한국심리학회지 : 문화 및 사회문제
Korean Journal of Culture and Social Issues
2013, Vol. 19, No. 3, 343～365.

Explaining Variance in Children's Recall of a Stressful Experience: Influence of Cognitive and Emotional Individual Differences

Seungjin Lee

Institute of Psychological Science Seoul National University

This study examined the effects of various individual differences on children's memory of a stressful experience. The participants for the current study were children (N=85) aged 4-9 years those who experienced a naturally occurring stressful experience from a dental procedure. There was overall negative relation between the level of stress and children's memory performance. However, more interestingly, the results of this study provided some further evidence that several cognitive (i.e., receptive language ability and working memory capacity) and emotional (i.e., children's general anxiety condition, children's self-report of pain and anxiety about the event) individual difference factors were associated with variations in children's remembering across ages. The results suggest that the relation between stress and children's memory might be impacted in part by children's various individual characteristics. Furthermore, the findings are discussed in the applied context that based on the results clinical and legal professionals can tailor interviews to best meet children's needs and capabilities, and create developmentally and individually sensitive guidelines for interviewing children in the legal system.

Key words : children's remembering, receptive language ability, working memory capacity, stress, anxiety

† 교신저자 : Seungjin Lee, Institute of Psychological Science, Seoul National University.
E-mail : sjmagiclife@gmail.com

Introduction

Children may undergo a variety of stressful experiences as a result of illness or hospitalization and dental, medical, and surgical procedures. It is also the case, unfortunately, that many children throughout the world are witnesses to social crimes or domestic violence in their homes (Kenning, Merchant, & Tomkins, 1991). Additionally, countless children are victims of physical or sexual maltreatment or both (Volpe, 1996).

In the past two decades, researchers have devoted significant effort to understanding the memory functions involved in children's processing of stressful events. Studies in this field were expected to yield answers about how stress affects children's remembering of information gathered under stressful conditions and the reliability of their recall over time. The relation between stress and immediate and long-term recall was also studied in applied areas, with the hope that such knowledge would help tailor treatment regimens for children's individual differences in clinical contexts and to definitively determine the reliability of a child's testimony by which guilt or innocence of a defendant may be based in a legal trial.

The findings of the effects of stress on children's memory to date, however, have been inconsistent. To some extent, it is reasonable to assume that observed differences in the effects of stress on memory may be a function of the nature of the event itself. In addition, a range of individual characteristics exist that have the potential to moderate the ways in which stressful events are encoded and remembered. Thus researchers have started to think that some specific individual difference variables could explain why children, even those in the same age group, have performed so differently when remembering a stressful event.

Individual difference variables studied among children's memories of a stressful event can be categorized generally as demographic factors, such as socioeconomic status (McFarlane, Powell, & Dudgeon, 2002) or gender (Danielsdottir, Sigurgeirsdottir, Einarsdottir, & Haraldsson, 1993); cognitive factors, such as intelligence (Henry & Gudjonsson, 2004), theory of mind (Templeton & Wilcox, 2000), executive functioning (Roberts & Powell, 2005), creativity (Brown, 1989), source-monitoring ability (Ackil & Zaragoza, 1995), and social-emotional factors such as social engagement (Roebers & Schneider, 2001), self-concept and self-efficacy (Chae & Ceci, 2005), stress arousal (Eisen, Goodman, Qin, & Davis, 2002), parent-child communication pattern (Goodmanm, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1997), parenting style (Crossman, 2001), child temperament (Burgwyn-Bailes Baker-Ward, Gordon, & Ornstein, 2001), and the overall mental health of the child and the parents (Clarke-Stewart, Malloy, & Allhusen, 2004). A detailed understanding of such variables could benefit efforts to identify children

who are particularly susceptible to providing erroneous reports.

Although many authors have reviewed those various predictive strategies for understanding individual difference factors on children's memory (Bruck & Melnyk, 2004; Ornstein & Elischberger, 2004), the precise individual difference factors that moderate the ways in which children's memory of stressful events is formed still remain unknown. In the current study, several individual difference factors were deliberated. Specifically, social-emotional factors such as children's general anxiety condition, pain and anxiety status about the event and cognitive factors such as receptive language ability and working memory capacity were examined as potentially important sources of variability in children's recollections of stressful events considering following reasons.

Effects of Cognitive Abilities

In the past, measurements of cognitive ability as general intelligence, working memory capacity, or cognitive developmental levels have been included as central components in children's memory evaluations (Baddeley, 2003). Although researchers have since broadened their scope to incorporate a more integrated model of memory of a stressful event (Peterson & Warren, 2009), individual differences in cognitive ability remain, undoubtedly, important. Measures of general cognitive ability help explain processing and memory for stressful experiences. For instance, studies with children (Perez-Edgar & Fox, 2003) and adults (Edelstein, 2006) have revealed patterns of basic information processing and working memory that differ for emotional and neutral information as emotional information appeared to tax attentional and processing resources more than neutral information.

As such, general cognitive measures seem to be certainly related to memory for emotional experiences and yet possible relations have been thoroughly illuminated between individual differences in children's general cognitive capacity and children's memory performance when employing some natural paradigms as to-be-remembered stressful events in research.

Effects of working memory capacity. Working memory can refer to biological storage of information. Biological working memory (WM) is the natural physiological ability to retain and transform temporary information by the brain (Hitch & Towse, 1995). In humans, WM facilitates the momentary maintenance and manipulability of task-relevant information and manifests as reasoning, learning, and comprehension.

Strong correlations have been found between WM capacity and the misinformation effect. Jaschinski and Wentura (2002) evaluated individuals with large WM capacity and found they were less prone to integrate misleading, postevent information into their memory. Various explanations exist as to why WM capacity can,

in part, be associated with recall accuracy, especially in children.

