

Pain-Sensitive Temperament: Does It Predict Procedural Distress and Response to Psychological Treatment Among Children With Cancer?

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Objective: To evaluate the relationship between pain sensitivity and children's distress during lumbar punctures (LPs), and whether pain sensitivity functions as a moderator of children's responses to a psychological intervention aimed at reducing LP distress.

Method: Fifty-five children with acute lymphoblastic leukemia (ages 3 to 18) and their parents completed a questionnaire measure of pain sensitivity. Self-report, physiological, and observed measures of distress were collected during the study baseline LP. Children were then randomized into a psychological intervention or an attention control group. Postintervention and follow-up LPs were observed.

Results: Higher levels of pain sensitivity were associated with greater anxiety and pain, both prior to and during the LP. Preliminary analyses indicated that pain sensitivity moderated the effects of intervention on distress. Children who were more pain-sensitive and who received no intervention showed greater increases in LP distress over time. In contrast, children who were more pain-sensitive and who received intervention showed greater decreases in LP distress over time.

Conclusions: A measurement of pain sensitivity may be useful in pediatric oncology settings for effectively targeting pain-vulnerable children for psychological intervention. Preliminary analyses indicate that an empirically-supported intervention for procedural distress is efficacious for those children who are most pain-sensitive.

Key words: *pain; anxiety; pediatric oncology; procedural distress; psychological intervention; medical procedures.*

Acute lymphoblastic leukemia (ALL) is the most common type of cancer among children, with between 2,500 and 3,000 children diagnosed with ALL

each year (Margolin & Poplack, 1997). Children undergoing treatment for ALL must endure a series of invasive medical procedures, including lumbar punctures (LPs), which can be associated with intense pain and anxiety (Jay, Elliott, Ozolins, Olson, & Pruitt, 1985). During these procedures, children of-

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ten display crying, screaming, groaning, muscle tension, and verbalizations of anxiety and pain (Jacobsen et al., 1990).

There is wide variability in the extent of pain and anxiety children exhibit in response to invasive medical procedures such as LPs (Jay, Ozolins, Elliott, & Caldwell, 1983; Katz, Kellerman, & Ellenberg, 1980). Laboratory pain studies also demonstrate significant individual differences in pain sensitivity and tolerance among children (LeBaron, Zeltzer, & Fanurik, 1989; Zeltzer, Fanurik, & LeBaron, 1989). Moreover, individual differences in emotional and behavioral responses to medical procedures remain stable over time (demonstrated in infants: Izard, Hembree, & Huebner, 1987; Wrobey & Lewis, 1989). These differences in terms of sensitivity and reactivity to environmental stimuli are thought to result from differences in children's temperament (Chess & Thomas, 1986; Goldsmith et al., 1987). With this wide variability, we need to be able to identify children who are most vulnerable to experiencing intense distress during medical procedures. If these children could be identified prior to undergoing a painful medical procedure, psychological intervention could be used preventively. Additionally, intervention prior to a first LP for pain-vulnerable children might disrupt a cycle whereby painful experiences lead to negative memories, which can produce greater anxiety and pain during future LPs (Chen, Zeltzer, Craske, & Katz, *in press*). Thus, a means of targeting children most vulnerable to pain could have important potential benefit for children undergoing the numerous LPs required in ALL treatment protocols.

Previous researchers have used various strategies to identify pain-sensitive children. Some researchers have emphasized biological parameters associated with children's responses to environmental stimuli (Rothbart & Posner, 1985). For example, infants and young children undergoing medical procedures exhibit substantial variability in cortisol secretion and autonomic balance (Lewis & Thomas, 1990; Porter, Porges, & Marshall, 1988). Other researchers have used laboratory-based paradigms such as the cold-pressor task to elucidate individual differences in children's pain responsivity (Fanurik, Zeltzer, Roberts, & Blount, 1993; LeBaron et al., 1989; Zeltzer et al., 1989). Children's responses to these laboratory pain tasks are assumed to mirror their responses in clinical settings, but laboratory pain studies have the advantage of being able to control many more factors (e.g., intensity of stimulus) than possible in a clinical setting. Although these approaches have

demonstrated reliable individual differences in pain sensitivity, they may be infeasible as a screening tool in medical settings. Biologically based individual differences are measured while a child undergoes a medical procedure and thus cannot be used preventively. Laboratory pain paradigms may require equipment that hospitals lack and that staff would need to be trained to use.

