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Effects of Stress Coping Strategy, Previous History, and Parental Preparation on Children's Memory of a Stressful Event

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The purpose of this study was to explore linkages between stress and a range of individual difference factors on children's memory for a potentially stressful event. Children (N=63) aged from 4 to 10 years, who undergone a minor dental operative procedure were evaluated. Overall, the results of this study replicated and extended previous findings of the related literature, providing some further evidence for a negative relation between stress and children's recall. More considerable variation in individual difference variables, in particular, children's stress coping strategies, quality of previous experiences, amount of the advanced parental preparation were existed among the children, influencing the relation between the level of stress and children's remembering of a stressful event. Future inquiries for understanding theoretical, clinical, and forensic issues in children's remembering of a stressful event were discussed.

Key words : stress, coping strategy, previous experiences, parental preparation, children's memory

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Introduction

Understanding children's memory for stressful personally-experienced events is of theoretical, forensic, and clinical significance. In particular, given the importance of children's eyewitness testimony about events involving sexual or physical abuse, it is imperative to understand the extent to which stress experienced by a child as the details of an experience are encoded impacts his or her subsequent memory reports. Given that the child and an alleged perpetrator are often the only witnesses to a stressful experience, progress must be made in developing concrete strategies for eliciting credible and reliable testimony from children at different ages. Despite extensive research efforts thus far, much remains to be learned, especially because each new research finding has supported the notion that children's reactions to potential stress-provoking events are affected by a variety of individual difference variables (Kwak & Lee, 2006).

Initially, insights into stress's impact on children's memory were gained through investigations of children's remembering of medical experiences. Clinical and medical situations were recognized as naturally occurring, and even beneficial, events that share many elements consistent with forensic allegations of abuse (e.g., personal touch, feelings of betrayal, physical discomfort). Therefore, routine physical examinations (Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993), inoculations (Goodman, Hirshman, Hepps, & Rudy, 1991), visits to the emergency room (Peterson & Bell, 1996) or pediatric dentistry (Vandermass, Hess, & Baker-Ward, 1993), and experiences with invasive, painful, and frightening medical procedures (Chen, Zeltzer, Craske, & Katz, 2000) have been employed to study children's recall of stressful events. However, the findings remain mixed as to whether stress helps or hurts children's memory when employing these natural paradigms as to-be-remembered stressful events in research. Recently, there has been a significant upsurge in the efforts to identify individual characteristics that are predictive of children's memory for a stressful event due to the inconsistent findings, to date, on the effects of stress on children's memory. Although many authors (Ornstein & Elischberger, 2004) have reviewed various predictive strategies for understanding individual difference factors on children's memory and suggestibility, the precise individual difference variables that influence the ways in which children's memory of stressful events is formed remain unknown.

A number of individual characteristics have been identified as potentially important sources of variability in children's recollections of stressful events. Particularly, children's coping strategies during or after a stressful experience, whether intentional or not, may strongly influence the accuracy of children's remembering of that experience. Effective coping relies on

one's ability to regulate or modulate emotion or arousal; effortful control (i.e., reflecting the child's ability to shift and refocus attention) appears to be integral to this process (Salmon & Pereira, 2002). For instance, during medical procedures some children request information from medical personnel, and others cry and resist or request parental support or comfort (Quas, Hong, Alkon, & Boyce, 2000). In the forensic context, the reactions of children are known to vary broadly during sexually abusive events and can include active resistance, feigning sleep, compliance, or mentally withdrawing and pretending that the abuse is not occurring (Quas, Goodman & Jones, 2003).

To date, very little research has been carried out to determine how particular coping strategies influence children's recall of stressful experiences. Some coping strategies that involve focusing on the experience itself (e.g., cognitive reframing and other forms of self-talk) are believed to facilitate recall, whereas strategies of avoidance that result in a shift of attention away from an unpleasant stimulus (distraction) or attempts to block out awareness of the stimulus (escape or denial) have been considered by many to contribute to poorer recall. Children's coping strategies are undoubtedly influenced by the individual's developmental stage. Linguistic and metacognitive maturity enables older children to invoke advanced cognitive strategies in addition to the behavioral strategies routinely used by younger children (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). Differences among children's emotional coping skills and attention focus during a stressful event and their willingness or ability to deliberate and discuss emotional events with others likely affect encoding, storage, and retrieval processes, and subsequent memory reports. It has long been considered that experiential avoidance, of which a core feature is an "unwillingness to remain in contact with aversive private experiences" such as thoughts, feelings, and memories, is considered to be a stronger contributor to psychopathology than the intensity, frequency, or negative valence of these experiences (Chawla & Ostafin, 2007; Hayes & Wilson, 2003). These findings, together with those that implicated an association between avoidance and poor psychological adjustment, highlight the need for further research to directly examine the role of memory in the development of psychopathological responses. Differences among children's emotional coping techniques and stress reactivity during a stressful event, along with comparable differences in their willingness or ability to discuss emotional events with others is very likely to affect encoding, storage, and retrieval processes, and consequently, children's subsequent memory reports. Thus, individual differences in stress-coping styles may moderate the predictive ability of children's stress responsivity and memory performance.

