Variable	M (*SD*)	Actual range	Possible range
Initial pain intensity			
FPS-R	3.29 (3.10)	0–10	0–10
Initial anxiety			
FAS	1.17 (1.12)	0–4	0–4
CAPS	1.13 (1.16)	0–4	0–4
Child distress (proportion)	0.43 (0.30)	0–1	0–1
Child coping (proportion)	0.39 (0.32)	0–1	0–1
Recalled-pain intensity			
FPS-R	2.38 (3.06)	0–10	0–10
Recalled anxiety			
FAS	1.15 (1.20)	0–4	0–4
CAPS	0.98 (1.12)	0–4	0–4
Contextual questions	7.09 (2.06)	2–10	0–12

Note. FPS-R: Faces Pain Scale-Revised; FAS: Faces Anxiety Scale; CAPS: The anxiety scale of the Children's Anxiety and Pain Scales.

Results

Mean pain intensity and anxiety ratings, behavioral distress and coping, and correctly answered contextual questions across time points are shown in Table II.

Hypothesis 1: The Relationship between Children's Initial Anxiety and Pain Intensity and Subsequent Recall

After controlling for initial pain intensity and behavioral distress, anxiety reported immediately following the needle, as measured by the FAS and the CAPS, was not related to children's recalled pain intensity ($r = .23$, $p > .05$; $r = .25$, $p > .05$, respectively). After controlling for initial anxiety and behavioral distress, pain intensity reported immediately following venepuncture was related to children's recalled anxiety as measured by the FAS ($r = .50$, $p < .001$) but not the CAPS ($r = .24$, $p > .05$). To examine the relationship between children's initial level of pain intensity and the degree of distortion of their memories of anxiety, children were categorized into one of three groups: over-estimators, accurate estimators, and under-estimators. Over-estimators and under-estimators were operationally defined as children who had differences between initial and recalled anxiety of plus or minus at least one face on the FAS. This is a similar, and slightly more conservative, approach to defining accuracy to previous research on children's memory for pain (Badali et al., 2000). Mean pain intensity scores across distortion groups are shown in Figure 1. Children who initially reported higher levels of pain intensity tended to over-estimate their level of procedural anxiety 2 weeks following the procedure whereas children who initially reported lower levels of pain intensity tended to accurately or under-estimate their levels of procedural anxiety at follow-up [(t (46) = –2.84, $p < .05$]. This result remains significant if a more stringent alpha level (e.g., $p < .01$) is applied.

Children's contextual recall (i.e., total number of contextual questions answered correctly) was not related to: pain intensity reported immediately following venepuncture ($r = .17$, $p > .05$) or anxiety as measured by the CAPS ($r = .04$, $p > .05$) or the FAS ($r = .13$, $p > .05$).

[2]Each of the CAMPIS-R behavior categories was also calculated as proportion of time (i.e., the number of verbalizations in each of the CAMPIS categories was calculated as a rate per minute score). All analyses were also conducted using proportion of time instead of proportion of behavior. The results for all of the regression analyses did not change. In terms of the bivariate correlations, higher proportions of parent distress-promoting behaviors were related to more child distress behavior ($r = .64$, $p < .001$), higher pain intensity ratings ($r = .48$, $p < .01$), and higher anxiety ratings as measured by both the FAS ($r = .52$, $p < .01$) and the CAPS ($r = .50$, $p < .001$). Higher proportions of staff distress-promoting behaviors were related to more child distress behavior ($r = .37$, $p < .05$), higher pain intensity ratings ($r = .43$, $p < .01$), and higher anxiety ratings as measured by both the FAS ($r = .35$, $p < .05$) and the CAPS ($r = .40$, $p < .01$). Parent and staff coping-promoting behaviors were not related to any of the child variables.