A simpler approach, such as a questionnaire that could be given to parents and children, might be more appealing in pediatric oncology settings. Researchers have found that certain aspects of children's temperament (e.g., being a "difficult child") are associated with pain responses to medical procedures (Schechter, Bernstein, Beck, Hart, & Scherzer, 1991). However, to our knowledge, no studies have specifically assessed pain sensitivity as an aspect of temperament and its relationship to responses to painful medical procedures. The first goal of this study was to test the ability of a pain-sensitivity questionnaire to predict children's distress during LPs. We predicted that children with ALL who were high in pain sensitivity would exhibit more pain and anxiety both in anticipation of and during an LP.

The second goal of the study was to conduct preliminary analyses investigating whether pain sensitivity would relate to the efficacy of a psychological intervention designed to reduce LP-related distress. Abundant literature demonstrates the efficacy of numerous types of psychological interventions for medical procedures including hypnosis (Katz, Kellerman, & Ellenberg, 1987; Zeltzer & LeBaron, 1982), behavioral techniques such as deep breathing (French, Painter, & Coury, 1994; Manne, Bakeman, Jacobsen, Gorfinkle, & Redd, 1994), cognitive techniques such as positive suggestion and distraction (Fowler-Kerry & Lander, 1987), combined cognitive and behavioral techniques (Jay et al., 1985; Manne et al., 1990; McGrath & de Veber, 1986), and combined psychological and pharmacological intervention (Jay, Elliott, Woody, & Siegel, 1991; Kazak, Penati, Brophy, & Himelstein, 1998). However, these studies typically do not examine moderators of treatment response. Thus, it remains unclear whether certain interventions are best suited to children with particular constellations of psychological characteristics. In this study, children were randomized into either a psychological treatment group or a control group, and we tested pain-sensitivity as a moderator of treatment response. We hypothesized that without intervention, children highest in pain sensitivity would do worse over time; that is, higher pain sensitivity

would be associated with greater increases in pain and anxiety over time in the control group. In contrast, we predicted that with intervention, children higher in pain sensitivity might do better over time; that is, higher pain sensitivity would be associated with greater decreases in pain and anxiety over time in the intervention group.

Method

Participants

This study was conducted at the Childrens Center for Cancer and Blood Diseases at Childrens Hospital Los Angeles (CHLA). Eligibility criteria included diagnosis of acute lymphoblastic leukemia (ALL), age between 3 and 18 years, and being English- or Spanish-speaking. One family declined participation, one family moved before completing any study measures, and one patient died before completing any study measures; thus, 55 participants were included in correlational analyses. Two families chose to continue treatment at a different hospital (DH), two patients completed treatment (CT) before completing participation in the study, and one patient was changed to a different treatment protocol (DTP) after one LP; thus, a total of 50 participants were included in moderator analyses. Seven additional patients did not participate in a follow-up LP (2 DH; 2 DTP; 1 CT; and 2 did not have three LPs during the course of the study period).

Sixty-seven percent of participants were male. Gender proportions were comparable to national statistics (Margolin & Poplack, 1997). In addition, the study sample consisted of Caucasians (25%), Hispanics (61%), Asians (11%), and African Americans (4%). Twenty-nine percent of the children spoke Spanish only, and 33% of the parents spoke Spanish only. Children in the study averaged 7.3 ($SD = 3.7$) years of age, and ranged from 3 to 18 years of age. All children were receiving treatment on an outpatient basis. The majority of children (52%) were in the first phase of their treatment protocol (induction) at the time of recruitment; the remainder of the children were in other phases of treatment.