Developmental patterns in WM and suggestibility appear to be inversely related. One of the most consistent findings in suggestibility research is that susceptibility to suggestive influence decreases with age. In particular, preschool children have been shown to be more suggestible than their older counterparts (Ceci & Bruck, 1993), and WM capability has been shown to increase with age (Case, 1995). The developmental patterns of WM and suggestibility indicate that an increase in WM capacity likely produces decreased suggestibility. Case (1985) also purported that any functional increases in the efficiency of mental operations would facilitate increased information storage in the WM; therefore, a greater volume of information would be available for manipulation, consequently enabling the enhancement of increasingly sophisticated cognitive tasks (Hitch & Towse, 1995). In addition, Thierry, Spence, and Memon (2001) asserted that younger children, whose strategy execution process takes up more mental space or capacity, may not use strategies as efficiently as older children (Bjorklund, Muir-Broaddus, & Schneider, 1990). For instance, when answering misleading questions, children have to keep track of what is asked in the question while simultaneously trying to remember where certain details occurred. If the task is too much of an information processing load for younger children, they can fail to produce as many correct responses as older children (Thierry et al., 2001). As such, poor information memory competency may reflect poor information processing capacity, which can compromise an individual's ability to distinguish between true and false information, thereby making susceptibility to suggestive influence more likely.

However, findings to date remain unknown regarding a relation between WM capacity of children and children's recall of stressful events. Thus focused investigations are needed to clarify the potential association, if any, that exists between individual differences in children's WM capacity and their memory performance of a naturally occurring stressful event.

Effects of receptive language abilities. Language competence has been proposed as one of the predictors of a child's capacity to recall events. This hypothesis was based on the fact that language skills are important for the verbal encoding of event details, which in turn may support memory extent and recall. Indeed, higher verbal skill levels have been associated with enhanced levels of children's recall, in particular for the details of nonstressful events (Boland, Haden, & Ornstein, 2003; Simock & Hayne, 2002). Likewise, a study by Burgwyn-Bailes, Baker-Ward, Gordon, & Ornstein (2001) that assessed 3- to 7-year-olds' recall of details surrounding facial surgery to correct lacerations found that children's receptive vocabulary (as

measured by the Peabody Picture Vocabulary Test [PPVT]) was sufficiently predictive of younger children's recall; the relation was not observed in older children. Peterson and Warren (2009) extended this PPVT-based study to investigate the variation in language competence in a cohort of 95 children between the ages of 2 and 6 who experienced hospital treatment of an injury. This larger group study was found, however, no relations between receptive language skills and the accuracy or information content of the children's recount of the injury event or subsequent hospital treatment. Interestingly, Clarke-Stewart et al. (2004) found that lower language ability, as assessed by Feagans, Fendt, and Farran's (1995) Adaptive Language Inventory, was independently predictive of 5-year-old children's susceptibility to suggestion, as determined by a 9-month recall study of a nonstressful event. Similar investigations by Roebers and Schneider (2005) concluded that 4-year-olds with relatively high language skills were more vulnerable to misleading information than their lower skilled peers, possibly because the advanced children were better able to recall the misleading information as a result of their enhanced verbal encoding abilities. Moreover, by using an interview protocol with simpler syntax and other developmentally appropriate linguistic features, Imhoff and Baker-Ward (1999) elicited increased recall and reduced suggestibility among preschoolers, highlighting the importance of proper investigative approaches when working with young children. McGuigan and Salmon (2004) observed with 3-year-old significant positive correlations between both expressive and receptive language and total recall of a staged event. Among 5-year-olds, though, the relation held only for expressive language. Similarly, Burgwyn-Bailes et al. (2001) demonstrated that increases in receptive language skills were correlated with concomitant increases in recall of the younger children only. These collective findings suggest that language is not an effective predictor of recall ability in older children.

While findings to date remain mixed as an association between language skills of children and children's recall when employing these natural paradigms as to-be-remembered stressful events in research, further research is needed to thoroughly explore the degree of age-related influences of language ability on children's memory performance of a naturally occurring stressful event.

Effects of Emotional Difference

Besides cognitive ones, other nonphysiologic factors are likely to contribute to the complex and dynamic process of memory and recall. In particular, variation in social-emotional factors such as the level of general anxiety, and responses to pain and anxiety would be expected to play a role in children's memory performance for a stressful event. This study was designed to specifically evaluate those social-emotional personality factors addressed

above and determine their relation to children's memory recall of a stressful event as following reasons.

Effects of anxiety and pain. Anxiety is believed to affect memory of stressful situations. In particular, high state anxiety, which is situation specific, has been associated with less accurate recall of the experienced pain's intensity in adults (Arntz, van Eck, & Heijmans, 1990). Among children, the results have been equivocal. A significant positive correlation has been found between state anxiety and the amount of pain that children (aged 5 to 17 years) expected and recalled from a venipuncture procedure (Lander, Hodgins, & Fowler-Kerry, 1992). Children who reported high levels of anxiety prior to the venipuncture event, as measured by the Spielberger State-Trait Anxiety Inventory for Children (STAIC; Spielberger, 1972), tended to overestimate the level of pain they would experience. After a 2-month delay, they were more likely to remember experiencing more pain than they reported immediately after the event.

On the other hand, Zonneveld, McGrathb, Reidd, and Sorbia, (1997) examined daily pain diaries of hospitalized children (aged 5 to 16 years) and found that anxiety was not related to the accuracy of pain recall. Another study examining children's expectations and recollections of discomfort associated with dental treatment found that state anxiety did not affect children's self-reported discomfort (Huq, Lindsay, & Roberts, 1992). Specifically, when children's (aged 7 to 16 years) memory of their discomfort during the procedure was assessed 3 months following the procedure, even the most anxious children (as assessed by the STAIC) recalled no more discomfort than they had reported immediately after the treatment. The authors concluded that anxious children were able to recall their discomfort without distortion.

In the Chen, Zeltzer, Craske, and Katz (1999) study, age was also determined to mediate the effects of anxiety on recall. Children's self-reports of anticipatory anxiety and anxiety during the Lumbar Puncture (LP) procedure were both negatively associated with total memory scores 1 week after the LP was performed. However, when age was controlled for, only the children's reports of anxiety during the LP procedure remained marginally significant. The authors suggested that this finding may be accounted for because the younger children showed more distress during LPs and had poorer memories than the older children.

Children's fear level has been related to accuracy of event details corresponding to a Voiding cystourethrogram fluouroscopy (VCUG) procedure (Merritt, Ornstein, & Spicker, 1994). Fear is considered to be comprised of feelings of intense and circumscribed anxiety that often manifest in complex reactions, taking the form of escape or avoidance of the threatening situation (Barrios & O'Dell, 1998). Merritt et al.

