THE ROLE OF REWARD SENSITIVITY AND RESPONSE

EXECUTION IN CHILDHOOD EXTRAVERSION

by

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A DISSERTATION

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Extraversion is a broad trait found in nearly all models of temperament and

personality. The current study explored extraversion through parent- and self-report

questionnaire measurement in 8-10 year old children. The primary goal of the study was

to define extraversion through its subcomponents found in multiple temperament and

personality models. A principal components analysis for both parent- and self-report

scales showed that two components were formed by the shared temperament and

personality scales. One describes less socialized aspects of extraversion

(Assertiveness/Dominance, High Intensity Pleasure, and Impulsivity) and is labeled

Unsocialized Stimulation Seeking. The second component was comprised of more

socialized aspects of extraversion (Positive Affect and Reward Sensitivity). Subscales of

Gregariousness and Activity Level loaded on both components. The Big Five Inventory

(BFI) extraversion scale was determined to be a broad measure of the trait. Parent-child

agreement was found to be higher than in previous studies. All scales for both parent- and

self-report showed good internal consistency and findings suggest that children are reliable reporters of their own temperament and personality when age-appropriate measures are used.

A general hypothesis that reward sensitivity is a core feature of extraversion was posited and methods were developed to validate questionnaire measurement of reward sensitivity. Partial support was found for the hypothesis that extraverted children would perform differently in reward than in non-reward conditions on a computerized reaction time task, a gift unwrapping task, and a card sorting task. Children who earned more points in a reward condition on a computerized task requiring speed and accuracy were higher in Unsocialized Stimulation Seeking. Children who were faster to sort cards when given monetary incentives were higher in Socialized Extraversion. Gift unwrapping was not related to extraversion.

It was also hypothesized that more extraverted children would show greater motor differences, as measured by the response execution phase of the computerized task, and that reward conditions would amplify motor differences. A three-way interaction showed that more extraverted children demonstrated greater differences between left and right hands in reward conditions than less extraverted children. This finding suggests that an interaction of motor and reward systems may underlie extraversion.

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DEDICATION

To all who supported my strange and circuitous route to finding work I love.

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CHAPTER I

INTRODUCTION

Temperament and personality researchers seek to understand the basic dimensions of individual differences as well as the mechanisms that underlie them (Briggs, 1989). Essential to understanding these dimensions are (1) identification of ways in which people consistently differ from one another, and (2) explanation of identified attributes and their underlying processes. Through these levels of inquiry, we can gain deeper knowledge of how dimensions of difference relate to each other, and how individual differences are related to other aspects of psychosocial functioning.

Theorists have put forward models of higher-order constructs and their subcomponents based chiefly on the use of questionnaire measures (e.g., Ashton, Lee, & Paunonen, 2002; Costa & McCrae, 1987; Lucas, Diener, Grob, Suh, & Shao, 2000; Watson & Clark, 1997). In some cases, researchers have validated higher-order constructs through behavioral, cognitive, and/or neuroscientific measures (e.g., Derryberry & Reed, 1994; Rothbart, Derryberry, & Hershey, 2000; Sutton & Davidson, 1997), but few studies have used multiple types of measurements to define traits (an exception is Brock, Beauducel, & Tasche, 1999). Past research has also chiefly examined temperament in infancy and childhood; and personality in adolescence and adulthood, with a major gap in research addressing both temperament and personality in middle childhood (Diener & Scollon, 2002; Shiner, 1998).

With a focus on children at ages 8-10, the current study addresses definition and assessment of the broad trait of extraversion through behavioral and questionnaire measurement. In the introductory chapter, extraversion is defined and previously identified links between trait and psychosocial functioning are described. Second, subcomponents proposed to comprise the broad extraversion construct are introduced and ideas about features of extraversion that may be central to the construct are presented. Reward sensitivity is then posited as a candidate for a core feature of extraversion. Measurement issues, including multi-informant reports, are discussed and previous research investigating the relations between extraversion and reward sensitivity is reviewed. Finally, findings linking extraversion to preparation for and execution of motor response, known as response execution in the literature, are presented.

The general goal of the current study is to provide more definitional specificity for extraversion than found in previous studies through measurement of components that have been shown to comprise the trait in multiple models of temperament and personality. Temperament can be considered as biologically based individual differences in emotional, motor, and attentional reactivity and regulation (Rothbart & Derryberry, 1981). Personality is thought to emerge out of temperament and describes individual difference in more cognitively-based patterns in emotion, behavior, and thought (Funder, 2001), as well as temperament. Temperament and personality are explored in more detail in a later section. A more specific goal of this project is to study potential core features of extraversion with behavioral assays. One assay is designed to determine relations between questionnaire measures of extraversion and reward sensitivity in childhood, and

behavioral differences in response to reward and non-reward stimuli. Another assay

allows for exploration of whether correlations between extraversion and response

execution found in adults are present in children.

Extraversion Defined

At the most literal level, extraversion can be defined as "a turning inside out"

(American Heritage Dictionary, 2000*).* As a psychological term, extraversion refers to

tendencies to orient to the external world. One of the earliest definitions of extraversion

was put forth by Jung (1936/1971), who characterized the trait as:

> interest in the external object, responsiveness, and a ready acceptance of external
> happenings, a desire to influence and be influenced by events, a need to join in
> and get 'with it,' the capacity to endure bustle and noise of every kind, and
> actually find them enjoyable, constant attention to the surrounding world, the
> cultivation of friends and acquaintances, none too carefully selected, and finally
> by the great importance attached to the figure one cuts, and hence by a strong
> tendency to make a show of oneself. (p. 546)

Most prominent among the precursors to current theories about the nature of

extraversion was Eysenck's (1967) arousal theory. Eysenck posited that introverts have

higher cortical arousal and therefore seek to withdraw from external stimuli at lower

intensity levels than extraverts, whereas extraverts have lower cortical arousal and

therefore tend seek even higher levels of stimulation from external events. Extraversion

has been found in most, and possibly all, models of temperament and personality as a

central construct (Watson & Clark, 1997). For the purposes of the current study,

extraversion is defined as active engagement with the external environment. Empirical

models of extraversion have been developed through factor analysis to determine the

lower-level traits that correlate to form the broader dimension (Watson & Clark, 1997).