Measures

All measures were translated into Spanish by several research assistants from different Spanish-speaking countries. These translations were combined into

one form that minimized idioms unique to a specific country. This version was then translated back to English to ensure that the meaning of the questions had been preserved. Children and parents completed the measures in their preferred language. Most children chose to complete measures in English (all except 5), whereas a large number of parents chose to complete measures in Spanish (21 out of 50).

Visual Analogue Scale (VAS). (1) Children rated their anxiety and pain on a 10 cm vertical visual analogue scale, ranging from 0 ("not anxious/painful at all") to 10 ("extremely anxious/painful"). (2) Parents rated their child's anxiety and pain and their own anxiety on the same VAS. (3) The physician assistant (PA) who performed the LP rated the child's procedural distress on the VAS. Pain and anxiety questions were administered to all children; however, if a child was too young to understand the question, the data were not analyzed.

Sensitivity Temperament Inventory for Pain (STIP). Pain sensitivity was assessed using versions of the STIP designed for children (STIP-C) and parents (STIP-P) (Baum, 1994). Items probe daily life experiences that reveal individual differences indicative of a pain-sensitive or pain-tolerant nervous system. Questions were included from each of the five sensory modalities (e.g., Smell: "I enjoy the smell of flowers or perfume more than other kids." Hearing: "Loud sounds hurt my ears."), and an equal number of positive and negative experiences were probed within each modality (e.g., Positive: "I like to ride my bike fast down hills." Negative: "I get sick to my stomach when riding in a car, boat, or airplane."). The STIP-C contains four factors including Sensation Seeking/Pain Tolerance (e.g., "I can hold an ice cube in my hand longer than most people."), Perceptual Sensitivity (e.g., "I am very sensitive to bad smells from buses and cars."), Symptom Reporting (e.g., "I get a lot of headaches."), and Introversion/Avoidance of Sensations (e.g., "When I don't feel well, I like to be by myself."). The STIP-P contains the same factors as the STIP-C without the Introversion scale.

The STIP-C consists of 35 items each rated on a 4-point scale (ranging from "a lot like me" to "not at all like me"). Higher STIP scores indicate greater pain sensitivity. Adequate internal consistency (Cronbach's $\alpha = .78$) and good test-retest reliability (.87) for total STIP scores were demonstrated (Baum, Zeltzer, & Jospe, submitted). The STIP-C was administered to all children; however, if a child was too young to understand the questions, the questionnaire was discontinued. The STIP-P for parents

contains 33 items each rated on a 4-point scale. Higher STIP scores indicate greater pain sensitivity. Adequate internal consistency (Cronbach's $\alpha = .71$) and test-retest reliability (.81) for total STIP scores were demonstrated (Baum, Zeltzer, & Jospe, submitted). In this study, internal consistency for the STIP-C and STIP-P was similar ($\alpha = .72$ and $.66$, respectively).

Observational Measure. In the Procedure Behavior Check List (PBCL; LeBaron & Zeltzer, 1984): children's distress during the LP was rated by trained observers, along 10 operationally defined behaviors that indicate anxiety and/or pain (e.g., screaming, crying, etc.). Each behavior is rated on a scale from 1 (very mild) to 5 (extremely intense) during three time periods: preparation, needle insertion, and postprocedure. Observational distress scores are calculated by summing the ratings for the 10 behaviors for each phase. This measure correlates significantly (.26–.53) with patient ratings of anxiety and pain before and during cancer procedures (LeBaron & Zeltzer, 1984).