(1994) found that the more fearful children were judged to be by a dentist, the less they recalled of the procedure, in both immediate and delayed recall.

In summary, a range of individual characteristics exist that have the potential to impact the ways in which stressful events are encoded and remembered. Considering the results of the previous researches, it seems quite likely that a multifaceted and dynamic mechanism involving all of individual characteristics contributes to children's memories of stressful experiences. To unravel such a complex interplay, investigatory efforts should be focused on the identification and characterization of potential moderators that is, individual differences which influence the degree of impact of stress on remembering. In addition, the stage of children's development has a broad influence on and is central to understanding how children remember stressful events. With age, children's expressions of distress may change, as may their strategies to cope with stressors. The magnitude and duration of their stress responses and their ability to provide coherent and detailed narratives expand substantially. Each of these advances in individual differences with age has implications for how children remember and recount prior stressful experiences. As such, it is not possible to interpret children's memory performance without taking into account developmental considerations. Thus, this research was designed to examine and measure various cognitive and emotional individual difference factors across ages- in particular, working memory capacity, receptive language ability, and anxiety status- to determine the impact of stress on memory in the context of a naturally occurring stressful experience, namely, a dental operative procedure.

As a hypothesis 1, cognitive individual variability might account for the relation between stress and memory. Working memory (WM) capacity and receptive language ability, in particular were expected to be positively related to memory accuracy, as children with superior WM capacity and better language ability were expected to exhibit better memory during both the immediate and delayed interviews (McGuigan & Salmon, 2004) but the effects might differ across ages.

As a hypothesis 2, children who have a positive emotional characteristic (e.g., lower level of general anxiety) would accept a stressful event more easily, which would lead them to positive approach responses to stressful stimuli, thereby enabling them to obtain more information during the event, which ultimately would facilitate accurate remembering.

Overall, considerable variation in those individual difference variables was expected to exist among the children and explain some of the variation in children's remembering of a stressful experience.

Method

Design and Participants

This investigation was designed to examine the extent to which variability in children's reports of a stressful event could be accounted for by selected individual difference characteristics. The measures included variables derived from parental reports and children's reports of their memory for the dental treatment that they received.

This research was carried out at private Dental Clinic located in a metropolitan area in Seoul, Korea. The staff of the pediatric dental clinic notified researchers of children who were scheduled for minor operative dental procedures, typically fillings or sealants, and whose families had agreed to be contacted about possible research participation. During the conversations with the possible participants, the study was explained, verbal agreement for participation was obtained, and the time and date of the physical examination were confirmed. Of the families who agreed to participate, the data for five children were subsequently dropped for various reasons, including the child's mood after the dental treatment and time conflicts of their parents. The resulting sample was thus composed of 85 children (45 boys and 40 girls) who were patients at this clinic and ranged in age from 48 – 119 months [M(SD) = 83.25(19.82)]. Due to the location of the clinic, the sample consisted primarily of children from middle- and upper-middle-class families. No child was excluded based on gender or socioeconomic status. The parent or guardian who accompanied the child (76 mothers, 4 fathers, 5 grandmothers) also participated by providing background information as well as informed consent. On average, the participating children had 4-6 times of past experiences of receiving preventive dental care. One pediatric dentist who is the director of the private dental clinic treated all of the participating children. One interviewer interviewed the children who had advanced training in developmental psychology.

Measures

Memory Interview. The memory interviews were developed on the basis of pilot research related to the current study and consisted of questions about typical features of the dental treatment. Interviews by Ornstein, Gordon, and Larus (1992) were used as models for this research because the questions were in the form of a hierarchically structured interview protocol that began with general, open-ended questions and moved to increasingly more specific probes for information not generated in response to the initial questions.

The interviews were taped and then coded according to a system that focused on the particular features of the dental examination and the specificity level of the probe required to

retrieve the information. For example, the first question was very general ("Tell me what happened during the dental procedure"), so that children could provide free recall. Nonspecific responses (e.g., "The dentist fixed my teeth") were probed until the response defined a feature or until it became clear that the child could not provide further information.

After nonspecific probing to the free recall questions, a series of increasingly specific questions was asked to assess whether the child encoded the information. For example, the child was first asked a structured but relatively open-ended question (e.g., "What did the dentist use to fix your teeth?"). A number of possible target features could be offered in response to this question such as a tooth pillow, special light-to-dry fillings, metal pliers to pull a tooth out, and so on. Children who did not provide information about a specific feature were then asked a more specific question, such as "Did the dentist use the tooth pillow (mouth prop) to keep your mouth open?" The specific memory questions were organized and were asked in the same order for each participant.

On average, 17.40 (SD = 2.32, range = 12 - 24) features were included in the child's dental treatment, and the children were questioned about each of these "present" features. Particularly, children's free recall responses, which were defined in terms of the proportion of total present components of the dental procedure that were reported to general probes at the immediate and delayed interview were focused on examination in the current study because of the greater credibility and sensitivity associated with this measure (Gordon & Follmer, 1994).

Visual analogue scale (VAS). During the dental visit, children were asked to use a VAS (Marsac, 2008) to indicate their anxiety and pain regarding the dental treatment. The children were asked to complete this scale again during the delayed interview to indicate how much pain and fright they experienced during the dental treatment the previous week. The VAS is a picture of a thermometer with a 5-point Likert scale, ranging from extremely painful/ frightened (5) to not painful/ frightened at all (1).

Spielberger State/Trait Anxiety Inventory for Children (STAIC). Children were administered the STAIC (original, Spielberger 1972; the Korean version, Cho & Choi, 1989) to measure their anxiety about the dental procedure. The STAIC consists of two scales that measure transitory anxiety (state anxiety; e.g., I feel very nervous/nervous/not nervous at all) and dispositional anxiety (trait anxiety; I feel like crying-hardly ever/sometimes/often). Both scales consist of 20 weighted items, with three response options such as hardly ever, sometimes, often. Theses scales are known to be reliable and valid (Spielberger, Gorsuch, Lushenem, Vagg, & Jacobs, 1983).

Digit Span. Memory span is defined as the number of items that a child can retain and recall, whereas digit span is the number of digits a child can retain and recall. Digit span backward is considered a measure of WM, although both attention and comprehension contribute to performance as well (McCarthy, 1972).