Current models of extraversion and/or surgency commonly include components describing individual differences in approach, sociability, energy or activity level, dominance or ascendance, lack of shyness, and positive emotionality (Shiner & Caspi, 2003).

<center>Extraversion and Psychosocial Functioning</center>

Extraversion has been found to relate to both positive and negative psychosocial outcomes. In adults, low extraversion has been found to be a significant predictor of panic disorder, major depression, and social phobia, and a marginally significant predictor of simple phobias and agoraphobia (Bienvenu et al., 2001; Watson, Gamez, & Simms, 2005). Ranjith, Farmer, McGuffin, and Cleare (2005) found that higher extraversion scores predicted higher levels of social adaptation in depressed individuals. In another study, subjects with higher levels of extraversion performed at levels similar to psychopaths in showing deficits in learning from punishment in a simple maze task (Newman, Widom, & Nathan, 1985).

Findings of positive and negative outcomes associated with extraversion have also been found in childhood studies. Externalizing behavior problems, such as conduct disorder, have been found to relate to higher levels of extraversion (Huey & Weisz, 1997; Victor, 1994). In a longitudinal study, high scores on both extraversion and attention predicted social competence at ages 8-12, and ten years later at ages 17-23 (Shiner, 2000). Surgency at age 10 was correlated with a number of positive outcomes at age 30: academic achievement, competence at work, and success in romantic and friendship relationships (Shiner, Masten, & Roberts, 2003). Low extraversion with higher

neuroticism predicted social inhibition in 8 to 10-year-old children (Asendorpf & Van

Aken, 2003).

Relations between subcomponents of extraversion and psychopathology have

been found in children. Both depressed and anxious children scored high on measures of

negative affect, but only children with depressive symptoms reported lower positive

affect, a component of extraversion (Phillips, Lonigan, Driscoll, & Hooe, 2002). Activity

level, another component of extraversion, is a main feature of Attention Deficit-

Hyperactivity Disorder (Teicher et al., 2003). Impulsivity, found to be part of a

surgency/extraversion factor in childhood (Putnam, Ellis, & Rothbart, 2001), was

positively related to both externalizing problems and resiliency in 4.5 and 8-year-old

children (Eisenberg et al., 2004).

Findings for extraversion as a predictor of psychosocial functioning are mixed.

Extraversion and its related components can promote adaptive social connection with

others (Ranjith et al., 2005) and motivate spontaneous testing of ways to navigate

stressful circumstances (Eisenberg et al., 2004); however, the same spontaneous

tendencies toward action can lead to problems in avoiding punishment (Newman et al.,

1985) and maladaptive externalizing behaviors (Huey & Weisz, 1997; Victor, 1994), and

extraversion has been related to a number of psychological problems (Bienvenu et al.,

2001; Watson et al., 2005). A clear understanding of extraversion and its subcomponents

is needed to understand both the development of personality and the development of

psychopathology. Developmental features in middle childhood may highlight these

differences, with children 8 to 10-years-of age at a stage when children start making

unsupervised decisions about interactions with other children (Shiner, 1998) and are thus expressing themselves as individuals without the direct influence of parents.

Temperament and Personality

The current study is designed to examine empirical relations among different aspects of extraversion in childhood, including subcomponents from both temperament and personality models of extraversion. A challenge for researchers seeking to understand the development of individual differences in childhood is to be able to characterize differences as more temperamentally based or better described as personality. As previously discussed, temperament is defined as constitutionally based individual differences in emotional, motor, and attentional reactivity and self-regulation (Rothbart & Bates, in press). Temperament is relatively consistent across situations and stable through time, although changes related to development have also been reported (Rothbart & Bates, in press).

Recent literature has called for more research on temperament and personality, as well as links between the two, in childhood (Diener & Scollon, 2002; Shiner, 1998; Shiner & Caspi, 2003). Temperament serves as the biologically based foundation of personality and as a subset of biologically based variables within personality. Dimensions of personality that go beyond temperament include individual differences related to cognition, especially self-concept and the conceptions of the self in relation to others (Ahadi & Rothbart, 1994).

Personality can be defined as "an individual's characteristic patterns of thought, emotion, and behavior, together with the psychological mechanisms—hidden or not—

behind those patterns" (Funder, 2001, p. 2). This definition shares elements with temperament in its inclusion of emotion and behavior and some of these behaviors would be considered to be temperamental (e.g., behaviors that show differences in tendencies for motor activity). Characteristic patterns of thought are outside the definition of temperament, though differences in thought may be influenced by temperament and biological factors. Biological factors that influence thought, emotion, and behavior could easily be considered "hidden psychological mechanisms." A link between temperament and personality might provide the hidden mechanisms suggested in this definition.

The current investigation of the structure of extraversion in middle childhood uses subcomponents from multiple models of temperament and personality, and is exploratory in nature. First, internal consistency reliability is determined for new scales measuring subcomponents of extraversion and for revised temperament scales previously tested. The relations among these subcomponent scales is examined and then entered into a principal components analysis to determine the structure of the subcomponent scales. Finally, correlations between the scales and an existing broad measure of extraversion are examined. Two possible outcomes are equally plausible: (1) Extraversion forms a broad, unidimensional construct applicable to both temperament and personality models. Shiner and Caspi (2003) proposed a higher-order extraversion trait that includes lower-order traits that represent both temperamental and personality constructs: (negative) shyness, sociability, activity level, and dominance. Considering extraversion a broad trait is common to most models of adult personality (Watson & Clark, 1997). (2) Victor, Rothbart, and Baker (2006) included components of both temperament and personality in

one unified measure and found two separate factors related to extraversion. The first was labeled Sociable Extraversion and the other Unsocialized Stimulation Seeking. Subscales that comprised these factors are described in more detail in the following section.

