Journal of Pediatric Psychology, 41(2), 2016, 220–231
doi: 10.1093/jpepsy/jsv111
Advance Access Publication Date: 14 December 2015
Original Research Article

Children's Forgetting of Pain-Related Memories

Tammy A. Marche, PhD, Jennifer L. Briere, PhD, and Carl L. von Baeyer, PhD

Department of Psychology, Arts, and Science, University of Saskatchewan

All correspondence concerning this article should be addressed to Tammy A. Marche, PhD, Department of Psychology, St. Thomas More College, 1437 College Drive, Saskatoon, Saskatchewan S7N 0W6, Canada. Email: tmarche@stmcollege.ca

Received May 21, 2015; revisions received October 20, 2015; accepted October 23, 2015

Abstract

Objective Given that forgetting negative experiences can help children cope with these experiences, we examined their ability to forget negative aspects of painful events. **Methods** 86 children aged 7–15 years participated in a retrieval-induced forgetting task whereby they repeatedly retrieved positive details of a physically painful experience, and an experimental pain task (cold-pressor task). **Results** Repeatedly retrieving positive details of a prior pain experience produced forgetting of the negative aspects of that experience. Pain-related self-efficacy predicted retrieval-induced forgetting; children with a poorer belief in their ability to cope with pain experienced less forgetting. Children who had a more difficult time forgetting prior negative experiences were more anxious about the pain task and reported higher pain thresholds. **Conclusions** Understanding children's memory for painful experiences may help improve their pain management and coping ability.

Key words: autobiographical memory; children's memory; cold-pressor-task; emotion; emotional memory; pain; retrieval-induced forgetting.

The inability to forget negative thoughts, images, or memories is problematic for some individuals (Brewin, 1996), and may be a source of psychological distress that contributes to the maintenance of symptoms in various mental health disorders (Ehlers, 2010). Forgetting is not always a cognitive failure but may be a means of coping with negative experiences (Barnier, Hung, & Conway, 2004). Thus, our ability to control what we remember, and what we forget, is likely important for our emotional well-being. We know little about children's forgetting of negative autobiographical memories and whether their ability to forget such experiences is related to subsequent coping with similar experiences. Physical pain is a common negative experience that children may also find stressful. The purpose of this study was to examine children's ability to forget negative aspects of pain-related experiences and to determine whether forgetting ability influences ability to cope with pain.

Children's pain is often poorly managed (Chen, Joseph, & Zeltzer, 2000), and memory for painful experiences can have a profound impact on later fear of pain and pain coping behavior (Noel, Chambers, McGrath, Klein, & Stewart, 2012; von Baeyer, Marche, Rocha, & Salmon, 2004). Such memories can increase children's distress and anxiety concerning upcoming medical procedures, lead to negative attitudes about and avoidance of necessary medical care, initiate chronic pain syndromes, and facilitate the persistence of pain conditions into adulthood (Zeltzer & Blackett-Schlank, 2005). Thus, memory for pain can be as problematic in its impact on health and suffering as the actual pain experience (Arntz, van Eck, & Heumans, 1990). Hence, it is important to understand the mechanisms by which children cope with pain-related experiences and whether developmental and individual differences in children's ability to forget such experiences are related to their ability to manage and cope with pain. Before describing the current study, we provide a brief overview of some factors that may influence children's memories for pain-related events and describe a procedure that has been shown to induce forgetting of emotional experiences in adults.

A number of individual difference factors may impact children's ability to remember and forget negative aspects of pain-related memories, such as *general participant characteristics* (age, age at the time of the event, sex), *emotional factors* (anxiety, depression), and *pain-related factors* (prior pain-related experiences, coping strategies, pain-related self-efficacy, pain sensitive temperament; parental behavior regarding child's pain). Younger children usually report and remember more pain than older children (Goodenough et al., 1999; Noel et al., 2015), which may be owing to younger children's poorer ability to forget information. For example, the ability to inhibit information in memory, which is one of the mechanisms by which we forget (Anderson & Bell, 2001), develops during childhood (Harnishfeger & Bjorklund, 1994). In terms of sex, females usually report, as well as recall, more pain and anxiety during painful procedures than males (Fillingim, King, Ribeiro-Dasilva, Rahim-Williams, & Riley, 2009; Hechler et al. 2009). As for the effect of emotion on memory for pain, anxiety and catastrophizing influence children's memories for pain (Noel et al., 2015), and depression-related memory biases have been reported when children, who are not clinically depressed, recall negative or distressful information (Bishop, Dalgleish, & Yule, 2004).

Pain-related factors may also influence children's memory for pain. For example, children with recurrent pain (recurring for a minimum of 3 months but not constant) or chronic pain (constant and persisting for more than 3 months; Perquin et al., 2000) exhibit more accurate recall for pain than non-pain information when compared with those without such pain conditions (Koutantji, Pearce, Oakley, & Feinmann, 1999). Coping strategies like catastrophizing (thinking that the worst possible outcome will happen in circumstances where this is very unlikely) affect what is recalled during pain reports (Noel et al., 2015; Rhudy et al., 2009). Other factors that have been associated with children's ability to cope with pain, such as expectations regarding anxiety and pain (Arntz et al., 1990; Kain, Mayes, Caldwell-Andrews, Karas, & McClain, 2006), pain-related self-efficacy (Piira, Taplin, Goodenough, & von Baeyer, 2002), temperament (Schechter, Bernstein, Beck, Hart, & Scherzer, 1991), and parental actions that encourage illness behavior (Goodman & McGrath, 2003), may also affect memory and forgetting for those experiences. For example, parental solicitous behavior (e.g., frequent attending to pain symptoms, granting permission to avoid regular activities; Walker, Garber, & Greene, 1993) has been linked with children's recurrent pain (Langer, Romano, Levy, Walker, & Whitehead, 2009; Sieberg, Williams, & Simons, 2011). The strategies that parents use to encourage their children when they are sick may influence how pain is remembered and experienced (Dahlquist & Pendley, 2005). Parents may, unintentionally, draw children's attention to the pain as well as remind children about past pain-related experiences via adult–child conversations (Salmon, 2006), which may make it more difficult to forget such memories. Thus, factors known to influence pain outcome may also impact one's memory, and forgetting, for those experiences.

Forgetting can be generally defined as "the inability to recall something now that could be recalled on an earlier occasion" (Tulving, 1974, p. 74). The mechanisms by which we forget (e.g., decay, interference; Roediger, Weinstein, & Agarwal, 2010) are believed to underlie both *explicit* (conscious recall) and *implicit* (retrieval of information through task performance) memory and forgetting. Forgetting can occur incidentally or we can be motivated to forget (Baddeley, Eysenck, & Anderson, 2015). The most widely used incidental forgetting procedure is *retrieval-induced forgetting* (RIF; Anderson, Bjork, & Bjork, 1994). RIF is an explicit unintentional form of forgetting whereby the retrieval of some information from long-term memory impairs the ability to later recall other information that is related to the original information. Participants repeatedly retrieve, or practice, some information (Rp+), while other related information does not receive any practice (Rp-). Recall of retrieved information is typically enhanced compared with baseline information that does not receive any retrieval practice (NRp), which reflects typical practice effects. However, the extra retrieval of partial information also leads to reduced recall of the related, but unretrieved, information below baseline levels (i.e., forgetting). *Inhibition,* which is the suppression of previously activated cognitive contents and/or processes (Wilson & Kipp, 1998), is believed to be the cause of forgetting in this paradigm (Anderson & Bell, 2001).