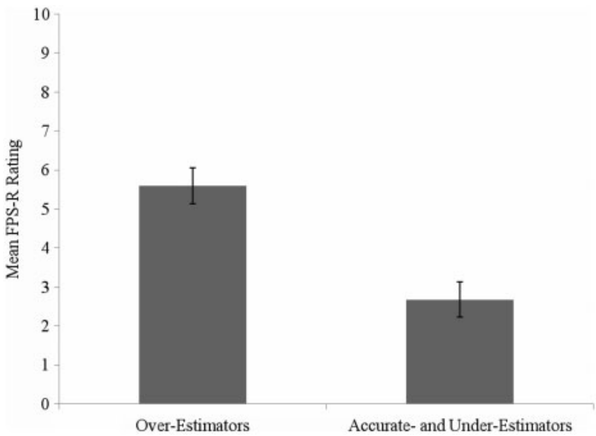

Fig. 1. Mean Pain Intensity Scores Across Distortion Groups.

Hypothesis 2: The Relationship between Adult Behaviors and Children's Subsequent Recall

Prior to analyzing the relationship between adult behaviors and children's memories, it was important to verify that the relationships between adult distress- and coping-promoting behaviors and children's immediate distress and coping were in the expected directions. As expected, higher proportions of parent distress-promoting behaviors were related to more child distress behavior ($r = .50$, $p < .001$), less child coping behavior ($r = -.47$, $p < .01$), higher pain intensity ratings ($r = .41$, $p < .01$), and higher anxiety ratings as measured by both the FAS ($r = .40$, $p < .01$) and the CAPS ($r = .41$, $p < .01$). Conversely, higher proportions of parent coping-promoting behaviors were related to less child distress ($r = -.34$, $p < .05$) and more child coping ($r = .33$, $p < .05$) as well as lower anxiety ratings as measured by the FAS ($r = -.31$, $p < .05$). Regression analyses revealed that parent behaviors explained a significant amount of the variance in pain intensity [$R^2 = .178$, $F(2, 45) = 4.88$, $p < .05$] and anxiety as measured by the FAS [$R^2 = .163$, $F(2, 45) = 4.366$, $p < .05$] and the CAPS [$R^2 = .166$, $F(2, 45) = 4.48$, $p < .05$].

Higher proportions of staff distress-promoting behaviors were related to more child distress behavior ($r = .64$, $p < .001$), less child coping behavior ($r = -.49$, $p < .001$), higher pain intensity ratings ($r = .53$, $p < .001$), and higher anxiety ratings as measured by both the FAS ($r = .53$, $p < .001$) and the CAPS ($r = .56$, $p < .001$). Conversely, staff coping-promoting behaviors were not related to any of the child distress, coping, pain intensity, or anxiety variables. Regression analyses also revealed that staff behaviors explained a significant amount of the variance in pain intensity [$R^2 = .341$, $F(2, 45) = 11.647$, $p < .001$] and anxiety as measured by both the FAS [$R^2 = .288$, $F(2, 45) = 9.116$, $p < .001$] and the CAPS [$R^2 = .323$, $F(2, 45) = 10.76$, $p < .001$]. Given that parent and staff behaviors were found to have different relationships to the child variables, separate regressions were conducted for parents and staff.

To determine whether adult behaviors (coping- and distress-promoting) during venepuncture predicted children's memories of pain intensity and anxiety, a series of hierarchical regressions were conducted separately for parents and medical staff. The results are shown in Table III. Pain intensity ratings at the time of the procedure were entered as a predictor and pain intensity ratings 2 weeks following the procedure as an outcome. Next, adult behaviors were entered as a predictor. Similar analyses were conducted for children's anxiety ratings. Results revealed that parent and medical staff behaviors did not predict children's recalled pain intensity and anxiety, over and above their initial levels of pain intensity and anxiety.