Measurement of Extraversion

Subcomponents

Different theorists have posited a variety of ideas about the fundamental nature of extraversion. Understanding what may be central to this broad trait, i.e., a core feature, can provide explanations for observed patterns of relationships between behaviors and trait measures (Lucas et al., 2000), and lead to an understanding of the underlying mechanisms of extraversion. Determination of a core feature of extraversion as discussed in a later section requires an understanding of theoretically derived definitions of the trait and the components that commonly comprise extraversion in factor analytic models. Extraversion components included in the current study are now discussed.

Activity Level is defined as level of gross motor activity, including rate and extent of locomotion (Rothbart, Ahadi, Hershey, & Fisher, 2001). Tendencies to run around when given the opportunity and to feel that one has a lot of energy characterize activity level in middle childhood (Simonds & Rothbart, 2006). Activity level is directly or indirectly considered to be a subcomponent of extraversion in many, but not all, temperament and personality models (Watson & Clark, 1997). John, Caspi, Robins, Moffitt, and Stouthamer-Loeber (1994) suggest that activity level is related to the way extraversion may change across development, with physical activity more important and

salient earlier in development and social activity more prominent in adulthood. In factor analytic studies of temperament, an activity level scale loads on a surgency/extraversion factor for all age groups in which activity level is measured (infancy, toddlerhood, childhood, adulthood) (Putnam et al., 2001). Victor et al. (2006) found that Activity Level loaded on both the Unsocialized Stimulation Seeking and Sociable Extraversion factors resulting from parent reports of 3- to 12-year-old children. In the course of development, the level of motor activity is less subject to uncontrolled impulses because of the development of temperamental systems, such as effortful control (Rothbart & Rueda, 2005).

Sociability/Gregariousness can be defined as a preference for and enjoyment of being with others rather than being alone (Asendorpf & Meier, 1993). Shiner and Caspi (2003) defined sociability as a preference for being with others and highlighted a distinction between sociability and shyness, seen as two separate constructs that become increasingly separable in middle childhood. A scale measuring gregariousness loaded highly on the Socialized Extraversion factor in Victor et al. (2006).

Assertiveness/Dominance is defined by Shiner and Caspi (2003) as a child's exertion of influence over other children's behavior. Aspects of dominance and assertiveness have been included in numerous extraversion models, either directly or indirectly (Watson & Clark, 1997). Watson and Clark proposed that social visibility combined with assertiveness defines a subcomponent of extraversion called "ascendance." Parent-reported assertiveness ratings of 3- to 12-year-old children loaded on the Unsocialized Stimulation Seeking factor in Victor et al. (2006).

Positive Affect is defined as the tendency to experience positive emotions such as happiness, cheerfulness, and optimism (Watson & Clark, 1997). Pavot, Diener, and Fujita (1990) found that extraverts experience more positive emotions than introverts, whether in social situations or alone. The tendency to experience positive emotions is often included in models as a component (Costa & McCrae, 1992), or used as a core feature of the construct (Shiner & Caspi, 2003; Watson & Clark, 1997). Positive affect, measured as smiling and laughter, has been found to load with a surgency/extraversion factor in infancy, but with effortful control in childhood in the United States, but not in China (Ahadi, Rothbart, & Ye, 1993; Putnam et al., 2001). In cultures where displays of positive affect are the norm, it is likely that smiling and laughing become more socialized in childhood. Victor et al. (2006) found that a scale measuring positive emotions loaded highly on a Sociable Extraversion factor and did not load on the less-socialized extraversion factor (Unsocialized Stimulation Seeking) in their study of 3- to 12-year-old children.

Reward Sensitivity is defined as increased physiological, emotional, and cognitive reactivity to the prospect of obtaining tangible incentive objects and increased behavioral responsiveness to tangible incentive objects. Reward sensitivity is discussed in detail in a later section.

High Intensity Pleasure is the amount of pleasure or enjoyment related to situations involving stimulus intensity, rate, complexity, novelty, and incongruity (Rothbart et al., 2001). This construct is similar to sensation seeking, defined by Zuckerman (1994) as the need for intense sensory stimulation and stimulation that is

varied, novel, and complex. Risk taking in order to satisfy the desire for such stimulation is also part of Zuckerman's conceptualization of sensation seeking. An excitement-seeking scale loaded on the Unsocialized Stimulation Seeking factor in Victor et al. (2006).

Impulsivity is defined as speed of response initiation (Rothbart & Bates, in press). Depue and Collins (1999) link impulsivity to the action readiness characteristic of an incentive motivation model of extraversion. In laboratory studies of infant temperament, short latencies to grasp novel objects are indicators of behavioral activation, or approach tendencies (Rothbart, Ahadi, & Hershey, 2000). Most models of adult personality separate impulsivity from extraversion, as the two are widely regarded to be different constructs (Depue & Collins, 1999; Watson & Clark, 1999). In infancy and childhood, however, factor analytic studies have shown primary loadings of Impulsivity on a Surgency/Extraversion factor (Putnam, Ellis, & Rothbart, 2002). An impulsivity scale conceptually similar to the one used in the current study loaded on the Unsocialized Stimulation Seeking factor in Rothbart, Victor, and Baker (2006). In development of the Temperament in Middle Childhood Questionnaire used in the current study (TMCQ; Simonds & Rothbart, 2006), conceptual work was done during item development toward isolation of impulsivity as speed of response initiation from lack of inhibitory control and sensation seeking (See Appendix A for scale names and definitions and Appendix B for items).

Low *shyness* has been included in a number of extraversion models (e.g., Shiner & Caspi, 2003). Shyness is associated with the inhibition of behavior and is also a part of

the fear system which influences emotional responses to perceived threats or danger (Rothbart & Bates, in press). In the case of shyness, the emotional response is discomfort and perceived threat associated with people, most frequently strangers. Because shyness is a part of the system associated with behavioral inhibition rather than approach, it is not included as an extraversion component. However, it is measured and this study allows for examination of relationships of temperament and personality extraversion scales to shyness.