Upon completion of their training, all research assistants rated five videotaped LPs. Reliability correlations (the correlation in distress rating between every pair of trained observers across the five videotapes) ranged from .82 to .90 for each phase. In addition, 25% of all LPs at CHLA were observed by two raters, and reliability correlations for each phase of the LP ranged from .90 to .95. Raters were within two points of each other 89% of the time for total distress score during each phase of the LP (possible range of scores: 10–50).

Physiological Measures. Physiological measures were included as an additional indicator of distress: (1) Blood pressure was recorded from a Dinemap automatic system. The cuff was placed around the child's arm over the brachial artery. Three blood pressure readings taken 1 min apart were obtained at each time point described in the Procedures section, and an average blood pressure reading was calculated. (2) Heart-rate also was recorded from the Dinemap automatic system. Three heart-rate readings were taken 1 min apart, and an average heart-rate was calculated. (3) Salivary cortisol: a 1–2 mL saliva sample was obtained from each child prior to the LP and immediately after the LP. Given that cortisol responses peak 20–30 minutes after the onset of a psychological stressor (Kirschbaum & Hellhammer, 1989), we expected increases in pre-LP cortisol to reflect distress during the waiting period in anticipation of the LP, and increases in post-LP

cortisol to reflect distress resulting from the LP itself. Saliva was obtained by having each child place a small cotton roll in his/her mouth for 1–2 min. Saliva was extracted using a 10 cc syringe and frozen at -70 C, until shipped overnight to the Pennsylvania State University Behavioral Endocrinology Laboratory. Samples were pH corrected by dilution using 20 \times phosphate buffered saline. The assay employed a commercially available serum cortisol radioimmunoassay (Pantex, Santa Monica, CA) modified for use with saliva by the University of Minnesota Endocrine Hospital. The average interassay coefficient of variation was 8.81%. All samples were tested in duplicate and values were averaged. Samples were reassayed if the values returned from duplicate tests had greater than 5% error.

Intervention

Children discussed their memories of their most recent LP with a therapist, who observed the child's first study LP. The therapist encouraged children to (1) re-evaluate their reactions to the last LP through enhancing their beliefs about the efficacy of their own coping strategies (e.g., reminding them how asking the physician assistant questions helped them); (2) realistically appraise their responses to the LP (e.g., assessing the extent to which they cried, screamed, or protested); and (3) increase the accuracy of their memories about pain and anxiety. For example, some children remembered crying during the entire LP when in fact they may have cried 50% of the time. In all cases, the therapist and child discussed differences between the child's memories and observed behaviors or the child's self-report of the LP. This intervention was shown to reduce children's LP-related distress and to produce effect sizes in the "moderate" to "large" range by Cohen's (1988) standards (Chen, Zeltzer, Craske, & Katz, 1999).

Procedures

Parental consent as well as children's assent was obtained at CHLA during a regularly scheduled appointment. The STIP was completed by the parent and child on a day when the child was not having an LP, so that anticipatory distress would not influence STIP responses. Because of difficulties scheduling a hospital appointment prior to the LPs, some families completed the STIP after they had been observed for a study LP.

During a child's study baseline LP, an assessment was conducted prior to the LP, which included parent and child anticipatory anxiety and pain ratings and physiological measurements. During each LP, an observer rated behavioral displays of anxiety and pain, and the PA rated each child's distress. Post-LP assessment included parent and child anxiety and pain ratings of the LP and physiological measures. Intervention was conducted on half of the sample immediately following the first LP and immediately preceding the second LP for 15 min each time.

On the day of the second LP (typically 1 week later), the same pre-LP and post-LP assessment described above was conducted. This LP was considered the postintervention LP. On the day of the third LP (typically 1 week later), the same pre-LP and post-LP assessment described above was conducted. No intervention was conducted at this time, and this LP was considered the follow-up LP.

All children received a topical anesthetic cream (EMLA) during each LP; in addition, five children received oral Versed (midazolam) at 0.5 mg/kg (maximum dose of 15 mg) as a sedative. No changes in regular analgesia/sedation procedures occurred at CHLA over the course of this study. This protocol was approved by the CHLA Institutional Review Board.