To determine whether adult behaviors during venepuncture predicted children's memories of the procedural context, a series of hierarchical regressions were conducted with the total number of contextual questions that children answered correctly as the outcome. The results are shown in Table IV. As it was expected that older children may recall more contextual details than younger children (Quas, Goodman, Bidrose, Pipe, Craw, & Ablin, 1999), age was entered first as a predictor. Next, adult behaviors were entered as a predictor. Results revealed that above and beyond the effects of age, staff coping-promoting behaviors significantly predicted children's contextual memories [$R^2 = .31$, $F(2, 44) = 9.84$, $p < .05$]. This indicates that children who were exposed to medical staff who engaged in more coping-promoting behaviors tended to accurately recall more contextual details than children who were exposed to less coping-promoting behaviors. However, this result does not remain significant if a more stringent alpha level (e.g., $p < .01$) is applied. Conversely, staff distress-promoting behaviors and both distress- and coping-promoting parent behaviors did not predict children's contextual memories.

Discussion

The current study examined the relationship between children's pain, anxiety, and adult behaviors and their memories for venepunctures. Children's initial experience

Table III. Summary of Hierarchical Regression Analyses for Adult Behaviors Predicting Children's Recalled Pain and Anxiety

Variable	*B*	*SE B*	β	R^2	Change R^2
Pain Intensity (FPS-R)					
Step 1				0.684	
Initial FPS-R	0.815	0.082	0.827		
Step 2				0.687	0.003
Initial FPS-R	0.826	0.092	0.839		
Parent distress-promoting	−0.116	2.20	−0.005		
Parent coping-promoting[a]					
Parent neutral	1.256	2.122	.052		
Anxiety (CAPS)					
Step 1				0.621	
Initial CAPS	0.761	0.088	0.788		
Step 2				0.628	0.007
Initial CAPS	0.791	0.097	0.819		
Parent distress-promoting	−0.775	0.883	−0.091		
Parent coping-promoting[a]					
Parent neutral	−0.421	0.845	−0.047		
Anxiety (FAS)					
Step 1				0.598	
Initial FAS	0.832	0.101	0.773		
Step 2				0.635	0.037
Initial FAS	0.846	0.107			
Parent distress-promoting	−0.419	0.943			
Parent coping-promoting[a]					
Parent neutral	−1.898	0.902			
Pain intensity (FPS-R)					
Step 1				0.684	
Initial FPS-R	0.815	0.082	0.827		
Step 2				0.706	0.021
Initial FPS-R	0.905	0.099	0.919		
Staff distress-promoting	−5.251	4.025	−0.131		
Staff coping-promoting	−4.285	2.766	−0.134		
Staff neutral[a]					
Anxiety (CAPS)					
Step 1				0.621	
Initial CAPS	0.761	0.088	0.788		
Step 2				0.644	0.023
Initial CAPS	0.813	0.106	0.842		
Staff distress-promoting	−1.468	1.625	−0.100		
Staff coping-promoting	−1.668	1.069	−0.143		
Staff neutral[a]					
Anxiety (FAS)					
Step 1				0.598	
Initial FAS	0.832	0.101	0.773		
Step 2				0.603	0.005
Initial FAS	0.811	0.121	0.753		
Staff distress-promoting	0.630	1.796	0.040		
Staff coping-promoting	0.825	1.212	0.066		
Staff neutral[a]					

Note. FPS-R: Faces Pain Scale-Revised; FAS: Faces Anxiety Scale; CAPS: Children's Anxiety and Pain Scales.

[a]Variables that were excluded from the regression analyses. Variables were excluded in the analyses when the significance of a *t*-test that was calculated for a predictor's beta value was <.05.

Table IV. Summary of Hierarchical Regression Analyses for Adult Behaviors Predicting Children's Contextual Recall

Adult behavior	B	$SE\ B$	β	R^2	Change R^2
Parent distress-promoting					
Step 1				0.245	
Age	0.736	0.196	0.493		
Step 2				0.245	0.001
Parent distress-promoting	0.402	2.053	0.026		
Parent coping-promoting					
Step 1				0.245	
Age	0.769	0.199	0.515		
Step 2				0.253	0.009
Parent coping-promoting	1.248	1.753	0.095		
Staff distress-promoting					
Step 1				0.245	
Age	0.740	0.196	0.495		
Step 2				0.245	0.000
Staff distress-promoting	0.374	3.593	0.014		
Staff coping-promoting					
Step 1				0.245	
Age	0.670	0.190	0.448		
Step 2				0.309	0.064*
Staff coping-promoting	5.50	2.71	0.258		