Multi-Informant Reports

Parent Report

With some exceptions (Luby, Svrakic, McCallum, Przybeck, & Cloninger, 1999; Windle & Lerner, 1986), instruments designed for the measurement of child temperament have been limited to parental report (McClowry, Hegvik, & Teglasi, 1993). Parents as informants, however, have been criticized for potential biases that prevent accurately reporting their children's behaviors and attributes (e.g., Kagan, 2001). Potential biases in parent report include distortion of parent perception of a child's behavior through possible idealization of one's own child, limits of language and content in the development of questionnaire items, and low agreement of parent reports with those of neutral observers in some studies (Rothbart & Bates, in press). Despite these concerns, parent measures have continued be included in research and in the diagnosis of child psychopathology, and researchers continue to create parent-report instruments to measure child functioning (e.g., Nauta et al., 2004).

Continued use of parent-report measures is likely based on both methodological advantages and validation research. Among the methodological advantages: (1) Parents spend more time with their children than other potential informants and see their children across a variety of settings. Mothers, in particular, "become the chief archivists and historians of their young children's developmental milestones and behavior patterns" (Richters, 1992, p. 485). (2) By virtue of the amount of time spent with their children, parents are in a better position to observe low base-rate behaviors (Chamberlain & Reid, 1987) and to witness a wider range of behaviors than others (Wolk, Zeanah, Garcia-Coll, & Carr, 1992). (3) Questionnaire measures are advantageous for clinicians and researchers due to their brevity, ease of administration, and cost efficiency compared to observational and interview measures. (4) Until children have reached ages at which they are able to report about themselves with a fair degree of reliability, parents are the only observers readily available who can provide a comprehensive perspective on their children's lives. In a thorough examination of the validity of parent-report measures, Rothbart and Bates (in press) concluded that because parent reports allow assessment of a wide range of child behaviors, and because parent-report measures have established a "fair degree of objective validity" (p. 118), adequate evidence exists for the continued use of this method for measuring child temperament.

At present, research supporting claims of parental bias is inconclusive and most studies on the topic do not address the bias question directly (Simonds, 2005). Studies have been limited to examining correlations between reports of parents and other reporters, including child self-report, and between parent-report and behavioral measures.

Empirical studies have not been done that are specifically designed to test whether low agreement between parent-report and other measures is due to bias or to other types of measurement error. Without such studies, it is not possible to assess the degree to which parents are reliable, valid reporters of their own children's attributes and behaviors.

Child Self-Report

Children at age 7 and older, and with special methods, down to 4.5 years, seem to be able to reliably report about their own attributes, behaviors, and experiences (Danielson & Phelps, 2003; Hwang, 2003; Measelle, John, Ablow, Cowan, & Cowan, 2005; Scanlon & Ollendick, 1986; Schniering & Rapee, 2002; Shahinfar, Fox, & Leavitt, 2000). Cognitive development prior to and during middle childhood supports these abilities. By middle childhood, there is increased complexity in expressed self-representations (Harter, 1999). Chambers and Johnston (2002) reported that from ages 7 to 12, children begin to respond to traditional Likert-scale response items with more differentiation than the extreme responding style of 5- and 6-year-olds. Additionally, children seem to understand what they know about themselves compared to what others know about them. In one study, one quarter of 5-year-olds, approximately half of 7-year-olds and a majority of 10-year-old children reported themselves, rather than adults or teachers, to be the best source of information in self-knowledge domains (Burton & Mitchell, 2003).

Hwang (2003) and Measelle et al. (2005) used the Berkeley Puppet Interview technique (BPI; Ablow & Measelle, 1993) to assess temperament and personality in young children. Hwang (2003) found that children as young as age 4.5 were able to

report reliably about their own temperament. Self-reports of Big Five personality dimensions by children in a longitudinal study showed good internal consistency and a moderate degree of stability from ages 5 to 7 (Measelle et al., 2005). Behavioral observations of the same children were conducted at ages 6 and 7. Self-reports of Neuroticism were significantly correlated with sadness and anxiety observed in the laboratory. A self-report measure of the Big Five dimensions with 4th and 5th graders (Barbaranelli, Caprara, Rabasca, & Pastorelli, 2003) showed moderate correspondence with parent- and teacher-report and confirmatory factor analyses of self-report factors showed fit with the Big Five factors. Simonds and Rothbart (2006) found that 7- to 10-year-olds were reliable reporters of their own temperament on a computerized self-report measure.

In addition to multiple types of measurement, the current study uses both parent- and self-report measures. Parents tend to be better reporters of external behavior and children more accurate reporters of internal states and moods (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000; Wrobel & Lachar, 1998); therefore, collecting reports of temperament- and personality-related behaviors from both parents and their children may strengthen questionnaire measurement of the extraversion subcomponents by including two important perspectives on children's temperament and personality attributes.

It is expected that, as found in previous studies (Simonds & Rothbart, 2006; Simonds, Kieras, Rueda, & Rothbart, 2006), children in the current study are reliable reporters of their own temperament and personality. Parent-child agreement is expected to be moderate.

Core Feature(s) of Extraversion:
What is Central to the Trait?

Most existing definitions of extraversion are based on factor analysis, with extraversion defined by the scales that correlate to form the broad factor (Watson & Clark, 1997). Less attention is given by researchers to the specification of extraversion through identifying its underlying neurobiological system or systems although this has also been done (Depue & Collins, 1999). What is needed to identify a core feature of extraversion is understanding the way that scales consistently correlate with one another to form an extraversion factor. Put another way, a core feature is the "glue" that holds related subscales together (Lucas et al., 2000). By understanding the feature or features central to extraversion, we can understand what biological systems are likely to form the underlying core of the trait.