As such the principal goals of the current study were to explore the impact of stress on

children's remembering by using a naturally occurring stressful event, an operative dental procedure, as a model situation and taking into consideration the ways in which children's coping strategy as the event unfolds may be associated with children's stress responsivity and memory performance.

Method

Design and Participants

This investigation was designed to examine the extent to which variability in children's reports of a dental operative procedure could be accounted for by selected characteristics of the child age, the quality of preparation for the visit (i.e., prior dental experiences, discussion with parents), and children's emotional coping techniques. The measures included variables derived from parental reports, ratings and observations of child behavior, and children's reports of their memory for the dental treatment that they received.

This research was carried out at a private Dental Clinic located in a metropolitan area in Seoul. The sample was composed of 63 children (35 boys and 28 girls) who were patients at the clinic and ranged in age from 49-132 months (M = 86.41, SD = 18.65). The parent or guardian who accompanied the child (55 mothers, 3 fathers, 4 grandmothers, 1 grandfather) also participated by providing background information as well as informed consent. Written consent was also obtained from the participating dentist. The children's involvement in this study in no way affected their actual treatment. In general, the participating children had histories of receiving limited preventive dental care, and all were scheduled for minor operative procedures: sealant (32), filling (9), extractions (14), something else (e.g., pulp extirpation, canal irrigation, nerve treatment) (6), or multiple procedures (2).

A pediatric dentist who is the director of the private clinic treated all the participated children. An interviewer who had advanced training in psychology obtained the children's reports.

Measurement

Memory Interview

Twenty standard components ("features") of the dental visit were identified on the basis of consultation with the faculty of the dental clinic and refined through pilot testing. These features are listed in Table 1.

Following procedures used in previous research (e.g., Ornstein, Baker-Ward, Gordon, Pelphrey, Tyler, & Gramzow, 2006), the interview protocol was hierarchically structured, with the child's retention of each of typical features elicited through a series of increasingly specific probes. The first question was very general such as "Tell me what happened during your visit to

Table 1. Features that Could or Could Not Occur During the Children's Dental Treatments

	Name	Description
Likely to Present Features	Green mask	Dentist puts a green rubber mask on a child's mouth
	Water	Dentist puts squirting water tube into the child's mouth
	Rubber gloves	Dentist wears a rubber gloves
	Jelly on gums	Dentist puts jelly on the child's gums (hot cream)
	Air gun	Dentist uses an air blowing tool to check sensitivity
	Sucking saliva	Tool used that sucks saliva
	Mouth prop	Dentist puts a mouth prop to keep the child's mouth open
	White or silver filling	Dentist uses white or silver filling
	Special light	Special light used to dry filling (laser gun)
	Metal hat	Tooth ring
Absent Features	Check head for ticks	Helpers check the child's head for ticks
	Check a hair	Helpers check the child's hair
	Put Band-Aid on toe	Helpers puts a Band-Aid on the child's toe
	Take a picture	Helpers take a picture of the child's mouth
	Check eyes or hearing	Helpers check the child's eyes or hearing
	Take a shot	Dentist gives a shot to the child
	Check height and weight	Helpers check a child's height and weight
	Temperature	Helpers check the child's temperature

the dentist", so that children could provide general free recall. If the child provided a nonspecific response (e.g., "The dentist fixed my teeth") the interviewer followed up with nondirective prompts (e.g., "Tell me more about that") until no additional information was forthcoming. At that point, a series of increasingly specific questions were presented. For example, the child was first asked a structured but relatively open-ended question such as "What did the dentist use to fix your teeth?". A number of possible target features could be offered in response to this question, including descriptions of the use of a special light to dry fillings, the extraction of a tooth, and so on. Children who did not provide information about a specific feature were then asked a yes/no question, (e.g., "Did the dentist use the tooth pillow (mouth prop) to keep your mouth open?"). The specific questions addressing each feature included an item for which the correct answer was "yes" and an item for which the

right response was "no." These items were listed in the protocol in the order in which the actions they referenced transpired during the dental visit, and were generally asked in the same order for each participant. Given variations in treatment associated with different procedures, participants had different numbers of applicable features, as verified by a check-list completed by the researcher who video-recorded the procedure. On average, 11.92 (SD = 2.73, range = 6-16) features were included in the child's dental treatment, and the children were questioned about each of these "present" features. Questions regarding possible features that were not experienced by the child were classified as "absent feature" items. On average, the children were questioned about 19.08 (SD = 2.73, range = 15-25) of these features.

