

Behavioral Approach–Inhibition in Toddlers: Prediction From Infancy, Positive and Negative Affective Components, and Relations With Behavior Problems

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In this study, 126 children were observed at 6 months, 12 months, and 2 years. During infancy, latencies to reach for novel objects were measured. At 2 years, positive and negative affect, and behavioral approach–inhibition to low- and high-intensity situations were coded, and mothers assessed behavior problems. Confirmatory factor analysis indicated a 3-dimension model of positivity, negativity, and behavioral approach–inhibition. Positivity was related to low- and high-intensity behavioral approach–inhibition, whereas negativity was linked only to low-intensity behavioral approach–inhibition. Shorter 12-month latencies to reach were predictive of low negativity, high positivity, and behavioral approach at 2 years. Positivity and negativity were correlated with externalizing and internalizing behaviors, respectively. Finally, cluster analysis identified an exuberant group high in externalizing and an inhibited group high in internalizing.

Individual differences in tendencies to approach or inhibit approach toward stimuli have been documented in several species, including dogs (Pavlov, 1927), cats (Adamec, 1991), primates (Suomi, 1986), and rats (Fernandez-Teruel & Escorihuela, 1997). The importance of this behavioral dimension is further indicated by its prominence in models of child temperament and its long-term stability in humans. Nearly all questionnaires of infant temperament include scales referring to responses to novelty (Rothbart & Mauro, 1990), and high intercorrelations across these scales have been reported (Goldsmith & Rieser-Danner, 1986). In addition, several studies have documented stability over a decade or longer of approach–inhibition tendencies (Caspi & Silva, 1995; Kagan & Moss, 1962; Schwartz, Snidman, & Kagan, 1996).

The most concentrated empirical effort on this subject has been undertaken by Kagan and colleagues on what they refer to as behavioral inhibition

(Kagan, 1994; Kagan, Reznick, Snidman, & Garcia-Coll, 1984; Schwartz et al., 1996). These researchers followed two groups of children who, when exposed to novel laboratory situations during the 2nd year of life, were identified as being either extremely inhibited or uninhibited. These behavioral styles persisted during interactions with peers and adults at 4, 5, and 7 years of age. To investigate infant precursors of behavioral inhibition, Kagan and Snidman (1991) exposed 4-month-old infants to a series of visual and auditory stimuli. Infants who were high in motor activity and negative affect in response to the novel stimuli at 4 months tended to be highly inhibited when they were 4 years old, whereas infants who were low in both motor activity and crying tended to be less inhibited 4 years later (Kagan, Snidman, & Arcus, 1998).

Kagan and others who have examined individual differences in the behavioral inhibition of young children (e.g., Asendorpf, 1990; Reznick, Gibbons, Johnson, & McDonough, 1989) have considered a single process differentiating inhibited and uninhibited children. An alternate, although interrelated, mechanism may be children's approach tendencies. Several converging neurological theories (e.g., Cloninger, 1987; Davidson & Fox, 1982; Depue & Iacono, 1989) contend that approach and inhibition are controlled by separate neural systems. The most well known of these theories is that of Gray (1982, 1987), whose model presumes the existence of a behavioral approach system (BAS) that motivates behavior to-

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ward positive incentives. The behavioral inhibition system (BIS) organizes behavior by inhibiting appetitive approach to stimuli signaling punishment or nonreward.

Presumably, the reliance on a unidimensional model is based in the methodological difficulty in distinguishing approach and inhibition. In the typical paradigm used to assess such behavior, a novel object is presented (e.g., a clown or robot, an unfamiliar setting, an unknown adult or child) and the child's response is measured. Although two processes may be controlling these responses, researchers are only privy to the overt behavior; that is, inhibition is typically not measured directly but rather is inferred from a lack of approach. This inference, however, may be flawed in some cases, as a child who fails to approach may not be particularly inhibited but rather is simply not compelled to explore (i.e., he or she may be low on approach rather than high in inhibition). The reciprocal nature of approach and inhibition has led to alternate interpretations of the same behavior: Whereas Kagan et al. (1984; Kagan et al., 1998) assessed behavioral inhibition through latencies to approach presented objects, frequency of running across the room, time spent in close proximity to the parent, and number of vocalizations, other authors (Raine, Reynolds, Venables, Mednick, & Farrington, 1998) have used these same behaviors to operationalize stimulation seeking, a construct embedded in approach motivation. Because of this methodological challenge, the current study relied on a unidimensional approach–inhibition score but it attempts to shed light on the underlying processes by examining affective responses in combination with behavioral approach–inhibition. For instance, a failure to approach, when combined with negative affect, may indicate activity of the inhibition system, whereas nonapproach in the absence of fearful negativity may indicate low approach tendencies. Likewise, approach combined with positive affect may indicate strong approach motivation, but approach without positivity may indicate mild approach tendencies and low inhibition.

Several researchers have contended that emotion valence is informative regarding approach and inhibition. For instance, Schnierla (1959) documented developmental and conceptual connections between smiling and approach-oriented reaching, whereas Gray (1982) equated the inhibition system to fear and stress. The relation between positive affect and activity in left anterior brain regions has been interpreted by Davidson (1995) as evidence of an anterior approach system, whereas an analogous inhibition system is activated during negative emotional states.

The relation among emotion valence, approach, and inhibition is not perfect: The negative emotion of anger is associated with approach (Barrett & Campos, 1987) and left hemisphere activation (Harmon-Jones & Sigelman, 2001). To address this issue, procedures designed to elicit fear, not frustration and anger, were used in the current study; thus, it was presumed that the majority of negativity in these contexts was related to inhibition.

Indicating promise of using positivity and negativity as separable indexes of approach and inhibition, several studies have shown that positive and negative emotions are best considered as roughly orthogonal constructs (e.g., Watson & Tellegen, 1985). Similarly, examinations of the structure of adult personality and child temperament (e.g., Eysenck, 1973; Costa & McCrae, 1985; Goldberg, 1990; Putnam, Ellis, & Rothbart, 2002) continually identify independent dimensions of extraversion/surgency and neuroticism/negative affectivity. Questionnaire items indexing negative emotions are typically included in neuroticism scales, whereas extroversion scales contain items reflecting positive emotions. It is important that the two dimensions have been implicated as indicators of the approach and inhibition systems (Windle, 1995). Moving beyond questionnaire methodology, Belsky, Hsieh, and Crnic (1996) confirmed an earlier report by Goldsmith and Campos (1990) that found that positivity and negativity measures from both parent report and laboratory observation of 1-year-olds were more consistent with two-factor than one-factor models.