While there is some agreement about the components of extraversion, disagreements exist about its core feature (Ashton et al., 2002; Lucas et al., 2000; Watson & Clark, 1994). Based on strong correlations of reward sensitivity, positive affect, and other extraversion subscales, McCrae and Costa (1987) have identified the core feature of extraversion as sociability, defined as enjoyment of others' company, based on loadings of questionnaire items on the extraversion factor. Similarly, Ashton et al. (2002) argued that "social attention" is the core feature of extraversion. Watson and Clark (1994) proposed positive affectivity as a core component of extraversion, arguing that positive affect leads to and results from social activity. Watson & Clark (1999) later named a

"superfactor" as extraversion/positive emotionality, placing positive emotionality at a level equal to extraversion.

Lucas et al. (2000) found evidence supporting a model of extraversion with reward sensitivity as its core feature. Because many questionnaire items about sociability address the enjoyment of social activity (e.g., "You like parties."), Lucas and colleagues proposed that such items are simply measuring the rewarding aspects of social interaction. By developing items that addressed only the preference to be in groups or alone (e.g., "You rarely go out of your way to find time just for yourself" [Lucas et al., 2000, p. 468]), they found that social interaction alone was not related to the overall measure of extraversion. When only the preference for spending time with others or alone was included in items, important elements of extraversion, especially the pleasure derived from social interaction, were missing from the content of the items. Enjoyment of crowds is related to enjoyment of stimuli that are varied and intense in nature (High Intensity Pleasure), enjoyment of contact with groups of people (Gregariousness), and to the social rewards derived from interaction (Reward Sensitivity). Lucas et al. (2000) concluded that social interaction alone did not relate to overall extraversion, and found that only those aspects related to reward sensitivity loaded on a broad extraversion factor.

Many terms have been put forth to describe a motivational and behavioral system based on enhanced responsiveness to incentives: Incentive motivation, reward sensitivity, behavioral facilitation, and behavioral activation. All are slight variants of each other or are synonyms that can be used to describe a reward-based system that influences reactivity and responsiveness to incentives. For the purposes of the current study, the

term "reward sensitivity" is used and is defined as increased physiological, emotional, and cognitive reactivity to the prospect of obtaining tangible incentive objects and increased behavioral responsiveness to tangible incentive objects.

Based on biological models of extraversion-related behaviors (Depue & Collins, 1999; Gray, 1991), the current study focuses on reward sensitivity as a core feature of the trait. In this view, extraversion and co-occurring positive affect are based biologically in a reward-related approach system. Foundations of this system are believed to relate to primitive behaviors of foraging and the experience of expectancy, termed by Panksepp (1998) as the "seeking" system. In energetically setting out to explore one's environment, one is able to discover, seek, and obtain needed resources for survival. Positive affect is derived from emotional responses in anticipation of rewards (Panksepp, 1998).

Gray (1987) labeled the biological system relating to reward orientation the Behavioral Activation System (BAS); it describes individual differences in sensitivity to reward cues and active engagement with the environment. Depue and Collins (1999) define this system as "behavioral approach based on incentive motivation" (p. 498). Empirical evidence of relationships between underlying motivation and higher-order traits is found in correlations between reward sensitivity, positive affect, and other facets of extraversion (Carver & White, 1994). Depue and Collins (1999) posited that positive affect is a reflection of the underlying incentive motivation system and that "the basis of individual differences in the frequency and intensity of incentive motivation…is the main source of individual differences in extraversion" (p. 495).

Studies of neurological bases of reward behavior focus on the medial orbitofrontal cortex, the medial forebrain bundle (MFB), and the mesolimbic and mesocortical dopamine (DA) pathways (Bozarth, 1991; Cohen, Young, Baek, Kessler, & Ranganath, 2005; Depue & Collins, 1999; Nichols, Martin, Wallace, & Fuchs, 2001). The MFB extends from the lateral hypothalamus to the ventral tegmental area (VTA), where the mesolimbic DA pathway originates. This pathway innervates structures of the limbic system, including the nucleus accumbens and amygdala. The mesocortical dopaminergic pathway projects to the frontal cortex (Nichols et al., 2001). Stimulation of the MFB has been shown to affect behavior of animals when rewards are present (Bozarth, 1991). Dopamine has been implicated in the reward system by studies in which the MFB was stimulated, but dopamine receptors were blocked. Without functional dopamine receptors, animals showed normal motor functioning, but effects on behavior in the presence of reward were negligible (Bozarth, 1991). It appears that the rewarding effect of stimulation of the MFB depends on the dopaminergic neurotransmission that results from the stimulation. Depue and Collins (1999) describe this role as a modulatory one such that dopamine facilitates incentive motivation.

In a recent functional Magnetic Resonance Imaging (fMRI) study, Cohen et al. (2005) found significant differences in activation of the medial orbitofrontal cortex, amygdala, and nucleus accumbens during evaluation of a reward between adults who scored high and those who scored low on the extraversion scale of the Big Five Inventory (BFI; John & Srivastava, 1999). These brain activity differences were also related to the presence of the A1 allele on the D2 (dopamine) receptor gene (Cohen et al., 2005). These

findings provide empirical support for the centrality of reward processes as reflected in dopamine function and brain activity in areas known to affect reward behaviors.

Given the importance of reward in processes underlying extraversion, reward sensitivity is a plausible candidate as a core feature of the broader trait. Examination of a core-feature hypothesis requires empirical evidence of a strong correlation between the candidate core feature, the broader trait, and other subcomponents. In this study, reward sensitivity is tested for its relationship to extraversion using behavioral and questionnaire measurements. This study will contribute to our understanding of extraversion in middle childhood and may provide a set of methods to study extraversion at other developmental stages, and to study the structure of other broad traits.