Background Questionnaire

The adult family member who accompanied the child to the dental clinic completed a brief background questionnaire to confirm the child's exact age, provide some demographic information about the child's and family's background (e.g., child's date of birth, parents' occupations and education level). In addition, it was included the questions to indicate whether or not the child had an unpleasant past dental visit. As an indicator of preparation for the dental visit, the parents also responded to the question, "Did you discuss the dental visit with your child before you came to the dentist today?" by selecting one of the four options ("Yes, briefly; yes, in some detail; yes, extensively; no.").

Children's Behavior Stress Responses during Treatment

The Behavior Profile Rating Scale (BPRS: Melamed, Weinstein, Hawes, & Katin-Borland, 1975) was used to code videos of the operative procedures for the presence or absence of behaviors that occurred over 3-minute intervals during the dental event. An independent observer scores the frequency of these behaviors over three-minute intervals, with the total BPRS score obtained by multiplying the total number of blocks in which the behavior occurs by the weighting factor, summing across all behaviors, and dividing by the number of intervals. Concurrent and discriminative validity have been established for the BPRS, and high levels of inter-rater reliability have been reported (Aartman, van Everdingen, Hoogstraten, & Schuurs, 1996). Thus, the observers coded the presence or absence of theses behaviors in each 3-minute block of the procedure including cries during injection, rolls over, screams and so forth. In addition, dentists rated each child's cooperation during the procedure using the Frankl Scale (Frankl, Shiere, & Fogels, 1962), an extensively used measure in dental settings across countries. This scale categorizes children's behavior in specific situations along four points based on their cooperation during the dental treatment. For the current study, the dentist was

asked to rate each child's overall cooperation using this scale from 'Definitely Cooperative' (4) to 'Definitely Uncooperative' (1), with the expectation that cooperation would be negatively associated with the children's behavioral manifestations of stress, as assessed with the BPRS.

Stress Coping Strategy

Children's coping activities were examined with a series of questions drawn from the KIDCOPE (Spirito, Stark, & Williams, 1988) and the HICUPS ("How I Coped Under Pressure Scale": Ayers, Sandier, West, & Roosa, 1994) scales. The children were asked if they made use of each of 15 potential strategies for coping (e.g., mood elevation, social support, information seeking, avoidance actions, activated escape, emotional expression, resignation), and for each technique that was employed, they were directed further to indicate the frequency of usage ("some, a lot, or the whole time") and the extent to which it was helpful ("not at all, a little, some, or a lot").

Procedure

A researcher obtained written consent from the parents and verbal assent from the children before the scheduled dental procedures. The entire dental procedure was video recorded for subsequent analysis, and a researcher also kept an independent record for each child of the specific components of the treatment that were administered. While children were receiving treatment, the parents, who remained in the waiting area of the clinic, completed background questionnaire. Following the procedure, the dentists provided ratings of children's levels of cooperation, using the Frankl scale. The majority of the dental procedures were completed within about 30 minutes, although in some cases the treatment required up to 40 minutes. Immediately following the procedure, the children were asked to play in a playroom for about 10 minutes to calm them down. The children were then escorted to a separate room in the clinic for their individual interviews. The interviewer first established rapport with the child through conversation, then conducted the memory interview, following the protocol described above.

After the memory assessment, the child's self-report of coping strategies were obtained, using the questionnaire described above. The memory interview and the discussion of coping strategies were video-recorded for subsequent analyses. Following the completion of the reports, children were given a simple debriefing and the opportunity to ask questions about the interview. The entire interview procedure required less than 30 minutes.

Coding

Procedures used in previous research (e.g.,

Ornstein et al., 2006) were followed to quantify the children's memory for the dental procedures. The video records of the interviews were inspected to determine the percentage of present features (i.e., those included in each child's treatment) reported as a function of level of questioning (open-ended, Wh-, and yes-no). Thus, total recall is the combined scores of children's accurate responses of open-ended, Wh-, and yes-no questioning and free recall is the combined scores of children's accurate responses of only open-ended and Wh-questioning. In addition, for the purpose of measuring child's suggestibility, the proportion of 'yes' responses on absent questions (i.e., false alarm) was tallied.