Relating early emotionality to approach and inhibition, Park, Belsky, Putnam, and Crnic (1997) found that infants who were high in negativity but low in positivity were highly likely to be behaviorally inhibited at 3 years of age, whereas infants low in both positive and negative emotionality were the least inhibited as toddlers. Fox has also used separate measures of positive and negative emotionality in regard to behavioral inhibition and exuberance (Calkins, Fox, & Marshall, 1996; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). Consistent with Kagan and Snidman (1991), infants high in both negativity and activity were most inhibited at 14 months; however, infants high in both positivity and activity were least inhibited at 14 months. These profiles persisted to 48 months of age.

Whereas Park et al. (1997) and Fox (Calkins et al., 1996; Fox et al., 2001) demonstrated the benefit of considering positivity and negativity as separate constructs in predicting later behavioral inhibition, they did not consider the roles of positive and negative emotions as related to, or as components of,

concurrent approach and inhibition. Indeed, although Fox et al. (2001) used "exuberant," a term indicating unrestrained joy, to describe their sample of uninhibited children, they did not measure positive affect displayed by children at later ages. Conversely, to assess inhibition, Kagan et al. (1998) indexed inhibition at 4.5 years through (a lack of) smiling but not through expressed negative emotion.

A second method to disentangle approach from inhibition is to vary the intensity of the stimuli presented, based on Schrierla's (1959) reasoning that approach is engaged in response to low-intensity stimuli, indicating potential reward, whereas inhibition is elicited by novel or high-intensity stimuli, indicating potential harm. It has been noted, however, that high-intensity stimuli may also provoke approach among some individuals (Rothbart, 1989). In the current study, stimuli intensity was manipulated through tasks designed to mimic situations commonly experienced by young children. In addition to using high-intensity procedures similar to those employed by previous researchers (e.g., Fox et al., 2001; Kagan et al., 1984), which were expected to evoke both approach and inhibition, low-intensity tasks expected to evoke primarily approach responses were used.

A final strategy to separate approach from inhibition uses theory and research indicating that the inhibition system, but not the approach system, develops dramatically during the second half of the 2nd year. Although infants indicate joy and interest during the first 6 months of life, Schaffer (1966) noted that fearful expressions toward strangers do not emerge until the second half of the 1st year. Schaffer, Greenwood, and Parry (1972), Rothbart (1988), and Putnam and Stifter (2002) further illustrated this phenomenon by examining differences in infants' latencies to approach toys that were either high or low in novelty and intensity. Latencies to reach for familiar or less intense objects did not increase from early to later infancy. Beginning at 8 months of age, however, infants became more wary of unfamiliar and intense objects, reaching for them at a slower rate. The current study made use of this developmental occurrence by examining latencies to reach for low- and high-intensity objects at 6 and 12 months as predictors of approach and inhibition at 2 years. Rates of reaching for both high- and low-intensity toys at 6 months and of reaching for low-intensity objects at 12 months were conceptualized as relatively pure indicators of approach tendencies, whereas latencies to reach for the high-intensity objects at 12 months represented the balance between approach and inhibition processes.

Efforts to provide roughly separate indexes of approach and inhibition using positive and negative emotions, in addition to addressing a basic question regarding mechanisms underlying individual differences in approach-inhibition, may also be informative regarding developmental psychopathology. The third goal of the current study was to examine how affective and motor manifestations of approach and inhibition were related to early-appearing behavior problems. A great deal of research has linked dominance of BAS over BIS functioning to externalizing problems, with BIS dominance implicated in internalizing difficulties. For instance, sensation seeking, which entails both the desire to engage in novel and intense activities (approach motivation) and the willingness to take risks for the sake of such experiences (lack of inhibition), has been related to manic, bipolar, and antisocial personality disorders in adults (Zuckerman, 1994) and to elevated rates of conduct disorder, high levels of self-reported negative behaviors, and low rates of internalizing problems in children (Frick, O'Brien, Wotton, & McBurnett, 1994; Kafry, 1982; Russo et al., 1993). Similarly, high behavioral inhibition has been implicated in internalizing problems (Biederman et al., 1990; Fox et al., 2001), whereas low inhibition has been linked to externalizing difficulties (Schwartz et al., 1996).

Although most research on temperament has focused on relations between variables (Caspi & Silva, 1995), a person-centered approach using constellations of multiple variables to categorize individuals may lend unique understanding regarding interactions among behavioral components (Magnusson, 1990). This approach has roots in Thomas and Chess's (1977) grouping of children into difficult, easy, or slow-to-warm-up groups. As reviewed previously, Kagan et al. (1984) and Fox et al. (2001) classified children as inhibited, uninhibited, and exuberant. The groups used by these researchers were not exhaustive, and several children were left unclassified. Other recent studies have used cluster analysis to classify all children in a sample (e.g., Caspi & Silva, 1995). The final goal of the present study was to examine whether clusters of children could be identified by their affective and behavioral propensities. It was expected that groups indicating inhibited (high negativity, low positivity, high behavioral inhibition) and exuberant (low negativity, high positivity, low behavioral inhibition) temperament would emerge. We additionally sought a cluster of children that strayed from the pattern relating high negativity to low positivity and high inhibition. We reasoned that a child who was low in both pos-

itive and negative affect, if moderate in their behavioral approach–inhibition, may be low in both the motivation to explore and the impetus to inhibit exploration.

In summary, the goals of the current study were to (a) provide an initial effort to examine relations among the separable components of positivity, negativity, and behavioral approach–inhibition exhibited in response to low- and high-intensity situations; (b) assess relations between 6- and 12-month latencies to approach novel objects and emotional and nonemotional indexes of approach-inhibition at 2 years; and (c) explore relations between approach–inhibition and problem behavior. To address these goals, we measured, at 6 and 12 months, latencies to reach for low- and high-intensity toys. At 24 and 25 months, children were placed in several novel situations varying in intensity. Ratings of the children's positive and negative emotions were coded, as were various nonemotional (e.g., motor and vocal) indexes of their approach–inhibition behavior. Mothers also completed a questionnaire regarding their children's problem behavior around their 2-year birthday.