Results

Preliminary Analyses

Parent and child STIP ratings were not correlated significantly, ($r [36] = .28$, ns). There were no differences in STIP scores for parents who completed the English versus Spanish versions. Finally, STIP scores did not differ for children/parents who completed the STIP prior to study LPs versus those who completed the STIP after being observed for a study LP (all $t_s < 1.1$).

There was no association of age with parent or child STIP scores (r_s ranging from $-.13$ to $-.20$). There were no ethnic differences in parents' or children's responses on the STIP (all $F_s < 1.0$). However, gender differences emerged. Parents rated girls to be more sensitive to pain than boys ($t [48] = 2.0$, $p = .05$), and girls rated themselves to be more sensitive to pain than boys ($t [37] = 3.7$, $p < .01$).

Age was negatively associated with LP distress. Younger children reported more anticipatory anxiety ($r [39] = -.45$, $p < .01$), anticipatory heart rate

($r [50] = -.27$, $p = .05$), marginally higher procedural anxiety ($r [33] = -.32$), observed distress ($r [54] = -.56$, $p < .001$), PA-rated distress ($r [54] = -.28$, $p < .05$), parent-rated procedural anxiety ($r [50] = -.38$, $p < .01$) and pain ($r [50] = -.35$, $p < .025$). However, older children displayed higher pre-LP systolic blood pressure (SBP) ($r [49] = .49$, $p < .001$) and post-LP SBP ($r [48] = .41$, $p < .01$). In addition, gender differences in LP distress emerged. Girls reported experiencing more pain during the LP ($t [32] = 2.8$, $p < .01$), but displayed lower SBP immediately after the LP ($t [46] = 2.8$, $p < .01$). No ethnic differences emerged.

Correlations Between Pain Sensitivity and LP Distress

Parent Ratings. Parent STIP ratings were positively associated with child self-report of LP pain and anxiety. Higher pain sensitivity was associated with higher child anticipatory pain ($r [35] = .34$, $p < .05$), marginally higher child anticipatory anxiety ($r [35] = .32$), higher child self-report of pain during the LP ($r [30] = .55$, $p < .01$), and higher child self-report of anxiety during the LP ($r [29] = .37$, $p < .05$) (see Table I). However, higher pain sensitivity was associated with lower systolic blood pressure (SBP) before the LP ($r [44] = -.46$, $p < .01$) and immediately after the LP ($r [43] = -.34$, $p < .05$). Controlling for number of previous LPs did not alter the significant associations between parent STIP and distress. In addition, correlations with each factor

Table I. Correlations Between Total STIP Scores and Lumbar Puncture (LP) Distress (Self- and Other-Report)

	Parent STIP	Child STIP
Child ratings		
Anticipatory pain	.34**	.21
Anticipatory anxiety	.32*	.36**
LP pain	.55***	.58***
LP anxiety	.37**	.42**
Parent ratings		
Child's anticipatory pain	.14	.22
Child's anticipatory anxiety	.07	.10
Child's LP pain	.07	-.01
Child's LP anxiety	.12	.04
Physician assistant ratings		
Child's LP distress	.00	.07

STIP = Sensitivity Temperament Inventory of Pain.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

of the parent STIP produced a similar pattern of results and thus are not reported separately.

Child Ratings. Children's STIP ratings were positively associated with child self-report of LP pain and anxiety. Higher pain sensitivity was associated with higher anticipatory anxiety ($r [35] = .36, p < .05$), higher child self-report of pain during the LP ($r [31] = .58, p < .01$), and higher child self-report of anxiety during the LP ($r [31] = .42, p < .025$) (see Table 1). Controlling for number of previous LPs did not alter the significant associations between child STIP and distress. In addition, correlations with each factor of the child STIP produced a similar pattern of results, with the exception that lower pain tolerance was marginally associated with post-LP cortisol levels, controlling for children's prednisone dosage ($r [31] = .34$).