To assess the children's stress during the operative procedures, two trained researchers viewed the video records and coded the observed behaviors according to the BPRS scale developed by Melamed et al. (1975), as discussed above. Inter-rater reliability was .96, as determined by double coding of a randomly selected subject (25%) of the protocols.

The children's stress coping strategies were grouped into the areas of approach oriented coping including mood elevation (3 items), social support (3 items), information seeking (2 items) and avoidance oriented coping including avoidance actions (3 items), activated escape (2 items), emotional expression (1 item), and resignation (1 item). For purposes of analysis, means were calculated for each of these two strategy types (Ayers et al., 1994).

Finally, the parents' ratings of the children's prior negative experiences at the dentist and of the amount of preparation for the treatment were derived from the Background Questionnaire. Previous dental history was scored 0 if children had no previous unpleasant dental experience, in contrast, scored 1 if children had previous unpleasant dental experiences. Parental advance preparation was scored 0 if children had none or little advance preparation by parent in regards to the dental visit, in contrast, scored 1 if children had some or extensive advance preparation by parent in regards to the dental visit.

Results

The major questions of interest concerned the children's recall of the various features of the dental treatment as a function of age, specificity of the memory prompt, behavioral stress reactivity, and a range of individual difference variables. Because the number of features that appeared during the children's dental treatments varied by individual, the basic recall data are reported as percentages.

To examine the linkage between stress levels and children's memory performance, stress levels during the dental procedure as measured by the dentist and using by BPRS were calculated in combination with the dentist's assessment of

each child's anxiety and compliance.

In the sections that follow, several aspects of the data are presented in detail. After a brief treatment of preliminary analyses, the formal assessment of the findings begins with an inspection of the basic recall data, examination of age differences in memory performance. Correlation analyses were also conducted to explore linkages between stress levels and children's memory performance including possible interactions with age and other individual differences. Finally, given that the central focus of this exploratory study was to examine which selected individual difference variables could explain some of the variation in children's memories of a stressful event, a hierarchical regression analyses was performed in which measures of individual differences were used as predictors of the major dependent measures of memory performance with children's ages, level of behavioral stress responses, and individual differences as independent variables.

A series of preliminary analyses indicated no differences in recall as a function of parent's education level, the specific types of dental treatments such as fillings, extractions, sealants, and the three different hygienists' identities, and they were therefore excluded as variables of interest.

Age Differences on Recall

At the memory interview, children were asked 15.98 (SD = 2.73) present-feature questions on average, which included events that occurred and tools used in their dental preparation process and treatment procedure. The particular questions posed varied from child to child to reflect the differences in their individual dental treatments. The basic recall data are presented in Table 2.

Based on preliminary analysis, clearly the children aged 7 years and older recalled a considerable amount of information during

Table 2. Descriptive Statistics for Recall Data and Level of Questioning by Younger/Older[a] Age Groups

Age Groups (*n*)	**Total Recall**	**Free Recall**	**False Alarm**
		M(*SD*)	
Younger (28)	0.76(0.10)	0.39(0.23)	0.04(0.05)
Older (35)	0.95(0.05)	0.61(0.22)	0.01(0.02)
Total (63)	0.87(0.12)	0.51(0.25)	0.02(0.04)

Note. *n* = number of children. Total Recall: the combined scores of children's accurate responses of open-ended, Wh-, and yes-no questioning, Free Recall: the combined scores of children's accurate responses of only open-ended and Wh- questioning, False alarm: the proportion of 'yes' responses on absent feature questions.

general probes. Thus, it was beneficial to merge the children into two age groups as younger (4-, 5-, and 6-year-olds) and older (7-, 8-, 9-, and 10-year-olds).

As has been consistently demonstrated in past research (Ornstein et al., 2006), older children provided more total information (i.e., total recall) and reported a greater proportion of the features of the dental treatment in response to general probes (i.e., free recall). In this study, one-way analyses of variances yielded significant age effects in total and free recall, Fs (1, 61) $\geq$ 14.99, *ps* $<$ .01 respectively, indicating that older children recalled more present-features than younger children. Age differences were not evident in the children's responses to yes-no questions, but this result should not be interpreted as indicating that developmental differences in memory performance were not relevant in considering the children's responses to forced-choice questioning. The interview was administered in such a way that yes-no questions were only asked about features that did not come up during the free recall questioning. Overall older children recalled more than younger children during total and general probes.