RIF has been extended beyond simple word lists (Anderson et al., 1994) to social stereotypes (Storm, Bjork, & Bjork, 2005), forensic-like laboratory materials (Shaw, Bjork, & Handal, 1995), and more ecologically valid materials in children (Ford, Keating, & Patel, 2004) and adults (Barnier et al., 2004; MacLeod, 2002). Barnier et al. (2004) examined RIF in adults' emotional (i.e., negative, positive) and unemotional (i.e., neutral) autobiographical memories. By grouping emotional or unemotional words (referred to as *category-cues*) with personal memory details, along with a word intended to remind participants of each particular memory detail, a personalized RIF procedure was developed. One subset of elicited memories was repeatedly retrieved (Rp+), while the remaining related details from that memory experience did not receive retrieval practice (Rp−). A third, unrelated, subset of memories did not receive any retrieval practice manipulation and served as a baseline (NRp). Final recall of all elicited autobiographical memories demonstrated typical RIF effects. Repeatedly retrieved memories (Rp+) were recalled more often than related un-retrieved memories (Rp−), and these un-retrieved memories showed significantly lower recall than memories from the no-retrieval practice (NRp) baseline category. The retrieved items were assumed to inhibit the unretrieved items. No study has yet examined whether children can be induced to forget emotionally negative experiences.

In the current study, children were asked to recall their two most physically painful experiences, to undergo an RIF procedure whereby they practiced retrieving positive details from one of their pain-related memories, and to undergo an experimental pain stimulus, known as the cold-pressor task (CPT; von Baeyer, Piira, Chambers, Trapanotto, & Zeltzer, 2005; Birnie, Petter, Boerner, Noel, & Chambers, 2012). We investigated three issues. First, we examined whether we can induce unintentional forgetting of negative aspects of emotional experiences. Given the robustness of the RIF effect, we expected that having children retrieve positive aspects of a painful experience would produce forgetting of negative unretrieved details of those memories. Second, we examined whether there are developmental and individual differences in children's ability to forget negative aspects of pain-related experiences. RIF is an unintentional form of forgetting that appears to develop early (Aslan & Bäuml, 2010) and, therefore, may not be affected by developmental differences. However, RIF has been found to have a positive relationship with extraversion (Law, Groome, Thom, Potts, & Buchanan, 2012), and a negative relationship with working memory capacity (Aslan & Bäuml, 2011), state anxiety (Law et al., 2012; Koessler, Steidle, Engler, & Kissler, 2013), and trait anxiety (Saunders, 2012). We therefore expected that some of the variables that have been related to pain and memory for pain, such as anxiety, would predict individual differences in RIF performance. Finally, we examined whether difficulties in forgetting are related to children's ability to cope with pain.

Method

Participants

Eighty-six, primarily Caucasian, middle-class children participated. Caregivers, who were mainly biological mothers (78.6%) and married (73.5%) provided demographic information for 66 children whose ages ranged from 7.30 to 15.42 years ($M_{age} = 9.85$ years, $SD = 2.02$ years). Over half of the sample (56%) was male.

Materials

Demographics Questionnaire

The demographics questionnaire included a number of questions pertaining to both the child's and parents' demographic and health history, such as age, sex, health problems, and the presence of *persistent pain* (recurrent or chronic pain). In terms of persistent pain, parents were asked whether their child complained about experiencing pain, and if they indicated yes, they were asked to indicate the frequency and location of their child's pain. For the purposes of this study, based on parents' report, *recurrent pain* was defined as pain occurring one to three times a month, and *chronic pain* was defined as occurring more than three times a month, with both occurring over at least three months.

Comprehensive Narrative Elaboration Technique

The *Narrative Elaboration Technique* (NET) is an interview preparation and memory enhancement technique, using four pictorial cue cards, that has been shown to increase the amount of information that children (ages: 4–15 years) recall about an event, without increasing the amount of false information reported (Saywitz & Snyder, 1996). An expanded version of the NET was developed for use in the current study, named the *Comprehensive Narrative Elaboration Technique* (CNET). In the CNET, eight pictorial cues are used signifying place, sayings, people, actions, feelings, time, senses, and thoughts, which capture six components of memory. A pain-specific cue card was added for the current study.

State-Trait Anxiety Inventory for Children

The State-Trait Anxiety Inventory for Children (STAIC)-C1 and C2 consist of 20 items each and are used to assess children's *state* and *trait anxiety*, respectively (Spielberger, Edwards, Lushene, Montuori, & Platzek, 1973). Higher total scores from each scale identify a child with more anxiety-prone state or trait personalities. Spielberger et al. (1973) report that the STAIC test–retest reliability estimates for school children (Grade 4–6) over a 6-week interval are strong to moderate for trait anxiety (females: $r = .71$, males: $r = .65$), and low for state anxiety (females: $r = .47$, males: $r = .31$), which is consistent with the transitory nature of state anxiety. Internal consistency reliabilities are also strong (State: $\alpha = .82$ males, $\alpha = .87$ females; Trait: $\alpha = .78$ males; $\alpha = .81$ females).

Children's Depression Inventory

The Children's Depression Inventory (CDI; Kovacs, 1981) is a 27-item, self-report measure of depressive symptoms in children and adolescents. Higher CDI scores indicate presence of depressive symptoms. The CDI has demonstrated high internal consistency ($\alpha = .83$–$.89$) and acceptable test–retest reliability (females: $r = .74$, males: $r = .77$; Smucker, Craighead, Craighead & Green, 1986).

Pain Catastrophizing Scale for Children

The 13-item Pain Catastrophizing Scale for Children (PCS-C; Crombez et al., 2003) was used to measure the extent to which children catastrophize or hold irrational thoughts about pain by assessing three dimensions of pain catastrophizing: rumination, magnification, and helplessness. Answers are recorded on a 5-point Likert scale ranging from "0 = not at all" to "4 = extremely," with total PCS-C scores ranging from 0 to 52. Moderate internal consistency has been reported for PCS-C total scores ($\alpha = .87$) as well as for the rumination ($\alpha = .73$), magnification ($\alpha = .68$), and helplessness ($\alpha = .79$) subscales (Crombez et al., 2003).

Self-Efficacy Questionnaire

The Self-Efficacy Questionnaire (SEQ) measures children's belief in their ability to cope with general pain and has been used with children between the ages of 7 and 14 years (Piira et al., 2002). It is a 4-item questionnaire in which participants are asked to rate "How sure are you that you can handle . . . " each of the following types of pain: "the cold water task (CPT)," "a headache," "a stomachache," and "the pain when you fall over and hurt your knee." Ratings are made on a 5-point scale where "1" denotes "not sure at all" and "5" is "very sure." Two scores are obtained; the first is specific to children's belief in their ability to cope with the CPT pain and the second is a general pain self-efficacy score, which is the mean of the three remaining items.