It was expected that confirmatory factor analysis would demonstrate a better fit of the data to a model presuming separate dimensions of positive and negative emotions, and of emotional and nonemotional forms of approach–inhibition, than to a unifactorial model of high positivity, low negativity, and high behavioral approach (i.e., low behavioral inhibition). The second hypothesis was that nonemotional indexes of approach–inhibition would be influenced most strongly by positive affect during low-intensity situations but that positivity and negativity would be equally predictive of behavioral approach–inhibition during high-intensity situations. The third hypothesis was that rapid reaching for toys at 6 and 12 months of age would be associated with high positivity, low negativity, and high behavioral approach (low behavioral inhibition) at 2 years. More specifically, it was expected that latencies to reach for low-intensity objects at both 6 and 12 months, as well as latencies to reach for low-intensity objects at 12 months, would be predictive of 2-year positive emotionality and behavioral approach during low-intensity tasks. Because at 12 months high-intensity toys are expected to evoke both approach and inhibition tendencies, latencies to reach for high-intensity objects at 12 months were expected to be predictive of both positive and negative emotions, as well as behavioral inhibition during 2-year tasks involving high threat. The final hypotheses were that externalizing problems would

be associated with high behavioral approach/low behavioral inhibition, high positivity, and low negativity, whereas internalizing problems would be related to the opposite 2-year profile. Finally, to shed light on the relative contribution of approach and inhibition processes, person-oriented analysis of children representing different configurations of positivity, negativity, and behavioral approach–inhibition was used. It was hypothesized that children low in both positivity and negativity would be moderate in latencies to grasp toys as infants and be low in both internalizing and externalizing as toddlers.

Method

Participants

The sample used here was recruited as part of a longitudinal study following infants and their families from 2 weeks to 25 months of age. Families were contacted through a local community hospital and an area Women, Infants, and Children (WIC) program. Criteria for inclusion in the study were full-term pregnancy (gestational age ranged from 36.5 to 42 weeks with a mean of 39.8 weeks) and ability to speak and read English. The 150 families (78 female infants) recruited were primarily White, with 5 African/African American, 2 African, 3 Asian, and 1 Native American family. Maternal and paternal ages averaged 29.7 years (range = 16–43 years) and 31.8 years (range = 19–46 years), respectively. Mother's education level averaged 15.6 years (range = 10–26 years) and father's education level averaged 16.3 years (range = 10–28 years).

From the original sample, 144 families visited the laboratory at 6 months of age, 139 completed a 12-month visit, 126 completed a 24-month visit, and 124 completed a 25-month visit. The typical reason for leaving the study was relocation. Data were lost from the toy-reach procedures for two primary reasons. On 14 occasions at 6 months and on 3 occasions at 12 months, a problem occurred during the placement of the tray containing the toys (e.g., the child tipped over the tray before making contact with a toy or the toys were placed beyond the child's reach). In addition, data for nine 6-month-olds and fourteen 12-month-olds were lost because of audiovisual difficulties. A small number of children who completed the 24- and 25-month visits had missing data for certain procedures at 24 and 25 months because of audiovisual difficulties, experimenter error, and minor changes in protocol.

*Procedures**6 and 12 Months*

The toy presentation procedure administered at 6 and 12 months was adapted from protocol developed by Rothbart (1988) to assess approach and inhibition. While seated in the high chair with the mother slightly behind the child, infants were presented with a set of low-intensity toys (plate, block, small box) for 30 s. This set was then removed and a high-intensity set of toys (flashing red light, electronic beeper, and wind-up toy) was presented for 30 s.

24 and 25 Months

Children were brought into the laboratory by their mothers at 24 months of age and by their fathers at 25 months of age, where they were administered tasks involving stimuli designed to be either high or low in intensity. Although several of the procedures were repeated at both 24 and 25 months, time constraints required that some tasks were only performed at one or the other of the visits.

High-intensity procedures. The following high-intensity procedures, similar to those used in previous studies (e.g., Fox et al., 2001; Kagan et al., 1984), involved situations presenting an overt and salient threat to the child, using intense objects or intrusions by an adult into the child's personal space. During both the 24- and 25-month visits, an assistant asked the parent and child to play three rounds of ring around the rosie, with the assistant, child, and parent holding hands and singing three verses of the song, asking the child to join in between verses. During the 24-month visit only, the experimenter placed electrodes on the child's torso as the child sat in a high chair or on the mother's lap. Later during this visit, while the child was standing next to his or her mother, the experimenter showed the child a small "champagne popper" and said that it would make a loud noise. The experimenter discharged the popper, sending confetti into the air, and then asked the child if he or she would like to see another one; the experimenter discharged another popper if the child either said "yes" or did not say "no." Thirty seconds after the last popper was discharged, a laboratory assistant entered the room and cleaned up the confetti with an electric vacuum cleaner for 1 min. During the 25-month visit, children were presented with three pairs of toys and asked their toy preference. Each pair contained one item with intense properties (moving plastic ball, loud toy buzzer, and play lazer gun emitting lights and sounds) and a low-intensity item (still plastic ball, quiet toy buzzer,

and silent lazer gun). Children were asked which toy of the pair they would like to play with. If the child did not respond, the items were displayed twice more and the child was asked to choose a toy on each occasion. Also at 25 months, the experimenter pointed out a large black box, telling the child that there might be something in it. Three standard prompts followed, repeating the message that there was something in the box and asking the child to explore. After this, the experimenter placed a set of three steps (8, 16, and 19 in.) next to a mattress. The experimenter jumped off the first (8-in.) step, then gave the child three standard prompts asking the child if he or she would like to do so. Regardless of the child's response, the experimenter repeated jumping and prompting the child to jump from the other two steps.

Low-intensity procedures. During the low-intensity procedures, children were not directly approached or touched by an experimenter, and no loud, risky, or fast-moving objects were used. At both 24 and 25 months, after the children were introduced to the lab, the experimenter told the children they could "go ahead and look around" and asked the parent not to encourage or discourage any of their child's behaviors. Also during both visits, children were given either a set of five (24-month) or a single (25-month) "boring" toy. Parents were asked to complete a questionnaire and to tell their child that "they are busy." After 2 min, a basket of more attractive toys was brought in and set out of the child's reach, and the child was told that "these toys are for later." The child was then left with the unattractive toys for an additional 2 min. At both visits, the child was exposed to a quietly sitting stranger: an unfamiliar female who, interrupting a structured play episode between parents and children, entered the room and knelt near the table where the child and parent were playing. The stranger remained silent for 1 min and then spoke with the parent for 1 min. During the 25-month visit, following the introduction to the lab, an assistant sat with a basket of toys for 5 min, occasionally asking the child softly if he or she would like to play with the assistant but never directly approaching the child.

