

Temperament, Development, and Personality

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ABSTRACT—*Understanding temperament is central to our understanding of development, and temperament constructs are linked to individual differences in both personality and underlying neural function. In this article, I review findings on the structure of temperament, its relation to the Big Five traits of personality, and its links to development and psychopathology. In addition, I discuss the relation of temperament to conscience, empathy, aggression, and the development of behavior problems, and describe the relation between effortful control and neural networks of executive attention. Finally, I present research on training executive attention.*

KEYWORDS—*temperament; development; personality; neural networks; attention training*

What are the origins of human personality? Are they chiefly the result of the child's reinforcement history? The child's learned attributions about the social world? The child's genes? Or is there more to understand than would result from a simple choice between nature and nurture? Concepts of temperament are necessary to understand the origins of personality development. Temperament describes the initial state from which personality develops and links individual differences in behavior to underlying neural networks. Temperament and experience together "grow" a personality, which will include the child's developing cognitions about self, others, and the physical and social world, as well as his or her values, attitudes, and coping strategies.

From early infancy, children show considerable variability in their reactions to the environment. One child is fearful, has only a brief attention span, and cries even at moderately stimulating play; another child enjoys vigorous play, is not easily distracted, and seeks out exciting events. These reactions, together with the mechanisms that regulate them, constitute the child's temperament. Temperament is defined as individual differences in

emotional, motor, and attentional reactivity measured by latency, intensity, and recovery of response, and self-regulation processes such as effortful control that modulate reactivity (Rothbart & Derryberry, 1981). These differences are biologically based and are linked to an individual's genetic endowment (Posner, Rothbart, & Sheese, 2007).

The study of temperament is as old as the Hindu Upanishads and as recent as yesterday's studies in molecular genetics. Considerable advances have been made in recent years in our understanding of the structure of temperament, its development, and its relation to aspects of personality and neural structure (see reviews by Posner & Rothbart, 2007a; Rothbart & Bates, 2006). In this article, I present a general description of temperament followed by a more detailed discussion of the broad temperament construct of effortful control (EC). EC describes children's ability to choose a course of action under conditions of conflict, to plan for the future, and to detect errors. This construct emerged initially from sophisticated psychometric studies of parent reports and has also been measured in the laboratory (Rothbart & Bates, 2006). EC has been linked to important developmental outcomes, including the development of conscience and of behavior problems. In addition, EC is related to the executive attention network as identified in imaging studies. It also involves specific genes (Posner et al., 2007).

Here, I review the research on the structure of temperament, its relation to the Big Five personality traits, and its links to outcomes in personality and psychopathology (Rothbart & Posner, 2006). I describe the links between EC, executive attention, and brain networks related to executive attention and discuss their modifiability by experience.

THE STRUCTURE OF TEMPERAMENT

Many psychologists are aware of the nine dimensions of temperament identified by the New York Longitudinal Study, taken from interviews with parents about their infants (Thomas & Chess, 1977). These included activity level, approach/withdrawal, intensity, threshold, adaptability, rhythmicity, mood, attention span persistence, and distractibility. More recently,

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TABLE 1

Definitions of Temperament in the Children's Behavior Questionnaire and the Early Adolescent Temperament Questionnaire

Broad dimensions/ Temperament scales	Scale definitions
Effortful control	
Attention Control	The capacity to focus attention as well as to shift attention when desired
Inhibitory Control	The capacity to plan future action and to suppress inappropriate responses
Perceptual Sensitivity	Detection or perceptual awareness of slight, low-intensity stimulation in the environment
Low-Intensity Pleasure	Pleasure derived from activities or stimuli involving low intensity, rate, complexity, novelty, and incongruity
Negative affectivity	
Frustration	Negative affect related to interruption of ongoing tasks or goal blocking
Fear	Negative affect related to anticipation of distress
Discomfort	Negative affect related to sensory qualities of stimulation, including intensity, rate, or complexity of light, movement, sound, or texture
Sadness	Negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss
Soothability	Rate of recovery from peak distress, excitement, or general arousal
Extraversion/surgency	
Activity	Level of gross motor activity including rate and extent of locomotion
Low—Shyness	Behavioral inhibition to novelty and challenge, especially social
High-Intensity Pleasure	Pleasure derived from activities involving high intensity or novelty
Smiling & Laughter	Positive affect in response to changes in stimulus intensity, rate, complexity, and incongruity
Impulsivity	Speed of response initiation
Positive Anticipation	Positive excitement and anticipation for expected pleasurable activities
Affiliation ^a	Desire for warmth and closeness with others, independent of shyness or extraversion