Peabody Picture Vocabulary Test (PPVT). Each child completed the Korean version of the PPVT (original, Dunn & Dunn, 1981; standardized Korean version, Kim, Jang, Im, & Pack, 1995), a standard measure of receptive language skills. The validity of this measure on a sample of individuals aged 2.5 years through adulthood has been firmly established (Calculator & Singer, 1992).

Procedure

Sequence of events for first visit. The current study did not involve the administration of any new dental procedures. Rather, it was an observation of established minor procedures, typically sealants or fillings. Thus, the children's participation in this study in no way affected their dental treatment. Although we could not control the time required for the dental operative procedure, such procedures usually required approximately 15 to 20 minutes. During the dental procedure, the parents were asked to provide information concerning their family demographics as well as to complete several measures of their children's previous dental experience. Immediately following the procedure, the children were asked to play in a playroom for about 10 minutes to calm down. They then entered a quiet counseling room in the clinic. Once in the room, the children were asked to use a Visual Analogue Scale to report their anxiety and pain about the dental procedure and expanded their responses on a state-and-trait anxiety questionnaire. They also completed the digit span test to gauge their WM capability, and a Korean version of the PPVT to measure their receptive language. After answering all the questions, the children participated in a one-on-one memory interview with a protocol which assessed their retention of the predefined components of the stressful event in their responses to probes of increasing specificity. For this report, the focus was on free recall, defined in terms of the proportion of total components of the dental procedure that were reported in response to general probes. The initial interview session after the dental procedure was also videotaped. The entire session lasted around 60 minutes. The children and their parents were reminded to return in 1 week to complete the final interview.

Sequence of events for second interview. When the children returned to the dental practice after one week, we assessed their memory for the dental procedure they had

experienced previously, using the same hierarchical interview that had been employed during the initial assessment. This delayed-memory interview took around 30 minutes.

Coding

Each video record of the interviews was coded to specify the particular dental treatment features reported by the child. Codes were assigned to the memory protocols on the basis of the specificity of questioning necessary to elicit a verbal response and the accuracy of the child's answer. 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. One researcher coded all of the data, whereas a second coded 25%, and inter-rater reliability was determined for each type of question and each type of feature. The average percentage of agreement across the present features was 100% for responses coded at the open-ended level; 95% (range = 90%-100%), for the wh- responses; and 97% (range = 90% -100%), for the yes/no items. With regard to the individual difference variables, the scoring of language ability followed the guidelines of Dunn and Dunn (1981), the scoring of digit span was based on McCarthy (1972), the scoring of STAIC followed Spielberger (1972) and the scoring of VAS followed Marsac (2008).

Results

In an attempt to examine the effects of the potential individual differences on children's remembering of a stressful event, this study explored a range of individual differences in depth.

Preliminary Analyses

A series of immediate analyses indicated no differences in recall as a function of gender, parent's education levels, and the identity of four different dental hygienists. They were therefore excluded as variables of interest. In addition, at each age level, no differences between the immediate and delayed memory performances were found for different treatment types (i.e., fillings, sealant, multiple procedures such as fillings and extraction or fillings and crowns). This indicates that differences observed in memory performance were not due to the different procedure types.

In terms of the age grouping, clearly, the children aged 7 years and older recalled a considerable amount of information during general probes (i.e., free recall). Thus, it was beneficial to merge six different ages groups of the children into two age groups: younger (4-, 5-, and 6-year-olds) and older (7-, 8-, and

9-year-olds).

Correlation Analysis

For the variables of cognitive individual differences, raw PPVT scores and raw digit-span-backward scores were investigated in a subset of the analyses to provide information on the children's receptive language abilities and WM capacities, respectively. For the variables of emotional individual differences, STAIC and VAS scores were investigated in a subset of the analyses to provide information on child's general anxiety levels, child's anxiety and pain during the dental procedure, respectively.

Effects of Cognitive Abilities

As hypothesized, there were strong correlations between children's memory performance and cognitive individual differences as presented in Table 1, yet the correlation between children's memory performance and WM capacity was canceled out when age was controlled. However, there was an interaction between age and WM capacity in that WM capacity was correlated with concomitant increases in free recall for only younger children at both the immediate and delayed interviews. These findings suggested that WM capacity was not an effective predictor of children's remembering of a stressful event for older children.

The receptive language scores were also positively associated with children's total and free recall during both interviews. They particularly impacted children's responses to general probes, because the relation was statistically significant even with age controlled. For this cognitive ability there was also an age interaction: increases in receptive language skills were correlated with concomitant increases in free recall for younger children at both immediate and delayed interviews, but not for

Table 1. Correlations Among Children's Memory Performance and Selected Individual Difference Factors

	Working Memory Capacity			Receptive Language Ability		
Memory Performance	Total	Older (a)	Younger (b)	Total	Older (a)	Younger (b)
Immediate Total Recall	.23*	-.08	.21	.32**	.20	.24
Immediate Free Recall	.39**	-.19	.37*	.66**	.26	.55**
Delayed Total Recall	.18	.19	.10-	.26*	.06	.11-
Delayed Free Recall	.44**	.01	.53**	.51**	.14	.55**

Note. Total Recall : Responses of Open-Ended+Wh-+Yes/No questions, Free Recall : Responses of Open-Ended + Wh- questions. a. Older: 7-to 9-year-olds. b. Younger: 4-to 6-year-olds. $^{**}p < .01$, $^{*}p < .05$.

the older children. These findings suggested that for older children, receptive language skills were not an effective indicator of children's remembering of a stressful event.

Overall, WM capacity and receptive language ability were not associated with older children's remembering of a stressful event. However, those specific cognitive abilities significantly accounted for the variance in younger children's remembering of a stressful event.

Effects of Emotional Difference

There were a series of significant impact of emotional individual differences on children's memory. First of all, children who self-reported having greater anxiety about the dental procedure exhibited poorer recall for both total and free recall at both immediate and delayed interviews as presented in Table 2. Children who reported higher levels of general anxiety in their daily lives (i.e., higher STAIC scores) exhibited poorer total and free recall at the immediate interview. It appears that children's general anxiety condition was associated with their immediate memory performance of a stressful event.