*Measures**6 and 12 Months*

To examine the precursors of approach-inhibition, the latency to touch a toy (in seconds) was coded from videotape (Rothbart, 1988). Coders were trained to 94% reliability (ratings within 1 s). If

children failed to touch a toy, they were assigned a latency score equal to the duration of the presentation (i.e., 30 s).

24 and 25 Months

Observed behavior. Table 1 contains descriptive statistics for all variables. Detailed descriptions of all

of the following measures are available from the first author. For all procedures, positive affect and negative affect were rated, based on facial and vocal expressions, from videotape on separate global scales ranging from 0 (*no affect*) to 5 (*continuous, high-intensity affect*). For each procedure, between one and five ratings for both positive and negative affect were made; these ratings were averaged. Reliability was calculated across all procedures on 11% of the visits.

Table 1
Descriptive Statistics for All Variables

	<i>n</i>	Min.	Max.	<i>M</i>	<i>SD</i>
6-month					
Latency to low intensity	124	0.00	30.00	5.51	8.91
Latency to high intensity	138	0.00	30.00	7.81	9.96
12-month					
Latency to low intensity	122	0.00	30.00	4.20	5.88
Latency to high intensity	134	0.00	30.00	9.16	9.43
24-month					
Positivity					
Introduction to lab	126	0.00	4.00	1.38	1.64
Boring toy	126	0.00	4.00	1.90	1.45
Quiet stranger	126	0.00	4.00	1.56	1.32
Ring around the rosie	126	0.00	5.00	1.25	1.59
Champagne popper	124	0.00	5.00	1.32	1.54
Vacuum cleaner	125	0.00	4.00	0.50	0.90
Electrode placement	120	0.00	4.00	0.65	1.22
Negativity					
Introduction to lab	126	0.00	5.00	0.85	1.22
Boring toy	126	0.00	5.00	1.25	1.19
Quiet stranger	126	0.00	4.00	0.38	0.68
Ring around the rosie	126	0.00	4.67	0.59	1.22
Champagne popper	124	0.00	5.00	0.46	0.98
Vacuum cleaner	125	0.00	5.00	0.65	1.06
Electrode placement	120	0.00	5.00	1.04	1.45
Proximity to mother					
Introduction to lab	126	1.00	5.00	2.95	1.43
Boring toy	126	1.00	5.00	3.77	0.97
Quiet stranger	126	1.00	4.30	2.66	0.77
Champagne popper	124	1.00	5.00	3.58	1.41
Vacuum cleaner	125	1.00	5.00	2.56	1.28
Vocalizations					
Introduction to lab	126	0.00	10.00	1.70	2.54
Quiet stranger	126	0.00	16.00	4.03	3.94
Activity level					
Introduction to lab	126	0.58	3.58	2.03	0.65
Boring toy	125	1.25	3.07	2.30	0.37
Electrode placement acceptance	126	1.00	5.00	4.13	1.12
Ring around the rosie participation	126	1.00	5.00	2.58	1.13
Boring toy off-task activity	125	0.00	1.81	0.34	0.40
25-month					
Positivity					
Introduction to lab	122	0.00	5.00	1.31	1.61
Boring toy	121	0.00	4.00	1.42	1.35
Negativity					
Introduction to lab	122	0.00	5.00	1.01	1.52
Boring toy	121	0.00	5.00	1.39	1.24
Quiet stranger	121	0.00	4.50	0.44	0.71
Ring around the rosie	120	0.00	5.00	0.64	1.33
Jump off steps	122	0.00	4.33	0.48	0.87
Explore box	122	0.00	5.00	0.52	1.03
Play with assistant	117	0.00	4.20	0.40	0.79
Toy preference	122	0.00	4.00	0.27	0.70
Proximity to father					
Introduction to lab	122	1.00	5.00	3.07	1.54
Boring toy	121	1.00	5.00	3.34	1.05
Quiet stranger	121	1.00	4.88	2.72	0.81
Jump off steps	122	1.00	5.00	3.07	1.73
Explore box	122	1.00	5.00	3.45	1.71
Play with assistant	117	1.00	5.00	3.63	1.60
Toy preference	122	1.00	5.00	3.58	1.41
Vocalizations					
Introduction to lab	122	0.00	12.00	1.20	2.34
Quiet stranger	121	0.00	19.00	3.40	4.25
Play with assistant	117	0.00	35.00	7.15	8.53
Toy preference	122	0.00	19.00	1.99	3.01
Activity level					
Introduction to lab	122	0.42	4.83	1.86	0.67
Boring toy	121	0.67	3.43	2.02	0.54
Play with assistant	117	0.13	2.73	1.62	0.64
Ring around the rosie participation	120	1.00	5.00	2.70	1.34
Black box exploration	122	1.00	6.00	3.19	1.96
Step participation	122	3.00	19.00	6.79	5.50
Toy choice latency	122	1.00	20.00	8.85	5.57
Boring toy off-task activity	121	0.00	1.33	0.30	0.36
2-year CBCL					
Internalizing	109	0.00	25.00	4.86	4.01
Externalizing	109	0.00	55.00	17.72	10.18

Note. CBCL = Child Behavior Checklist.

Kappas were .71 for positive affect and .73 for negative affect.

The remaining measures were similar to those used by previous studies (e.g., Fox et al., 2001; Kagan et al., 1984; Park et al., 1997; Raine et al., 1998) to assess behavioral inhibition or stimulation seeking. Proximity to parent was coded from videotape for all episodes except electrode placement and ring around the rosie. Proximity was coded on continuous basis using a scale ranging from 1 (*clinging to parent*) to 5 (*two steps or more away from parent*). Reliability was calculated on a second-by-second basis across all procedures for 13% of the visits; these 1-s scores were averaged to create a single proximity score for each episode. The average kappa for individual visits was .78.

The number of spontaneous, nondistressed vocalizations was coded from videotape during four procedures: initial introduction to the lab, quietly sitting stranger, toy preference, and play with assistant. When reliability was calculated on 14% of the data, 83% of the vocalizations coded were agreed on.