Note. Subscales are grouped according to their broad dimensions.

^aIn Early Adolescent Temperament Questionnaire only.

psychometric studies have refined these categories (Rothbart & Bates, 2006). Temperament dimensions that have now emerged show strong similarities to the structure of temperament in other animals, including the defensive reactions of fear and anger, approach reactions of activity and pleasure to high intensity stimulation, and attentional scales of duration of orienting in infancy and of EC in toddlerhood. Recent research with the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001), a parent report measure for children 3 to 7 years of age, also identified three broad dimensions of temperament described in Table 1 and depicted in Figure 1.

These dimensions of temperament are related to the Big Five personality factors of Extraversion (extraversion/surgency), Neuroticism (negative affectivity), and Conscientiousness (EC). The Openness and Agreeableness factors have been found to relate to the adult temperamental dimensions of perceptual sensitivity and affiliation (Evans & Rothbart, 2007). It is important to remember, however, that temperament theory goes beyond a list of unrelated traits or broad dimensions. Of central importance are the interactions between children's reactive impulses and their efforts to control them. In particular, researchers are interested in the relations among EC, extraversion/surgency, and negative affectivity.

Very similar broad dimensions of temperament have been found across cultures, and different correlations among these dimensions in the United States and China are shown in

Figure 1 (Ahadi, Rothbart, & Ye, 1993). In the United States, but not in China, children high in EC showed lower negative affectivity. In China, but not in the United States, children high in EC showed lower extraversion/surgency. These differences may be related to culturally valued behaviors (low distress in the United States; low outgoing behavior in China), guiding development. Basic biological processes of temperament appear to be shared across cultures, but outcomes vary depending on cultural values and the child's experiences.

DEVELOPMENT OF TEMPERAMENT

Temperament characteristics can be seen in the newborn and measured in the fetus. The newborn shows distress and avoidant movements, and by 2 to 3 months, approach reactions are evidenced in smiling, laughter, and body movement. Physical approach is seen when developing motor systems permit, usually by 4 to 6 months. Anger or frustration is seen at 2 to 3 months, and fear in the form of behavioral inhibition appears to be differentiated from general distress proneness by 7 to 10 months. Fear in infancy predicts children's later fearfulness and low aggression; anger predicts later higher frustration and aggression. Fear thus appears to act as a control on both approach and aggression (Rothbart & Bates, 2006).

Fear is a reactive dimension that also contains regulatory components (behavioral inhibition or withdrawal from threat-

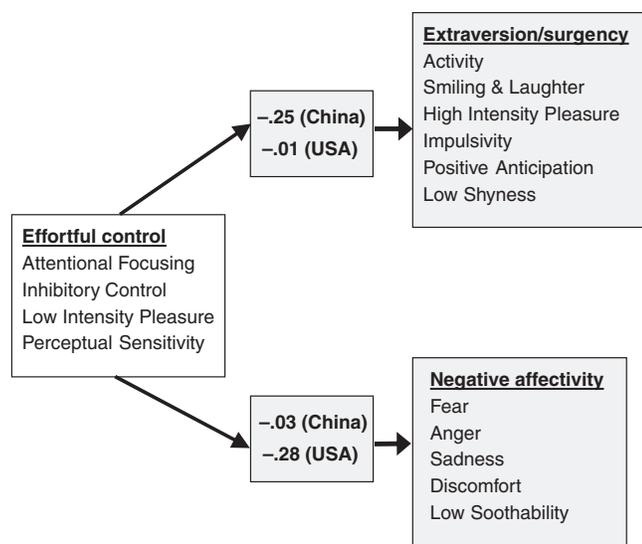


Fig. 1. Temperament in 6- to 7-year-old children from the United States and China as evaluated by the Children's Behavior Questionnaire. The similar overall temperament structure suggests that the basic building blocks of temperament are the same in both cultures; but their relationships differ, as shown by the correlations in the middle boxes.