In summary, children's total recall decreased as children's anxiety and pain scores increased, supporting the argument that stress and anxiety negatively impact children's remembering of a stressful event. More interestingly, children who were having greater general anxiety exhibited poorer recall at both immediate and delayed interviews.

Table 2. Correlations Between Children's Memory Performance and a Range of Pain/Anxiety Variables

Anxiety Variable	Immediate Recall		Delayed Recall	
	Total Recall	Free Recall	Total Recall	Free Recall
Immediate pain	-.42**(-.34**)	-.31**(-.21)	-.47**(-.42**)	-.52**(-.43**)
Immediate anxiety	-.32**(-.27*)	-.34**(-.32**)	-.21	-.41**(-.37**)
Delayed pain	-.39**(-.36**)	-.21	-.35**(-.32**)	-.33**(-.27*)
Delayed anxiety	-.27*(-.25*)	-.22	-.27*(-.25*)	-.33**(-.30*)
Average Trait score	-.33**(-.37**)	-.27*	-.03	-.03-
Average State score	.35**(.37**)	.27*(.25*)	-.02	.11

Note. Numbers in parentheses are controlled for age. Total recall: responses of Open-Ended+Wh-+Yes/No, Free recall: responses of Open-Ended+Wh- questions. Immediate pain and anxiety are scores from VAS scales. State and Trait scores are elements of the STAIC questionnaire (Spielberger, 1972). Lower state scores and higher trait anxiety scores indicate higher anxiety in a child's routine life. $^{**}p < .01$, $^{*}p < .05$.

Hierarchical Multiple Regression Findings

The central focus of this exploratory study was the extent to which selected individual difference variables may explain some of the variation in children's remembering of a stressful event. This issue was examined by performing a series of hierarchical regression analyses, in which measures of individual differences were used as predictors of the memory performance, specially free recall (i.e., responses of Open-Ended + Wh-questioning) because of the greater credibility and sensitivity associated with this measure (Gordon & Follmer, 1994).

Age was always the first step in the hierarchy, given its importance to children's memory performance. It explained 26% and 18% of the variance at the immediate and delayed interviews respectively (see Table 3). Thus, children's ages in months accounted a great deal of variance in free recall and more variances in immediate recall than delayed recall. This does make sense considering that children's free recall relies on their developmental abilities. Next because children's free recall strongly depends on children's cognitive abilities, the receptive language and working memory were entered on Step 2 when it met the criterion for inclusion in the model. This second model explained 44% of the variance in children's free

Table 3. Hierarchical Multiple Regressions of the Predictor Variables on Free Recall at Both Immediate and Delayed Interviews

		Immediate Interview				Delayed Interview			
Model		R^2	$\triangle R^2$	$\triangle F$	df	R^2	$\triangle R^2$	$\triangle F$	df
1	Age in months	.26	.26	29.63**	(1,83)	.18	.18	15.73**	(1,70)
2	Age in months Language/WM	.44	.18	12.68**	(1,81)	.30	.12	5.39**	(1,68)
3	Age in months Language/WM State and Trait scores	.47	.03	2.06	(1,79)	.32	.02	0.96	(1,66)
4	Age in months Language/WM State and Trait scores Immediate pain/anxiety	.49	.02	1.50	(1,77)	.41	.09	5.00**	(1,64)

Note. Language= PPVT raw scores, WM= digit span backward raw scores, State and Trait scores are the STAIC questionnaire. Immediate pain and anxiety are the scores of VAS scales. $^{**}p < .01$, $^{*}p < .05$.

recall at the immediate interview and 30% at the delayed interview. Children's cognitive ability also explained more variances in their immediate, rather than delayed, recall as was the age in months. Next, given that children's general anxiety was strongly related to children's memory performance on the prior correlation analyses, it was added in Step 3 when it met the criterion for inclusion in the model. This step explained 47% and 32% respectively of the variance in children's free recall at the immediate and delayed interviews. Both children's cognitive ability and their general anxiety scores accounted for a significant amount of the unique variance in free recall at the immediate and delayed interview, yet the models were not significantly increased from the previous ones. Thus, children's general anxiety status did not impact their remembering at the interviews as much as the cognitive variables including working memory and receptive language abilities. Finally, the children's immediate reports of pain and anxiety variables were added when they met the criterion for inclusion in the model. This final model explained 49% and 41% respectively about the variance of children's free recall at the immediate and delayed interviews. The increase of the model was significant only for the delayed interview, indicating that the level of children's anxiety when the event was occurred would impact children's later remembering more than immediate remembering

In summary, children's age in months, their cognitive ability, the levels of general anxiety, and immediate reports of pain/anxiety accounted for a significant amount of variances in free recall both at the immediate and delayed interviews. More importantly, cognitive ability could explain a great deal of the variances of children's accurate reports from the general probes (i.e., free recall) both at the immediate and delayed interviews. In addition, the level of anxiety or stress of children's report regarding a stressful event could be expected for the extent to which children can remember at delayed interview.

Discussion

The purpose of this study was to explore the impact of a range of cognitive and emotional individual difference variables on children's remembering of a naturalistic, personally experienced, stressful event.

Conducting the study in a naturalistic setting offered several benefits 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 an actual 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 used before (see, e.g., Baker-Ward, Ornstein, Quinonez, Milano, Langley, Lee, & Morris, 2009; Vandermass, Hess, & Baker-Ward, 1993). However, this is one of the first studies to provide descriptive results of various individual difference factors have not been investigated regarding children's memory performance for a naturally occurring stressful events.

For the cognitive individual differences, raw PPVT scores and raw digit-span-backward scores were investigated in a subset of the analyses to provide information on the children's receptive language abilities and WM capacities, respectively. The results of this study indicated that children's receptive language abilities were strongly associated with memory performances, as previous studies had demonstrated (Burgwyn-Bailes et al., 2001; McGuigan & Salmon, 2004). Children with higher receptive language abilities revealed a higher level of recall of the event, particularly in response to general probes (i.e., free recall), over and above the influences of age and stress levels than children with lower receptive language abilities. In addition, language skills were more closely associated with children's errors during an immediate assessment, rather than a delayed assessment after a week: children who had relatively higher receptive language abilities made fewer errors at the immediate interview, supporting the conclusion that children's immediate suggestibility is influenced by their receptive language skills whereas their later suggestibility would be more influenced by other individual difference variables, such as stress levels. However, it should be noted that this finding might reflect children's attention intensity when the tasks were assessed. The receptive language tasks was conducted on the day that children received the dental procedure. Children who experienced comparatively lower levels of stress during the dental procedure were more likely to be willing to actively participate in a series of tasks. Although receptive language and children's level of stress were not associated statistically, there might be a possibility that those children who were in higher level of stress might have been reluctant to fully engage in the PPVT task, regardless of their genuine receptive language ability.