Sensitivity Temperament Inventory for Pain

The parent and child versions of the Sensitivity Temperament Inventory for Pain (STIP-P and STIP-C, respectively; Baum, 1994) were used to gather parent- and self-reports of child's pain sensitivity in daily life experiences. The STIP-C consists of 35 items across four factors (sensation seeking/pain tolerance, perceptual sensitivity, symptom reporting, and introversion/avoidance of sensations). Children answer each question on a 4-point scale ranging from "a lot like me" to "not at all like me," with higher scores indicating greater pain sensitivity. The STIP-C had demonstrated good internal consistency ($\alpha = .78$) and strong test–retest reliability ($r = .87$; Baum, Zeltzer & Jospe, as cited in Chen, Craske, Katz, Schwartz, & Zeltzer, 2000). The STIP-P measure contains 33 items across the same factors as the STIP-C, with the exception of the introversion subscale. Parents answer questions using a 4-point scale ranging from "a lot like my child" to "not at all like my child," with higher scores indicative of greater pain sensitivity. Similar to the child version, the STIP-P has shown adequate internal consistency ($\alpha = .71$) and good test–retest reliability ($r = .81$; Baum, Zeltzer & Jospe, as cited in Chen et al., 2000).

Illness Behavior Encouragement Scale

The Illness Behavior Encouragement Scale (IBES-P; Walker & Zeman, 1992) is used to collect information about how children's parents/guardians treat them when they are sick or in pain, and was used as a measure of parental solicitous behavior. Parents/guardians answer each question using 5-point Likert scale ranging from "0 = Never" to "4 = Always," with higher IBES-P scores indicating caregiver's illness-indulgent behavior. Adequate internal consistency reliability has been demonstrated for the "cold" ($\alpha = .81$) and "gastrointestinal" ($\alpha = .85$) versions of the scale, with acceptable test–retest reliability ($r = .73$; Walker & Zeman, 1992).

Cold-Pressor Task

The CPT is a widely used experimental pain task that involves placing one hand in cold water. It provides measures of *pain threshold* (point in time when pain is first felt), *pain tolerance* (point in time when the participant withdraws his/her hand from the CPT), and *pain intensity* (self-report ratings of pain) (von Baeyer et al., 2005). The cold-pressor apparatus used in this study was a modified JetSpray (model JS7 – Single Flavour Series) machine equipped with a built-in thermoregulator, thermostat with external temperature control, cooler, and water pump to cool and circulate over 18 litres of water. An armrest was inserted and an insulation cover was fitted for the water tank to minimize temperature fluctuations.

Numerical Rating Scale-11

The Numerical Rating Scale-11 (NRS-11) is an 11-point scale from 0 (none at all) to 10 (the most possible) that is used to obtain self-report ratings (e.g., pain intensity; Williamson & Hoggart, 2005). It was used to measure memory clarity and degree of negative emotion in the current study.

Facial Affective Scale

The Facial Affective Scale (FAS; McGrath et al., 1996) is a self-report measure for children of the affective dimension of pain. The FAS comprises nine faces varying in emotion and scores range in intervals from the maximum positive affect (i.e., happy face) of .04 to a maximum negative affect (i.e., sad face) of .97.

Pain Coping Questionnaire

The Pain Coping Questionnaire (PCQ) is a measure of the coping strategies used during a pain experience and includes eight subscales: problem solving, positive self-statements, cognitive distraction, externalizing, internalizing/catastrophizing, information seeking, seeking social support, and behavioral distraction (Reid, Gilbert, & McGrath, 1998). As CPT pain lasts for no longer than 4 min, only the first five subscales were used in the current study. Answers for the 25-item PCQ are recorded using a Yes/No format and only subscale scores are calculated, with higher scores indicating greater use of the coping strategy.

Procedure

After receiving parental consent and child assent, the parents were asked to fill out the IBES, STIP-P, and the Demographics Questionnaire, while the CDI, STIP-C, and STAIC-2 were administered to the children. The children then completed memory elicitation, and during Phase 2, they completed the RIF and CPT portion of the study. Given that completing all three tasks in one session would be taxing for participants, to reduce attrition rates, and to allow time for transcription of the memories, generation of the RIF slideshows, and to control the delay between the learning and forgetting phases, a two-phase, rather than three-phase, design was chosen. We elicited the memories as comprehensively as possible so that the first session could serve as one complete learning trial; this along with the completion of the questionnaires took approximately 1 hr. The RIF and CPT tasks were also completed within a 1-hr session, in counterbalanced order across participants, approximately one week after the first session.

Memory Elicitation

The children were trained to use the CNET procedure and were then asked to recall two physically painful memories. The interviewer gave the following instructions:

> I'd like you to think about a time when your body felt the most hurt or most pain that you can remember. The pain could have happened over a few minutes, hours or even days, but it has to be one of the most painful memories that you can remember. When you are telling me about your memory, try to picture it in your mind and talk about everything that you can remember without making anything up. When you've told me everything that you can remember about what happened, we will use these different cards to help remind you about things that happened that you might not have thought of right away.

Memory elicitations were audio-recorded and the interviewer simultaneously recorded all pertinent elicited information. When free recall was finished, the CNET cards, and accompanying prompts, were presented. A minimum of 16 details for each memory were sought from the memory elicitation sessions.

Upon completion of the memory elicitation procedure, for each memory, the children rated the emotional affect of each memory detail reported, using the FAS. The interviewer read the sentences that were recorded during the CNET procedure and the children chose a face for "how good or bad that part of the memory was." The children then rated the overall emotional affect of both memories at the time of the event (*remembered affect*), as well as at the time of recall (*current affect*), with the FAS. In addition, the children gave estimates of their age when the event occurred, and using the NRS-11, they rated each memory in terms of clarity, level of anxiety, worry, and/or fear at the time of the event (*remembered negative emotion*), and level of anxiety, worry, and/or fear at the time of recall (*current negative emotion*). The participants, sometimes with the help of the experimenter, decided on a name for each memory, which served as their memory cue for the second phase of the study. The children were then debriefed, given a small reward, and thanked for their help with the project. The children and their parents were invited to come back in a week for the second portion of the study.

During the second phase of the study, half of the children completed RIF prior to participating in the CPT, with the rest completing the CPT before RIF. The CDI was re-administered before the RIF procedure and the state version of the STAIC was administered immediately before completing the CPT.

Retrieval-Induced Forgetting

Based on a modification (Barnier et al., 2004) of the classic RIF procedure (Anderson et al., 1994), an individualized RIF slideshow was constructed for each participant that included four phases: (a) initial learning of all selected memory details, (b) three retrieval-practice trials on targeted positive details (Rp+), (c) distractor task, and (d) final cued recall of all selected details. The four most positive details (e.g., Mom said she was proud I didn't cry) and the four most negative details (e.g., I cried for three days) from each reported memory were selected for use in the RIF slideshow. The most negative memory, which was often the first memory reported, was targeted for retrieval-practice (Rp), whereas the least negative memory (often the second memory reported) served as the no retrieval-practice baseline memory (NRp). For ethical reasons, we did not ask participants to repeatedly retrieve negative aspects of the experience, thus the four Rp+ items were always the details that participants rated as positive through the FAS (McGrath et al., 1996).