Reward Sensitivity and Behavior

Questionnaire Measures of Reward Sensitivity

In Cloninger's (1986) measure of three dimensions of personality, the Tridimensional Character Inventory (TCI), the Novelty Seeking scale is designed to measure a dopamine-driven system described as behavioral activation. Included in Novelty Seeking are four subscales measuring tendencies to: explore new things (Exploratory Excitability), behave in a reckless fashion (Impulsiveness), engage in excessive spending behavior (Extravagance), and lack structure (Disorderliness). Cloninger's (1986) Reward Dependence measures social and emotional closeness with others. Reward Dependence is based on the concept that social approval and sentiment

are "signals of reward." Cloninger's Reward Dependence construct is closer in definition to affiliation (see Appendix A) than reward sensitivity as defined for this study.

Jackson and Smillie (2004) approached measurement of the Behavioral Activation System (BAS) "from the perspective of impulsively approaching appetitive stimuli with the goal of obtaining a rewarding experience" (p. 1628). One factor was found for items on this scale. Some difficulty was nevertheless posed by the inclusion of multiple constructs in the items (for example, "I believe rules are stifling." [Jackson & Smillie, 2004, p. 1630] addresses compliance and aspects of agreeableness), and by vocabulary that assumes a certain level of socioeconomic status ("I am excited by what is new in my field." [p. 1630], requiring that the respondent is engaged in certain professions and careers). Item content was not appropriate for adaptation to a child version.

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Ávila, Moltó, & Caseras, 2001) was also developed to assess BAS functioning. Like the Jackson and Smillie (2004) measure, item content included multiple constructs ("Are you frequently encouraged to act by the possibility of being valued in your work, in your studies, with your friends or with your family?" [p. 846] is conceptually and grammatically complex) and its items were not appropriate for adaptation to a child version ("Do you often take the opportunity to pick up people you find attractive?" [p. 846]).

Carver and White (1994) designed the Behavioral Activation Scales (BAS) as a measure of appetitive motivation as conceptualized by Gray (e.g., 1987). The instrument

is designed to measure the system such that "greater BAS sensitivity should be reflected in greater proneness to engage in goal-directed efforts to experience positive feelings when the person is exposed to cues of impending reward" (Carver & White, 1994, p. 319). The BAS includes three subscales: Drive, Fun Seeking, and Reward Responsiveness. Muris, Meesters, de Kanter, and Timmerman (2005) developed a self-report version of the BAS scales for Dutch children, 8- to12-years-old and found good internal consistency, as well as the expected positive relationship to extraversion. An adaptation of the BAS scales is included in the current study based on the applicability to self-report for children. The Reward Responsiveness subscale includes items that relate directly to the way reward sensitivity has been defined for this study (e.g., "When I get something I want, I feel excited and energized," Carver & White, 1994, p. 323).

<div align="center"><i>Incentive-Related Behavior, Reward Sensitivity,
and Extraversion</i></div>

In steps of the validation process for the Behavioral Activation Scales (BAS; Carver & White, 1994), participants were given incentives for performance on a simple task and mood reports were collected at three time points: at the start of the task, in the middle of the task, and at the end of the task. At the second and third mood-measurement times, participants were told they had achieved the level of performance required for a reward, regardless of actual performance. When controlled for initial happiness, reports of positive mood at the final report time were positively correlated with the drive and reward responsiveness subscales of the BAS, but not with a measure of overall extraversion or the fun-seeking subscale of the BAS.

Kamboropoulos and Staiger (2004) used a card-sorting task involving within-subject incentive and non-incentive conditions. Following a task description, but prior to beginning the task, participants were asked the degree to which they thought the task would be rewarding. Upon completion of the task, participants were asked how rewarding they thought the task actually was. Participants were considered to find the task rewarding if they reported greater rewardingness of task upon completion than initial anticipation of rewardingness. Participants who scored above the median on reward sensitivity (SPSRQ; Torrubia et al., 2001) and who found the task rewarding sorted significantly more cards in the same amount of time when given a monetary incentive than when no incentive was offered.

Using the extraversion and neuroticism scales of the Eysenck Personality Questionnaire (EPQ-RS, Eysenck, Eysenck, & Barrett, 1985), Derryberry and Reed (1994) found differences in performance on a target-detection task with incentives and punishments. Neurotic extraverts showed more costs to reaction time for positive cues that followed negative feedback. Derryberry and Reed concluded that "negative feedback enhances goal-oriented behavior in extraverts…this involves enhanced attention to reward cues and decreased attention to punishment cues" (1994, p. 1137).

In the current study, it is predicted that behavioral differences between reward and non-reward conditions are correlated with questionnaire measures of reward sensitivity and with overall extraversion. For behavioral measures of reward sensitivity, testing for increased reactivity to potential incentive objects and behavioral responsiveness to incentive objects, three tasks include situations with a non-incentive condition and an

incentive condition: a computerized reaction time measure, gift unwrapping, and a card-sorting task. It is predicted that children with the largest differences between reward and non-reward conditions are children who are reported by themselves and parents as more extraverted.

Extraversion and Response Execution

Extraversion-related differences have been found in tasks separating the time between stimulus and response into reaction time (RT) measured as the time from presentation of a stimulus to the time of lift-off from a home key and movement time (MT) measured as the time from lifting off of a home key to the time of pressing a response key. No differences have been found between extraverts and introverts on RTs, but differences in MTs have been found, showing that extraverts are faster in their motor response to stimuli than are introverts (Doucet & Stelmack, 1997, 2000).

These findings are supported by an additive-factors model in which overall RT can be divided into components that indicate different stages of processing between stimulus presentation and response (Sternberg, 1969). Different factors indicate differences in sequential stages of processing. The serial-stage processing theory predicts that effects of any one factor will be orthogonal to effects of other factors. This model allows identification of differences based on hypothesized underlying mechanisms that influence early, middle, or late stages within overall reaction time.

Dehaene (1996) investigated three orthogonal processing stages in a number-size identification task: stimulus identification, magnitude identification (response organization), and response execution. The task required participants to respond based on

whether a number stimulus was higher or lower than the number 5. Stimulus identification was manipulated through the notation of number stimuli (Arabic digit or word in text), magnitude identification through how close the stimulus number was to 5 (close to or far from 5), and response execution through left- versus right-handed key presses.

