Adult Shyness: The Interaction of Temperamental Sensitivity and an Adverse Childhood Environment

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*This article examines the relation between adult shyness and sensory-processing sensitivity and posits a new model in which the interaction of sensitivity and adverse childhood environment leads to negative affectivity (with the highly sensitive being more impacted), which in turn leads to shyness. Consistent with this model, two questionnaire studies (*N*s = 96 and 213) supported three hypotheses: (a) sensory-processing sensitivity interacts with recalled quality of childhood parental environment to predict shyness, (b) sensory-processing sensitivity interacts in the same way with childhood environment to predict negative affectivity, and (c) the interaction effect on negative affectivity mediates the effect on shyness. Hypothesis 2 was tested and supported in an additional questionnaire study (*N *= 393) and also in an experiment (*N *= 160) that manipulated negative contemporaneous experience as an analog for adverse childhood environment.*

Keywords: *shyness; neuroticism; childhood; sensitivity; depression; anxiety; temperament*

A series of previous studies (Aron & Aron, 1997) supports the hypothesis that sensory-processing sensitivity is an individual difference characteristic in adults that is at least partially independent of social introversion and negative affectivity (fearfulness, anxiety, depression). As discussed below, this hypothesized temperament trait approximately corresponds to the physiological aspect of what has often been labeled introversion, as well as to temperament traits that carry a variety of names, including inhibitedness and reactivity. This article extends that work to the relation of sensory-processing sensitivity to adult shyness. We propose that these two seemingly related constructs of sensitivity and shyness are separable but are linked through a relatively simple hypothesized model: an interaction between sensory-processing sensitivity and adverse childhood environment leads to negative affectivity, which in turn leads to shyness.

SENSORY-PROCESSING SENSITIVITY

Aron (1996, 1999; Aron & Aron, 1997) described sensory-processing sensitivity as an individual difference characteristic in which those who are high are particularly sensitive to subtle stimuli, easily overstimulated, prone to "pause to check" in a novel situation, and prefer to reflect and revise their cognitive maps after an experience. Aron and Aron (1997) developed a measure of the trait that is unifactorial, reliable, and with substantial convergent and discriminant validity. The trait is meant to encompass what other adult personality researchers have variously described as a weak nervous system (Pavlov, 1927), low screening (Mehrabian, 1976, 1991), augmenting (of stimulation; Petrie, 1967), reducing (of evoked potential; Buchsbaum, Haier, & Johnson, 1983), reactivity (Strelau, 1983), avoidance temperament (Elliot & Thrash, 2002), and nondisinhibition or reflectivity (Patterson & Newman, 1993). In addition, it may be related to arousal focus (Feldman, 1995), which is hypothesized to involve individual differences in attention and processing of somatic states. Sensory-processing sensitivity is also meant to encompass, roughly, what child temperament researchers have

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PSPB, Vol. 31 No. 2, February 2005 181-197
DOI: 10.1177/0146167204271419

called inhibitedness (Kagan, 1994), infant or innate shyness (Cheek & Buss, 1981; Daniels & Plomin, 1985), reactivity (Rothbart, 1989; Strelau, 1983), and threshold of responsiveness (Thomas & Chess, 1977).[1]

Above all, Aron and Aron (1997) note that the trait is probably the same as the aspect of introversion that Eysenck (1991), Stelmack (1990), Stelmack and Geen (1992), and others suggest accounts for the large physiological differences between extroverts and introverts, such as faster auditory brainstem evoked potentials (De Pascalis, 1993), greater sensitivity in signal detection tasks (Harkins & Geen, 1975), and lower pain thresholds (Barnes, 1975). "Overall there is a good deal of evidence that introverts are more sensitive to physical stimulation than extraverts" (Stelmack & Geen, 1992, p. 227). However, in a series of seven studies with diverse samples using a variety of measures and analysis strategies, Aron and Aron (1997) found this aspect of introversion to be separable from the larger concept of introversion as it is typically measured (which includes sociability). For example, correlations between sensitivity and standard measures of introversion are clearly less than unity (ranging from .12 to .52) and have predictably different patterns of correlations with other variables when each is partialed from the other.

Whatever name is assigned to this individual difference, it seems likely that it is an inherited temperament trait given the extensive data on that point from Eysenck (1981), Daniels and Plomin (1985, who used a full adoption design), Kagan (1994), and many others. Indeed, a very similar genetic trait is found in a wide variety of animal species (for a review, see Aron & Aron, 1997). One suggested explanation (Wilson, Coleman, Clark, & Biederman, 1993) is that there are two behavior styles because there are two survival strategies—processing information thoroughly before acting ("do it once and do it right") versus acting immediately ("go for it"). Nevertheless, the model we propose is entirely consistent with the possibility that the trait is not inherited but simply appears early.

Finally, this characteristic seems best represented as a dichotomous variable (rather than a continuum) with 10% to 35% highly sensitive, given the infant observation data (e.g., Kagan, 1994), formal taxometric work (Woodward, Lenzenweber, Kagan, Snidman, & Arcus, 2000), and the extensive animal literature cited above where it is almost always observed as a dichotomous variable in these proportions. (For a discussion of typological conceptions of personality, see Robins, John, & Caspi, 1998; for a discussion of the related idea of global traits, see Funder, 1991.) Indeed, for Drosophilia, a single gene has been identified distinguishing "sitters" from "rovers" (sitters evidence greater neuron excitability, synaptic transmission, and nerve connectivity, consistent with sitters using a strategy of greater information processing; Renger, Yao, Sokolowski, & Wu, 1999). Finally, samples of adults administered our sensitivity measure have consistently yielded bimodal distributions and the sensitive and nonsensitive individuals fall into distinct clusters when measured on a number of variables (Aron & Aron, 1997).

NEGATIVE AFFECTIVITY ARISING FROM THE INTERACTION OF SENSITIVITY AND CHILDHOOD ENVIRONMENT

We begin with the proposed relation of sensitivity to negative affect in general before turning to the proposed further-downstream relation to shyness.[2] If those who are high on sensory-processing sensitivity process all experiences more thoroughly, including social and emotional experiences, these individuals also would have been especially affected by their childhood environment. Aron and Aron (1997) found results consistent with this view in cluster analyses of three independent samples (including a random-digit-dialing telephone survey). In each sample, there appeared to be two distinct clusters of highly sensitive individuals (along with a third, much larger cluster who were not highly sensitive). The smaller of the two highly sensitive clusters in each sample, about a third of the highly sensitive individuals, reported less happy childhoods and more negative affectivity; the larger of the two highly sensitive clusters in each sample were just as sensitive but reported childhoods and negative affectivity at about the same level as the not highly sensitive cluster. Furthermore, in another analysis of these samples, among those who reported relatively objective problems in their childhood home such as alcoholism or mental illness, those who were highly sensitive were more likely than those not highly sensitive to have reported difficult childhoods. These various results suggested the possibility of a general pattern of an interaction between temperamental sensitivity and a history of many stressors that leads to chronic negative affect.

Some researchers working with children have reported such an interaction looking at temperamental qualities similar to sensitivity (or perhaps sensitivity that has been differently labeled—see earlier discussion and Note 1). In a longitudinal study, Hagekill (1996) reported that the most variance in children's neuroticism was accounted for by an interaction of "low sociability" as an infant temperament trait and negative life events, such that children evidencing initial low sociability and having more negative life events were more fearful at later ages. Fox (1996) found that infants evidencing more of a temperament trait of "negative affectivity" (sensitive infants' reaction to levels of test stimulation that would be comfortable to nonsensitive infants?) and

right hemisphere activity had more variable outcomes at 4. Medical researchers Boice et al. (1995) studied high and low reactive children (measured as change from baseline of heart rate and immune reactivity in a challenge situation). High reactive children in stressful home and school conditions were more prone to illness and injury (likely signs of negative affect) than nonreactive children. However, when in normal-stress environments, high reactive children were less prone to illness and injury than nonreactive children. Gannon, Banks, and Shelton (1989) found similar results for adolescents (according to their tables—they only discussed the increased illness and injuries under high stress). In sum, as Boice et al. (1995) speculated, "Children with a heightened sensitivity to psychosocial processes [might have superior health] under low-stress, nurturing, and predictable conditions, in which social cues denote encouragement and acceptance" (p. 419) because of "a heightened sensitivity to the character of the social world" (p. 420).

Gunnar, Nachmias, and their colleagues (Gunnar, 1994; Nachmias, Gunnar, Mangelsdorf, Hornik Parritz, & Buss, 1996) report similar interactions with regard to "inhibited" children. These researchers employed laboratory experiments with novel, arousing situations to compare inhibited and uninhibited children with or without secure attachments to their mothers. Inhibited children in general (i.e., regardless of their security of attachment) entered the novel situations gradually and evidenced adrenaline reactions. However, only those inhibited children with insecure attachments showed a rise in cortisol. (Security of attachment style was not related to cortisol levels in noninhibited children.) Chronically high cortisol levels would certainly contribute to the development of negative affectivity. For example, cortisol disturbs sleep, and sleep disturbance leads to still greater vulnerability to negative affect, especially in children (Weissbluth, 1989). Consistent with our interpretations, Stansbury (1999) concluded from his own review of these studies that there are two pathways to adult hyperreactivity of the adrenocortical system (signs of anxiety and depression)—temperament and less than optimal mothering early in life. But the majority of variance "would be captured by studies of the interactions between these two variables during early development" (p. 41).