ening stimulation). As noted above, behavioral fear develops later than approach responses. Although fear serves to inhibit approach and aggression, it may also capture attention (Rothbart & Sheese, 2007). A second, attentional control system, EC, allows more flexible inhibition of action (not eating a rich dessert), facilitation of action (eating more vegetables instead), detection of errors, and planning. EC as measured in laboratory tasks develops strongly over the preschool and into the school years. By 30 months, children show consistency in performance across tasks and considerable stability of EC is found thereafter (Kochanska, Murray, & Harlan, 2000; Rothbart, Sheese, & Posner, in press).

TEMPERAMENT AND SOCIALIZATION-RELEVANT CHARACTERISTICS

Temperament is consistently related to important social behaviors such as empathy and conscience. In my research, infant fear predicted parent-reported guilt, empathy, and low aggression at age 6 to 7 years. In Kochanska, Aksan, and Joy's (2007) research, more fearful children developed greater conscience during the preschool years than less fearful children did. Fear provides internal cues of discomfort that can be attributed to conscience rather than to external reward or coercion. The relation between temperament and conscience was also affected by parenting. Fearful children who received gentle and nonpunitive socialization developed greater conscience than did fearful children whose parents were punitive. For more fearless children, conscience depended on another aspect of parenting. More fearless children who had positive relations with their

parents developed greater conscience than fearless children whose relations with their parents were less positive.

EC also positively predicts conscience (Kochanska et al., 2000), as well as empathy, guilt, and low aggressiveness. EC may provide the attentional flexibility needed to react to negative feelings in others without being overwhelmed by them (empathy) and to relate these feelings to responsibility for one's own actions (conscience). Thus, two control systems, one emotional (fear) and one attentional (EC), appear to influence the development of conscience: Fear provides the distress and reactive inhibition components, and EC provides the attentional flexibility needed to link distress cues, action, and moral principles. A review by Eisenberg, Smith, Sadovsky, and Spinrad (2004) provides important additional findings relating EC to social and personality development.

Temperament is also an important contributor to a lower incidence of behavior problems, and this is found even when there is no overlap in content between the temperament and psychopathology measures (Rothbart & Bates, 2006). Figure 2 depicts relations reported in the literature, including a recent study by Ormel et al. (2005), which used the Early Adolescent Temperament Questionnaire–Revised to relate temperament at 10 to 11 years to the development of behavior problems at 12 to 14 years. Extraversion/surgency is related to greater externalizing problems (acting out) and to fewer internalizing problems (fear, sadness, low self-esteem). Anger and frustration predict both internalizing and externalizing problems, but fear is more strongly related to internalizing and anger to externalizing difficulties. The new scale of Affiliativeness in the Early Adolescent Temperament Questionnaire predicted both high internalizing and low externalizing problems. Low EC is a consistent and strong predictor of externalizing problems and a less strong predictor of internalizing problems. EC also moderates the effects of negative affectivity on problems; highly negative children will be less likely to show problems when they have higher EC (Rothbart & Bates, 2006; Rothbart & Posner, 2006).