Dehaene (1996) found that response execution differences (i.e., differences between RTs of right-handed vs. left-handed responses) correlated with differences in lateralized readiness potentials (LRPs). LRPs are electrical potentials localized in the left and right premotor and motor cortices (Dehaene, 1996) thought to reflect the preparation of different hands for motor response (Wild-Wall, Sangals, Sommer, & Leuthold, 2003). Rammsayer and Stahl (2004) found shorter LRP latencies for extraverts prior to motor response and execution of the actual response in a go/no go task.

Response hand differences serve as a behavioral measure of motor differences in the current study. Given the relation between extraversion and motor performance, it is expected that differences in response execution, but not stimulus identification or overall RTs, will be related to extraversion. In this study, using the number comparison task described in Dehaene (1996), response execution is examined in relation to extraversion and reward sensitivity is measured through questionnaire and laboratory task performance. All three processing stages (stimulus identification, magnitude identification, and response execution) and overall RTs are examined for extraversion-related differences when incentives are or are not present. It is predicted that children with larger differences between response with the preferred hand and the non-preferred

hand are those rated as more extraverted and that the reward condition amplifies response hand differences in the more extraverted children.

<div align="center">Research Questions and Predictions</div>

Through measurement of multiple components of extraversion found in models of the trait, this study will provide information about the structure of extraversion in middle childhood. Candidate core features are examined with questionnaire measures of multiple components and behavioral assays of two of those components: reward sensitivity and activity level.

This study tests a recent revision of a self- and parent-report temperament measure and provides information about the reliability of scales in this measure. It is expected that both parent- and self-report scales will show good internal consistency, revealing that children are reliable reporters of their own temperament and personality. Parent- and self-report agreement is predicted to be moderate on this measure. Also examined in this study are as yet untested self-report adaptations of scales measuring gregariousness, positive affect, reward sensitivity, and personality. It is expected that parent-child agreement will also be moderate on these scales.

Through principal components analysis of the extraversion subcomponents included in this study, the structure of extraversion for self- and parent-report is determined for this sample. This componential analysis will add to our understanding of extraversion in both temperament and personality models.

Reward sensitivity is measured through both questionnaire (child- and parent-report) and behavioral assays. It is predicted that questionnaire measures of reward

sensitivity will show a high degree of correlation with measures of extraversion and its subscales. Behavioral assays of reward sensitivity include conditions in which a tangible incentive is possible or in which no tangible incentive is possible: (1) a computerized task in which points are earned, half of which are connected to earning toys; (2) unwrapping gifts, one of which is a reward; and (3) sorting card decks, one of which is connected to a monetary incentive.

For the purposes of this study, it is predicted that children with larger differences between performance in reward and non-reward conditions are those who are rated as more sensitive to rewards and as more extraverted on questionnaire measures. It is also hypothesized that differences in response execution as shown through reaction time differences between the preferred and non-preferred hands correlates with extraversion, and that the presence of tangible incentives increases the magnitude of that relationship. This prediction is based on Dehaene's (1996) findings that response hand differences correspond to differences in brain activity in the motor cortices, lateralized readiness potentials (LRPs), found by Rammsayer and Stahl (2004) to relate to extraversion. The presence of incentives was expected to increase the effect of response hand in more extraverted children.

CHAPTER II

METHOD

Participants

Fifty-eight children participated in the study. Participants consisted of a group of 21 children aged 8 years (11 boys, 10 girls); a group of 19 children aged 9 years (8 boys, 11 girls); and a group of 18 children aged 10 years (8 boys, 10 girls). Overall mean age of the sample was 8.95 years ($SD = 0.82$). Of the 59 participants, 55 were White/Caucasian, 2 were Native American, and 2 were Multiracial (races unspecified).

Participants were recruited by phone and mail from the University of Oregon Psychology Department Developmental Database, a list of children and families in the Eugene-Springfield area developed from newspaper birth announcements. Stratified sampling was used to include approximately equal numbers of subjects by gender and by age. Children were compensated with $20 in their choice of cash or a gift certificate to a local variety store. Only right-handed children were included in the analyses.

Materials and Procedure

Participants completed a 1½ -hour session during which they completed two questionnaires, a computerized number task, decision tasks related to a separate study, and a card-sorting task. With the exception of the decision measures, each task the

children completed is discussed in detail in the following section. The list of tasks and the

amount of time each required is presented in the order they were completed (Table 1).

Table 1

List of Tasks and Approximate Completion Times

Task Number	Name of Task	Completion Time (minutes)
1	Temperament in Middle Childhood Questionnaire (TMCQ) (computerized)	20-25
2	Gift Unwrapping – Incentive Gift	2-3
3	Number Task	20-30
4	Gift Unwrapping – Non-Incentive Gift	2-3
5	Personality Questionnaire (BFI and Additional Measures) (non-computerized)	14–15
6	CARROT Card Sort Task	5–7

Questionnaire Measures

Temperament in Middle Childhood Questionnaire (TMCQ)

Computerized self-report and paper-and-pencil parent-report versions of the

Temperament in Middle Childhood Questionnaire (TMCQ; Simonds & Rothbart, 2006)

were used to measure surgency and other temperament constructs. The TMCQ was

largely based on the Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001), a

parent-report measure of temperament for 3- to 7-year-old children, with a majority of

items directly adapted for school-age children from the CBQ. Four scales not included on

the CBQ were added to the TMCQ (Activation Control, Assertiveness/Dominance,

Fantasy/Openness, and Affiliation). Items not adapted from the CBQ were written

specifically for the TMCQ or adapted from the Childhood Temperament and Personality

Questionnaire (CTPQ; Victor, Rothbart, & Baker, 2003) and the Berkeley Puppet

Interview self-report version of the CBQ (CBQ-BPI; Ablow & Measelle, 1993; Hwang,

2003).