Activity level was coded from videotape in 5-s intervals for the entire duration of the introduction to the lab, boring toy, and play with assistant tasks, using a scale ranging from 0 (*child completely still*) to 4 (*running or vigorous movement*); these 5-s scores were averaged to create a single activity score for each episode. Kappa, computed over 14% of the visits, was .80.

In addition to these codes, several episode-specific ratings were made. The child's willingness to allow electrode placement was rated on a scale ranging from 1 (*strongly avoids electrode placement*) to 5 (*no avoidance of electrodes*) immediately after each 24-month lab visit. This rating was made by consensus between the team leader and two assistants. Willingness to play ring around the rosie was coded from videotape. Three ratings per visit were made, corresponding to the three rounds played. A scale ranging from 1 (*child actively refuses to play*) to 5 (*child immediately and enthusiastically plays*) was used. Kappa, calculated on 14% of the visits, was .80. The child's degree of exploration of black box was rated from videotape on a scale ranging from 1 (*no approach to box*) to 6 (*places entire head inside box*). Kappa, calculated on 14% of the data, was .85. The child's willingness to jump from steps was rated from videotape on a scale ranging from 1 (*no approach to steps*) to 7 (*jumps off prior to prompts*). The individual scores for the three steps were summed. Kappa for these ratings, calculated on 14% of the data, was .85. Three ratings of the child's latency to choose toys during the toy preference episode were coded, in seconds,

from videotape. When reliability was assessed on 14% of the data, 93% of these judgments were found to be accurate within 2 s. Children who did not choose a toy were assigned a latency score of 20 s. The three latency scores were averaged into a summary latency-to-choose score. Because, in contrast to all other variables, a high latency score indicated high inhibition/low approach, this score was reversed by multiplying it by -1 . Finally, the child's off-task activity during the boring toy task was coded in 5-s increments as either 0 (not engaging in off-task activity), 1 (passive engagement with off-task activity, such as looking at stickers on wall), or 2 (active engagement in off-task activity such as climbing up camera pole or peeling stickers off the wall). Kappa, calculated on 14% of the data, was .80. These ratings were averaged into a single off-task activity score.

To reduce the number of variables, ratings made for both the 24- and 25-month individual assessments were first combined by averaging across the two visits. Before collapsing these scores, the stability of these behaviors over the two laboratory visits was examined through correlation. Of the 17 variables collected at both time points, all but 2—activity level during entry to lab, $r(122) = .16$, $p < .10$, and negativity to stranger, $r(121) = .01$, $p > .10$ —were positively correlated to a statistically significant degree ($p < .05$). Correlations ranged from .01 to .57, with an average correlation of .30.

For each task, a behavioral approach–inhibition score was computed by standardizing and averaging the nonaffect codes listed earlier. High scores indicated a high level of approach or a low level of inhibition, or both. A total of 33 observed codes were retained: For each of the 11 procedures, children received scores corresponding to their positive affect, negative affect, and behavioral approach–inhibition. Scores for high-intensity positivity, high-intensity negativity, and high-intensity behavioral approach–inhibition were calculated by averaging the standardized scores for positivity, negativity, and behavioral approach–inhibition across the high-intensity tasks. Analogous scores were created for low-intensity positivity, low-intensity negativity, and low-intensity behavioral approach–inhibition.

Mother-rated behavior problems. Before the 24-month visit, parents were mailed the Child Behavior Checklist for Ages 2–3 (CBCL/2–3; Achenbach, Edelbrock, & Howell, 1987). Two scores generated from this measure were used in the current study. The externalizing scale assesses aggressive and destructive problems. The internalizing scale assesses behavior indicative of anxiety, social withdrawal, and depres-

sed affect. The two scales were positively correlated ($r = .57, p < .01$). Because of this statistical overlap, each scale was regressed on the other (e.g., the internalizing scores used in the following are residuals remaining after externalizing was partialled out), so that the variables used in analysis were more pure indexes of the two different forms of dysregulation.

Results

Patterns of Missing Data

To determine whether missing data were systematically related to approach and inhibition tendencies, a series of t tests were performed. Participants with complete data sets for a given assessment (i.e., 6-month, 12-month, 2-year observation, 2-year CBCL) were compared with participants who had any missing data for that assessment, with scores on measures from other assessments as dependent variables. Of 47 t tests performed, 3 were statistically significant. Children missing CBCL data had slower latencies to reach for low-intensity toys at 6 months, $t(\text{unequal variances } df = 43.87) = 2.21, p < .05$. Children missing toy-reach latencies at 12 months were rated lower in internalizing, $t(107) = 2.41, p < .05$, and expressed less positivity during low-intensity procedures, $t(\text{unequal variances } df = 31.27) = 2.66, p < .05$. To maximize power, all analyses reported were conducted using the maximum number of participants (i.e., all participants with data for the variables analyzed). When analyses were restricted to only the 77 children with complete data sets, the direction of all findings remained the same.

Relative Independence of Positive and Negative Emotionality and Behavioral Approach–Inhibition

The 11 task-specific positivity, negativity, and behavioral approach–inhibition variables were subject to confirmatory (maximum likelihood) factor analyses to compare one- and three-dimensional factor structures. Three versions of one- and three-factor models were examined. In the first, variable residuals were not allowed to correlate. In the second, errors in positivity, negativity, and behavioral approach–inhibition ratings for the same episode were allowed to correlate. In the third, modification indexes guided correlation of errors in an iterative fashion to develop best-fitting one- and three-dimensional models (Rothbart, Ahadi, Hershey, & Fisher, 2001). Indicating the relatively separate nature of positivity and negativity, and of emotional and nonemotional aspects of approach–inhibition, in all versions of the confirmatory factor analysis, three-dimensional models of positivity, negativity, and behavioral approach–inhibition provided the best fit (see Table 2). In addition, only the three-factor solution demonstrated good fit after modification indexes were used.

