

Temperament and Pain Reactivity Predict Health Behavior Seven Years Later

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Objective Minor illnesses and major diseases are affected by individual, environmental, and social factors. We sought to determine if children's temperament and pain reactivity (individual response styles) measured in kindergarten are related to future health behavior. **Methods** Seven-year follow-up measures of health behavior were gathered in 42 children (mean age $M = 11$ years) who participated in a previous study of pain reactivity and somatization. Current health behavior was compared with children's pain reactivity and temperament measured in kindergarten. **Results** Pain reactivity in kindergarten was associated with children's self-reports of somatization 7 years later, independent of their temperament. Temperament was related to children's self-reports of somatization and to maternal reports of health care utilization and psychosocial health status. **Conclusions** Early response styles (i.e., heightened pain reactivity and difficulty adjusting) may indicate risk for increased health care utilization and poorer health and well-being later in childhood.

Key words child; health; pain; somatization; temperament.

Population studies suggest that ill-health can be determined by a host of psychosocial factors, including various forms of adversity commonly referred to as psychological stress (Keating & Hertzman, 1999). Yet studies of adults and children suggest that the relation between the experience of stressful events and health outcomes is empirically modest (Barr, Boyce, & Zeltzer, 1996). There is currently substantial interest in the idea that certain individuals are more or less resilient to the effects of various forms of stressors. However, there is little evidence on what "marks" resilience or on its determinants. Barr et al. (1996) and Boyce and Jemerin (1990) have suggested that individual differences in *psychobiological stress reactivity*, a concept referring to the intensity of integrated psychological and physiological responses to acute stressors, may account for the variability seen in illness or morbidity following stress, especially in children. The range of stimuli and events considered stressful in the literature is large. The focus of this article is on a particular kind of experience that, in children, is plausibly considered stressful—pain.

The concept of psychobiological stress reactivity relates to the idea of temperament—a relatively stable

style of reacting to the environment (Thomas & Chess, 1977). Temperament is believed to influence sensitivity and reactivity to stressful situations (e.g., Boyce, Barr, & Zeltzer, 1992). From early work we know that children with a difficult temperament have greater frequency of colic (Carey, 1968) and sustain more accidents requiring sutures (Carey, 1972) than those with easy temperaments. Kagan (1992) has reported that children with particular temperamental characteristics show enhanced cardiovascular responses to external stresses. In turn, cardiovascular reactivity may be associated with the incidence of acute illness as injuries. For example, Dembroski, MacDougall, Slaats, Elliot, and Buell (1981) found that adolescents displaying marked increases in heart rate and diastolic blood pressure during a competitive laboratory task were significantly more likely to have repeated minor illnesses than those displaying low-to-moderate increases.

More recent research has found that children in oncology settings with high levels of pain sensitivity showed greater pain response to lumbar punctures and, importantly, pain sensitive temperament

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moderated the effects of intervention on distress levels (Chen, Craske, Katz, Schwartz, & Zeltzer, 2000). Long-term effects of temperament on health behavior have also been reported. For example, Caspi et al. (1997) found that children rated as uncontrolled (irritable, impulsive, impersistent) at the age of 3 years were twice as likely to be involved in health risk behavior at the age of 18 years. Children with difficult temperaments have also been found to have an enhanced likelihood of developing insulin resistance syndrome, which may increase risk of coronary heart disease (Ravaja, Katainen, & Keltikangas-Järvinen, 2001). Thus, existing evidence supports the suggestion of linkages among temperament, health behavior, and health outcomes.

Pain reactivity, the magnitude of a behavioral reaction to a painful stimulus, is another individual response style that may be associated with health outcomes in children. Researchers have documented the long-term effects of experiencing repeated pain [for reviews see Young (2005) and Porter, Grunau, and Anand (1999)]. For example, studies have demonstrated sensitization due to early pain experiences with outcomes such as increased pain reactivity (Taddio, Katz, Ilersich, & Koren, 1997), increased somatization (Grunau, Whitfield, Petrie, & Fryer, 1994), and more medical fears (Rennick, Johnston, Dougherty, Platt, & Ritchie, 2002). Childhood pain reactivity has also been linked to health behavior in children and adults. Barr et al. (1996) reported that children who had an increased pain response to the cold pressor test showed a corresponding elevation in somatic complaints, nurse visits, and school absences. Furthermore, adults retrospectively reporting experiencing high pain reactivity as children were more likely to display medical fears and avoidance as adults (Pate, Blount, Cohen, & Smith, 1996). As some painful stimuli (e.g., inoculations) are standardized and common, the response to such stimuli might provide a useful marker of vulnerability to stressful stimuli in general.