Initial Learning of Memory Details. After receiving child assent, participants were reminded of each memory using the assigned memory names, and were shown examples of "memory name – memory sentence" pairs that would appear on the screen for each memory (e.g., "soccer – I scraped my knee"). While viewing the pairs, participants were encouraged to think of the words "in your mind" to help remember them together. After answering any questions, the interviewer began reading the words on the screen as the pairs were automatically presented, one-by-one for 10 s each.

Retrieval-Practice. The children were told that the interviewer had selected some of the sentences that they saw for further study. On the first retrieval-practice trial, the last word of each memory sentence was replaced with a line to indicate a missing word. Examples were shown on the screen for each memory (e.g., "soccer – I scraped my ____"). It was explained that the interviewer would read the memory name and the child would read the sentence that follows including the correct word that completes the sentence. Participants were told that they would not be timed and that if they could not remember the right memory sentence, it was okay to say so and to continue to the next slide. The interviewer recorded the number of successful sentence completions. The second retrieval-practice trial was similar to the first but was more difficult, as a portion of words were missing in the memory sentences the children were to complete (e.g., "soccer – I sc___ my kn___"). The third retrieval-practice trial was again more difficult than the previous trial, whereby entire words were now missing in the sentence that the child was to complete (e.g., "soccer – I scraped ______"). The same four Rp+ memory details were used for all trials of retrieval practice.

Distractor Task and Cued Recall. The children engaged in a distractor task (e.g., 'Where is Waldo?') for 5 min. They were then asked to recall all the sentences associated with each memory that they could remember when the memory names for Rp and NRp memories appeared on the screen, which were presented one at a time and were read by the interviewer. The children were encouraged to do their best but were told that there was no "good or bad amount to remember," to decrease social pressure and avoid false recall. The interviewer recorded participants' recall. Recall of memory details was scored as correct if participants specifically referred to the same event detail at final test as they described at elicitation (exact wording was not necessary), and "Don't know," ambiguous memories, or reports of different events were scored as failure to recall (Barnier et al., 2004).

Cold-Pressor Task Procedure

Immediately prior to administering the CPT, the children completed the PCS-C, SEQ, and the STAIC-C1, with the assistance of the experimenter who read the questions to them. They were asked to rate *expected pain* and *expected anxiety* using the NRS-11. The children then submerged their non-dominant arm, up to their elbow, in warm water ($M_{temperature} = 34.8°C$) for 2 minutes to help ensure that all participants had the same skin temperature prior to CPT immersion. A stopwatch was started as children submerged their arm up to their elbow in cold circulating water ($M_{temperature} = 10.8°C$). They were asked to keep their arm in the water for as long as they could ("until it hurt too much to keep in the tank") or until 4 min had elapsed (they were not shown the stopwatch during the task). They were asked to report when their arm first started to hurt, at which point the time was recorded (*pain threshold*), as well as their *pain intensity* rating (how much pain they felt) on the NRS-11. The duration of their total submersion was recorded (*pain tolerance*) and self-reports of pain intensity were again recorded using the NRS-11. After the CPT, the children were escorted from the CPT testing area and completed the PCQ, which was tailored to the CPT, with the assistance of the experimenter. The children and parents were debriefed and thanked for their time and the children were given a small reward.

Results

Data Analysis

To test whether forgetting of negative aspects of children's emotionally negative experiences can be induced via the RIF procedure, a one-way analysis of variance (ANOVA) was conducted with the practice variable as the independent variable and proportion of items recalled as the dependent variable. To determine whether there are developmental and individual differences in children's autobiographical RIF, the relationship between the predictor variables and RIF was analyzed with either an ANOVA or correlation and multiple regression analysis. Finally, to determine whether poorer RIF predicted subsequent ability to cope with pain, degree of RIF scores were correlated with children's coping prior to, during, and after the CPT, with significant variables entered into a multiple regression analysis. All reported post hoc tests were either Student–Newman–Keuls tests or *t*-tests with the Bonferroni correction.

Descriptive Information for Children's Pain Memories

A total of 40 parents in our sample provided details regarding their child's chronic or recurrent pain, with some indicating multiple pain locations. Nine (22.5%) participants reported knee pain; 8 (20%) each reported abdominal pain and headache; 6 (15%) reported pain in their child's feet; 5 (12.5%) each reported pain in their child's legs and ankle; 4 (10%) each reported thigh and back pain; 3 (7.5%) reported shin pain; 2 (5%) reported hip, neck, or shoulder pain; and 1 (2.5%) reported pain in their buttocks, elbow, heart, arm, fingers, ear, or chest. Whereas both memories were similar in terms of the total number of details recalled, as well as for the degree of pain intensity and pain affect reported, there were slightly more negative details reported for the first ($M = 12.40$, $SD = 6.53$) than second ($M = 11.18$, $SD = 7.84$) memory, $t(80) = 2.00$, $p = .049$. The vast majority of participants' painful memories involved accidents (e.g., sports or playing accidents, such as hockey, biking, or burns), with a few children reporting medical procedures as their most painful memories (e.g., surgeries, emergency room visits).

Forgetting of Negative Pain-Related Details by Practicing Positive Details

The one-way ANOVA to determine whether children can incidentally forget negative details of their pain-related experiences revealed a significant effect of practice, $F(2, 154) = 46.76$, $p < .001$, $\eta_p^2 = .38$, with greater recall of Rp + details ($M = .70$; $SD = .28$) than Rp− ($M = .37$; $SD = .22$) and NRp ($M = .55$; $SD = .22$) details, and poorer recall of Rp− than NRp details, all ts > 5.13, all ps < .001 (Figure 1).

Developmental and Individual Differences in Children's Ability to Forget

A 2 (*Sex* [male, female]) × 3 (*Practice* [Rp+, Rp−, NRp]) ANOVA revealed, in addition to the significant practice effect reported above, no main effect of *sex*, $F(1, 75) = 0.81$, $p = .776$, nor a *sex* x *practice* interaction, $F(2, 150) = 0.24$, $p = .977$. A 2 (*Pain* [persistent pain, no persistent pain]) × 3 (*Practice* [Rp+, Rp−, NRp]) ANOVA indicated, in addition to the practice effect, there was no main effect of *pain*, $F(1, 68) = 2.64$, $p = .109$, nor a *pain* × *practice* interaction, $F(2, 136) = 0.18$, $p = .835$.

The remaining variables [*age*, *age when event occurred*, *clarity of the memory*, *remembered and current affect*, *remembered and current negative emotion*, *state and trait anxiety*, *depression (and its subscales)*, *pain catastrophizing*, *pain-related self-efficacy (and its subscales)*, *pain sensitive temperament (and its subscales)*, *level of parental illness encouragement*], along with a difference score that reflected degree of RIF, were entered into a correlation analysis, and variables significant at $p < .05$ were entered into a regression analysis. As for the difference score, the number of NRp details recalled was subtracted from the number of Rp- details recalled ($M = -.18$, $SD = .28$), where more negative numbers indicate poorer memory (i.e., greater forgetting). Three of the variables were significantly correlated with the degree of RIF scores: *parental encouragement*, $r(57) = .276$, $p = .037$; *current negative emotion*, $r(76) = .235$, $p = .041$; and *pain-related self-efficacy*, $r(78) = -.246$, $p = .030$. A forced entry multiple regression analysis indicated that *pain-related self-efficacy* predicted degree of forgetting when it was entered on the first step, accounting for 9% of the variance, $F(1, 53) = 5.06$, $p = .029$. *Pain-related self-efficacy* and *current negative emotion* predicted bias on Step 2, accounting for 15% of the variance, ($R^2_{change} = .06$), $F(2, 52) = 4.68$, $p = .013$. On Step 3, when all three variables were entered, *pain-related self-efficacy* ($\beta = -.27$, $p = .034$) predicted degree of RIF, whereas *current negative emotion* and *parental encouragement* did not significantly predict variance in degree of RIF. All three predictors accounted for 20% of the variance in RIF scores, ($R^2_{change} = .05$), $F(3, 51) = 4.32$, $p = .009$. Refer to Table 1 for a summary of these results.