NEURAL CORRELATES OF TEMPERAMENT

One exciting aspect of temperament is that it can be studied at multiple levels. Reactive temperament, for example, has been related to neural structure, especially to the functioning of the amygdala and (for extraversion/surgency) to dopamine systems (Rothbart & Posner, 2006). In the laboratory, researchers have studied the brain's attentional networks, which develop over time and are related to individual differences in EC. Monitoring and resolving conflict between incompatible responses have been linked to specific executive attention networks in the brain (Posner & Rothbart, 2007b). A basic measure of conflict resolution is provided by the Stroop task, in which the name of a word conflicts with the name of the color it is printed in. Tasks such as the Attention Networks Test (ANT) present flanking stimuli that distract from the task of responding to a central stimulus. Stroop

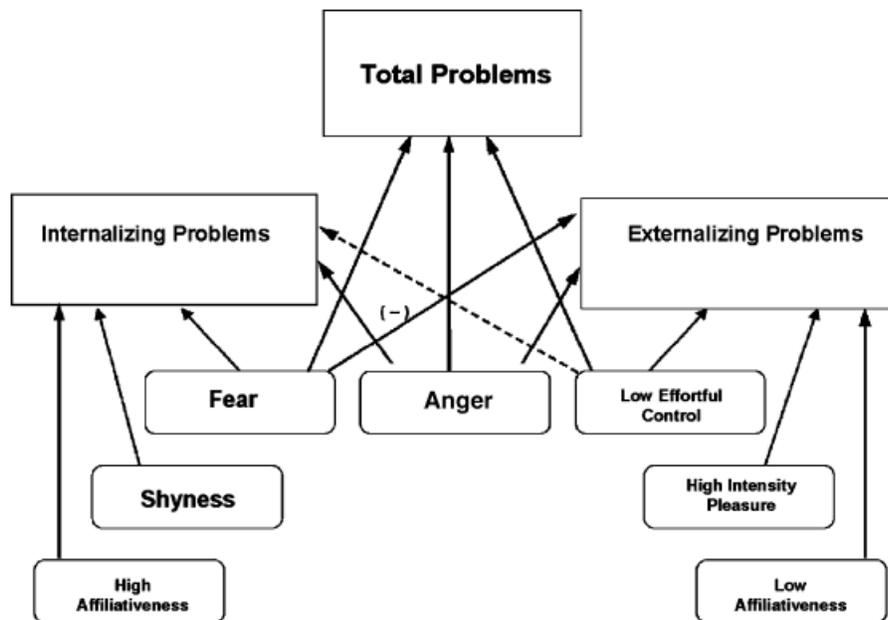


Fig. 2. Temperament in relation to developing behavior problems. Internalizing problems refers to anxious, inhibited, depressed, and withdrawn behavior; externalizing problems refers to disruptive, aggressive, and hyperactive behavior. The broken line denotes a weak relation.

and flanker tasks used in adult imaging studies activate the anterior cingulate and lateral prefrontal areas of the brain, which are parts of the executive attention network (Posner & Rothbart, 2007a; Rothbart et al., in press).

When Stroop and flanker tasks are adapted for children as markers of executive attention development, researchers can trace brain function through children’s performance. For toddlers, the spatial conflict task is used. Here the child must match an animal picture (dog or cat) cue with a picture of the same animal on one of two response keys. The location of the key can be directly below the cue or on the opposite side. There is a strong tendency to respond on the same side as the cue and the child must overcome this conflict to make the correct response. (see Posner & Rothbart, 2007a). At 30 months (the age when Kochanska et al., 2000, found EC tasks to be related), children moved from repeatedly performing the same incorrect response to showing more accurate performance. By 3 years, they showed high accuracy but were slower in the conflicting condition, as is found in adults. Preschool children who performed well on the tasks also scored higher in measures of EC and lower on impulsivity and were less prone to frustration (as evaluated by the Children’s Behavior Questionnaire). By age 7, the rapid period of development of executive attention appears to be complete.