Positivity and Negativity in Relation to Approach–Inhibition

Correlation and simultaneous multiple regression were employed to examine the relative contributions of positive and negative emotions to behavioral approach–inhibition. It was expected that positivity would be associated with low-intensity behavioral approach–inhibition, such that high positivity would be associated with elevated approach and

Table 2
Goodness-of-Fit Indexes for One- and Three-Dimensional Models

	χ^2	χ^2/df	Index				
			NFI	RFI	IFI	TLI	CFI
Errors not correlated							
One dimension ($df = 406$)	1334*	3.29	.34	.24	.42	.31	.40
Three dimensions ($df = 402$)	1000*	2.49	.50	.43	.63	.55	.61
Positive and negative errors correlated							
One dimension ($df = 377$)	1037*	2.75	.49	.36	.60	.47	.57
Three dimensions ($df = 373$)	598*	1.60	.70	.63	.86	.82	.85
Modification indexes guided							
One dimension ($df = 356$)	495*	1.39	.73	.64	.91	.87	.90
Three dimensions ($df = 369$)	404	1.10	.78	.72	.98	.97	.97

Note. NFI = normed fit index; RFI = relative fit index; IFI = incremental fit index; TLI = Tucker–Lewis index, CFI = comparative fit index.
* $p < .05$.

negativity would account for negligible unique variance in low-intensity behavioral approach–inhibition. Both positivity and negativity were expected to be associated with high-intensity behavioral approach–inhibition, such that high approach (low inhibition) would be related to high positivity and low negativity.

Low Intensity

Low-intensity behavioral approach–inhibition was positively correlated with low-intensity positivity, $r(126) = .61, p < .01$, and negatively correlated with low-intensity negativity, $r(126) = -.30, p < .01$. Low-intensity positivity and low-intensity negativity were negatively correlated, $r(126) = -.36, p < .01$. As predicted, the regression analysis revealed that low-intensity behavioral approach–inhibition was strongly associated with low-intensity positivity ($\beta = .57, p < .01$), whereas low-intensity negativity did not account for a significant amount of additional variance ($\beta = -.10, ns$). The model was significant, $F(2, 123) = 37.41, p < .01, R^2 = .38$.

High Intensity

High-intensity behavioral approach–inhibition was positively correlated with high-intensity positivity, $r(126) = .44, p < .01$, and negatively correlated with high-intensity negativity, $r(126) = -.43, p < .01$. High-intensity positivity and high-intensity negativity were negatively correlated, $r(126) = -.25, p < .05$. As predicted, both high-intensity negativity ($\beta = -.34, p < .01$) and high-intensity positivity ($\beta = .36, p < .01$) contributed unique variance in predicting high-intensity behavioral approach–inhibition. The model was significant, $F(2, 123) = 27.10, p < .01, R^2 = .31$.

Prediction of 2-Year Approach–Inhibition From Toy-Reach Latencies at 12 Months

It was hypothesized that shorter latencies to reach for objects at 12 months would be associated with high positivity and high behavioral approach–inhibition scores at 2 years. Reach latencies to low-intensity objects were expected to be most strongly correlated to 2-year emotionality and behavior in low-intensity situations; intensity-specific consistency was similarly anticipated for high-intensity conditions. A more specific prediction was made regarding negativity, for which correspondence was only expected across the high-intensity conditions.

Low Intensity (2-Year)

Consistent with predictions, low-intensity behavioral approach–inhibition was negatively correlated with 12-month latency to reach for low-intensity objects, $r(109) = -.26, p < .01$. Contrary to expectations, however, low-intensity behavioral approach–inhibition was slightly more strongly correlated with 12-month latency to reach for high-intensity objects, $r(121) = -.33, p < .01$. No emotionality scores were significantly correlated with 12-month reach latencies, although 2-year high-intensity positivity was marginally correlated with latencies to reach for high-intensity toys, $r(121) = -.15, p < .10$. No 6-month latency scores were significantly correlated with 2-year low-intensity variables.

High Intensity (2-Year)

As expected, high-intensity behavioral approach–inhibition was negatively correlated with 12-month latency to reach for low-intensity objects, $r(109) = -.21, p < .05$, and more highly correlated with latency to reach for high-intensity objects, $r(121) = -.30, p < .01$. Consistent with our hypothesis, slow reaching to high-intensity objects at 12 months was associated with elevated high-intensity negativity, $r(121) = .25, p < .01$, in addition to low high-intensity positivity, $r(121) = -.19, p < .05$. No relations were apparent between latencies to approach low-intensity objects at 12 months and 2-year high-intensity emotionality. No 6-month latency scores were significantly correlated with 2-year high-intensity variables.

Relations Between 2-Year Observed Behavior and Mother-Rated Behavior Problems

Correlation and regression analyses were performed to assess the contributions of positivity, negativity, and behavioral approach–inhibition to variability in behavior problem scores. It was expected that positivity and behavioral approach–inhibition scores in both high- and low-intensity conditions would be positively correlated with externalizing behavior and negatively correlated with internalizing behavior. It was predicted that negativity in high-intensity, but not low-intensity, episodes would be differentially related to externalizing and internalizing behavior.

Low Intensity

Neither low-intensity negativity, positivity, nor behavioral approach–inhibition was significantly correlated with internalizing. As expected, positivity in low-intensity situations was associated with externalizing, $r(109) = .27, p < .01$, as was low-intensity behavioral approach–inhibition, $r(109) = .24, p < .05$. When the three low-intensity variables were entered in a regression model as simultaneous predictors of externalizing, the model was significant, $F(3, 105) = 4.01, p < .01, R^2 = .10$. Only the coefficient for positivity was significant ($\beta = .25, p < .05$).

High Intensity

As predicted, internalizing was positively correlated with high-intensity negativity, $r(109) = .30, p < .01$, and with low behavioral approach–inhibition (i.e., high inhibition), $r(109) = -.28, p < .01$. The regression equation was significant, $F(3, 105) = 5.29, p < .01, R^2 = .13$, with both negativity ($\beta = .24, p < .05$) and behavioral approach–inhibition ($\beta = -.23, p < .05$) remaining significant. High-intensity positivity was not associated with internalizing. Externalizing was positively correlated with high-intensity positivity, $r(109) = .27$, and behavioral approach–inhibition, $r(109) = .28$. The regression model was significant, $F(3, 105) = 3.70, p < .01, R^2 = .10$. Betas were not significant, although a marginal coefficient emerged for high-intensity behavioral approach–inhibition ($\beta = .21, p < .10$).