In previous work we studied children's responses to the pain of their Diphtheria Pertussis Tetanus Polio (DPTP) inoculations (Rocha, Prkachin, Beaumont, Hardy, & Zumbo, 2003). The temperament dimension of difficulty in adjusting to situational demands (defined as a tendency toward low mood, low adaptability, and low approach) and previous experience with medical procedures were related to children's pain reactivity. In turn, pain reactivity was related to parents' reports of their children's somatic complaints.

If temperamental and pain response styles are prospectively predictive of children's health behaviors,

then they may be useful markers for risk of increased health care utilization. The present study addressed this issue. A portion of our original sample was followed up and parents' and children's reports of their health behavior, conceptualized as their current health status, somatization, and health care utilization, were examined. We predicted that heightened pain reactivity and difficulty adjusting to situational demands at 5 years of age would be prospectively associated with increased somatization, health status, and health care utilization 7 years later.

Method

Participants

Participants were 42 mothers and their children who took part in a previous study (Rocha et al., 2003). In 1997, families of children scheduled for their pre-kindergarten inoculation were recruited at the local community health unit. Participation in the original study included parents completing a questionnaire package and children receiving an inoculation in the upper arm by a nurse. During the inoculation, children's facial reactions were videotaped and parent-child interactions were coded. Of the original participants, contact information was available on 159/163. Thirty-four percent of telephone numbers were out of service or incorrect, 1% of families had moved, and 35% could not be contacted. Forty nine (30%) were reached; all agreed to participate and 42 (86%) returned questionnaires. The mean child age was 11 years 10 months (range = 11.4–12.4 years, $SD = 0.28$ years); 58 percent were boys. Mean maternal age was 40 years ($SD = 5$). Families' occupational status was generally middle class (mean Socioeconomic Index = 45.69, $SD = 15.64$), according to the scale developed by Blishen, Caroll, and Moore (1987). Ninety-one percent of the families were Caucasian, the remainder were of Aboriginal descent (consistent with census data for our region showing 9% reporting Aboriginal or Metis background). Ninety percent were from two parent families. Nonsignificant independent sample *t*-tests showed that occupational status, and temperament and pain reactivity scores of the present sample were comparable with the original sample.

Procedure

With approval of the institutional Research Ethics Board, mothers who participated in the earlier study were recruited to the follow-up study via telephone and mailed a questionnaire package (including consent

forms) to be completed at home and mailed back to the researcher. Participants' names were put into a draw for a \$100 Canadian prize.

Predictor Variables

Both measures were previously collected at the age of 5 years; see Rocha et al. (2003) for more detail. Due to the relatively small sample size, we restricted our attention to predictor variables that were related to the concept of psychobiological stress reactivity.

Child's Pain Reactivity

Videotaped facial responses during inoculation at the age of five were used to index pain reactivity, using an abbreviation of the Facial Action Coding System (FACS; Ekman & Friesen, 1978). One coder carried out all the coding and a second scored 7% of the segments to determine interobserver agreement. Both coders demonstrated proficiency on the FACS final test. The facial action units (AUs) coded were AU 4 = brow lowerer, AU 6 = cheek raise, AU 7 = lid tightener, AU 9 = nose wrinkle, AU 10 = upper lip raise, AU 20 = lip stretch, AU 27 = jaw drop, and AU 43 = eyes closed. These actions have been identified by researchers as being correlated with pain (e.g., Prkachin, 1992). Interobserver agreement, calculated according to the formula provided by Ekman and Friesen (1978) was .87, comparing favorably with other FACS studies. An FACS pain index was calculated by summing the products of the intensity (1–5) of each of the actions present and their duration (Prkachin, Berzins, & Mercer, 1994).