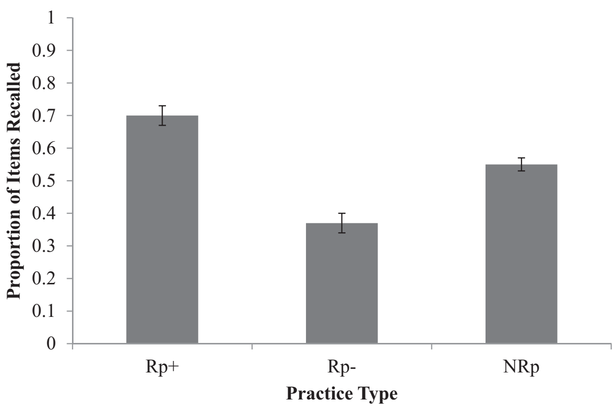

Figure 1. The RIF effect: greater recall of repeatedly retrieved (Rp+) details than details that received no retrieval practice (Rp− and NRp), and poorer recall of non-retrieved details from the practiced category (Rp−) than non-retrieved details from the baseline category (NRp). All ps < .001, error bars represent the standard error of the mean.

Table I. Regression Analyses for Individual Differences in RIF

	B [confidence interval]	*SE*	*B*	*P*
Step 1				
Constant	.15 [−.15, .45]	.15		.315
Pain-related self-efficacy	−.10 [−.18, −.01]	.04	−.30	.029
Step 2				
Constant	.06 [−.25, .36]	.15		.716
Pain-related self-efficacy	−.09 [−.17, −.01]	. 04	−.28	.031
Current negative emotion	.03 [.00, .05]	.01	.26	.050
Step 3				
Constant	−.13 [−.50, .23]	.18		.476
Pain-related self-efficacy	−.09 [−.17, −.01]	.04	−.27	.034
Current negative emotion	.02 [−.01, .05]	.01	.24	.062
Parental encouragement	.01 [−.01, .02]	.01	.22	.080

Note. $R^2 = .09$, $R^2_{change} = .06$ for Step 2 and .05 for Step 3 (ps < .029).

The Relationship Between Forgetting Ability and Pain Coping

In terms of whether the ability to forget prior pain experiences influences subsequent ability to cope with pain, prior to, during, and after the CPT, degree of RIF scores were correlated with: *expected CPT pain*, *expected CPT anxiety*, *CPT self-efficacy (one of the two SEQ subscales)*, *pain threshold*, *pain tolerance*, *pain intensity at threshold*, *pain intensity at tolerance*, *pain coping strategies (PCQ)*, *remembered pain*, and *remembered anxiety*. Three of the correlations were significantly related with degree of RIF scores: *expected anxiety*, $r\ (78) = .390$, $p = .001$; *pain threshold*, $r\ (77) = .312$, $p = .006$; and *remembered anxiety*, $r\ (61) = .295$, $p = .021$. Once the Bonferroni correction of $p < .005$ was applied, only *expected anxiety* remained significantly correlated with RIF scores. Interestingly, the relationship between RIF and *expected anxiety* became much stronger when only the 11 children who reported experiencing chronic pain were included, $r\ (11) = .862$, $p = .001$. The Fisher *r*-to-*z* transformation to determine the significance of the difference between two correlation coefficients was significant, $Z_{\text{one tailed}} = 2.\ 39$, $p = .0084$.

Discussion

The purpose of this study was to examine children's ability to forget negative aspects of pain-related experiences and to determine whether forgetting ability influences children's ability to cope with pain. In addition to the various types of materials that are susceptible to RIF (e.g., word lists, social stereotypes), forgetting of negative details of prior pain-related autobiographical experiences can also be induced. This is interesting given that some studies find an absence of RIF with negative words (Kobayaski & Tanno, 2013), and with material that is relevant to the self (Macrae & Rosenveare, 2002). Our finding demonstrates both the robustness of the RIF effect and the potential application of RIF in helping children cope with negative experiences. For example, it may be possible to change children's memories of painful experiences so as to help them subsequently cope with pain. Chen, Zeltzer, Craske, and Katz (1999) found that children who were very anxious about medical procedures exaggerated the negative details of these procedures, which resulted in increased anxiety and pain during future pain-related events. The experimenters helped the children re-evaluate their reactions to their last pain experience, encouraged them to believe in the efficacy of their own coping strategies, and helped them remember positive aspects of the experience, such as moments when they did not cry rather than the times they did cry. The intervention used by Chen et al. was designed to reframe memory of previous procedures and was found to help reduce children's distress for subsequent medical procedures. However, as Chen et al. comment, it is not known whether memory change truly drove this intervention.

RIF appears to be one possible memory-based mechanism that could lead to such memory modification. Even if memory reframing through RIF is short-lived, our results suggest that those with pain might benefit from repeated reframing of their painful experiences. However, given the limitations of our sample, it is not clear whether these results would persist if extended to clinical settings or to individuals who experience clinically diagnosed chronic pain. It would also be of interest to determine whether RIF would persist if memory is tested implicitly, rather than explicitly. We expect that this would be the case, given that RIF has been found with conceptually based (rather than perceptually based) implicit memory tests (Perfect, Moulin, Conway, & Perry, 2002). It would also be of interest to determine whether children's RIF ability is related to their ability to regulate emotions or to their ability to re-appraise past painful experiences, given that positive reinterpretation of stressful experiences is an important emotion-focused coping strategy (Carver, Scheier, & Weintraub, 1989).

In terms of whether there are developmental and individual differences in children's ability to forget negative aspects of pain-related experiences, we examined various participant characteristics, emotional factors, and pain-related factors. Only three of our variables were significantly correlated with children's degree of RIF scores. Less RIF occurred in children with poorer self-efficacy (a weaker belief in their ability to cope with pain), in children with more negative memories of past prior pain experiences, and in children whose caregivers reported more illness-indulgent behavior. The regression analysis indicated that pain-related self-efficacy was the main predictor of RIF scores. Although there is little research on the role that self-efficacy plays in children's memory, there is indication that enhancing older adults' self-efficacy can improve their memory performance (West, Bagwell, & Dark-Freudeman, 2008). More research is, therefore, needed on this topic.