Person-Oriented Analysis

To explore the possibility that groupings of variables may be useful in separating children who, for instance, fail to approach stimuli because of high activation of an inhibition system from those who

choose not to approach because of a deficit of approach activation, and that these groupings may be informative regarding mechanisms underlying behavior problems and infant touch latencies, cluster analysis was performed on the six 2-year observational variables in a two-step process. To determine the appropriate number of clusters, dendograms resulting from hierarchical cluster analysis (Ward's method) were examined, from which a four-cluster solution was suggested. Next, *K*-means solutions were calculated to assign children into groups. As shown in Figure 1, the first cluster was extremely high on negativity variables and low on the other variables, analogous to the extremely inhibited group identified by Kagan et al. (1984); this cluster was labeled *extremely inhibited*. The second cluster was high in positivity and behavioral approach–inhibition but low in negativity; this cluster was labeled *exuberant*, in reference to Fox et al. (2001). Cluster 3 was low on both emotion variables and moderately low in behavioral approach–inhibition; this cluster was labeled *low/low*. A final cluster had a similar, but less extreme, configuration as Cluster 1; this cluster was labeled *inhibited*.

The four clusters were then used in analyses of variance (ANOVAs) predicting toy-reach latencies and internalizing and externalizing scores. As shown in Table 3, cluster membership did not distinguish children in terms of their latencies to approach toys at 6 months or low-intensity toys at 12 months, but a marginal effect emerged for 12-month high-intensity toy reach. Consistent with expectations, post hoc (least squared differences) tests indicated a significant difference between exuberant children, who had reached quickly, and inhibited children, who had longer latencies.

Consistent with the preceding analyses, the inhibited and extremely inhibited groups were highest in internalizing, and the low/low group was lowest.

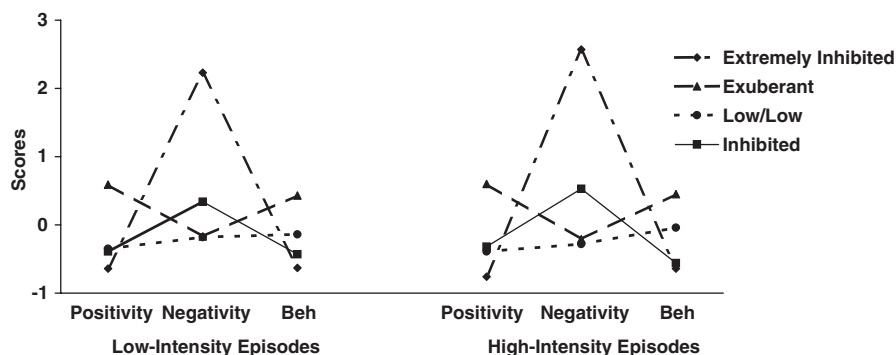


Figure 1. Mean scores of clusters on 2-year positivity, negativity, and behavioral approach–inhibition (Beh).

Table 3
ANOVA Comparing Clusters' Mean Infancy Approach Latencies and 2-Year Mother-Reported Behavior Problems

	Cluster				<i>df</i>	<i>F</i>
	Extremely inhibited (<i>n</i> = 3)	Exuberant (<i>n</i> = 48)	Low/low (<i>n</i> = 45)	Inhibited (<i>n</i> = 30)		
Latencies to approach (in seconds)						
6-month low intensity	5.00 (5.29) _a	4.91 (8.58) _a	5.30 (9.33) _a	4.70 (7.93) _a	3, 105	0.03
6-month high intensity	11.33 (16.17) _a	7.49 (9.10) _a	6.61 (9.84) _a	6.68 (9.51) _a	3, 116	0.27
12-month low intensity	4.50 (4.95) _a	4.00 (6.65) _a	3.74 (4.55) _a	5.15 (7.22) _a	3, 105	0.30
12-month high intensity	13.50 (14.85) _{a,b}	6.09 (6.64) _a	9.16 (9.35) _{a,b}	11.24 (10.01) _b	3, 117	2.47 [†]
Behavior problems (residuals)						
Internalizing (controlling for externalizing)	1.08 (3.61) _{a,b}	−0.83 (2.47) _a	−0.39 (3.03) _a	1.61 (4.12) _b	3, 105	3.69*
Externalizing (controlling for internalizing)	−1.37 (3.32) _{a,b}	3.23 (7.88) _a	−1.92 (8.27) _b	−2.19 (8.19) _b	3, 105	3.66*

Note. ANOVA = analysis of variance. Groups that share a subscript do not differ significantly from each other. Values in parentheses are standard deviations.

[†]*p* < .10. **p* < .05.

Post hoc (standard deviation) tests confirmed significant differences between the inhibited and low/low groups. A significant effect was also revealed for externalizing. The exuberant group was rated highest in externalizing, whereas the low/low group was rated lowest.

Discussion

In contrast to previous studies (e.g., Kagan et al., 1984; Kagan & Snidman, 1991; Reznick et al., 1989), which have combined negative affect with nonemotional behavior to provide a single measure of inhibition, the current study relied on expression of both positive and negative affect, separately from nonemotional indexes, to generate insight into children's motivation to approach or inhibit approach. Confirmatory factor analysis indicated, as expected, that positivity and negativity are best considered separable dimensions, in contrast to earlier models of temperament placing the two on opposite ends of a quality of mood continuum (e.g., Thomas & Chess, 1977), and that nonemotional approach–inhibition behavior was relatively distinct from affective displays. Furthermore, positive and negative affects were meaningfully linked to qualities of the stimulus that children approached. Consistent with reasoning offered by Schrierla (1959), when novel stimuli were low in intensity, positivity was strongly related to children's approach responses, whereas negativity was minimally related. Our coding system did not differentiate specific types of negative affect, and it is possible that some of the negativity expressed in these contexts was not fear related and thus would not be expected to relate to behavioral approach–

inhibition. In situations of high intensity, invoking both approach and inhibition tendencies, negativity and positivity corresponded to behavioral approach–inhibition.

Our longitudinal findings suggest that the mechanisms underlying approach–inhibition may be well developed by the end of the 1st year. Children who quickly reached for high-intensity objects at 12 months of age tended to be high in approach and positivity as 2-year-olds. It is important to note that reaching toward high-intensity objects, indicative of both inhibition and approach (Putnam & Stifter, 2002; Rothbart, 1988), was predictive of 2-year negativity in high-intensity situations. In contrast, 12-month reach latencies to low-intensity objects, expected to provoke minimal inhibition, were not predictive of 2-year negativity, nor was 2-year negativity in low-intensity contexts associated with 12-month reach latencies. This context-specific relation between infant behavior and negative emotionality in toddlers underlines the importance of considering intensity level when assessing approach–inhibition, and it validates the use of negative affect as an indicator of inhibition. The fact that the extremely brief (30-s) toy-reach task successfully predicted 2-year behavior across a wide battery of situations speaks to the promise of this method for identifying approach–inhibition tendencies during late infancy. Investigators interested in incorporating this predisposition into their research are strongly encouraged to consider this easily administered task.