More important results of this study indicated that there was an interesting interaction between children's age and receptive language ability that can be observed on their recall of general probes both at the immediate and delayed interviews, demonstrating that younger children's free recall - but not that of the older children- was related to receptive language ability. Thus, the effect of receptive language ability on children's remembering of a stressful event is an important indicator for younger children, but other variables should be taken into consideration when evaluating the performance of

older children.

As expected, working memory (WM) capacity increased with age in this investigation; nonetheless, it did not affect children's remembering when the effects of age was controlled, with one exception; children who had a higher WM capacity revealed better free recall at the delayed interview than children who had a lower WM capacity. There was also an interesting interaction between age and WM capacity. Increases in WM capacity were correlated with concomitant increases in the free recall of younger children, but not the older children, both at immediate and delayed interview. Thus, although the current investigation does not support Jaschinski and Wentura's (2002) findings that revealed a strong association between poorer WM and lower accuracy of remembering for children of all ages, the findings of this study suggested that there was a meaningful relation between WM capacity and children's remembering of a stressful event, particularly for younger children.

On the other hand, WM capacity was not related to any other anxiety variables such as children's general anxiety condition, children's self-report of pain and anxiety about the event and yet it should be noted that the studied event was not as controlled as events that can be staged in a laboratory environment. Therefore, as mentioned above, there is a possibility that children did not execute the WM task (i.e., the digit span) at their full capacity. Thus, the linkages between WM capacity, anxiety and memory performance should be interpreted with caution. However, this study provided descriptive results of various individual difference factors seldom investigated regarding the memory for stressful events. It was designed to obtain fundamental knowledge of the effect of children's general cognitive abilities-namely, language and working memory abilities-on memory as it cannot be explained without taking into consideration of these essential cognitive skills. As mentioned previously, the lower scores on some of the tasks may have been due to children's inattention - after spending considerable time in a waiting room and having gone through a dental procedure - not their inferior abilities.

In terms of emotional individual difference variables, children, especially the younger children, who self-reported greater anxiety about the dental procedure remembered less than children who reported less pain and anxiety about the dental procedure. Thus, the children's self-report of anxiety, particularly younger children, could be an essential criterion for predicting the accuracy level of children's memory for the details of a stressful event. In addition, children who reported higher level of general anxiety in their daily lives seemed to report greater pain and anxiety for the dental treatment.

Overall, there were strong evidences to support the argument that stress was negatively

related to children's remembering of a stressful event. More interestingly, among various anxiety measures, a child's self report of pain would be a reliable indicator of children's both immediate and delayed remembering of an event. In addition, the finding that STAIC scores reflecting the children's general anxiety status are associated with the recollection of pain and anxiety of a treatment is a new result achieved from the current study. Children in a higher general anxiety status were likely to expect more pain and anxiety in a dental treatment.

Finally, the results of this study highlight several avenues for future inquiry in the domains of theoretical relation between children's memory and the level of stress and the applied areas such as legal investigations and pediatric dentistry. Given that the present study was exploratory, it is still unclear how these various individual difference factors can consistently influence children's remembering of a stressful event. Further research may help forensic interviewers develop a comprehensive understanding of children's psychological functioning for eliciting more accurate eyewitness testimony. Traditionally, the clinical and forensic literatures have been somewhat separate; yet understanding that a child who is anxious, depressed, or experiencing intrusive memories potentially requires on the part of the interviewer to conduct a more sensitive and effective interview is commonly agreed.

Ultimately, the findings of this study that several cognitive and emotional individual difference factors affect children's remembering of stressful events should facilitate our understanding of the ways in which clinical and legal professionals can tailor interviews to best meet the needs and capabilities of the younger children who experienced stressful event.

Given that creating developmentally and individually sensitive guidelines for interviewing children in the legal system is strongly recommended and such pursuits may help identify children for whom special interviewing precautions should be taken to maximize accurate testimony in a legal setting, the importance of the effects of various individual differences on children's memory of a stressful event should carry great weight in future researches.

References

Aartman, I. H. A., Everdingen Van, T., Hoogstraten, J., & Schuurs, A. H. B. (1998). Self-report measurements of dental anxiety and fear in children: A critical assessment. *ASDC Journal of Dentistry for Children, 65,* 252-258.

Ackil, J. A., & Zaragoza, M. (1995). Developmental differences in witness suggestibility and memory for source. *Journal of Experimental Child Psychology, 60,* 57-83.

Arntz, A., van Eck, M., & Heijmans, M. (1990). Predictions of dental pain: the fear of any expected evil, is worse than the evil itself.

Behavior Research and Therapy, 28, 29-41.

Baddeley, A. (2003). "Working memory: looking back and looking forward". *Nature Revieus Neuroscience, 4,* 829-39.

Baker-Ward, L., Ornstein, P. A., Quinonez, R., Milano, M., Langley, H., Lee, S., & Morris, C. (2009). *Children's Memory for a Dental Procedure: The Impact of Stress and Coping on Remembering.* Poster presented in Cognitive Developmental Society in San Antonio.

Barrios, B. A., & O'Dell, S. L. (1998). Fears and Anxieties. In E. J. Mash, & R. A. Barkley (Eds.), *Treatment of Childhood Disorders* (2nd ed., pp.249-337). New York: The Guilford Press.

Bjorklund, D. F., Muir-Broaddus, J. E., & Schneider, W. (1990). The role of knowledge in the development of children's strategies. In: D. F. Bjorklund (Eds.), *Children's strategies: Contemporary views of cognitive development* (pp.93-128). Erlbaum, Hillsdale, NJ.