In addition, to explore issues of suggestibility and possible response bias, children's answers to the absent-feature questions, which were about features that did not occur during the dental procedure, were analyzed. In the memory interview, younger children were asked 15.50 (SD = 2.53) and older children were asked 16.51(SD = 2.87) absent-feature questions on average. These were questions asked about events or tools that were not part of their dental preparation process and treatment procedure. The particular questions posed varied from child to child, reflecting a few differences due to the individual dental treatments. For each child, the proportion of yes responses (i.e., false alarms) to absent-feature questions was calculated. The children's overall responses to these questions were very good, with false alarms scores, on average, M(SD)=.02(.04). Overall, older children exhibited significantly lower rates of false alarm responses to the absent-features than did younger children, F (1, 61) =15.67, p $<$ .01, which is consistent with the argument that younger children tend to respond yes to all questions, even when a yes response is incorrect.

Clearly, and as demonstrated by the previous literature (e.g., Ceci & Bruck, 1993 for a review), there were age-related differences in the children's responses to questions about activities not included in the stressful experience.

Effect of Stress on Recall

A principal purpose of the study was to examine the effects of stress on children's remembering of a potentially traumatic, personally experienced event. The mean ratings of anxiety suggest that the sample, as a group,

Table 3. Means, Ranges, and Standard Deviations for the Predictor Variables used in the Analyses of Anxiety

Anxiety Variables	Mean(*SD*)	Range
Frankl Behavior Rating Scale Checklist by dentist	3.75(0.56)	1 - 4
Noncompliance by dentist	1.62(1.08)	1 - 7
Anxiety by dentist	1.62(1.08)	1 - 7
Behavioral Profile Rating Scale score	0.89(1.48)	0 - 6.33

Note. Behavioral Profile Rating Scale score is observed stressful behaviors during the dental procedure according to the BPRS scale developed by Melamed et al. (1975).

was less anxious or stressful during the dental procedure than had been anticipated. The dentist's mean rating of child anxiety during the dental procedure was very low, although a full range of ratings was observed, indicating that the dentist saw her patients as moderately relaxed on average as presented in Table 3. On the other hand, there was high variability in the BPRS scores for children even when undergoing the same treatments; some children in the sealant treatment expressed high anxiety (BRPS scores was comparatively high: maximum BPRS score was 6.33 in the sample, and some did not exhibit any signs of anxiety, meaning that BPRS score was 0).

To examine the relations among the various measures of anxiety employed in this study, correlations were calculated for behavioral stress responses and dentist 's ratings of anxiety. These measures were significantly correlated with each other indicating that the anxiety variables were reliable measures of the children's negative emotions (i.e., stress) in regards to the dental treatment. Particularly, there were significant correlations between the dentist's ratings of the children's anxiety and children's behavioral reactivity during the dental procedure ($r = -.32$, $p < .05$).

More importantly, the dentist's ratings of the children's anxiety (i.e., Frankl scores) was positively correlated with the children's free recall($r = .29$, $p < .05$). It indicated that children who were more cooperative and able to build good rapport with the dentist during the dental treatment exhibited better recalls in response to general probes compared to children who were uncooperative and reluctant to accept the dental treatment.

In addition, the children's errors on the absent-feature questions, the proportions of false alarms ($r = -.26$, $p < .05$) were highly correlated with the dentist's anxiety ratings, indicating that children who showed generally higher anxiety during the dental procedure exhibited higher errors on absent features (i.e., greater suggestibility) than children who showed

lower anxiety during the dental procedure.

Overall, the correlation results reliably indicate a linear pattern of stress negatively impacting children's remembering.

Individual Difference on Recall

To explore the effect of other potential influences on the relation between stress and children's memory and children's individual differences were investigated. There were no significant effects on memory performances seen from the following variables: the total number of times children have seen a dentist in their life, the frequency of seeing this particular dentist in the past year, whether or not the child had any dental experience at another dentistry. They were therefore excluded as variables of interest.

Stress coping strategies

From a developmental perspective, significant age differences were expected in the usage of coping strategies. In the current study, that held true. Older children used approach-oriented coping strategies during the dental procedure more often than younger children, F (1, 59) = 8.65, $p < .01$, yet there was no differences in the use of avoidance-oriented coping strategies between the two age groups.