SHYNESS

Shyness—the fear of negative social evaluations that leads to discomfort and limitations on the desire for social contact—has richly deserved increasing focus. At least 40% to 50% of Americans label themselves as dispositionally shy, 75% of whom report they do not like being shy and 66% of whom find it a personal problem (for reviews, see Carducci & Zimbardo, 1997; Cheek & Krasnoperova, 1999). Beginning with Baldwin (1894), it has been observed that shyness sometimes appears early, as if inherited, and sometimes appears later, as if learned. Studies of shyness have consistently shown that the family environment (e.g., Daniels & Plomin, 1985; see Eastburg & Johnson, 1990, for a review) and experiences with peers (e.g., Roopnarine, 1985) can be as important as genetics. Nevertheless, the high heritability of shyness (Daniels & Plomin, 1985) suggests some genetic factor is involved, although not necessarily a "shyness gene."

Our suggestion is that something basic like sensory-processing sensitivity is probably the aspect that is inherited but does not become shyness except in the context of a problematic environment, particularly in childhood or adolescence. When observing infants, a preference to pause to check and a withdrawal from overstimulation may be understandably construed as shyness, and as children develop self-consciousness and choice, this temperament quality may well manifest as preferring less stimulating environments, such as preferring to spend time with familiars. But these behaviors are not yet shyness. As Nachmias et al.'s (1996) data suggested, when "inhibited" toddlers are placed in a novel situation, they pause to observe and evidence increased adrenaline, an inhibition only in the sense of initial reaction. Environmental stressors seem to be required to turn this temperament quality, a high attention to novelty, into chronic fear of novelty and later into fear of social evaluation. In the Nachmias et al. work, the stressor was an insecure attachment style (in particular, anxious and intrusive involvement by the mothers of the insecure "inhibited" toddlers).[3]

That shyness or social withdrawal is the result of an interaction of some aspect of temperament and environment is consistent with the literature on children. For example, Rubin and his colleagues (e.g., Mills & Rubin, 1993; Rubin, LeMare, & Lollis, 1990) have been researching a model in which social withdrawal in children is the result of an interaction of unnamed inborn characteristics, socialization within and outside of the family, and the parents themselves—such as their inability to respond appropriately to this temperament difference because of their attitudes and beliefs, with negative effects increasing when the family is under stress. Likewise, Engfer (1993) found that "children who as infants were already somewhat more sensitive and vulnerable showed a marked increase in shyness under the cumulative impact of deteriorating family relationships and an abrupt change in the peer-group environment" (p. 77; i.e., changing schools or school classrooms). However, this interaction has not been studied in adults. Further-

more, the question remains as to the underlying nature of the temperament trait that interacts with life history to create shyness.

Of course, negative affect and shyness can develop in a not highly sensitive person as well through repeated experiences of criticism and rejection in childhood or even adulthood. What we hypothesize is that highly sensitive individuals develop these more readily because they experience the same adverse environment more negatively. (There are also, no doubt, ways shyness can develop independently of negative affectivity, such as through direct modeling.) Furthermore, because high sensitivity involves processing experiences more thoroughly, it seems likely that, for sensitive individuals, distressing experiences would lead to more distressed, negative affect (anxiety and depression) and many such experiences would lead to chronic negative affect. If these (or any) individuals enter a social situation already feeling or anticipating negative affect, it seems more likely that these distressed individuals would seek in memory other negative moments. In social situations, these would be other moments of being negatively evaluated, which they would now fear again. Thus, in addition to hypothesizing sensitivity-childhood interaction's impact on both negative affectivity and shyness, we also hypothesized that the impact on negative affectivity is a mediator of the effect on shyness. (For direct evidence of the relation of negative affectivity to social behavior, see Furr & Funder, 1998.)

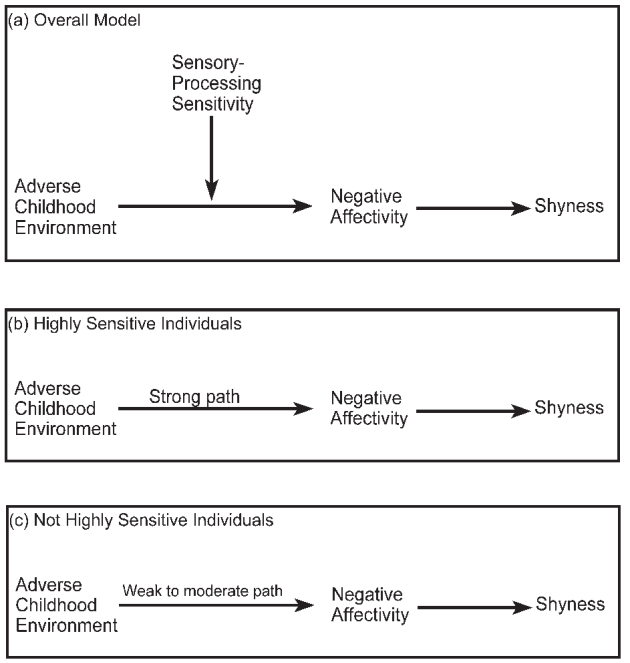

Figure 1 **(a) The overall hypothesized model. (b) Predicted relation of childhood parental environment to negative affectivity and shyness for highly sensitive individuals. (c) Predicted relation of childhood environment to negative affectivity and shyness for not highly sensitive individuals.**

SUMMARY OF OUR MODEL AND HYPOTHESES

Our overall model is shown in Figure 1a. As shown in Figure 1b and 1c, the predicted pattern is that the path from childhood environment to negative affectivity is stronger for individuals who are highly sensitive than for those who are not highly sensitive and that this negative affectivity in turn is a cause of increased shyness.This model implies three hypotheses:

Hypothesis 1: There should be an interaction of sensory-processing sensitivity and childhood environment in predicting shyness, such that highly sensitive individuals, compared to not highly sensitive individuals, should demonstrate a stronger association between adverse childhood environment and shyness.

Hypothesis 2: There should be an interaction of sensory-processing sensitivity and childhood environment in predicting negative affectivity, such that highly sensitive individuals, compared to not highly sensitive individuals, should demonstrate a stronger association between adverse childhood environment and negative affectivity.

Hypothesis 3: Negative affectivity should mediate the relation between shyness and the interaction of sensory-processing sensitivity and childhood environment.

THE PRESENT RESEARCH

As a first test of central aspects of our hypothesized model, we conducted four studies. Each study employed our measure of sensory-processing sensitivity (Aron & Aron, 1997) and measures of negative affectivity. The first two studies, which focused on the entire model, also included Cheek's (1983) shyness measure and retrospective measures of the quality of the parental environment during childhood. (We chose to ask questions about parents because they are probably the largest potentially negative environmental influence but do not mean to suggest that parents are the only influence.) Study 1 used the same brief parental environment and negative affectivity measures originally constructed as part of the Aron and Aron (1997) research. Study 2 was a replication of Study 1 with a larger sample, using a procedure in which different questionnaires appeared as separate studies and employing measures of parental environment and negative affectivity with established strong psychometric properties and evidence of validity. Study 3 was a further replication, with a new large sample, of the aspect of our model regarding the hypothesized interaction of sensitivity and childhood environment pre-

dicting negative affectivity, employing the same Study 1 negative affectivity measure in addition to a different combination of childhood environment measures. Study 4 was an experiment testing the underlying principle that negative experiences create greater negative affect in highly sensitive individuals.

We are aware of the limitations of asking adults to recall conditions from their childhood (e.g., Cutler, Larsen, & Bunce, 1996; Larsen, 1992). However, the likely recall biases (individuals who are sensitive or with negative affectivity or shyness recalling more negative childhoods) would lead to effects opposite to those predicted by our model. For example, consider two individuals with equal levels of negative affectivity or shyness but one is highly sensitive and the other is not. Any bias from negative affectivity or shyness will be the same for both individuals. But if there is also a negative bias effect of sensitivity, the highly sensitive individual should report a worse childhood than the not highly sensitive individual. However, our model predicts that the not highly sensitive individual will report a worse childhood than the highly sensitive individual. This is because our model hypothesizes that it takes a worse childhood to impact a not sensitive individual to the same degree as a sensitive individual. That is, if the highly sensitive individual is more affected than the not highly sensitive individual by his or her childhood environment, then to end up with an equal level of negative affectivity or shyness, the highly sensitive person would need a less adverse childhood. (We return to this point again in the General Discussion; see also Figure 11.)