TRAINING AND GENETICS OF EXECUTIVE ATTENTION

Given the central importance of EC and executive attention to development, can these systems be influenced by experience? Previously, researchers in our laboratory created a set of training exercises to help preschool children develop executive attention

skills (Rueda, Rothbart, McCandliss, Saccamanno, & Posner, 2005). Exercises were adapted from tasks used to train monkeys for space travel. Children ranging in age from 4 to 6 years were trained to use a joystick as they controlled the movement of a cat on the screen. They were instructed to guide the cat to the grass without getting in the mud (see Fig. 3). Over trials, the grass area

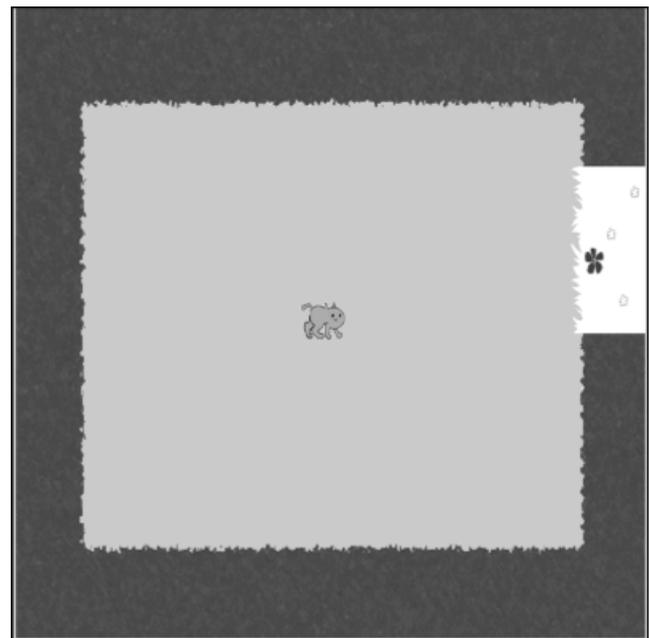


Fig. 3. Attention-training exercise (the cat seeking grass). As the extent of the mud (the dark gray area around the perimeter of the picture) increases, the extent of the grass (the white patch on the right) decreases. When the grass area becomes very small, the children are using the cat as a cursor to be moved from one spot to another.

shrinks and the mud area expands, so that the child is effectively moving the cat as a cursor. Children then learn how to have the cat move to intercept the travel of a duck, who either visibly swims across a pond or dives into it, and are trained on working-memory and Stroop-like conflict tasks.

These exercises were completed in five training sessions, with pre- and posttraining assessments including the ANT described previously and the Kaufman-Brief Intelligence Test. During ANT performance, 128 channels of electroencephalography were also recorded. We wished to measure the negative brain response arising around 200 milliseconds following the target (N2), which in adults arises in the anterior cingulate and is related to conflict performance.

Both 4- and 6-year-old children who had undergone training performed better on conflict trials than did children in the control group, but performance was highly variable and the difference did not reach statistical significance. Analysis of the N2 data, however, indicated that the trained children showed a more adultlike response. Intelligence scores of trained children were also higher after this brief training. Temperament measures were not affected, but both EC and children's distress proneness may be influenced if longer training programs were used, as in preschool settings (Posner & Rothbart, 2007a).

Executive attention efficiency has also been related to alleles (variants) of specific genes in both adults and children (Posner et al., 2007), and in children, genetic alleles have been related to parent reports of negative affectivity, EC, and extraversion/surgency. Researchers at the University of Oregon have also recently found an interaction between specific genes and parenting in the prediction of children's temperament. Research on genes and the development of temperament and personality will be of great interest in future studies.

FUTURE DIRECTIONS

This article provides a brief review of advances in our understanding of temperament and development. These advances have been considerable, but much remains to be learned. Future studies will explore temperament in relation to how children experience their social and physical world and their development of situation-specific behavior. Genetic analyses will allow for a much more differentiated study of temperament in relation to experience in children's development. By studying temperament at behavioral, mental, and brain-network levels and by investigating children's variability, development, and psychopathology, researchers will make increasing progress in this area (Posner & Rothbart, 2007b).

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Acknowledgments—The research reported here was supported by National Institutes of Mental Health Grants MH43361 and MH01471 and by a McDonnell Foundation grant. The author wishes to thank Michael Posner and Myron Rothbart for their help in developing this review.

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