The extent of parent's preparation yielded a main effect with age, F (1, 59) = 8.92, $p < .01$, indicating that older children were more prepared by their parents before coming to the dentistry compared to younger children. The quality of past experiences also yielded a main effect with age, F (1, 59) = 22.03, $p < .01$, indicating that younger children had more previous unpleasant dental experiences than older children (see Table 4).

Table 4. Means and Standard Deviations for Children's Coping Styles, Dental History, and Parental Preparation By Age Groups

Age Groups [a] (n)	Mean(*SD*)
Approach-oriented coping	
Younger (28)	1.69(0.53)
Older (35)	2.12(0.59)
Total (63)	1.93(0.60)
Avoidance-oriented coping	
Younger (28)	1.30(0.44)
Older (35)	1.35(0.48)
Total (63)	1.33(0.46)
Previous dental experience	
Younger (28)	0.68(0.48)
Older (35)	0.17(0.38)
Total (63)	0.40(0.49)
Parental preparation	
Younger (28)	0.36(0.49)
Older (35)	0.71(0.46)
Total (63)	0.56(0.50)

Note. *n* = number of children. a. Younger children = 4- to 6-year-olds, older children = 7- to 10-year-olds.

As seen in Table 5, the average score of the approach-oriented coping style was related to the

Table 5. Correlations of Combined Coping Styles and Specific Recall Types and other Individual Differences

	Approach-Oriented Coping	Avoidance-Oriented Coping
Total Recall	.36**	-
Free Recall	.34**	-
False Alarm	-.28*	-
Behavioral stress reactivity	-	.39**
Previous dental experience	-	.30*
Parent preparation	-	-.30*

Note. Statistical significant corelation was presented controlled by age of months. *$p < .05$, **$p < .01$.

children's total recall and free recall (r = .36, .34, *ps* < .01, respectively), indicating that children who self-reported that they used more approach-based coping styles exhibited more total information (i.e., total recall) and reported a greater proportion of the features of the dental treatment in response to general probes (i.e., free recall) than children who did not. In addition, the average score of the approach-oriented coping style was related to the children's false alarm (r = -.28 $p < .01$), indicating that children who self-reported that they used more approach-based coping styles exhibited lower errors on absent features than children who did not.

The average score of the avoidance-oriented coping style was not related to any of children's recall performances. However, the avoidance-oriented coping strategies were associated with children's behavioral responses to stress, indicating that children who used avoidance-oriented strategies exhibited more stress-related behaviors during the dental procedure (r = .39, $p < .01$).

On the other hand, children who had unpleasant previous dental experiences used fewer approach-oriented coping strategies during the studied dental visit (r = -.27, $p < .05$). Both the quality of previous dental experience and the extent of parental preparation of the child for the dental visit were negatively correlated with children's use of avoidance-oriented strategies regardless of the children's ages (r = .30, -.30, *ps* < .05, respectively). Thus, the children who had unpleasant previous dental experiences or were not prepared for the visit by their parents were more likely to use avoidance-oriented coping strategies during the dental procedure.

Hierarchical Multiple Regression Findings

To explore further the extent to which the level of stress and the individual difference variables discussed above may explain variation

in children's memory performance for stressful events, a series of hierarchical regression analyses was carried out, in each of which measures of individual differences were used as predictors of children's memory performances.

Age was always the first step in the hierarchy, given its importance in children's memory performance. Each following step examined the incremental contributions beyond age of the additional predictors.

In the second step, the main anxiety indictors (i.e., Frankl and the BPRS scores) were entered after age when they met the criterion for inclusion in the model. The second step was designed in this manner so it could be determined if the levels of stress added significantly to the amount of variability explained by age alone. Next, the individual difference variables (i.e., the quality of previous experience, advanced parental preparation, coping styles) identified in the correlation analyses was entered to test whether each variable's presence could add significantly to the prediction made by earlier predictors.

As can be seen in Table 6, according to the first model, 70%, 17%, 16% of the variance in children's total recall, free recall, and false alarm, can be explained by the children's age in months respectively. Each subsequent step examined the incremental contributions beyond age of the additional predictors. The levels of stress indictors (i.e., BPRS, Frankl scores) were entered after age. Stress levels, however did not add significantly to the amount of variability explained by age alone except for children's free recall, indicating that the level of stress would affect significantly only the amount of the children's responses in the general probes, not forced-choice questioning (i.e., yes/no questioning).