Pain Sensitivity as a Moderator of Treatment Response

To assess whether pain sensitivity moderates the effects of a psychological treatment on distress, we computed a series of regression equations where distress change scores (e.g., postdistress minus study baseline distress) were regressed upon STIP scores, treatment condition, and the interaction of STIP and treatment condition. Significant interaction effects indicate a moderating effect of the STIP.

With the parent STIP, no significant interaction effects emerged at posttreatment. At follow-up, however, a significant interaction was found for PA rating of child's distress ($\beta = -.38, p = .05$). Among children in the control group, there was a positive association between STIP scores and distress ($\beta = .41$), indicating that children with higher pain sensitivity showed greater increases in distress over time. Among children in the treatment group, there was a negative association between STIP scores and distress ($\beta = -.25$), indicating that children with higher pain sensitivity showed greater decreases in distress from study baseline to follow-up. That is, without intervention, children with the greatest pain sensitivity demonstrate the greatest increases in distress over time. Psychological intervention appears to be most efficacious for those with the greatest pain sensitivity, as these children showed the greatest reductions in distress after intervention (please see Figure 1).

In the physiological realm, a significant interaction effect also emerged at follow-up for SBP imme-

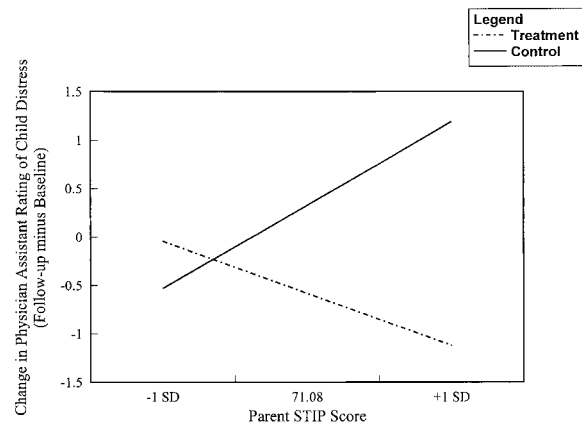


Figure 1. Association between pain sensitivity (parent STIP) and change in physician assistant rating of distress (follow-up minus study baseline) for treatment and control groups. Positive scores indicate increases in distress over time; negative scores indicate decreases in distress over time.

diately after the LP ($\beta = -.46, p < .05$). Among children in the control group, there was a positive association between STIP scores and SBP ($\beta = .24$), indicating that children with higher pain sensitivity showed greater increases in SBP over time. Among children in the treatment group, there was a negative association between STIP scores and SBP ($\beta = -.53$), indicating that children with higher pain sensitivity showed greater decreases in SBP from study baseline to follow-up. That is, without intervention, children with the greatest pain sensitivity demonstrate the greatest increases in SBP over time. Psychological intervention appears to be most efficacious for those with the greatest pain sensitivity, as these children showed the greatest reductions in SBP after intervention.

For the child STIP, a significant interaction emerged for parent anticipatory anxiety at postintervention ($\beta = -.51, p < .05$). Among children in the control group, there was a positive association between STIP scores and parent anxiety ($\beta = .57$), indicating that children with higher pain sensitivity had parents with greater increases in anxiety over time. Among children in the treatment group, there was a negative association between STIP scores and parent anxiety ($\beta = -.16$), indicating that children with higher pain sensitivity had parents with greater decreases in anxiety from study baseline to posttreatment. No significant interactions were found at follow-up.