Temperament

Mothers completed the Behavioral Styles Questionnaire (BSQ); a 100-item temperament measure for children aged 3–7 years (McDevitt & Carey, 1978). The BSQ assesses nine temperament traits: activity, rhythmicity, approach/withdrawal, adaptability, intensity, mood, persistence, distractibility, and threshold. Internal consistency ranges from .47 to .84 for the nine BSQ categories (McDevitt & Carey, 1978). In our previous study, a factor analysis of the BSQ identified three factors, consistent with other such analyses (e.g., Simonds & Simonds, 1982). Approach/withdrawal, mood, and adaptability loaded on the second factor, which we termed "Adjustment;" we have maintained its label here to be consistent. In our previous study, only the "Adjustment" factor predicted the outcomes of interest, thus, we restricted our attention to this factor in the present study. Lower scores on "Adjustment"

indicate more negative mood and withdrawal and less adaptable behavior.

Criterion Measures

Somatization

The Children's Somatization Inventory—Child Form and Parent Form were used (P-CSI & CSI; Garber, Walker, & Zeman, 1991). The CSI is a widely used measure of children's somatization derived from DSM criteria. Ratings were made by the mother and the child on the extent to which the child had experienced each of 36 symptoms (e.g., headaches, muscle weakness, stomach pain, low energy) in the last two weeks. Ratings were made on a 4-point scale ["not at all" (0) to "a whole lot" (3)]. Total scores can range from 0 to 108. The P-CSI and CSI have adequate internal consistency (Cronbach's $\alpha = .86$ & $.92$, respectively; Garber et al., 1991). Garber et al. (1991) provide evidence for their concurrent validity in terms of correlations with alternative measures of physical and psychological symptom reporting.

Health Status

The Child Health Questionnaire—Parent Form 28 (CHQ-PF28; Landgraf, Abetz, & Ware, 1999) is a 28-item multidimensional health status questionnaire developed for measuring children's (aged 5–18 years) functional health and well-being. The CHQ-PF28 provides 10 scale scores and summary scores of Physical and Psychosocial health (standardized using a linear T-score transformation; $M = 50$, $SD = 10$). For the eight multiple-item scales, internal consistency ranged from .54 to .89 (Landgraf et al., 1999). Landgraf et al. (1999) provide evidence for its face, content, and construct validity.

Health Care Utilization (HCU)

The HCU scale from the Stanford Patient Education Research Centre was used (Lorig et al., 1996). Parents indicated the number of times, in the last 6 months, the child had the following services: family physician visits, therapist visits, emergency room visits, and overnight hospital stays. The total number of visits for each of the services was summed to create a composite score. Items on this scale show high test–retest reliability (.76–.97). Other psychometric properties are documented in Lorig et al. (1996).

Results

Summary data are presented in Table I. To assess the association between temperament and pain reactivity

and the five health outcomes, the Pearson's correlation matrix was examined (Table II). Children scoring lower on the "Adjustment" factor of temperament, as rated by their mothers at the age of five years, had higher numbers of health care visits [$r(41) = -.55$, $p < .001$], decreased psychosocial health [$r(41) = -.32$, $p = .04$], and increased self-reports of somatization [$r(41) = -.31$, $p = .04$] when assessed 7 years later. Because it was possible that higher scores on the "number of health care visits" variable may have reflected positive health behaviors such as well-visits for preventive care, the analysis of its relation to temperament was repeated, and the number of physician visits was subtracted from the composite. Despite this alteration, the correlation remained statistically significant; $r(42) = .45$, $p = .003$. Temperament was not significantly related to parental report of somatization or physical health status.