The children's previous dental experiences and

Table 6. Hierarchical Multiple Regressions of the Predictor Variables on Children's Recall

	Total recall				Free recall				False Alarm			
	R^2	$\triangle R^2$	$\triangle F$	df	R^2	$\triangle R^2$	$\triangle F$	df	R^2	$\triangle R^2$	$\triangle F$	df
1.	.70	.70	123.54**	(1, 53)	.17	.17	11.54**	(1, 55)	.16	.16	10.79**	(1, 55)
2.	.70	.00	0.27	(2. 51)	.25	.07	2.51*	(2, 53)	.24	.08	2.83	(2, 53)
3.	.78	.08	17.96**	(1, 50)	.38	.14	11.28*	(1, 52)	.39	.15	12.39**	(1, 52)
4.	.79	.01	1.86	(1, 49)	.43	.06	4.96*	(1, 51)	.40	.01	0.81	(1, 51)
5	.79	.01	0.12	(1, 48)	.45	.01	1.13	(1, 50)	.41	.01	0.66	(1, 50)

Note. Model 1 includes age (months), Model 2 includes age (months), stress measures, Model 3 includes age(months), stress measures, quality of the previous experience, Model 4 includes age (months), stress measures, quality of the previous experience, advanced parental discussion. Model 5 includes age (months), stress measures, quality of the previous experience, advanced parental discussion and approach-oriented coping strategy.

the extent of parental preparation for the dental visit were added in the next two steps, and Step 3 explained 78%, 38%, 39% and Step 4 explained 79%, 43%, 40% of the variance in children's total recall, free recall, and false alarm, respectively. Those two variables significantly improved the models from the previous one for children's free recall but the quality of previous dental experiences variable did not significantly improve the models from the previous one for children's total recall and false alarm.

Finally the approach-oriented coping strategy variable was added in Step 5, because it was likely to account for some variances in the children's memory performances based on prior correlation analyses. This fifth step explained 79%, 45%, 41% of the variance in children's total recall, free recall, and false alarm, respectively. Although it is not statistically significant, that percentage indicates that approach-oriented coping style was a little more influential for children's free recall performance rather than total recall and false alarm performances.

Overall, children's age in months, the presence of their previous negative dental experiences, and the amount of advanced parental preparation for their visits mostly explained a significant amount of the unique variance in children's free recall. This result was consistent with the literature demonstrated that older children have superior recall in response to general probes (Ornstein et al., 2006), children with higher rates of negative previous experiences have poorer recall(Chen, Zeltzer, Craske, & Katz., 1999), and that parental preparation, in general, has a positive influence on children's memory performance of a stressful event (Salmon, Price, & Pereira, 2002).

Discussion

The overall results replicated and extended previous findings. This study provided further evidence for a negative relation between stress and strength of recall, as demonstrated by the association of the higher anxieties during the dental procedure with the children's poorer remembering.

First, children who were more cooperative and able to build good rapport with the dentist during the dental treatment reported a greater proportion of the features of the dental treatment in response to general probes compared to children who were uncooperative and reluctant to accept the treatment. In addition, children who showed generally higher anxiety during the dental procedure exhibited greater suggestibility than children who showed lower anxiety during the dental procedure. Overall, the correlation results reliably indicate a linear pattern of stress negatively impacting children's remembering. There is considerable controversy in the field about the magnitude

and direction of the association between stress and children's memory, but the findings from this study were consistent with a negative relation between stress and remembering, which in turn supports Chen et al.'s (2000) argument that stress has debilitative effects on memory.

Several individual differences were associated directly or indirectly with variation in the children's remembering not limited to children's developmental levels including coping style, presence of the previous negative experiences, and extent of the children's advance preparation for the event by parents. It thus seems possible that unpleasant previous dental experience and comparatively little or no preparation may be linked to higher pain and anxiety during the dental procedure and may lead children to pay less attention to their surroundings, eventually resulting in poorer remembering. However, interpretations should be tentative, because the only measures of those variables were based on parental reports, which may not have been completely accurate. It is worth noting that no specific contents of parents' preparations of children for the dental procedures are known, merely that a discussion prior to the visit took place. Whatever the content, such discussions were positively associated with children's memory of the event. Given these findings, further studies should investigate in depth the effects of prior traumatic dental experiences and the specific information that may be provided by parents to soothe their children as they prepare for dental treatment.