Based on the few RIF studies that have been conducted with young children, RIF appears to be adult-like by early childhood. Aslan and Bäuml (2010) found RIF in 4- and 5-year-olds and Zellner and Bäuml (2005) found RIF in 7-year-olds. Given that our youngest children were 7 years of age, our finding that RIF did not interact with age is consistent with prior research indicating that RIF develops early. However, inhibition is believed to be the cause of forgetting in this paradigm (Anderson & Bell, 2001), and there is a good deal of support that inhibitory mechanisms are diminished in young children (e.g., negative priming, directed forgetting; Bjorklund &

Harnishfeger, 1990), likely due to an incompletely developed frontal lobe (Carlson & Moses, 2001). However, a distinction needs to be made between intentional and unintentional types of inhibition. Lechuga, Moreno, Pelegrina, Gómez-Ariza, and Bajo (2006) found developmental differences when children and adults intentionally suppressed information, but not when the task required unintentional inhibition of competing items, as is the case with an RIF task. Further research examining the mechanisms driving RIF in young children is therefore needed to determine whether non-inhibitory mechanisms (e.g., interference) produce the RIF effects that have been found with young children.

There have been only a handful of studies to date examining whether there are biological, social, and/or psychological predictors of RIF (Aslan & Bäuml, 2011; Koessler et al., 2013; Law et al., 2012; Saunders, 2012). Although we assessed both state and trait anxiety in the current study, as measured by the STAIC, we found no relationship with this measure of anxiety and RIF in children. However, it is possible that this relationship is small and only emerges under specific conditions. For example, when Law et al. (2012) entered state anxiety and extraversion into a multiple regression analysis, they found extraversion to be the main predictor of RIF performance. Although we did not assess state anxiety while children completed the RIF task, Koessler found that individuals with high state anxiety during retrieval-practice did not show RIF.

Finally, we examined whether children's ability to forget prior pain-related experiences is related to their ability to cope with their CPT experience. Interestingly, children who showed poorer forgetting of prior pain experiences had higher thresholds for pain. Maybe remembering times when they coped well with prior painful experiences, which oftentimes involves pain over which they had little control, boosts children's confidence and self-efficacy. This may then help them cope better with less painful situations over which they have control, such as the pain experienced with the CPT. This finding is consistent with research indicating that encouraging children to believe in the efficacy of their own coping strategies reduces children's distress for subsequent procedures (Chen et al., 1999). However, informing participants of the 4-min ceiling likely influenced our pain intensity and pain tolerance results (von Baeyer et al., 2005).

We also found that children who reported more worry, anxiety, or fear prior to the CPT, as well as those who remembered feeling worried, afraid, or anxious during the CPT, performed more poorly on the RIF task. However, only the expected anxiety predictor remained significant after correcting for the possibility of Type 1 error. Although there was no significant relationship between performance on the state or trait versions of the STAIC and RIF, we did find a negative relationship between state anxiety and RIF when anxiety was measured with the NRS-11. The finding of a negative relationship between anxiety and RIF is consistent with proponents of the Attentional Control Theory, who propose that cognitive inhibition is impaired by anxiety (Eysenck, Derakshan, Santos, & Calvo, 2007).

The relationship between RIF and anxiety was especially strong for children reporting chronic pain. There have been a handful of studies finding that RIF is poorer for certain adult populations, such as those under stress (Koessler, Steidle, Engler, & Kissler 2013), with posttraumatic stress disorder (Amir, Badour, & Freese, 2009), social phobia (Amir, Coles, Brigidi, & Foa, 2001), clinical depression (Groome & Sterkaj, 2010), and attention-deficit hyperactivity disorder (Storm & White, 2010). Although children in the current study who reported recurrent and chronic pain displayed similar levels of RIF as did those children reporting little pain, this may not be the case for children with clinically diagnosed cases of pain. There is some indication in the adult literature of pain-related cognitive impairment (Moriarty, McGuire, & Finn, 2011), including impairment to executive functioning, which includes inhibitory functions (Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003). One of the main limitations of the current study is that very minor pain memories were examined in a sample with few participants who experience chronic pain. It is possible that if our sample had included children with clinically diagnosed pain, or children with longer-lasting pain conditions such as arthritis or migraine, then this relationship would have been stronger.

Pain seriously interferes with school and family life for a significant number of children and adolescents (Goodman & McGrath, 1991). Improved pain management has many benefits such as reducing hospital stays, avoidance of future medical treatment, psychological trauma, school absenteeism, and the chance of developing a disabling pain condition (Cummings, Reid, Finley, McGrath, & Ritchie, 1996). Because RIF appears promising in its ability to induce forgetting in children, understanding how factors like self-efficacy and anxiety influence forgetting ability in children with pain may lead to innovative techniques for improved pain coping and pain management. For example, as a possible next step, clinicians could practice retrieving positive aspects of prior negative medical events with clients, as this may help reduce children's expected anxiety regarding subsequent medical events. The benefits of doing so could be tested by using RIF as an intervention in a randomized controlled trial experiment. Understanding how we can induce children's forgetting of the negative aspects of their painful experiences will improve their pain management and coping ability.

Acknowledgments

We would like to thank the children and parents who participated, the local school and community organizations (especially the Boys and Girls Club of Saskatoon, SK) who supported our participant recruitment and testing, our collaborator, Dr. Krista Baerg, and our research assistants.

Funding

Canadian Institutes of Health Research and the Saskatchewan Health Research Foundation (G00007252).

Conflicts of interest: None declared.

References

Amir, N., Badour, C. L., & Freese, B. (2009). The effect of retrieval on recall of information in individuals with posttraumatic stress disorder. *Journal of Anxiety Disorders, 23*, 535–540. doi:10.1016/j.janxdis.2008.10.012

Amir, N., Coles, M. E., Brigidi, B., & Foa, E. B. (2001). The effect of practice on recall of emotional information in individuals with generalized social phobia. *Journal of Abnormal Psychology, 110*, 76–82. doi:10.1037/0021-843X.110.1.76

Anderson, M. C., & Bell, T. (2001). Forgetting our facts: The role of inhibitory processes in the loss of propositional knowledge. *Journal of Experimental Psychology: General, 130*, 544–570. doi:10.1037/0096-3445.130.3.544

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology, 20*, 1063–1087. doi:10.1037/0278-7393.20.5.1063

Arntz, A., van Eck, M., & Heumans, M. (1990). Predictions of dental pain: The fear of any expected evil, is worse than the evil itself. *Behaviour Research and Therapy, 28*, 29–41. doi:10.1016/0005-7967(90)90052-K

Aslan, A., & Bäuml, K. -H. T. (2010). Retrieval-induced forgetting in young children. *Psychonomic Bulletin & Review, 17*, 704–709. doi:10.3758/PBR.17.5.704

Aslan, A., & Bäuml, K. H. T. (2011). Individual differences in working memory capacity predict retrieval-induced forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*, 264–269. doi:10.1037/a0021324

Baddeley, A., Eysenck, M. W., & Anderson, M. C. (2015). *Memory*. New York, NY: Psychology Press.

Barnier, A. J., Hung, L., & Conway, M. A. (2004). Retrieval-induced forgetting of emotional and unemotional autobiographical memories. *Cognition and Emotion, 18*, 457–477. doi:10.1080/0269993034000392

Baum, L. D. (1994). The Sensitivity Temperament Inventory for Pain (STIP): A new method for identifying the pain-vulnerable child. *Dissertation Abstracts International, 55*, 582 (University Microfilms No. 94-18966).