Separately assessing positivity and negativity in response to novel stimuli also contributed to understanding of the nature of early-emerging behavior problems. Because anecdotal descriptions

and traditional measures of childhood maladjustment rarely include mention of excessive positivity, one of the more intriguing findings concerned the relation between positive emotionality and behavior problems, a finding replicated in both variable- and person-oriented analyses. The connection between externalizing and positivity, however, was expected because of the conceptualization of positive affect as a marker of approach tendencies. Two other recent studies have reported positive correlations between adult-rated positivity-exuberance and concurrent behavior problems in school-age children (Eisenberg et al., 1996; Rydell, Berlin, & Bohlin, 2003), and Rothbart, Ahadi, and Hershey (1994) reported a positive correlation between positive reactions to novel objects and sounds during infancy and aggression measured at 6 to 7 years of age. Because anger, an emotion implicated in externalizing behaviors, functions to overcome obstacles and gain rewards (Barrett & Campos, 1987), it is reasonable to expect greater anger, and hence greater externalizing behaviors, among individuals who are particularly reward oriented, such as the children in the current study who expressed positive affect when presented the opportunity to explore novel environments. The fact that positivity, but not a lack of fearful negativity, was associated with externalizing provides support to theory proposed by Newman (1987) and empirically supported by Scerbo et al. (1990), implicating high approach tendencies as a crucial mechanism underlying externalizing difficulties. The fact that behavioral approach–inhibition in low-intensity situations, but not in high-intensity situations, was associated with externalizing behaviors, however, suggests that inhibition may serve a regulatory function in controlling aggressive approach (Derryberry & Rothbart, 1997).

As expected, based on theory and research by Gray (1982, 1987), negativity and unwillingness to approach in high-intensity contexts were associated with internalizing behavior. Low levels of positivity, however, were not linked to internalizing, contrary to expectations generated in reference to Fowles (1994). A potential explanation concerns differences in forms of internalizing: Whereas inhibition processes are predominantly associated with anxiety symptoms, deficits in approach motivation, including the inability to experience positive affect, are hallmarks of depression. The internalizing scale of the CBCL contains items concerning both forms of internalizing, but symptoms of anxiety may be more apparent than symptoms of depression to mothers.

Additional insight into the processes underlying behavioral approach–inhibition emerged in person-oriented analyses. Two groups of children discerned through our cluster analysis are reminiscent of Rubin's (1982) differentiation between children who are unsociable (i.e., low on social approach motivation) and those who are behaviorally inhibited or shy (moderate on social approach but high on inhibition). Coplan, Prakash, O'Neil, and Armer (2004) contended that the lack of research distinguishing these groups is due to the lack of specific methodologies to do so, noting that the few efforts to separate these groups used parent or teacher report. Assessment of positive and negative affect, concurrent with approach–inhibition, may provide an observational technique to distinguish the two types. The low/low group in the current study, who were moderately low in behavioral approach but did not indicate high levels of inhibition through negative affect, are analogous to the socially disinterested children proposed by Rubin (1982). The inhibited and extremely inhibited groups in the current study, who demonstrate inhibition through their negative affect, are conceptually similar to the children described as inhibited by Rubin and others (e.g., Kagan, 1984). Supporting this analogy, Coplan et al. (2004) reported a positive correlation between temperamental negativity and mother-reported shyness of preschoolers, but a negative correlation between temperamental negativity and social disinterest.

Relations between group membership and internalizing behavior in the current study are also consistent with prior work distinguishing high inhibition from low approach motivation. Internalizing behavior was associated with low behavioral approach only for groups additionally characterized by negative affect. In contrast, children moderately low in behavioral approach, but also low in negativity, were rated lower in internalizing. Similarly, whereas extreme inhibition, assessed through combined emotional and nonemotional behaviors, has been linked to anxiety problems (Biederman et al., 1990; Coplan et al., 2004; Fox et al., 2001), low sociability was not predictive of maladaptation (Coplan et al., 2004; Rubin, Coplan, Fox, & Calkins, 1995).

The current study demonstrates the benefits of decomposing approach–inhibition indexes into emotional and nonemotional components, separately measuring positive and negative affect, and varying the intensity of stimuli to enhance understanding of processes underlying the well-studied construct of behavioral inhibition. A priority to be addressed is scrutinizing the predictive, discriminant, and convergent validity of these separable

characteristics, and of the group-level configurations. Longitudinal efforts are required to determine whether the separable constructs of positivity and negativity, as well as behavioral approach–inhibition, foreshadow analogous conduct in older children.

Another potential research direction involves investigation of relations between potential parental influence on approach and inhibition tendencies. Parents who are highly sensitive and accepting of their children's inhibition may interfere with children's own ability to regulate their fearfulness, enhancing the stability of the children's inhibited behavior (Arcus, Gardner, & Anderson, 1992; Park et al., 1997). It may be that this phenomena is particularly true for children who are either high or low in positive emotionality as well. A second arena of investigation regarding inhibition and parenting is in regard to the development of conscience. Research by Kochanska (1991, 1995, 1997) suggests that parenting deemphasizing power assertion may positively influence inhibited, but not uninhibited, children's acceptance of parental agenda, whereas parental responsiveness and secure mother–child attachment leads to higher conscience in uninhibited children. Incorporating positive emotionality into measurement strategies may be informational in testing Kochanska's assertion that positive parent–child orientation builds on children's intrinsic level of positive motivation.

To inform subsequent inquiries, a caveat regarding the generalizability of this work is in order. The families who participated in this effort were drawn from a predominantly White and college-educated population. White adults have consistently been found to be higher in sensation seeking than other adults (Zuckerman, 1994), and developmental studies have documented particularly high levels of behavioral inhibition among Asian children (Kagan, 1994). There is reason to suspect, therefore, that the children in the current sample may be higher in approach (or lower in inhibition) than a more heterogeneous sample. Volunteering for participation in psychological research itself has been associated with high levels of sensation seeking (Zuckerman, 1994), suggesting that the parents of the toddlers in the current sample may be higher on the trait than the general population, and as sensation seeking and inhibition are believed to have genetic underpinnings, it is possible that the children themselves may be more approach oriented than other children. Only when results similar to those described herein are replicated in samples that are more ethnically, financially, and socially diverse can they be fully embraced.

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