There are four additional reasons the recall bias concerns are somewhat minimized here. First, a negative recall bias for sensitivity would predict a correlation between sensitivity and reported adverse childhood environment. However, as will be seen, across the three studies involving childhood environment, the correlations with sensitivity were small and averaged near zero (–.03). Second, the specific measures of adverse childhood events in Studies 1 and 2 included scales focused on relatively objective childhood events, and the other key childhood measure in Studies 2 and 3 has been found to correlate strongly with objective childhood events in other research (Parker, 1986). Third, in Study 4, we experimentally manipulated current negative experience rather than relying on retrospective self-report at all. Fourth, we believe that the novelty and broad significance of the present model in the context of childhood environment are such that even a less than optimal test suggests important new thinking about the role of childhood environment and temperament in relation to adult negative affectivity and shyness.

A more general concern of relying so strongly on self-report measures of any kind is the possibility of everything-is-correlated-with-everything kinds of interpretations due to common method variance, such as possible general response biases. However, in these studies, all predicted effects are tested in analyses in which other self-report variables (with likely similar method variance and biases) are partialed out. That is, any common method variance and general response biases among focal measures are removed from the tests of the hypothesized relationships.

Finally, there is the issue of the specificity of sensory-processing sensitivity in relation to other possible variables that may covary with it, such as social introversion and negative affectivity. As noted, we conceptualize sensory-processing sensitivity as roughly the same as a number of variables that have been studied under other names, such as reactivity and inhibitedness. Thus, we do not attempt to distinguish sensitivity from these variables but rather intend that our results should generalize to them. As also noted earlier, Aron and Aron (1997) found in a series of seven studies with different samples and methods that sensory-processing sensitivity is at least partially independent of social introversion and negative affectivity. Still, it remains possible that the specific effects found here arise from overlap that remains with these other variables. Fortunately, we were able to examine effects controlling for a measure of social introversion in Studies 1, 2, and 4. Also, throughout, most analyses either controlled for direct effects of negative affectivity or it is a dependent measure in analyses in which direct sensitivity effects are held constant (so that any overlap with sensitivity and negative affectivity is removed from the focal analyses). Furthermore, if negative affectivity or shyness represent a common underlying construct with sensitivity, this would imply main effects of both negative affectivity or shyness and sensitivity but would not imply our hypothesized interactions. (We return to this issue in the General Discussion; see also Figure 10.)

STUDY 1

Method

Participants were 96 1st- and 2nd-year State University of New York at Stony Brook psychology undergraduates (47 women, 46 men, 3 who did not indicate gender; *M* age = 18.7; in all studies, the few participants 25 or older were excluded from analyses).

Sensory-processing sensitivity was measured using the Highly Sensitive Person Scale (Aron & Aron, 1997), a 27-item questionnaire that has shown a unifactorial structure, solid reliability, and discriminant and convergent validity (example items include, "Are you made uncomfortable by loud noises?" and "Are you particularly sensi-

tive to the effects of caffeine?"). In this study, alpha = .85. As noted earlier, sensory-processing sensitivity appears to be a dichotomous variable with about 10% to 35% highly sensitive (and we have found the proportion tends toward the high end among psychology students). Thus, following procedures used in previous research, we inspected the distribution for an appropriate cutoff in which 20% to 35% would be in the highly sensitive group. This yielded a dichotomous variable with 35 classified as highly sensitive and 61 not. All analyses employed this dichotomous variable. (We also conducted all analyses here treating sensitivity scores as a continuous variable. In every case, the results were in the same direction and had at least the same level of significance. However, we report results using the dichotomy because of theory and evidence reviewed earlier suggesting that the underlying construct is dichotomous.)

Shyness was measured using Cheek's (1983) Revised Cheek and Buss Shyness Scale, a 13-item questionnaire with demonstrated strong validity and reliability (example items include, "I feel tense when I'm with people I don't know well" and "I am socially somewhat awkward"). Alpha in this study was .90.

Childhood parental environment was assessed with the six-item measure Aron and Aron (1997) used (example items include, "Was mental illness a problem in your immediate family while you were growing up?" and "Was alcoholism a problem in your immediate family while you were growing up?").[4] Alpha here was a marginally adequate .63. (However, alpha is not entirely appropriate because some items are causes rather than indicators of the construct; see Bollen & Lennox, 1991. Indeed, breadth of coverage seems more important here than internal consistency. Also, any lack of reliability works against our hypotheses.) Note that the items in this measure emphasize relatively objective conditions, reducing opportunities for recall bias.

Negative affectivity was assessed with the three-item measure Aron and Aron (1997) used: "Are you a tense or worried person by nature?" "Are you prone to fears?" and "Are you prone to depression?" Alpha in this study was .75.

Finally, our questionnaire included two items on social introversion: "Do you prefer to go out with one or two friends (vs. a larger group)?" and "Do you like having just a few close friends (as opposed to a large circle of friends)?" (alpha = .70). Aron and Aron (1997) found this two-item scale correlated highly with standard measures of social introversion.

Results

As shown in Table 1, correlations were all substantially and significantly less than 1.[5] Gender did not significantly moderate any of the correlations or hypothesis tests in any of the four studies (with one exception in Study 2).

TABLE 1: Correlations Among Key Variables in Studies 1 and 2

	1	*2*	*3*	*4*
1. Sensitivity	—	.16*	.40**	.20**
2. Adverse parental environment	–.03	—	.33**	.22**
3. Negative affectivity	.47**	.20*	—	.51**
4. Shyness	.26**	.03	.51**	—

NOTE: Correlations below the diagonal are for Study 1 (N = 96); correlations above the diagonal are for Study 2 (N = 213). Based on 1% confidence intervals, all correlations are significantly less than 1 (see Note 5).
*$p \leq .05$. **$p \leq .01$.

Hypothesis 1. The predicted interaction was significant, $t(91) = 1.79$, $p < .05$. (Throughout, tests of hypothesized effects are one-tailed.) This interaction (and all interactions in the article other than in the Notes) was tested in the standard fashion (Aiken & West, 1991) using a regression model in which the predictors were the two variables hypothesized to interact (sensitivity, as a dummy-coded variable; childhood environment, as a centered continuous variable) and a term representing the product of the two; the crucial test is the t value of the product term in the context of this overall equation.[6] As predicted, for highly sensitive individuals, the worse the childhood environment, the greater the shyness (r = .28); however, for the not highly sensitive individuals, this link was near zero (r = –.09). (see Figure 2).

Hypothesis 2. This predicted interaction approached significance, $t(91) = 1.50$, $p = .07$.[7] For highly sensitive individuals, the worse the parental environment, the greater the negative affectivity (r = .40); however, for not highly sensitive individuals, this link was much smaller (r = .12) (see Figure 3).

Hypothesis 3. The results met all four of Baron and Kenney's (1986) conditions for the predicted mediation. As shown in Figure 4, (a) the unmediated path from the distal cause (Childhood Environment X Sensitivity term residual after removing the effects of each main effect) to the distal effect (shyness) was significant (beta = .68, $p < .05$, per the Hypothesis 1 result); (b) the path from the distal cause to the mediator (negative affectivity) approached significance (beta = .51, $p = .07$, per the Hypothesis 2 result); (c) the path from the mediator to the distal effect, when controlling for the distal cause, was significant (beta = .50, $p < .01$); and (d) the unmediated relation of the distal cause to the distal effect (beta = .68) was reduced to nonsignificance (beta = .43) when the mediator was included in the model. The direct test of the mediation (Sobel's test) approached significance, $Z = 1.46$, $p = .07$ (see Note 7).

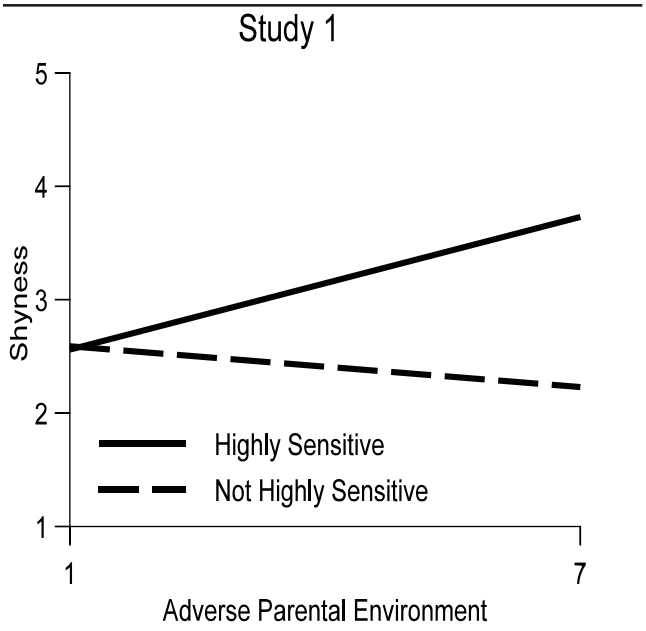

Figure 2 Relation of adverse childhood parental environment to shyness for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(91) = 1.79$, $p < .05$ (Study 1, test of Hypothesis 1).