Birnie, K. A., Petter, M., Boerner, K. E., Noel, M., & Chambers, C. T. (2012). Contemporary use of the cold pressor task in pediatric pain research: A systematic review of methods. *The Journal of Pain, 13*, 817–826. doi:10.1016/j.jpain.2012.06.005

Bishop, S. J., Dalgleish, T., & Yule, W. (2004). Memory for emotional stories in high and low depressed children. *Memory, 12*, 217–230. doi:10.1080/09658210244000667

Bjorklund, D. F., & Harnischfeger, K. K. (1990). The resources construct in cognitive development: Diverse sources of evidence and a theory of inefficient inhibition. *Developmental Review, 10*, 48–71. doi:10.1016/0273-2297(90)90004-N

Brewin, C. R. (1996). Intrusive thoughts and intrusive memories in a nonclinical sample. *Cognition & Emotion, 10*, 107–112. doi:10.1080/026999396380411

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032–1053. doi:10.1111/1467-8624.00333

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology, 56*, 267–283. Retrieved from http://dx.doi.org/10.1037/0022-3514.56.2.267

Chen, E., Joseph, M. H., & Zeltzer, L. K. (2000). Behavioral and cognitive interventions in the treatment of pain in children. *Pediatric Clinics of North America, 47*, 513–525. doi:10.1016/S0031-3955(05)70223-6

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. doi:10.1037/0022-006X.67.4.481

Crombez, G., Bijttebier, P., Eccleston, C., Mascagni, T., Mertens, G., Goubert, L., & Verstraeten, K. (2003). The child version of the pain catastrophizing scale (PCS-C): A preliminary validation. *Pain, 104*, 639–646. doi:10.1016/S0304-3959(03)00121-0

Cummings, E. A., Reid, G. J., Finley, G. A., McGrath, P. J., & Ritchie, J. A. (1996). Prevalence and source of pain in pediatric inpatients. *Pain, 68*, 25–31. doi:10.1016/S0304-3959(96)03163-6

Dahlquist, L. M., & Pendley, J. S. (2005). When distraction fails: Parental anxiety and children's responses to distraction during cancer procedures. *Journal of Pediatric Psychology, 30*, 623–628. doi: 10.1093/jpepsy/jsi048

Ehlers, A. (2010). Understanding and treating unwanted trauma memories in posttraumatic stress disorder. *Zeitschrift Fur Psychologie, 218*, 141–145. doi:10.1027/0044-3409/a000021

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: The attentional control theory. *Emotion, 7*, 336–353. doi:10.1037/1528-3542.7.2.336

Fillingim, R. B., King, C. D., Ribeiro-Dasilva, M. C., Rahim-Williams, B., & Riley, J. L. (2009). Sex, gender, and pain: A review of recent clinical and experimental findings. *The Journal of Pain, 10*, 447–485. doi:10.1016/j.jpain.2008.12.001

Ford, R. M., Keating, S., & Patel, R. (2004). Retrieval-induced forgetting: A developmental study. *British Journal of Developmental Psychology, 22*, 585–603. doi:10.1348/0261510042378272

Goodenough, B., Thomas, W., Champion, G. D., Perrott, D., Taplin, J. E., von Baeyer, C. L., & Ziegler, J. B. (1999). Unravelling age effects and sex differences in needle pain: Ratings of sensory intensity and unpleasantness of venipuncture pain by children and their parents. *Pain, 80*, 179–190. doi:10.1016/S0304-3959(98)00201-2

Goodman, J. E., & McGrath, P. J. (1991). The epidemiology of pain in children and adolescents: A review. *Pain, 46*, 247–264. doi:10.1016/0304-3959(91)90108-A

Goodman, J. E., & McGrath, P. J. (2003). Mother's modeling influences children's pain during cold pressor task. *Pain, 104, 559–565*. doi:10.1016/S0304-3959(03)00090-3

Groome, D., & Sterkaj, F. (2010). Retrieval-induced forgetting and clinical depression. *Cognition and Emotion, 24*, 63–70. doi:10.1080/02699930802536219

Harnishfeger, K. K., & Bjorklund, D. F. (1994). A developmental perspective on individual differences in inhibition. *Learning and Individual Differences*, *6*, 331–355. doi:10.1016/1041-6080(94)90021-3

Hechler, T., Chalkiadis, G. A., Hasan, C., Kosfelder, J., Meyerhoff, U., Vocks, S., & Zernikow, B. (2009). Sex differences in pain intensity in adolescents suffering from cancer. *Differences in Pain Memories, 10*, 586–593. doi:10.1016/j.jpain.2008.11.011

Kain, Z. N., Mayes, L. C., Caldwell-Andrews, A. A., Karas, D. E., & McClain, B. C. (2006). Preoperative anxiety, postoperative pain, and behavioral recovery in young children undergoing surgery. *Pediatrics, 118*, 651–658. doi:10.1542/peds.2005-2920

Kobayaski, M., & Tanno, Y. (2013). Retrieval-induced forgetting of words with negative emotionality. *Memory, 21*, 315–323. doi:10.1080/09658211.2012.725741

Koessler, S., Steidle, L., Engler, H., & Kissler, J. (2013). Stress eliminates retrieval-induced forgetting – Does the oral application of cortisol? *Psychoneuroendocrinology, 38*, 94–106. doi:10.1016/j.psyneuen.2012.05.004

Koutantji, M., Pearce, S. A., Oakley, D. A., & Feinmann, C. (1999). Children in pain: An investigation of selective memory for pain and psychological adjustment. *Pain, 81*, 237–244. doi:10.1016/S0304-3959(99)00020-2

Kovacs, M. (1985). The Children's Depression Inventory (CDI). *Psychopharmacology Bulletin, 21*, 995–998.

Langer, S. L., Romano, J. M., Levy, R. L., Walker, L. S., & Whitehead, W. E. (2009). Catastrophizing and parental response to child symptom complaints. *Child Health Care, 38*, 169–184. doi:10.1080/02739610903038750

Law, R., Groome, D., Thorn, L., Potts, R., & Buchana, T. (2012). The relationship between retrieval-induced forgetting, anxiety, and personality. *Anxiety, Stress & Coping: An international Journal, 25*, 711–718. doi:10.1080/10615806.2011.630070

Lechuga, T., Moreno, V., Pelegrina, S., Gómez-Ariza, C. J., & Bajo, T. (2006). Age differences in memory control: Evidence from updating and retrieval-practice tasks. *Acta Psychologica*, *123*, 279–298. doi:10.1016/j.actpsy.2006.01.006

Lehto, J. E., Juujarvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21*, 59–80. doi:10.1348/026151003321164627

MacLeod, M. (2002). Retrieval-induced forgetting in eyewitness memory: Forgetting as a consequence of remembering. *Applied Cognitive Psychology, 16*, 135–149. doi:10.1002/acp.782

Macrae, C. N., & Rosenveare, T. A. (2002). I was always on my mind: The self and temporary forgetting. *Pyschonomic Bulletin & Review, 9*, 611–614. doi:10.3758/BF03196320

McGrath, P. A., Seifert, C. E., Speechley, K. N., Booth, J. C., Stitt, L., & Gibson, M. C. (1996). A new analogue scale for assessing children's pain: An initial validation study. *Pain, 64*, 435–443. doi:10.1016/0304-3959(95)00171-9

Moriarty, O., McGuire, B. E., & Finn, D. P. (2011). The effect of pain on cognitive function: A review of clinical and preclinical research. *Progress in Neurobiology, 93*, 385–404. doi:10.1016/j.pneurobio.2011.01.002

Noel, M., Chambers, C. T., McGrath, P. J., Klein, R. M., & Stewart, S. H. (2012). The influence of children's pain memories on subsequent pain experience. *Pain*, *153*, 1563–1572. doi:10.1016/j.pain.2012.02.020

Noel, M., Rabbitts, J. A., Tai, G. G., & Palermo, T. M. (2015). Remembering pain after surgery: A longitudinal examination of the role of pain catastrophizing in children's and parents' recall. *Pain, 156*, 800–808.