Discussion

This study demonstrates that pain sensitivity is associated with children's self-reported distress during lumbar punctures. Higher parent and child STIP scores were associated with greater anticipatory and procedural anxiety and pain ratings by children. The STIP scores reported above accounted for 10% to 33% of the variance in distress. In addition, children with lower levels of pain tolerance showed elevations in cortisol after experiencing an LP. The finding that STIP scores were associated with child but not parent or physician assistant ratings of distress indicates that pain sensitivity may be associated with only certain aspects of distress. Nurse ratings are determined primarily by distress behaviors, whereas parent ratings are heavily influenced by parent anxiety (Manne, Jacobsen, & Redd, 1992). Thus, pain sensitivity may be associated with a child's cognitive and/or affective, rather than behavioral, experience of LP-pain and anxiety.

Other researchers have examined various aspects of child temperament in relation to pain and have reported similar directions in findings. Children with more "difficult" temperaments were slightly more likely to show greater distress during immunization (Schechter et al., 1991). Children who adapt less easily to new or different situations also show greater distress during immunizations (Schechter et al., 1991). Children whose temperament was more "intense" received more analgesic medication postoperatively (Wallace, 1989). Finally, the temperament variable of "approach" has been associated negatively with children's pain immediately after venipuncture (Young & Fu, 1988). This study extends these findings by demonstrating that a pain-sensitive temperament is related to children's self-reported distress during LPs. These results also provide preliminary evidence that using a brief questionnaire such as the STIP could be useful in pediatric oncology settings as a means of predicting which children will respond to an LP with the most distress. However, additional research with much larger sample sizes is needed to determine cutoff values for the STIP that accurately predict which children will develop clinically significant levels of LP distress.

The second goal of this study was to conduct preliminary analyses to assess whether pain sensitivity was related to the efficacy of a psychological intervention aimed at reducing LP-related distress.

To our knowledge, this is the first report to examine temperament as a predictor of children's response to intervention for acute procedural distress. We found that among children who received no intervention, STIP scores were positively associated with change in several domains of LP distress over time, including physician assistant ratings of child's distress, systolic blood pressure, and parent anxiety. That is, children with higher pain sensitivity who did not receive intervention showed greater increases in PA-rated distress, SBP, and parent anxiety over time. Among children who received a psychological intervention, STIP scores were negatively associated with change in PA-rated distress, SBP, and parent anxiety over time. That is, children with higher pain sensitivity who received intervention showed greater *decreases* in PA-rated distress, SBP, and parent anxiety over time compared to children lower in pain sensitivity. This indicates that intervention is most efficacious for those who are most pain-sensitive. Additionally, it supports the notion raised by other researchers that children without intervention do not habituate to LPs (Katz et al., 1980). Finally, the finding that pain sensitivity moderated the effect of intervention on parent anxiety suggests that providing pain-vulnerable children with intervention may also help reduce parent anxiety. Because parent anxiety is associated with children's procedural distress (Jay et al., 1983), reduction of parent anxiety may over time have beneficial effects on children's LP distress. However, these findings should be interpreted cautiously because of the small sample size in this study.

Given that most pediatric oncology settings have limited resources and cannot offer psychological intervention to every child, these results are encouraging because they suggest that a preventive approach to children's pain and anxiety may be possible if additional research is conducted on the predictive utility of this questionnaire for targeting children who will become highly distressed during LPs. This study also demonstrated that a psychological intervention is efficacious even for those children most sensitive to pain. This indicates that we possess the tools needed to alleviate pain and anxiety even among the most pain-sensitive children. Given that efficacious interventions have already been developed and extensively tested (see Sallie, Burgmeier, & Schmidt, 1988), researchers can now focus on how best to implement these interventions in medical settings, where limited resources

and constraints on staff time may prohibit offering intervention to all children. In addition, although the number of children receiving oral Versed was quite small, their inclusion in this study provides some indication that the STIP has predictive value across the range of analgesic/sedating approaches used by different practitioners. However, comparisons of the STIP among children receiving different types of pharmacologic intervention are needed in future studies, especially given the movement toward increasing analgesia or sedation during LPs. Children in this study who received Versed appeared similar to children without Versed in terms of LP-related memory (Chen et al., *in press*), indicating that the STIP moderation findings for psychological intervention may apply to children receiving a range of pharmacologic intervention. In addition, even with the movement toward general anesthesia for oncology procedures, issues of pain and temperament remain relevant, for children endure many pain- and anxiety-provoking situations throughout life.