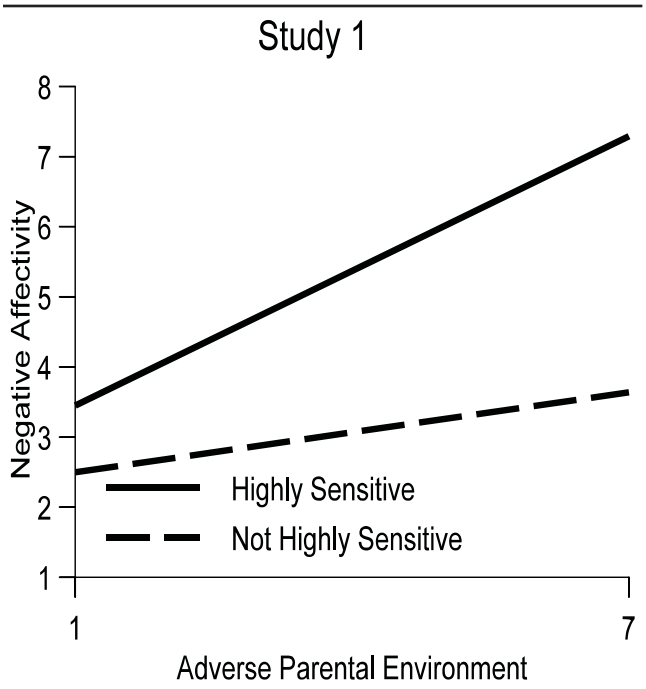

Figure 3 Relation of adverse childhood parental environment to negative affectivity for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(91) = 1.50$, $p = .07$ (Study 1, test of Hypothesis 2).

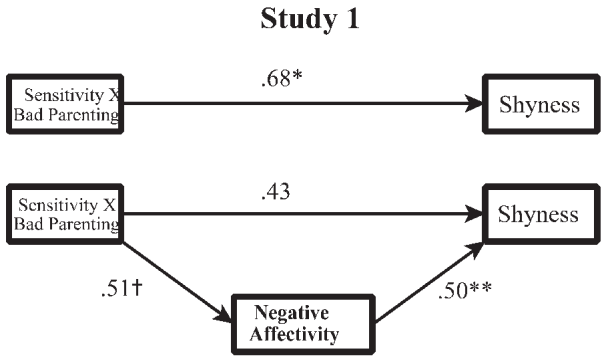

Figure 4 Standardized path coefficients for predicting shyness from interaction of sensitivity and adverse childhood parental environment, unmediated (top model) and mediated by negative affectivity (bottom model).

NOTE: In both models, sensitivity and poor parental environment are also included individually as exogenous variables with effects on the interaction term but are not shown. Mediation (Sobel's test) $Z = 1.46$, $p = .07$ (Study 1, test of Hypothesis 3).

†$p < .10$. *$p < .05$. **$p < .01$.

Specificity of sensory-processing sensitivity. In each analysis reported above, the pattern and significance level remained the same when the social introversion measure was included in the equation. As noted in the Introduction, the specificity of sensory-processing sensitivity or shyness in relation to negative affectivity is not much at issue here because negative affectivity is a criterion variable in the Hypothesis 2 analysis (in which main effects of sensitivity are also already partialed out) and it is a mediator in the Hypothesis 3 analysis. Also as noted, correlations among all variables were clearly less than 1.

Discussion

Results significantly or marginally significantly supported all three hypotheses from our model, even when controlling for a measure of the social aspect of introversion.

STUDY 2

Study 2 addressed three limitations of Study 1: (a) the Study 1 *N* was relatively small for testing interaction effects (perhaps making Study 1's Hypothesis 2 results and the Sobel test for Hypothesis 3 only marginally significant); (b) because all variables in Study 1 were assessed as part of the same overall questionnaire packet, participants may have somehow been affected by the knowledge that the researchers were exploring these variables together; and (c) the Study 1 measures of parental environment and negative affectivity were sets of

ad hoc items used previously in only one series of studies (Aron & Aron, 1997). Most important, Study 2 provided the opportunity to replicate Study 1 with a new sample using different measures of two key constructs.

Method

Participants were 213 1st- and 2nd-year Stony Brook psychology students (126 women, 87 men; *M* age = 19.1). Inspecting the distribution of sensitivity scores for an appropriate cutoff near the 20% to 35% proportion of highly sensitive individuals expected for psychology students yielded 48 classified as highly sensitive and 165 not.

Measures included the same sensitivity, shyness, and social introversion measures used in Study 1. Four scales collectively assessed general negative affectivity: The Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988), the Beck Depression Inventory (Beck, 1978), the average rating on 10 negative moods (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid) for how much participants "generally feel this way," and the three-item negative affectivity scale used in Study 1 (and Aron & Aron, 1997). Alpha among the four scales was .88. To assess parental environment, we used the mother and father versions of Parker, Tupling, and Brown's (1979) Parental Bonding Instrument (PBI), in which participants rate 25 statements, "As you remember your mother [father] in your first 16 years of life." Example items include, "Frequently smiled at me" and "Did not praise me" (reverse-scored). The PBI has shown strong psychometric properties and has been validated by correlations with interview data and reports of "objective" childhood events (e.g., Parker, 1986). We used the average of the mother and father versions (alphas = .91 and .89; mother-father correlation = .32). (The PBI for each parent is typically scored as two separate scales; however, following the same logic as in Study 1, we treated the individual scales and the two parent versions as reflecting causes, not symptoms, of an adverse childhood environment; see Bollen & Lennox, 1991. Also, again, to the extent these variables might be better considered indicators, low internal consistency would work against our hypotheses.)

Our measures were administered as two separate questionnaire sets within an overall "mass-testing" session that included numerous paper-and-pencil studies from other researchers (our two sets always had at least one other packet between them). One of our sets included the sensitivity and parental questionnaires, and the other included the shyness, negative affectivity, and introversion items. The two sets were printed in different type faces with different styles and page layouts to reinforce the impression that they were from unrelated studies conducted by different researchers.

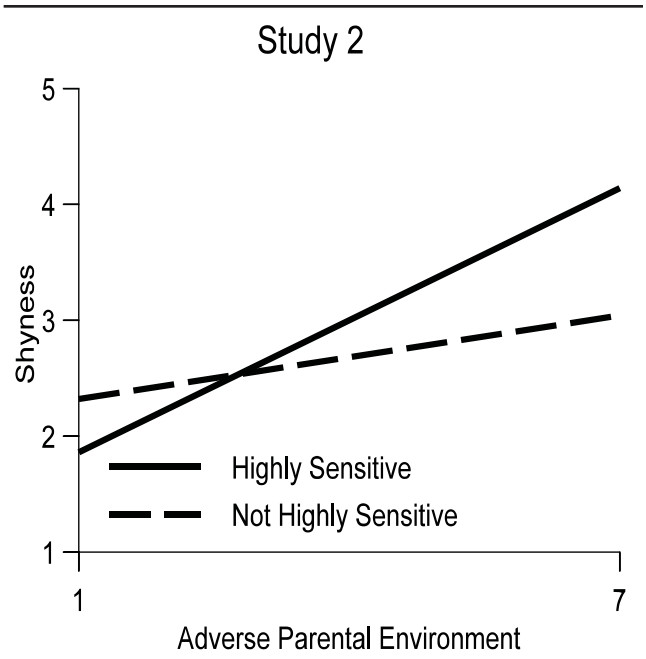

Figure 5 Relation of adverse childhood parental environment to shyness for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(211) = 1.74$, $p < .05$ (Study 2, test of Hypothesis 1).

Results

Correlations (see Table 1) were similar to those obtained in Study 1, which is notable given that different measures were used for negative affectivity and parental environment. Also, all correlations were again substantially and significantly less than 1 (see also Note 5).

Hypothesis 1. We again found the hypothesized interaction, $t(211) = 1.74$, $p < .05$. (In this study, there was also a significant three-way interaction with gender—the pattern was stronger for men.) The two-way interaction was again as predicted: For the highly sensitive, the worse the parental environment, the greater the shyness ($r = .43$); for the not highly sensitive, this link was much smaller ($r = .14$) (see Figure 5).

Hypothesis 2. This hypothesized interaction was again found in Study 2, this time reaching conventional significance levels, $t(211) = 2.02$, $p < .05$. For the highly sensitive, the worse the parental environment, the greater the negative affectivity ($r = .50$); for the not highly sensitive, this link was much smaller ($r = .21$) (see Figure 6).

Hypothesis 3. The results once again met all of Baron and Kenney's (1986) conditions for the predicted mediation (see Figure 7). Furthermore, this time the direct test of the mediation (Sobel's test) was clearly significant, $Z = 1.96$, $p < .05$.