Table I. Summary Data for Study Variables

Variable	<i>M</i>	<i>SD</i>	Range
Child Somatization Inventory	7.90	9.27	0–39
Child report (age 11 years)			
Child Somatization Inventory	5.02	6.11	0–25
Parent report (age 11 years)			
Child Health Questionnaire (age 11 years)			
Psychosocial domain	50.59	9.14	16.03–63.63
Physical domain	53.93	10.15	9.68–63.59
Number of health care visits (age 11 years)	1.32	2.20	0–11
Number of health care visits (age 11 years; no physician visits)	0.52	1.21	0–5
Pain reactivity (age 5 years)	16.11	33.88	0–140
Temperament (age 5 years; factor score)	–0.12	0.93	–1.6–2.32

Lower scores on temperament dimension of "Adjustment" indicate more negative mood and withdrawal and less adaptable behavior.

Table II. Intercorrelations Among Study Variables ($N = 42$)

Variable	Pain reactivity (age 5 years)	Temperament (age 5 years)	Number health care contacts (age 11 years)	CSI—parent report (age 11 years)	CSI—child report (age 11 years)	CHQ—psychosocial domain (age 11 years)	CHQ—physical domain (age 11 years)
Pain reactivity (age 5 years)	–	.23	–.14	–.00	.36*	–.00	–.12
Temperament (age 5 years)		–	–.55**	–.21	–.31*	.32*	.18
Number of health care contacts (age 11 years)			–	.17	.21	–.31	–.35*
CSI—parent report (age 11 years)				–	.54**	–.17	–.31
CSI—Child Report (age 11 years)					–	–.29	–.15
CHQ—psychosocial domain (age 11 years)						–	–.11
CHQ—physical domain (age 11 years)							–

Lower scores on temperament dimension of "Adjustment" indicate more negative mood and withdrawal and less adaptable behavior.

CHQ = Child Health Questionnaire; CSI = Child Somatization Inventory.

* $p < .05$, ** $p < .001$.

Examination of the relation of pain reactivity to health outcomes revealed that children's pain reactivity at 5 years of age was related to children's self-reports of somatization 7 years later [$r(41) = .36$, $p = .02$]. Pain reactivity was not significantly correlated with parental reports of somatization, health status, or utilization. In our original study, pain reactivity and temperament were significantly correlated. To evaluate whether the prospective relation between pain reactivity and later self-report of somatization was independent of child temperament, a hierarchical regression was performed. CSI scores were entered as the outcome measure with temperament entered first, followed by pain reactivity. These measures were entered separately, rather than combining them into an overall measure of "psychobiological stress reactivity" because they were not significantly correlated, suggesting that it would be inappropriate to consider them as loading on a common construct. As expected, R was significantly different from zero after step 1, $R = .31$, $F(1,39) = 4.25$, $p = .05$, and after step 2, $R = .43$, $F(2,38) = 4.26$, $p = .02$. The addition of pain reactivity resulted in a marginally significant increment in $R = .43$, $R^2_{\text{change}} = .09$, $F_{\text{change}}(1,38) = 4.0$, $p = .05$.

Discussion

Individual differences in temperament and pain reactivity at the age of five years were related to frequency of health visits, health status, and somatization at age 11 years. These findings lend support to the suggestion that childhood psychosocial factors, including temperament and pain reactivity, may predispose to the development of health problems.

Consistent with our earlier work (Rocha et al., 2003), pain reactivity was related prospectively to child reports of somatization. Although the probability level of this relation would not have been sufficient to meet the requirements of a Bonferroni correction ($p < .005$), there is, nevertheless, reason to believe that it is meaningful. The inclusion of pain reactivity in the regression model predicting somatization added significant variance over and above temperament, suggesting that it is a meaningful addition to the explanation of the principal outcome. Moreover, the fact that the measures of reactivity and somatization were derived from different sources (observations of facial behavior and self-report) and assessed at different times enhances our confidence that this finding is important. Given the small sample of the present study, it will nevertheless be important for future research to determine the robustness of these relations.

It is worth emphasizing that pain reactivity was related to somatization after controlling for temperament. This pattern of findings implies that pain reactivity and temperament are not isomorphic constructs. There are different candidate mechanisms to account for the relation between pain reactivity and somatization. First, although the two are different constructs, a child's repertoire of somatic complaints might be built on individual differences in pain reactivity. Thus, children who react vigorously to painful stimulation may also react vigorously to various forms of discomfort and provide greater opportunity for reinforcement of general bodily complaints. Second, from a physiological perspective, enhanced pain reactivity and somatization may both reflect the influence of a third variable, such as enhanced sensitivity to somatic sensations, or reactivity to stress in general. Addition of physiological measures of reactivity to the original study would have been useful to examine this relation.