*$p < .05$.

of pain intensity during venepuncture seems to be related to their memories of the procedure. Children who reported high levels of pain intensity immediately following venepuncture tended to *over-estimate* their prior level of anxiety over time. That is, they recalled the needle as being scarier 2 weeks later than they did immediately following the actual pain experience. Conversely, children who reported low levels of pain intensity immediately following venepuncture tended to accurately estimate or under-estimate their anxiety over time. Therefore, the current findings suggest that children's experiences of even minor episodes of acute pain are related to their memories of the event. These findings further extend research showing that children who experienced high levels of pain and behavioral distress during invasive medical procedures (e.g., lumbar punctures) tended to form negatively exaggerated memories (Chen et al., 2000). Importantly, these children experienced greater pain and behavioral distress at subsequent lumbar punctures than children who accurately recalled their experience (Chen et al., 2000). This suggests that once exaggerated memories develop, they become a powerful predictor of children's pain and distress during subsequent exposures to the same painful experience.

Consistent with previous research, several adult behaviors during medical procedures were related to children's distress, coping, pain intensity, and anxiety (Blount et al., 1997). However, only staff coping-promoting behaviors were related to children's memories of the procedure. Children exposed to medical staff who engaged in more coping-promoting behaviors tended to accurately recall more contextual details of the procedure. Previous research has shown that children who were exposed to distraction during vaccinations tended to produce more accurate memories than children who received standard care (Cohen et al., 2001). In the present study, distraction (i.e., non-procedural talk to children) was the most common coping-promoting behavior by medical staff. This behavior often involved focusing children's attention to aspects of the procedural context that were assessed at follow-up, which may account for their enhanced recall. Furthermore, this may have allowed children to devote more attentional resources to encoding the details of their environments, thereby leading to more organized and accurate contextual memories (Eysenck, 1982). Staff coping-promoting behaviors were not related to children's behavioral distress, pain, or anxiety.

None of the other adult behaviors were related to children's memories beyond the relationship between these behaviors and children's distress and coping in the immediate context. This is somewhat contrary to previous research showing that the levels of behavioral distress and pain that children experienced during invasive medical procedures were related to their memories (Chen et al., 2000). Although adult behaviors were related to children's pain and distress during venepuncture, this relationship seemed to be entirely subsumed in the immediate medical context. This suggests that adult behaviors are strongly related to children's immediate pain intensity, anxiety, and behavioral distress, and this pain intensity is related to how distorted children's memories become over time. However, adult behaviors are not related to children's memories beyond their relationship with children's immediate pain and distress. This finding may be explained in terms of theoretical explanations of the development of needle phobias. Needle phobias are an extreme fear of needles that may be rooted in early negative experiences with needles in childhood and are associated with chronic avoidance of medical care (Hamilton, 1995). The children in the present study who over-estimated their anxiety tended to have more negative (i.e., painful) experiences during venepuncture than children who accurately or under-estimated their anxiety. Direct conditioning explanations of the development of needle phobias suggest that it is children's direct experience of pain that influences the development of increased fear as opposed to distal and proximal factors (Du, Champion, & Yap, 2008). In other words, children acquire fear through direct conditioning such that a single exposure to a painful stimulus can cause an individual to remain fearful of that stimulus. Adult behaviors are certainly related to children's immediate pain experience, but children's *direct* experience of pain intensity may be most strongly related to the development of their memories over time. However, given that the majority of participating children reported relatively low levels of pain and anxiety, this theoretical explanation could only apply to a small group of children within the current sample.