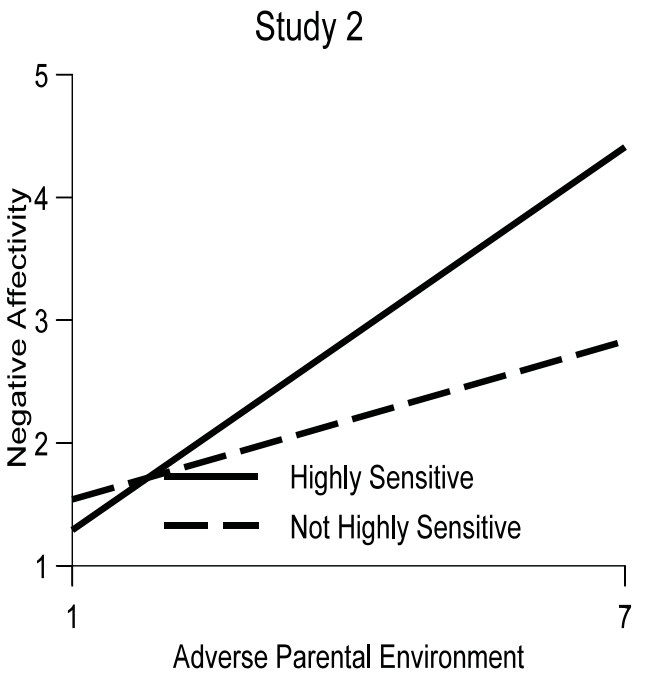

Figure 6 Relation of adverse childhood parental environment to negative affectivity for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(211) = 2.02$, $p < .05$ (Study 2, test of Hypothesis 2).

Specificity. As in Study 1, when we repeated each analysis controlling for our social introversion measure, the patterns of results and significance levels were unchanged.

Discussion

Study 2, employing various modifications of the Study 1 procedures to strengthen the methodology, replicated each of the Study 1 results, including finding clearly significant results for Hypothesis 2 and for Hypothesis 3's Sobel's test.

STUDY 3

To provide yet further replication, we were able to include some measures relevant to our model in a questionnaire study conducted by Davies and Aron (2004) on another topic (the relation of birth order and attachment). That study already included measures of childhood experiences. We were able to add to the packet our sensitivity measure and a brief negative affectivity measure, permitting us again to test, with a new sample, Hypothesis 2, that the interaction of sensitivity and childhood environment predicts negative affectivity, this time using a somewhat different set of measures of childhood environment.

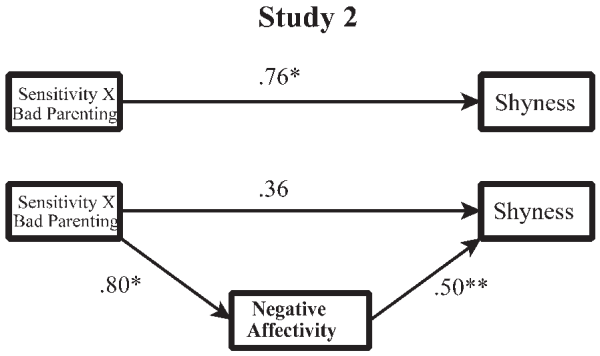

Figure 7 Standardized path coefficients for predicting shyness from interaction of sensitivity and adverse childhood parental environment, unmediated (top model) and mediated by negative affectivity (bottom model).

NOTE: In both models, sensitivity and poor parental environment are also included individually as exogenous variables with effects on the interaction term but are not shown. Mediation (Sobel's test) $Z = 1.96$, $p < .05$ (Study 2, test of Hypothesis 3).
*$p < .05$. **$p < .01$.

Method

Participants were 396 mostly 1st-year undergraduates (196 women, 200 men; *M* age = 19.0). Inspecting the distribution of sensitivity scores classified 116 as highly sensitive and 280 not. Measures included the sensitivity and the three-item negative affectivity measures from Studies 1 and 2. Parental environment was assessed with a composite of the mother version of the PBI (Parker et al., 1979) and ratings of actual and desired closeness to the mother at ages 5, 9, 13, and 16.

Results

Correlations were all similar to Studies 1 and 2; sensitivity with negative affectivity, $r = .46$; sensitivity with adverse childhood, $r = -.16$; and negative affectivity with adverse childhood, $r = -.03$; all significantly less than 1 (see also Note 5). The predicted Hypothesis 2 interaction (the only hypothesis that could be tested in Study 3) was once again supported, $t(389) = 1.69$, $p < .05$. For the highly sensitive, the worse the parental environment, the greater the negative affectivity ($r = .20$); for the not highly sensitive, this link was near zero ($r = -.004$) (see Figure 8).

Discussion

With a new sample and a different combination of measures of parental environment, Study 3 provided a further replication of a central element of our model—that the interaction of sensitivity and adverse childhood experience predicts negative affectivity.

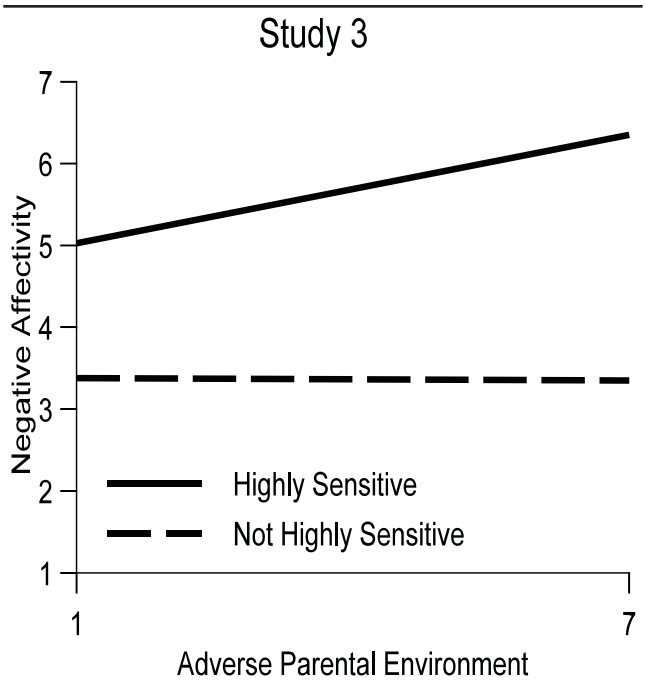

Figure 8 Relation of adverse childhood parental environment to negative affectivity for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(389) = 1.69$, $p < .05$ (Study 3, test of Hypothesis 2).

STUDY 4

A basic idea in our model is that highly sensitive individuals are more affected by their childhood environment because they are more affected by all events (Aron & Aron, 1997). Thus, when exposed to an experimentally manipulated negative event, highly sensitive individuals should show a stronger effect on state negative affect than should not highly sensitive individuals. We first assessed trait negative affectivity (as a baseline control variable) and sensitivity, next randomly assigned participants to be subjected or not subjected to a negative event (a frustrating, self-relevant stressor), then measured state negative affect.

Method

Participants were 160 Stony Brook psychology undergraduates (119 women, 41 men; *M* age = 20.03) taking part in the experiment during a regular class session. Inspecting the distribution of sensitivity scores classified 41 as highly sensitive and 108 not.

All participants completed a brief initial questionnaire—a six-item version of our sensitivity measure (alpha = .79) in addition to the three-item trait negative affectivity measure (which served as a covariate in all analyses) and the two social introversion items used in previous studies in this article and in Aron and Aron (1997). (We had to keep all aspects of the study very brief due to classroom time constraints.)

When everyone had completed the initial questionnaire, they began the "Iowa Individual Differences Survey," designed to appear as a completely independent standardized test packet (e.g., it was printed much more formally and in different paper and type, it used a quite different answering format, and it asked for age and sex again). Participants were told to complete one page at a time and wait for instructions before turning to the next. Each page was timed. The first two pages were the same for everyone, were innocuous (page 1, on artistic interests; page 2, on sports knowledge), and the allotted time was adequate to finish most items.

The next page was the experimental manipulation. It was labeled "Abilities Survey, Specific Topic: Applied Reasoning Ability," with problems adapted from intelligence and scholastic ability tests. For half of the participants, the problems were relatively easy; 84% answered all or all but one in the allotted time. For the other half of the participants, the problems were extremely difficult (one had no correct answer at all); 34% answered all or all but one. (Comparing percentages, $\chi^2[1, n = 160] = 42.15$, $p < .001$; treating proportion as a dependent variable in an overall analysis again yielded a significant version main effect, with no sensitivity main or interaction effect.)

The next page ("Personality Survey") was the same for everyone and contained the dependent variable; three items (buried among fillers) assessed state negative affect—feeling "sad," "anxious," and "depressed" (alpha = .72).