It is possible that the finding that the most pain-sensitive children responded best to intervention was due to a floor effect. That is, children who are least pain-sensitive may have reported very low levels of pain and anxiety at study baseline and thus would have little room for decreases in distress over time (or, conversely, those who are most pain-sensitive have the most room for decreases in distress). However, examination of mean LP pain and anxiety levels among children below the median on pain sensitivity revealed moderate levels of study baseline distress (mean pain and anxiety ratings ranging from 3.4–4.7 on a scale of 0–10). Although these ratings are lower than the high pain-sensitivity group (mean ratings of 4.1–6.7), they nonetheless indicate that children who are low on pain sensitivity are experiencing levels of distress that could benefit from intervention. In addition, the high pain sensitivity group's means are also in the moderate range, indicating that effects are not solely due to this group being in the extreme range on distress scores.

One puzzling finding from this study was the association of higher pain sensitivity with smaller increases in anticipatory and post-LP blood pressure. The reasons for this negative association are unclear. It may be that children who are higher in pain sensitivity demonstrate an acute anticipatory physiological response upon arriving at the hospi-

tal, which eventually subsides over the hour and a half they have to wait for their LP. In contrast, children lower on pain sensitivity may not demonstrate an anticipatory physiological response to the LP until shortly before the LP occurs. Thus, our measurement of blood pressure may have missed the peak anticipatory response in children high on pain sensitivity. It may also be that children who show higher anticipatory physiological reactivity are more aroused because they are preparing themselves for their LP, resulting in their being less distressed during and after the LP (see Melamed, Dearborn, & Hermez, 1983, for similar findings with children undergoing surgery). Thus, children lowest in pain sensitivity may show higher anticipatory physiological responses but lower LP-related distress in other domains.

A second unusual finding was that although both parent and child STIPs were associated with children's self-reported distress, parent and child STIP responses were not significantly correlated with each other. This may reflect parent-child differences in how pain is perceived. For example, children may rely primarily on internal perceptions of pain in determining pain sensitivity, whereas parents may rely on children's behavioral pain responses in assessing pain sensitivity. These two dimensions may not be highly correlated; however, both aspects of pain perception may relate to LP distress, as found in this study.

One limitation of this study was that not all children and parents completed the STIP prior to their first study LP due to hospital scheduling difficulties. We expect that responses to the STIP would remain stable over time because the STIP has good test-retest reliability (Baum et al., *submitted*); however, it is possible that LP experiences influenced some of the children's or parents' responses to the STIP. A second limitation was that the parent STIP was completed by the child's mother in some cases and the child's father in others. Parents may have different expectations about their child's pain tolerance, which may have obscured some of the results. Parental differences in perceptions of child pain sensitivity should be explored in more depth in future studies. Third, the relatively small sample size in this study may have made it difficult to detect more robust STIP by treatment group regression interaction effects, which often require large numbers of subjects for significance (Aiken & West, 1991). Future large-scale studies would enable more power-

ful tests of the STIP as a moderator of treatment response.

Finally, future studies should directly compare the efficacy of various interventions by pain sensitivity. Children with attending styles of coping have higher STIP scores than children with distracting styles of coping (Baum et al., submitted). Given that interventions are most efficacious when targeted toward a child's preferred style of coping (Fanurik et al., 1993), attending-based interventions (e.g., information) may prove to be more efficacious for highly pain-sensitive children. However, this hypothesis would need to be tested empirically in future research. This study represents a first step in this direction, by demonstrating that a pain-sensitivity questionnaire is associated with children's distress responses to a painful medical procedure and that a memory-based psychological intervention is efficacious for children with pain-sensitive temperaments.

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