Boland, A. M., Haden, C. A., & Ornstein, P. A. (2003). Boosting children's memory by training mothers in the use of an elaborative conversational style as an event unfolds. *Journal of cognition and development, 4,* 39-65.

Brown, R. T. (1989). Creativity. What are we to measure? In J. A. Glover, R. R. Ronning, & C. R. Reynolds (Eds.). *Handbook of creativity* (pp.3-32). New York: Plenum.

Bruck, M., & Melnyk, L. (2004). Individual Differences in Children's Suggestibility: A Review and Synthesis, *Journal of Applied Psychology, 18,* 2-48.

Burgwyn-Bailes, E., Baker-Ward, L., Gordon, B. N., & Ornstein, P. A. (2001). Children's memory for emergency medical treatment after one year: The impact of individual difference variables on recall and suggestibility. *Applied Cognitive Psychology, 15,* S25-S48.

Calculator, S. N., & Singer, K. M. (1992). Letter to the editor: Preliminary validation of facilitated communication. *Topics in Language Disorders, 12,* pp.ix-xvi.

Case, R. (1995). Capacity-based explanations of working memory growth: A brief history and reevaluation. In F. M. Weinert, & W. Schneider (Eds.), *Memory performance and competencies: Issues in growth and development* (pp.23-43). Hove, UK: Erlbaum.

Case, R. (1985). *Intellectual development: Birth to adulthood.* San Diego: Academic Press.

Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin, 113,* 403-439.

Chae, Y., & Ceci, S. J. (2005). Individual differences in children's recall and suggestibility: The effect of intelligence, temperament, and self-perceptions. *Applied Cognitive Psychology, 19,* 383-407.

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.

Cho, S. C., & Choi, J. S. (1989). Development of the Korean form of the State-Trait anxiety Inventory for Children. *Seoul Journal of Psychiatry, 14,* 150-157.

Clarke-Stewart, K. A., Malloy, L. C., & Allhusen, V. D. (2004). Verbal ability, self-control, and close relationships with parents protect children against misleading questions. *Applied Cognitive Psychology, 18,* 1037-1058.

Crossman, A. M. (2001). *Predicting suggestibility: The role of individual differences and socialization.* Unpublished doctoral thesis, Cornell University, NY.

Cunningham, A., & Hurley, P. (2007). *"A Full and Candid Account"* Using Special Accommodations and Testimonial Aids to Facilitate the Testimony of Children. Overview of Issues Related to Child Testimony. http://www.lfcc.on.ca/1_Overview. pdf.

Danielsdottir, G., Sigurgeirsdottir, S., Einarsdottir, H. R., & Haraldson, E. (1993). Interrogative suggestibility in children and its relationship with memory and vocabulary. *Personality and Individual Differences, 14,* 499-502.

Dunn, L. M., & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test-Revised.* American Guidance Service: Circle Pines, MN.

Edelstein, R. S. (2006). Attachment and emotional memory: Investigating the source and extent of avoidant memory deficits. *Emotion, 6,* 340-345.

Eisen, M. L., Goodman, G., Qin, J., & Davis, S. L. (2002). Memory and Suggestibility in maltreated children: Age, stress arousal, dissociation, and psychopathology. *Journal of experimental child psychology, 83,* 167-212.

Feagans, L. V., Fendt, K., & Farran, D. C. (1995). The effects of day care intervention on teacher's ratings of the elementary school discourse skills in disadvantaged children. *International Journal of Behavioral Development, 18*(2), 243-261.

Goodman, G. S., Quas, J. A., Batterman-Faunce, J. L., Riddlesberger, M., & Kuhn, G. (1997). Children's reactions to and memory for a stressful event: Influences of age, anatomical dolls, knowledge, and parental attachment. *Applied Developmental Science, 1,* 54-75.

Gordon, B. N., & Follmer, A. (1994). Developmental issues in judging the credibility of children's testimony. *Journal of Clinical Child Psychology, 23,* 283-294.

Gordon, B. N., Baker-Ward, L., & Ornstein, P. A. (2001). Children's testimony: A review of research on memory for past experiences. *Clinical Child and Family Psychology, 4,* 157-181.

Greenhoot, A. F., Ornstein, P. A., Gordon, B. N., & Baker-ward, L. (1999). Acting out the detail of a pediatric check-up: The impact of interview condition and behavioral style on children's memory reports. *Child Development, 70*(2), 363-380.

Henry, L. A., & Gudjonsson, G. H. (2004). The effects of memory trace strength on eyewitness recall in children with and without intellectual disabilities. *Journal of Experimental Child Psychology, 89,* 53-71.

Hitch, G. J., & Towse, J. (1995). Working memory: What develops? In W. Schneider & F. E. Weinert (Eds.), *Memory performance and competencies: Issues in growth and development* (pp.3-22). Northvale, NJ: Erlbaum.

Huq, A. H., Lindsay, S. J., & Roberts, J. F.

(1992). Children's expectations and recollections of discomfort associated with dental treatment. *International Journal of Pediatric Dentistry, 2*(1), 11-16.

Imhoff, M. C., & Baker-Ward, L. (1999). Preschoolers' suggestibility: Effects of developmentally appropriate language and interviewer supportiveness. *Applied Developmental Psychology, 20,* 407-429.

Jaschinski, U., & Wentura, D. (2002). Misleading postevent information and working memory capacity: An individual differences approach to eyewitness memory. *Applied Cognitive Psychology, 16,* 223-231.

Kenning, M., Merchant, A., & Tomkins, A. (1991). Research on the effects of witnessing parental battering: Clinical and legal policy implications. In M. Steinman (Ed.), *Woman battering: Policy responses* (pp.237-261). Cincinnati, OH: Anderson.

Kim, Y. T., Jang, H. S., Im, S. S., & Pack, H. J. (1995). *Standardized Korean version of Peabody Picture Vocabulary Test.* Seoul Community Rehabilitation Center, South Korea.

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

Marsac, M. L. (2008). *Relationships among Psychological Functioning, Dental Anxiety, Pain Perception, and Coping in Children and Adolescents.* Unpublished Doctoral Dissertation, The University of Toledo.

McCarthy, D. (1972). *McCarthy Scales of Children's Abilities.* New York: Psychological Corporation.