The final page contained filler items, a manipulation check item ("How do you think you stand in relation to other people in terms of your applied reasoning ability"), and at the very end, an open-ended item ("Please write below your best guess as to the overall purpose of the study"). No participants guessed the purpose, as indicated either by their answer to this item or in-class discussion afterward (before the true purpose was explained).

Results

Manipulation check. Those given the difficult version rated themselves lower on applied reasoning ability, $t(158) = 1.67$, $p < .05$.

Predicted effect. As hypothesized (the analog to Hypothesis 2), the interaction of sensitivity and condition predicted state negative affect (controlling for trait negative affectivity), $t(155) = 1.72$, $p < .05$. There was a clear difference between the two experimental conditions for the highly sensitive individuals (planned contrast $p < .05$; using the Tukey correction, $p < .05$) but little difference

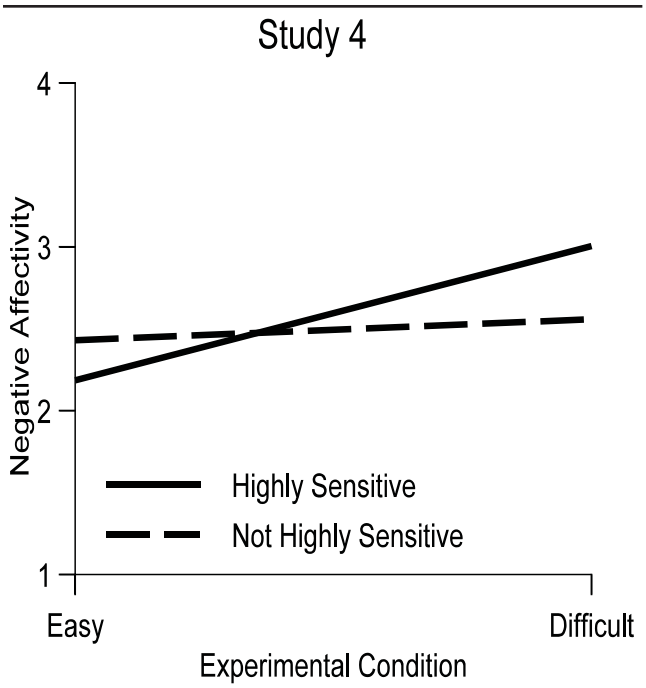

Figure 9 Relation of experiencing a negative event (an experimentally manipulated stressor) to state negative affect (controlling for trait negative affectivity) for highly sensitive and not highly sensitive individuals.

NOTE: Difference in slopes, $t(155) = 1.72$, $p < .05$ (Study 4, test of Hypothesis 2 analog).

between conditions for the not highly sensitive (contrast $t < 1$). In terms of correlations (to permit comparison to Studies 1-3), for the highly sensitive, having the hard (vs. easy) test was associated with greater state negative affect ($pr = .29$); for the not highly sensitive, this link was near zero ($pr = .06$) (see Figure 9).

Specificity. All results retained the same pattern and significance level after controlling for the social introversion measure. Trait negative affectivity was already partialed out of all analyses. Furthermore, in this study we were able to evaluate a model that included the interaction of condition and pretest trait negative affectivity as predictors of state negative affect. In this analysis, the predicted interaction of condition and sensitivity remained significant and substantial, but the interaction of condition with pretest trait negative affectivity was not significant ($t < 1$) and had a near-zero effect size.

Discussion

Sensitive individuals reacted significantly more strongly than not sensitive individuals to the experimentally manipulated negative experience. On one hand, this experiment can only be considered an analog to the situation of growing up in an adverse childhood environment. On the other hand, it is a direct test of a key underlying principle in the model and a result of considerable interest in its own right (the first experimental study using the sensitivity measure to show a differential effect in response to a contemporaneous stressor).

GENERAL DISCUSSION

These four studies provide consistent support for key aspects of our model of the relation of sensory-processing sensitivity to adult shyness. Across three independent questionnaire studies, we found the hypothesized interaction of sensitivity and childhood environment predicting adult trait negative affectivity, and in a fourth, experimental study, we found a parallel effect in which sensitivity interacted with a manipulated negative experience to predict greater state negative affect. Two of our questionnaire studies also tested the larger implications of the model, with both supporting the hypothesized interaction of sensitivity with adverse childhood environment predicting adult shyness as well as the hypothesis that negative affectivity mediates this relation of the interaction to shyness.

Implications

Our first main finding was that highly sensitive individuals are especially more likely to be shy when they experienced an adverse childhood environment. Otherwise, they are not more likely to be shy than not highly sensitive individuals. That is, the childhood-shyness correlation was moderate to high for the highly sensitive but much smaller for the not highly sensitive. Indeed, inspection of the regression lines for the two groups (Figures 2 and 5) suggests that when highly sensitive individuals have had a good childhood environment, they are no more likely (and may even be less likely) to be shy than are the not highly sensitive. This result is perhaps not surprising given the substantial role that parenting and peer relationships are known to have on shyness and the seemingly greater responsiveness of the highly sensitive to their childhood environment, both negative and positive (e.g., Boice et al., 1995).

Our second main finding was that, as with shyness, highly sensitive individuals are especially likely to experience negative affectivity when they had an adverse childhood environment. In all three questionnaire studies, for the highly sensitive, the childhood-negative-affectivity correlation was medium to large, but for the not highly sensitive it was much smaller. The possible impact of childhood experiences on adult negative affectivity would not seem to be surprising given, for example, the research of Shaver and Brennan (1992), who found correlations between insecure attachment and Big Five Neuroticism. And a stronger impact on highly sensitive individuals is also no surprise given the re-

search reported by Gunnar (1994) and Nachmias et al. (1996) and our own suggestive results (Aron & Aron, 1997) reviewed in the Introduction. Furthermore, the experimental study, although only an analog with regard to childhood environment, provides evidence for a stronger causal effect of negative experiences on negative affect for those who are highly sensitive.

Our final main finding is that the stronger link of adverse childhood environment to shyness among the highly sensitive is largely accounted for by a greater link of childhood environment to negative affectivity. That is, in both studies assessing shyness, the interaction effect of childhood environment and sensitivity on shyness was mediated by negative affectivity. This finding is consistent with our model and makes sense in light of the findings that the more an emotionally relevant experience is processed, the more emotion is felt (Tesser, 1978) and that the highly sensitive seem to show more negative and positive affectivity (Aron & Aron, 1997). If they process all experiences more deeply, and if the preponderance of their experiences are negative, it follows that their affect should be more negative, which in turn should lead to more negative expectations in social situations.

Methodological Strengths and Weaknesses

Strengths include the replications across as many as four separate samples, the use of established measures for each major variable in at least one of the studies, the procedure in Studies 2 and 4 making it appear that key variables were being assessed as parts of separate studies, the experimental manipulation in Study 4, and the clearly consistent pattern of results across all four studies—including moderation effects that are notoriously difficult to identify in regression designs (McClelland & Judd, 1993) and finding the same interaction in an experiment in which circumstances limited us to a relatively weak manipulation and relatively weak measurement of our dependent variable.

One key limitation of the questionnaire studies (Studies 1-3) is that they are purely correlational and cross-sectional, so it is not possible to draw unambiguous conclusions about direction of causality. It is encouraging that the statistically complex pattern of results (two moderations and a mediated moderation) were entirely consistent with the model. Furthermore, we attempted a variety of alternative models that yielded poorer results. For example, in Studies 1 and 2 where we tested the mediation model, the alternative possibility that shyness is the mediator between the interaction and negative affectivity was not significant, and neither were a variety of models in which negative affectivity was taken as the exogenous distal cause. The causal direction from the interaction to negative affectivity is also strengthened by Study 4, where we manipulated negative experience. In addition, in that experiment, there was a robust effect of the interaction of condition and sensitivity, but there was a near-zero effect size for an alterative model of the interaction of condition and pretest trait negative affectivity. Nevertheless, the possibility that the underlying relation among our variables follows a causal order other than what we have proposed cannot be ruled out conclusively with the present studies.

A related issue concerns the distinctiveness of our key variables from each other. The consistently, substantially below unity correlations among our measures make somewhat unlikely the possibility that these four variables (or some subset of them) are actually alternative operationalizations of a single underlying construct (see also Note 5). Furthermore, suppose sensitivity and negative affectivity or shyness actually are the same thing under different names or that they represent some common underlying negativity variable. (This would mean that having high scores on both sensitivity and negativity affectivity or shyness would be associated with stronger relationships with other variables.) Such a scenario, however, implies a pattern of results quite different from those hypothesized and found in these four studies. For example, suppose it is proposed that such a common underlying variable is unrelated to childhood environment or negative experiences (as might be the case if such a common variable were entirely biologically based). With these assumptions, the predicted effect on negative affectivity or shyness would be a main effect for sensitivity, with no main effect for childhood (see Figure 10b)—a pattern quite different from that predicted and found in the present studies (see Figure 10a). Or, suppose it is proposed that such a common variable is strongly related to childhood experience (as might be the case if such a common variable were entirely environmentally based). With these assumptions, the prediction would be for two main effects (see Figure 10c), again a result quite different from the interaction we hypothesized and observed in this research.