The present study only examined adult behaviors within the medical context. Studies have shown that adults have an influential role in the development of children's autobiographical memories (Reese, 2002) and the way that parents talked to their children about the procedure after the fact may have been related to their recall. Given that this was not an experimental study, other variables (e.g., child anxiety sensitivity) could have also affected adult behavior, children's fear behavior, and children's long-term memories. Furthermore, as part of their participation in the larger study, children viewed brief video clips of portions of their procedures depicting single utterances made by their parents. As such, it is possible that the representation of the event in their memories was reinforced, thereby influencing their subsequent recall. In addition, children's experiences of pain intensity were only related to their degree of distortion on one of the anxiety measures (i.e., the FAS vs. the CAPS). Although both measures correlated highly with one another, future research should further examine and compare the psychometric properties of these anxiety scales for use with children. Furthermore, given the dearth of research in this particular research area, a conservative adjustment was not conducted on the analyses. As such, results that would not remain significant if a more stringent alpha level is applied should be interpreted with caution. Finally, the present research did not disentangle the specific parts of the memory system that were most strongly related to adult behaviors and children's pain and anxiety. Future research should investigate whether this relationship occurs at the level of encoding, storage, or retrieval (Ornstein et al., 1999).

In addition to pain intensity, there may be individual cognitive and personality factors (e.g., pain catastrophizing and anxiety sensitivity) that also play a role in determining whether or not children develop negatively exaggerated memories. Future research should examine individual factors that may underlie the development of negatively exaggerated memories. This research could be used to guide cognitive and behavioral interventions aimed at not only reducing pain but also targeting these individual factors. The present findings add to the growing body of research documenting the deleterious long-term effects of poorly managed pain in childhood. Children whose pain memories become negatively exaggerated over time are at risk for developing phobic reactions to needles as well as avoidance of medical care as adults. The present findings highlight the importance of effectively managing children's pain during medical procedures in order to avert the negative long-term effects of poorly managed pain. Nonpharmacological interventions such as distraction as well as topical anesthetics have been found to be effective in buffering children against the development of negatively distorted memories associated with vaccinations (Cohen et al., 2001). The present findings reinforce the need for effective pain management by showing that higher levels of pain during a commonly experienced medical procedure are related to exaggerated memories of anxiety over time.

Acknowledgments

The authors wish to thank the children, parents, and medical staff who participated in this research.

Funding

Canadian Institutes of Health Research (CIHR) Canada Graduate Scholarships Doctoral Research Award, Nova Scotia Health Research Foundation Doctoral Student

Research Award, and Nova Scotia Health Research Foundation Doctoral Student Research Award and Killam Predoctoral Scholarship awarded to M.N.; Canadian Institutes of Health Research (CIHR) Canada Graduate Scholarships Doctoral Research Award and IWK Health Centre Category A Grant to C.M.M.; CIHR Operating Grant, Canada Research Chair (CRC), and Canada Foundation for Innovation (CFI) grant to C.T.C.; and Pain in Child Health (PICH) stipends to M.N. and C.M.M. during completion of part of this work.

Conflict of interest: None declared.

Received May 21, 2009; revisions received September 28, 2009; accepted September 29, 2009

References

Badali, M. A., Pillai, R. R., Craig, K. D., Giesbrecht, K., & Chambers, C. T. (2000). Accuracy of children's and parent's memory for a novel painful experience. *Pain Research and Management, 5*, 161–168.

Blount, R. L., Cohen, L. L., Frank, N. C., Bachanas, P. J., Smith, A. J., Manimala, M. R., et al. (1997). The child-adult medical procedure interaction scale-revised: An assessment of validity. *Journal of Pediatric Psychology, 22*, 73–88.

Bruck, M., Ceci, S. J., Francoeur, E., & Barr, R. (1995). 'I hardly cried when I got my shot': Influencing children's reports about a visit to their pediatrician. *Child Development, 66*, 193–208.

Chen, E., Zeltzer, L. K., Craske, M. G., & Katz, E. R. (1999). Alteration of memory in the reduction of children's distress during repeated aversive medical procedures. *Journal of Consulting and Clinical Psychology, 67*, 481–490.