Perfect, T. J., Moulin, C. J. A., Conway, M. A., & Perry, E. (2002). Assessing the inhibitory account of retrieval-induced forgetting with implicit memory tests. *Journal of Experimental Psychology: Learning, Memory and Cognition, 28*, 1111–1110. doi: 10.1037//0278-7393.28.6.1111

Perquin, C. W., Hazebroek-Kampschreur, A. A., Hunfeld, J. A., Bohnen, A. M., van Suijlekom-Smit, L. W., Passchier, J., & van der Wouden, J. C. (2000). Pain in children and adolescents: A common experience. *Pain, 87*, 51–58.

Piira, T., Taplin, J. E., Goodenough, B., & von Baeyer, C. L. (2002). Cognitive-behavioural predictors of children's tolerance of laboratory-induced pain: Implications for clinical assessment and future directions. *Behaviour Research and Therapy, 40*, 571–584. doi:10.1016/S0005-7967(01)00073-0

Reid, G. J., Gilbert, C. A., & McGrath, P. J. (1998). The pain coping questionnaire: Preliminary validation. *Pain, 76*, 83–96. doi:10.1016/S0304-3959(98)00029-3

Rhudy, J. L., France, C. R., Bartley, E. J., Williams, A. E., McCabe, K. M., & Russell, J. L. (2009). Does pain catastrophizing moderate the relationship between spinal nociceptive processes and pain sensitivity? *The Journal of Pain, 10*, 860–869. doi:10.1016/j.jpain.2009.02.005

Roediger, H. L., Weinstein, Y., & Agarwal, P. K. (2010). Forgetting: Preliminary considerations. In S. Della Sala (Ed.), *Forgetting* (pp. 1–22). Hove, UK: Psychology Press.

Salmon, K. (2006). Commentary: Preparing young children for medical procedures: Taking account of memory. *Journal of Pediatric Psychology, 31*, 859–861. doi:10.1093/jpepsy/jsj072

Saunders, J. (2012). Retrieval-induced forgetting deficits in high anxious individuals. *Memory, 20*, 794–802. doi:10.1080/09658211.2012.703676

Saywitz, K. J., & Snyder, L. (1996). Narrative elaboration: Test of a new procedure for interviewing children. *Journal of Consulting and Clinical Psychology, 64*, 1347–1357. doi:10.1037/0022-006X.64.6.1347

Schechter, N. L., Bernstein, B. A., Beck, A., Hart, L., & Scherzer, L. (1991). Individual differences in children's response to pain: Role of temperament and parental characteristics. *Pediatrics, 87*, 171–177.

Shaw, J., Bjork, R. A., & Handal, A. (1995). Retrieval-induced forgetting in an eyewitness-memory paradigm. *Psychonomic Bulletin & Review, 5*, 249–253. doi:10.3758/BF03210965

Sieberg, C. B., Williams, S., & Simons, L. E. (2011). Do parent protective responses mediate the relation between parent distress and child functional disability among children with chronic pain? *Journal of Pediatric Psychology, 36*, 1043–1051. doi:10.1093/jpepsy/jsr043

Smucker, M. R., Craighead, W. E., Craighead, L. W., & Green, B. J. (1986). Normative and reliability data for the Children's Depression Inventory. *Journal of Abnormal Child Psychology, 14*, 25–40. doi:10.1007/BF00917219

Spielberger, C. D., Edwards, J., Lushene, R., Montuori, J., & Platzek, D. (1973). *The State Trait Anxiety Inventory for Children (STAIC) preliminary manual*. Palo Alto: Consulting Psychologists Press.

Storm, B. C., Bjork, E. L., & Bjork, R. A. (2005). Social metacognitive judgments: The role of retrieval-induced forgetting in person memory and impressions. *Journal of Memory and Language, 52*, 535–550. doi:10.1016/j.jml.2005.01.008

Storm, B. C., & White, H. A. (2010). ADHD and retrieval-induced forgetting: Evidence for a deficit in the inhibitory control of memory. *Memory, 18*, 265–271. doi:10.1080/09658210903547884

Tulving, E. (1974). Cue-dependent forgetting: When we forget something we once knew, it does not necessarily mean that the memory trace has been lost; it may only be inaccessible. *American Scientist, 62*(1), 74–82.

von Baeyer, C. L., Marche, T. A., Rocha, E. M., & Salmon, K. (2004). Children's memory for pain: Overview and implications for practice. *The Journal of Pain, 5*, 241–249. doi:10.1016/j.jpain.2004.05.001

von Baeyer, C. L., Piira, T., Chambers, C. T., Trapanotto, M., & Zeltzer, L. K. (2005). Guidelines for the cold pressor task as an experimental pain stimulus for use with children. *The Journal of Pain, 6*, 218–227. doi:10.1016/j.jpain.2005.01.349

Walker, L. S., Garber, J., Greene, J. W. (1993). Psychosocial correlates of recurrent childhood pain: A comparison of pediatric patients with recurrent abdominal pain, organic illness, and psychiatric disorders. *Journal of Abnormal Psychology, 102*, 248–258. doi: 10.1037/0021-843X.102.2.248

Walker, L. S., & Zeman, J. L. (1992). Parental response to child illness behavior. *Journal of Pediatric Psychology, 17*, 49–71. doi:10.1093/jpepsy/17.1.49

West, R. L., Bagwell, D. K., & Dark-Freudeman, A. (2008). Self-efficacy and memory aging: The impact of a memory intervention based on self-efficacy. *Aging, Neuropsychology, and Cognition, 15*, 302–329. doi: 10.1080/13825580701440510

Williamson, A., & Hoggart, B. (2005). Pain: A review of three commonly used pain rating scales. *Journal of Clinical Nursing, 14*, 798–804. doi:10.1111/j.1365-2702.2005.01121.x

Wilson, S. P., & Kipp, K. (1998). The development of efficient inhibition: Evidence from directed-forgetting tasks. *Developmental Review, 18*, 86–123. doi:10.1006/drev.1997.0445

Zellner, M., & Bäuml, K. H. (2005). Intact retrieval inhibition in children's episodic recall. *Memory & Cognition, 33*, 396–404. doi:10.3758/BF03193058

Zeltzer, L. K., & Blackett-Schlank, C. (2005). *Conquering your child's chronic pain: A pediatrician's guide for reclaiming a normal childhood*. New York, NY: Harper.