Another issue is that, with the exception of the manipulated negative experience in Study 4, the studies employed entirely self-report measures. Thus, correlations among variables might be due to common method variance such as common general response bias effects. This interpretation, however, as noted in the Introduction, is made relatively unlikely by the moderational and mediational findings, all of which require partialing out one or more other self-report variables. That is, the obtained pattern of findings hold up over and above any general patterns of common biases or common method variance.

Perhaps the greatest methodological concern in these initial tests of our model is that the measures of childhood environment were entirely retrospective.

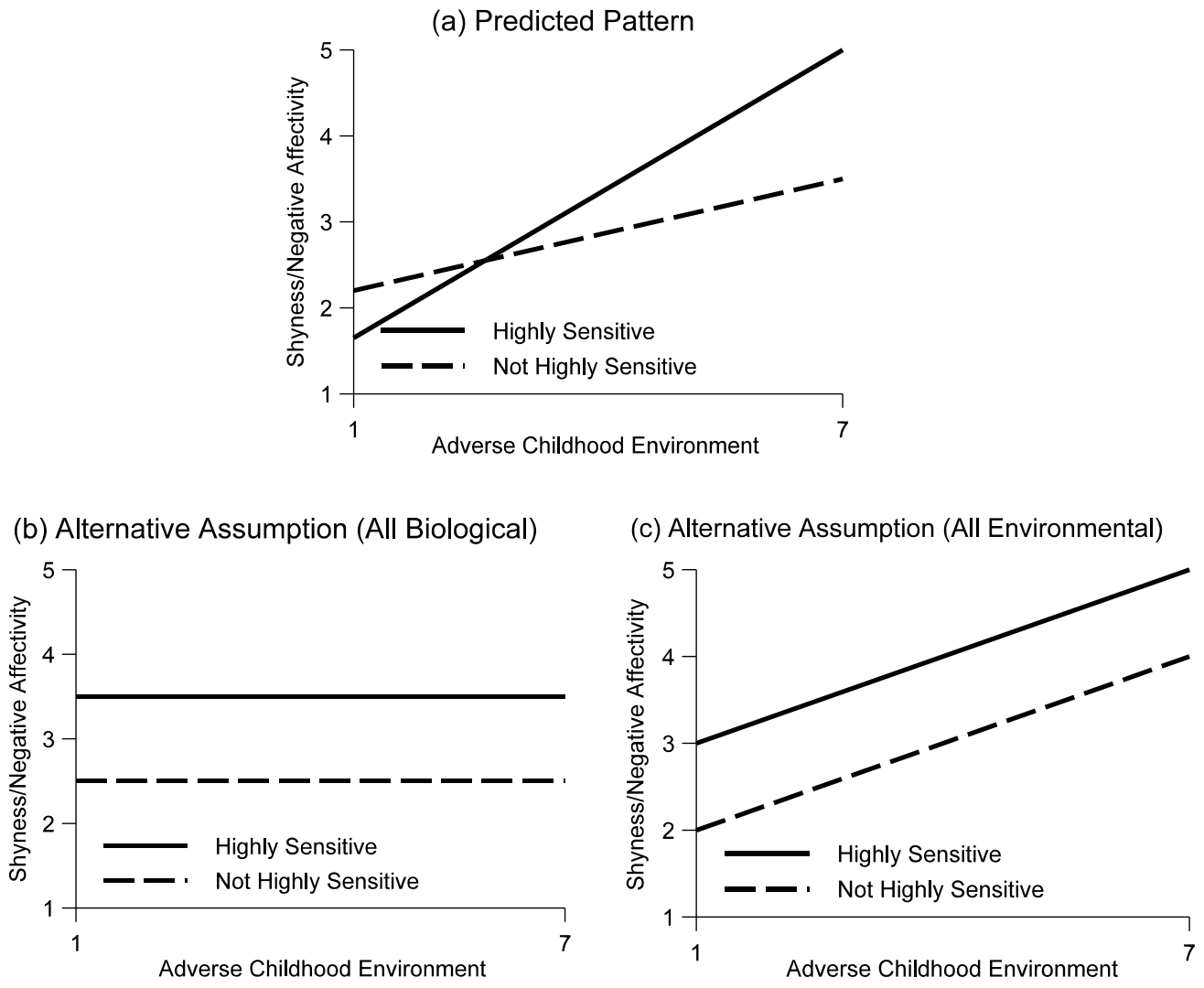

Figure 10 (a) The model's predicted pattern of results for the interaction of sensitivity with adverse childhood environment for predicting shyness or negative affectivity. (b) Alternative pattern of results predicted from the assumption that sensitivity and shyness or negative affectivity reflect a common underlying variable that is primarily biologically based. (c) Alternative pattern of results predicted from the assumption that sensitivity and shyness or negative affectivity reflect a common underlying variable that is primarily environmentally based.

NOTE: Actual results across four studies and six comparisons followed the pattern shown in (a) and not the patterns shown in (b) or (c).

However, the pattern of our significant interaction effects would seem to undermine alternative explanations in terms of systematic negative recall bias (e.g., Cutler et al., 1996; Feldman, 1993; Larsen, 1992). For example, negative recall bias for those with negative affectivity or shyness would imply a main effect for childhood but no main effect for sensitivity (see Figure 11b)—a quite different pattern of results from the one we hypothesized and found (see Figure 11a). The possibility that sensitivity also creates a recall bias for childhood events seems unlikely given that the correlations of sensitivity with adverse childhood in our studies were all small (.16, –.03, and –.16), averaging near zero. If one nevertheless insisted that there might be such a bias in spite of these low correlations, the implications would be for a very different pattern of results than we observed. That is, this situation would imply two main effects, one for childhood and one for sensitivity (see Figure 11c). (It may seem counterintuitive at first that the highly sensitive line in Figure 11c is below the line for the not highly sensitive. It works this way because, with the supposed added recall bias due to sensitivity, it would take less bias from negative affectivity or shyness to produce the same degree of overall bias in reports.)