Chen, E., Zeltzer, L. K., Craske, M. G., & Katz, E. R. (2000). Children's memories for painful cancer treatment procedures: Implications for distress. *Child Development, 71*, 933–947.

Cohen, L. L., Blount, R. L., Jansevics Cohens, R., Ball, C. M., McClellan, C. B., & Bernard, R. S. (2001). Children's expectations and memories of acute distress: Short- and long-term efficacy of pain management interventions. *Journal of Pediatric Psychology, 26*, 367–374.

Du, J., Champion, G. D., & Yap, C. S. L. (2008). Theories of fear acquisition: The development of needle phobia in children. *Pediatric Pain Letter, 10*, 13–17.

Eysenck, M. W. (1982). *Attention and arousal: Cognition and performance*. Berlin: Springer.

Fleiss, J. L. (2003). *The measurement of interrater agreement: Statistical methods for rates and proportions*. Hoboken, NJ: Wiley and Sons.

Hamilton, J. G. (1995). Needle phobia: A neglected diagnosis. *The Journal of Family Practice, 41*, 169–175.

Hicks, C. L., von Baeyer, C. L., Spafford, P. A., van Korlaar, I., & Goodenough, B. (2001). The faces pain scale-revised: Toward a common metric in pediatric pain measurement. *Pain, 93*, 173–183.

Kuttner, L., & LePage, T. (1989). Face scales for the assessment of pediatric pain: A critical review. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement, 21*, 198–209.

Lander, J., Hodgins, M., & Fowler-Kerry, S. (1992). Children's pain predictions and memories. *Behaviour Research and Therapy, 30*, 117–124.

McKinley, S., Coote, K., & Stein-Parbury, J. (2003). Development and testing of a faces scale for the assessment of anxiety in critically ill patients. *Journal of Advanced Nursing, 41*, 73–79.

McMurtry, C. M. (2009). *A multi-method examination of adult reassurance during children's painful medical procedures*. (Unpublished doctoral dissertation). Dalhousie University, Halifax, Nova Scotia.

Newcomer, J. W., Craft, S., Hershey, T., & Askins, K. (1994). Glucocorticoid-induced impairment in declarative memory performance in adult humans. *Journal of Neuroscience, 14*, 2047–2053.

Ornstein, P. A., Manning, E. L., & Pelphrey, K. A. (1999). Children's memory for pain. *Journal of Developmental & Behavioral Pediatrics, 20*, 262–277.

Pate, J. T., Blount, R. L., Cohen, L. L., & Smith, A. J. (1996). Childhood medical experience and temperament as predictors of adult functioning in medical situations. *Children's Health Care, 25*, 281–298.

Power, T. G. (2004). Stress and coping in childhood: The parents' role. *Parenting: Science and Practice, 4*, 271–317.

Quas, J. A., Goodman, G. S., Bidrose, S., Pipe, M. E., Craw, S., & Ablin, D. S. (1999). Emotion and memory: Children's long-term remembering, forgetting, and suggestibility. *Journal of Experimental Child Psychology, 72*, 235–270.

Reese, E. (2002). Social factors in the development of autobiographical memory: The state of the art. *Social Development, 11*, 124–142.

Sjöberg, R. L., & Lindholm, T. (2005). A systematic review of age-related errors in children's memories for voiding cysto-urethrograms (VCUG). *European Child & Adolescent Psychiatry, 14*, 104–105.

Stinson, J. N., Kavanagh, T., Yamada, J., Gill, N., & Stevens, B. (2006). Systematic review of the psychometric properties, interpretability and feasibility of self-report pain intensity measures for use in clinical trials in children and adolescents. *Pain, 125*, 143–157.

Sun-Ok, S., & Carr, D. (1999). Pain and memory. *International association for the study of pain. Pain: Clinical Updates, 7*, 1–4.

Taddio, A., Katz, J., Ilersich, A. L., & Koren, G. (1997). Effect of neonatal circumcision on pain response during subsequent routine vaccination. *Lancet, 349*, 599–603.