Conducting the study in a naturalistic setting offered several benefits because the children took part in an actual stressful event as opposed to a manufactured one such as watching a video of a child undergoing stressful procedures, or experiencing a fire alarm. As such, a naturalistic study design can examine significantly stressful events, which can offer distinctive examples of how children recount personal stressful experiences. In investigating the relation between stress and memory, to-be-remembered events must be salient, personally significant, and reliably induce stress in children. Among the various naturalistic stressful contexts, the use of a dental procedure as a discrete, situationally specific stressor is not unique to this study (see, e.g., Baker-Ward et al., 2009). However, the results of this study highlight several avenues for future inquiry in the domains of children's remembering of stressful events, legal investigations, and pediatric dentistry. Although the findings of this study provide support for recent explorations of the ways in which stress impacts children's remembering, they also raise a number of imperative questions for future investigations. The documented within-participant linkages between stress and remembering—over and above the effects of age—suggest the importance of fine-grained analyses of stress levels and a range of children's individual characteristics. Additionally, the strong, positive influences from parental preparation and

approach-oriented coping styles exhibited during the dental procedure suggest the need for a meaningful investigation regarding the contents of parents' preparative discussions with their children and specific coping styles children can apply that will potentially reduce stress levels during the event.

In research examining a range of individual difference factors as predictors of memory, additional work is needed to elucidate the precise conditions under which individual difference factors predict memory and the underlying mechanisms of the observed associations between stress and memory. Given that the present study was exploratory, it is still unclear how the numerous anxiety variables and various individual difference factors can consistently influence children's remembering. Because much of the research to date has been preliminary and exploratory, further research is needed to confirm associations found in one or two studies to determine how generalizable they are to children of varying ages and types of to-be-remembered events related to stressful experiences.

In addition, although not assessed in the present study, future research would benefit from larger-scale examinations that reveal the combined and independent contributions of various interrelated factors among the behaviorally different stress levels and a range of individual differences across ages. As new findings arise, researchers will be in a position to develop more complex theoretical models that can elucidate the specific factors giving rise to children's vulnerability to suggestible questions and give those recommendations to interviewers, lawyers, and other forensic professionals.

Considering that approach-oriented coping strategies were strongly correlated with children's remembering of a stressful event in this study, the efficacy of programs for developing effective coping strategies aimed at increasing approach-oriented and decreasing avoidance-oriented types to reduce anxiety and pain perception across ages for dental procedures should be assessed. In addition, teaching approach-oriented coping strategies may be applicable in different stressful environments. Future studies should take a closer look at the relation between certain coping strategies and dental anxiety to determine whether specific coping styles have a stronger relation to dental anxiety. Identifying specific coping styles should help clarify exactly which coping styles should be targeted to improve the experience in the dental office (i.e., reducing anxiety and pain perception and enhancing cooperation with the dental treatment) and how coping styles may work differently across ages.

Thus, there are numerous possibilities for further research to confirm the findings reported here, to determine the extent to which they are generalizable, and to deepen our understanding of the relation between stress and children's remembering. In addition to psychological fields, such research would be valuable in both the

gathering of children's eyewitness testimony and improving pediatric dentistry experience.

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아동의 스트레스 대처 전략과 사전 경험의 질적 특성 및 부모의 준비성 정도가 아동 기억의 신뢰성에 미치는 영향

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본 연구는 자연스런 스트레스 반응이 유발되는 소아 치과 진료를 경험한 4-10세 아동 63명을 대상으로 스트레스와 아동 회상 기억과의 관계성 검증 및 아동 회상 기억에 다양한 개인차 변인들이- 스트레스 대처 전략 유형, 사건에 대한 부모의 준비성 정도, 사건 관련 사전 경험의 특성- 미치는 영향을 살펴보고자 하였다. 전반적으로 본 연구는 스트레스 수준과 아동의 기억 수행 간에 부적 상관을 보여 관련 국외의 선행 연구들과 일치된 방향성을 보였다. 보다 흥미로운 결과는 스트레스적 경험에 대한 아동 회상의 정확성이 아동의 스트레스 대처 전략 유형, 사건과 관련된 아동의 사전 경험들의 질적 특성, 그리고 관련 사건에 대한 부모의 준비성 정도 등에 의해 직접적인 영향을 받는 것으로 나타났다. 이와 같은 결과는 성학대, 신체 폭력과 같은 범죄 사건과 관련된 아동 회상 진술의 신뢰성 평가시 스트레스 사건에 반응하는 아동의 개인차 및 부모와의 애착 수준 등이 복합적으로 고려되어야 함을 함의한다. 본 연구 결과를 바탕으로 스트레스 수준과 아동 회상 기억의 관계성에 대해 학문적, 임상적, 법정 맥락에서 다각적으로 논의해 보고자 하였다.

주요어 : 스트레스, 대처 전략, 사전 경험, 부모의 준비성, 아동 기억