McFarlane, F., Powell, M. B., & Dudgeon, P. (2002). An examination of the degree to which IQ, memory performance, socio-economic status and gender predict young children's suggestibility. *Legal and Criminological Psychology, 7,* 227-239.

McGuigan, F., & Salmon, K. (2004). The time to talk: The influence of the timing of adult-child talk on children's event memory. *Child Development, 75,* 669-686.

Merritt, K. A., Ornstein, P. A., & Spicker, B. (1994). Children's memory for a salient medical procedure: Implications for testimony. *Pediatrics, 94*(1), 17-23.

Murphy, B. C., Eisenberg, N., Fabes, R. A., Shepard, S., & Guthrie, I. K. (1999). Consistency and change in children's emotionality and regulation: A longitudinal study. *Merrill-Palmer Quarterly, 45,* 413-444.

Ornstein, P. A., & Elischberger, H. B. (2004). Studies of suggestibility: Some observations and suggestions. *Applied Cognitive Psychology, 18,* 1129-1141.

Ornstein, P. A., Baker-Ward, L., Gordon, B. N., Pelphrey, K. A., Tyler, C. S., & Gramzow, E. (2006). The influence of prior knowledge and repeated questioning on children's long-term retention of the details of a pediatric examination. *Developmental Psychology, 42,* 332-344.

Ornstein, P. A., Gordon, B. N., & Larus, D. M. (1992). Children's memory for a personally experienced event: Implication for testimony. *Applied Cognitive Psychology, 6,* 49-60.

Pérez-Edgar, K., & Fox, N. A. (2003). Individual

differences in children's performance during an emotional Stroop task: A behavioral and electrophysiological study. *Brain and Cognition, 52,* 33-51.

Peterson, C., & Warren, L. K. (2009). Injuries, emergency rooms, and children's memory: Factors contributing to individual differences. In J. Quas, & R. Fivush (Eds.), *Emotion and memory in development: Biological, cognitive, and social considerations* (pp.60-85). Oxford University Press.

Roberts, K. P., & Powell, M. B. (2005). Evidence of metacognitive awareness in young children who have experienced a repeated event. *Applied Cognitive Psychology, 19,* 1019-1031.

Roebers, C. M., & Schneider, W. (2001). Memory for an observed event in the presence of prior misinformation: developmental patterns in free recall and identification accuracy. *British Journal of Developmental Psychology 19,* 507-524.

Roebers, C. M., & Schneider, W. (2005). The strategic regulation of children's memory performance and suggestibility. *Journal of Experimental Child Psychology, 92,* 24-44.

Schacht, K. C., & Marche, T. A. (2001). *Individual differences in preschoolers' suggestibility: Can self-efficacy or source monitoring ability predict susceptibility to reporting false memories?* Poster accepted for presentation and the biennial meeting of the Society for Research in Child Development, Minneapolis, Mn.

Simock, G., & Hayne, H. (2002). Breaking the barrier? Children fail to translate their preverbal memories into language. *Psychological Science, 13*(3), 225-230.

Spielberger, C. D. (1972). *Manual for the State-Trait Anxiety Inventory for Children.* Palo Alto, Consulting Psychological Press.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state- trait anxiety inventory (form y): Self evaluation questionnaire.* Palo Alto, CA: Consulting Psychologists Press.

Templeton, L. M., & Wilcox, S. A. (2000). A tale of two representations: The misinformation effect and children's developing theory of mind. *Child Development, 71,* 402-416.

Thierry, K. L., Spence, M. J., & Memon, A. (2001). Before misinformation is encountered: Source monitoring decreases child witness suggestibility. *Journal of Cognition and Development, 2,* 1-26.

Vandermass, M. O., Hess, T. M., & Baker-Ward, L. (1993). Does anxiety affect children's reports of memory for a stressful event? *Applied Cognitive Psychology, 7,* 109-127.

Volpe, J. S. (1996). Effects of Domestic Violence on Children and Adolescents: An Overview. The American Academy of Experts in Traumatic Stress: Retrieved from: http:// www.aaets.org/article8.htm.

Zonnevelda, L. N. L., McGrathb, P. J., Reidd, G. J., & Sorbia, M. J. (1997). Accuracy of children's pain memories, *Pain, 71*(3), 297-302.

논문 투고일 : 2013. 02. 15
1 차 심사일 : 2013. 03. 13
게재 확정일 : 2013. 08. 26

한국심리학회지 : 문화 및 사회문제
Korean Journal of Culture and Social Issues
2013, Vol. 19, No. 3, 343～365.

스트레스적 경험에 대한 아동 기억의 신뢰성과 인지 및 정서적 개인차 특성들과의 관계

이 승 진

서울대학교 심리과학연구소

본 연구는 자연스럽게 스트레스 반응이 유발되는 치과 진료를 경험한 4-9세 아동 85명을 대상으로 스트레스적 사건에 대한 아동의 회상에 아동의 인지 및 사회 정서적 개인차 변인들이 어떤 영향을 미칠 수 있는 가를 살펴보고자 하였다. 본 연구의 결과는 스트레스 수준과 아동의 기억 수행은 전반적으로 부적 상관 관계가 있는 것으로 나타나 국외 선행 연구들의 결과를 반복 검증하였다. 그러나 보다 흥미로운 결과는 스트레스적 경험에 대한 아동 회상 보고의 정확성에 아동의 인지적(예: 수용적 언어 능력, 작업 기억 역량) 개인차 특성과 정서적(예: 평소 아동의 우울 및 불안 상태, 정보 부호화 시 아동의 불안 정도) 개인차 특성들이 유의한 영향을 미칠 수 있다는 점이다. 이와 같은 결과는 치명적인 범죄 사건과 관련하여 아동의 회상 보고를 해석할 경우 아동의 인지 및 정서적 개인차 특성들도 신중하게 고려되어야 함을 함의한다. 궁극적으로 본 연구는 다양한 개인차에 따른 아동의 기억 특성에 대한 심화된 지식을 규명하고 실제 수사 면담 시 아동의 개별적 특성을 고려한 면담 방식의 구축에 유용한 정보를 제공하는 데 그 의의를 두고자 한다.

주요어 : 아동 기억, 수용적 언어 능력, 작업 기억 역량, 스트레스, 불안