Children identified at the age of five years as low in "Adjustment" (prone to negative mood and withdrawal, less adaptable) reported more somatic symptoms, had more health care visits and were rated as having poorer psychosocial health status. Temperament is generally considered to reflect relatively stable individual differences in activity, reactivity, and sociability. Boyce et al. (1992) have suggested that some of these differences are linked to underlying physiological processes which, themselves, may "...set in motion the pathophysiologic events that lead...to...disease" (p. 483). Thus, if temperament is couched within the framework of biobehavioral reactivity (Boyce et al., 1992; Kagan, 1992),

then our results support the view that temperament characterized by low mood, less adaptability, and withdrawal is related to heightened reactivity, which may result in different health outcomes. This is consistent with the research reviewed above linking temperament to risky health behaviors (Caspi et al., 1997). The present study adds to this literature by also suggesting a link to health care outcomes (e.g., medical visits).

An alternative mechanism of the relation between temperament and the frequency of medical visits might arise more indirectly. Difficult "Adjustment" may be associated with enhanced vigilance about health issues among caretakers. Such vigilance may promote a greater tendency to seek medical care among caretakers of children with this type of temperament than among children who are easier to adjust. Further research in which each of these potential mediating mechanisms are addressed is needed.

Contrary to expectations, pain reactivity was not related prospectively to *parental* reports of somatization, health status, or utilization. This finding was unexpected because when the same children were in kindergarten pain reactivity was significantly correlated with parental report of somatization. The failure of this relation to stand up over time may reflect differences in parental access to the child's experience at this age. Similarly, the lack of a significant relationship between temperament and parental report of somatization may also be explained by this phenomenon. As children mature, peer relationships become prominent while parental supervision declines. Such a developmental change may reduce the validity and sensitivity of parental proxy reports about children's health status. Indeed, low parent-child agreement on internalizing behaviors, and particularly low agreement on measures of somatic complaints, in a group of children referred to mental health clinics has been found (Yeh & Weisz, 2001). More objective measures of health care utilization than parental reports, such as data from health care databases that enable linkage of health care identification numbers to utilization statistics, or use of other medical records may help to clarify this issue.

There are implications of this study for research on the link between temperament, pain reactivity, and health outcomes. Of the relations examined in the present study, the one between temperament and number of health care contacts appears to be the most robust. Replicating this finding with larger, prospective studies using objective health outcome measures

is needed. If individual response styles are found to be markers of risk for increased health care use, then public health applications may warrant consideration. Before such applications are considered, however, it will be necessary not just to confirm a prospective association between temperament and important health outcomes, but also to have a better understanding of the mechanisms underlying this association. The questions of the stability of these constructs as predictors throughout the lifespan and whether individual differences are important across the whole range of stress experiences or only for mild to moderate stressors will also need to be examined.

Although intriguing, the current findings should be viewed with caution. A sample size reflecting about one-fourth of the original sample limits generalizability. The results are most generalizable to middle class, Caucasian, two-parent families. Use of maternal reports of temperament, child health status, and physician visits means that we cannot rule out that some effects may be due to mother's *perceptions* of their children's temperament and aspects of their health behavior. Still, parents are key sources of information on children's health and their perceptions influence the extent to which the child may be exposed to medical examinations and treatments or hindered from receiving medical help. In addition, studies with objectively verified episodes of illness (e.g., Sandberg et al., 2000) have not invalidated the findings from earlier studies based on self-reports or parent-reports suggesting that psychosocial factors are associated with physical illness.

In sum, the present findings are among the first to suggest a prospective link between temperament and pain reactivity and frequency of health care visits. The data support the notion that the origins of health behaviors may be found early in life and persist over time. If further investigation also shows that these response styles identify children who will have more frequent engagement with the health care system, they might be regarded as markers of a need for intervention.

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