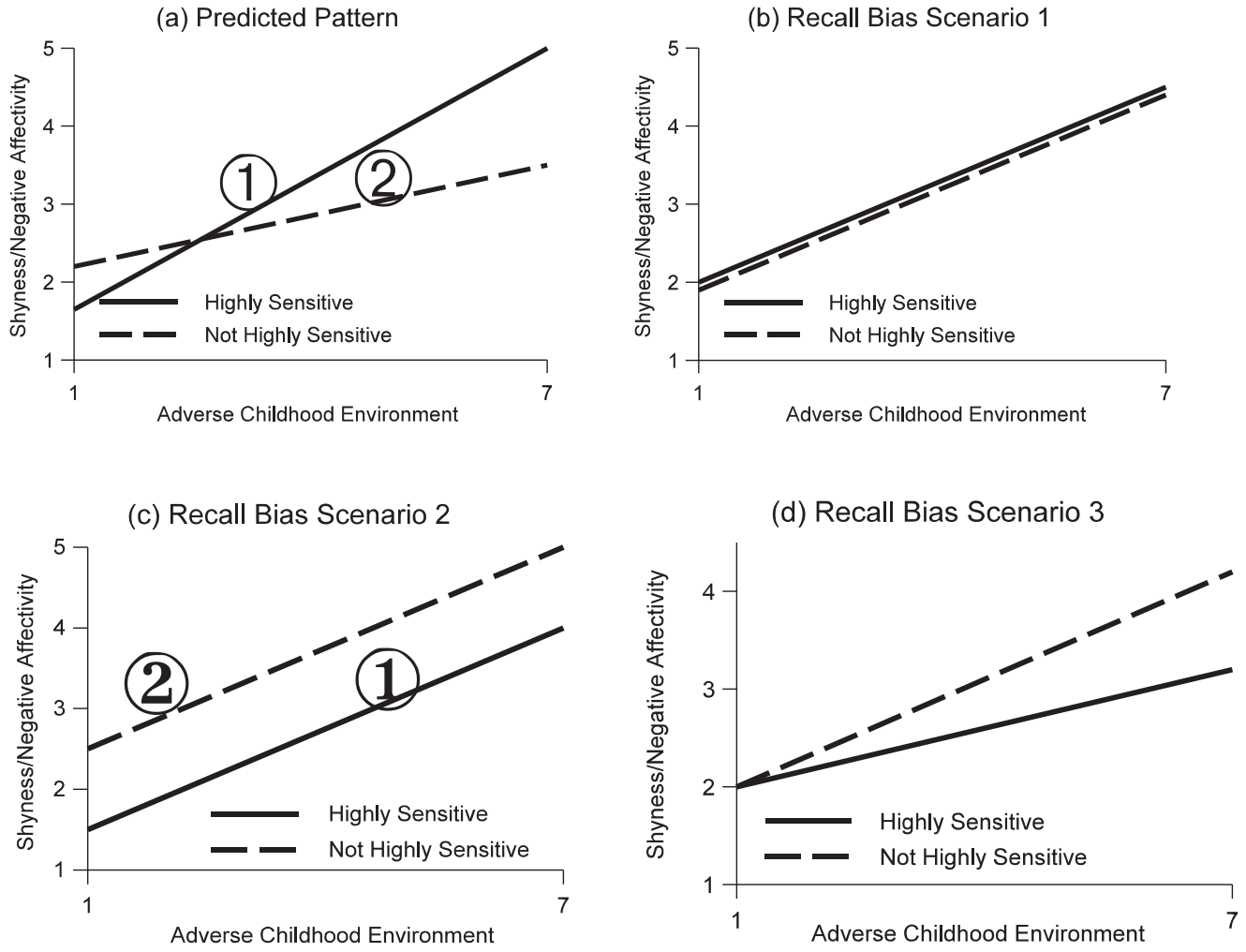

Figure 11 (a) The model's predicted pattern of results for the interaction of sensitivity with adverse childhood environment for predicting shyness or negative affectivity. (b) Alternative pattern of results predicted from scenario in which reports of adverse childhood are entirely a function of negative recall bias associated with shyness or negative affectivity (but not sensitivity). (c) Alternative pattern of results predicted from scenario in which reports of adverse childhood are entirely a function of negative recall bias associated with both shyness or negative affectivity and sensitivity. (d) Alternative pattern of results predicted from scenario in which reports of adverse childhood are entirely a function of negative recall bias associated with both shyness or negative affectivity and sensitivity and in which the combination of both kinds of bias creates a larger effect than the sum of the two biases.

NOTE: The circled 1 refers to Person 1, a data point on the line for highly sensitive individuals; the circled 2 refers to Person 2, a data point on the line for the not highly sensitive. These two data points vary in sensitivity but have equal levels of shyness or negative affectivity (about 3 in this example). In the pattern that was predicted and found in a, Person 1, although highly sensitive, actually would have to have a less adverse childhood than Person 2 to be at the same level of shyness and negative affectivity. In the main recall bias scenarios, using (c) as an example, Person 1, the highly sensitive individual, would be predicted to have reported a more adverse childhood than Person 2. But this did not happen—the actual results across four studies and six comparisons followed the pattern shown in (a) and not the patterns shown in (b), (c), or (d).

Indeed, as noted briefly in the Introduction, the idea of greater recall bias for those who are highly sensitive implies exactly opposite results from those we hypothesized and found. It may be helpful to expand briefly on this point here. Consider two persons located at the same place on the vertical axis, that is, with equal levels of negative affectivity and shyness. One (whom we will call Person 1) is a person or data point on the line for highly sensitive individuals and one (Person 2) is found on the line (i.e., a data point on the line) for not highly sensitive individuals. In the scenario in which sensitivity creates a recall bias (see Figure 11c), if Persons 1 and 2 have the same level of negative affectivity and shyness, then Person 1 must have reported a more adverse childhood than Person 2. But in the pattern we predicted and found, Person 1 reports a less adverse childhood than Person 2. (That is, our model hypothesizes that a highly sensitive individual, compared to a not highly sensitive individual,

requires a less adverse childhood to have the same degree of negative affectivity or shyness.)

What if the supposed recall bias effects of negative affectivity or shyness and sensitivity are not merely additive but are interactive such that when one has both negative affectivity or shyness and sensitivity, one has greater recall bias than would be expected by just their sum? This scenario (see Figure 11d) implies an interaction, but a quite different interaction than we predicted and found (see Figure 11a). (Our results could be predicted if the sum of the two biases was somehow less than the total, as might happen if there was a ceiling or floor effect on one or more of our variables. However, there was no sign of such a floor or ceiling effect on any of them.)[8]

In addition to the above considerations, we would also again note that (a) our interpretation of the general pattern of results in terms of negative experience interacting with sensory-processing sensitivity to create negative affectivity is supported by the experimental results, where recall bias regarding negative experiences is not an issue, and (b) the measures in Studies 1 and 2 included mainly relatively "objective" indicators and independent research on the Parental Bonding Instrument used in Studies 2 and 3 found it correlated with reports of other relatively objective childhood events (Parker, 1986).

Conclusions

These four studies provide consistent and substantial initial support for a novel model of the relation of origins of adult shyness, such that the interaction of sensory-processing sensitivity and adverse childhood environment leads to negative affectivity, which in turn leads to shyness. These findings do not seem easily entirely explained away as due to alternative directions of causality, common method variance, or systematic recall bias. At the same time, our results should be taken as only the first step, pending further research such as studies employing longitudinal designs and less direct measures. In addition, any generalizations beyond North American college students must be made with caution.

Nevertheless, if future research continues to support this model, it would have significant theoretical implications for understanding the development of shyness and negative affectivity and the nature of sensory-processing sensitivity and related variables. It also could have significant practical implications for child rearing, psychotherapy, and the treatment of social phobia.

NOTES

1. Aron and Aron (1997) argued that "sensory-processing sensitivity" is preferable to these other terms. For example, "reactivity" is a characteristic of all, so that what is implied is overreactivity, and whether a stimulus is being noticed more than is adaptive depends on the situation. Threshold of responsiveness seems to rule out the processing aspect of the trait, the preference to pause and process. As for innate fearfulness or inhibitedness, three points argue against these terms. First, Gray (1985) points out that innate fearfulness would explain a greater sensitivity to threatening stimuli but not to all stimuli. Second, natural selection would purge alleles that created inappropriate reactions to situations (Harpending & Cochran, 2002), as would be the case if the trait were general fearfulness. Third, Aron and Aron's adult data (reviewed briefly below) found a partial independence of sensory-processing sensitivity from negative affectivity in general (as do the data reported in this article).

Nevertheless, the distinctiveness of sensory-processing sensitivity from each of these other individual difference characteristics remains an open question. Thus, the role of sensory-processing sensitivity in the proposed model is consistent with the possibility that it is more appropriately labeled as one of these other constructs.

2. We treat negative affectivity as an overarching individual difference including both anxiety and depression because they operate similarly in our model. However, there is also evidence that they may more generally represent a relatively unitary characteristic (e.g., Feldman, 1993).

3. Experiencing the social and cultural unacceptability of being highly sensitive (Chen, Rubin, Sun, 1992), especially for boys (see Cheek & Krasnoperova, 1999; Henderson & Zimbardo, 1999; Stevenson-Hinde & Hinde, 1986), no doubt adds to the environmental stressors and fear of social evaluation. Aron (1999) found somewhat lower self-esteem in sensitive adults whatever the quality of their childhood experiences, although the interaction again appeared—self-esteem was still lower for sensitive adults with an adverse childhood.

4. Such conditions might themselves be genetically influenced in the parents so that an interaction with sensitivity could represent an interaction of two genetic variables (which would be an interesting finding in its own right). However, Study 2 combines these indicators with other kinds of measures, Study 3 does not use these indicators at all, and Study 4 uses a conceptually related manipulated variable. Thus, results consistent across studies (as was found) would seem to undermine such interpretations.

5. In each questionnaire study (Studies 1-3), we tested the relation among childhood environment, sensitivity (treated here as a continuous variable so we could make it a latent variable), negative affectivity, and shyness (except in Study 3, where shyness was not measured) using structural equation modeling (SEM). Every correlation among these latent variables was significantly less than 1, and all one-factor, two-factor, and three-factor models showed a significantly worse fit than the full three- or four-factor model (all $ps < .0001$).

6. For each hypothesis test in the questionnaire studies (Studies 1-3), we conducted parallel latent variable SEM analyses. The interactions were examined in the standard way in SEM (Jaccard & Wan, 1996) using a multiple-group model (highly sensitive and not) and testing whether the model became significantly worse when the path to be moderated (childhood environment to shyness or to negative affectivity) was constrained to be equal across groups. In every case (for all interaction hypotheses tested in all three studies), the pattern was the same and with at least the same significance level as the ordinary regressions reported in the main text. The Hypothesis 3 mediations could not be tested directly in SEM with latent variables, but these mediation models all showed the predicted pattern. Also, there was an excellent fit of the overall models for all hypotheses in all studies (e.g., in all cases, the high 90% Confidence Interval [CI] for the root mean square error of approximation [RMSEA] was $\leq .07$).

7. Some leniency in alpha level seems appropriate given the low power of regression interactions (McClelland & Judd, 1993). We are particularly confident here given that the parallel interaction reached conventional significance levels in Studies 2 through 4.

8. Also, all of the common underlying variable scenarios (e.g., Figure 10c) with the recall bias scenarios (Figures 11b-d) imply interaction patterns quite different from those we hypothesized and obtained.

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Received February 18, 2003
Revision accepted May 4, 2004