The measure contains 16 scales comprised of 157 items. The 20- to 25-minute

self-report version of the TMCQ used a computer to present questions to children with a

cartoon voice of "Ducky." A non-animated graphic of a cartoon duck, wearing glasses

and a lab coat and holding a briefcase, appeared on the screen. The cartoon voice read

instructions to guide children through practice items and then read each item as it

appeared simultaneously in text on the screen. Response choices appear in a 5-point scale

from "not at all" to "a lot." A list of all TMCQ scales and operational definitions is found

in Appendix A.

Psychometric development of the TMCQ. Two earlier versions of the TMCQ have

been tested with ethnically diverse samples of children in both school and laboratory

settings. The second version of the TMCQ was tested with a sample of 147 children.

Internal consistency was examined, assessed by Cronbach's alpha based on inter-item

correlations. Scales below an alpha level of .60 included Activity Level, Affiliation, and

Shyness. Internal consistency for the parent-report TMCQ in the second version ranged

from alpha values of .63 to .90 (*Mdn* = .79). Prior to the third and current version of the

measure, scales with Cronbach's alphas of <.70 were revised for improved construct

representation.

Factor analysis of the second version of the TMCQ-C and TMCQ-P resulted in four factor solutions for both instruments, with the factors labeled Negative Affect, Effortful Control, Surgency, and Sociability. The Surgency factor includes subscales of activity level, assertiveness/dominance, high-intensity pleasure, impulsivity, and reversed shyness. Cronbach's alpha for the Surgency factor scales was .66 and .70 for self- and parent-report respectively.

Big Five Personality and Additional Scales

A 79-item questionnaire was used to measure Big Five personality factors, behavioral inhibition, behavioral activation, gregariousness, and positive affectivity (see below). Items (included in Appendix B) were formatted for parent report and for child self-report. The parent report personality questionnaire was administered in pencil-and-paper format. Administration of the child self-report version was accomplished using a paper form similar in appearance to the computer screen in the computerized TMCQ. Participants heard items read to them on a cassette player and marked responses with a "Bingo" marker which is designed to make a dot shape by stamping on paper. All parent and child self-report response choices were in a 1-5 Likert-scale format.

Big Five Inventory for Children. The Big Five Inventory for Children (BFI-C) is an adaptation of the 44-item adult instrument that uses short phrases to measure each of the Big Five Factors of personality: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness (John & Srivastava, 1999). Self-report items were adapted from those used in a previous study (Tobin & Graziano, 2006). Parents responded to

original BFI items phrased in third person language to allow them to report about their

children. Both parents and children completed the BFI and BFI-C respectively on paper.

BIS/BAS for Children. Scales measuring Behavioral Inhibition and Behavioral

Activation (BIS-C and BAS-C) were adapted from the BIS/BAS scales for adults (Carver

& White, 1994) in paper-and-pencil form for parents and pen-and-paper format for

children with items read to children on a cassette player. The BIS-C contains 7 items; the

BAS-C contains subscales of Drive, Reward Responsiveness, and Fun Seeking in a total

of 13 items.

Between data collection and data analysis, items on the BAS were reviewed for

construct representation. Based on the definition of reward sensitivity as increased

physiological, emotional and cognitive reactivity and behavioral responsiveness to

tangible incentive objects, only three items were retained as a reward sensitivity scale in

the analyses. See Appendix B for the items that were included and Appendix C for item

analysis of all three BAS subscales.

Positive Affect Scale. Based on adjectives from the Positive Affect Negative

Affect Scales (PANAS, Watson, Clark, & Tellegen, 1988), a scale of 9 items was created

to measure trait positive affectivity. During pilot testing, it was determined that the

adjective form of the PANAS and PANAS for children (Laurent et al., 1999) were

beyond the vocabulary level of 8-year-olds. Behavioral items were developed to provide

items that would be easily understood by children. Participants completed the Positive

Affect Scale on paper with items read to them on an audio cassette player, and parents completed corresponding items in paper-and-pencil form.

Gregariousness/Sociability scale. A 6-item scale describing tendencies to seek and enjoy the company of others was used to measure gregariousness/sociability. Items were derived from different measures of gregariousness and sociability found in the International Personality Item Pool (2006) and in the Child Temperament and Personality Questionnaire (Victor et al., 2003). Children completed items on paper with items read to them on an audio cassette player, and parents completed corresponding items in paper-and-pencil form.

<center>*Additional Extraversion Measures*</center>

Observer Ratings

In the middle and at the end of each session, experimenters provided observational ratings of extraversion. For observational ratings, extraversion was operationalized as talkativeness, eye contact, physical activity, positive affect, and apparent excitement about incentives, based in part on a coding scheme developed by Kim-Cohen, Moffitt, Caspi, and Taylor (2004). Experimenters were instructed to rate each child on a 1 to 5 scale for each of the five subcategories of extraversion. No additional instructions were provided to experimenters. Observer data was complete for 54 participants. Four participants were not included in the analyses due to experimenter omission of some ratings.

Behavioral Measures

Number Task

A computerized number task described in Dehaene (1996) measured differences in response time based on incentive or no-incentive conditions and left and right hand key presses. In the task, children were instructed to determine whether a number stimulus was larger or smaller than the number 5. Stimuli consisted of Arabic digits 1, 4, 6, and 9 and text words ONE, FOUR, SIX, and NINE. Children were instructed to press a key with the left index finger if the number was lower than 5, and a key with the right index finger if the number was higher than 5.

An experimenter gave verbal instructions to the child and then a first practice block of 32 trials with feedback about correct or incorrect responses and a second practice block of 48 trials during which children received feedback in the form of a green plus sign or red minus sign to indicate whether they had earned points on each trial. The two practice blocks were followed by three blocks of 48 trials. The experimenter explained to the child that if responses were fast enough, he or she would earn points and if responses were too slow or incorrect, points would be subtracted. Points in gray text were an indication of a subject's progress (non-incentive trials); those in orange text (incentive trials) were the ones that counted and determined the number of tickets the child would earn at the end of the activity (see Figure 1 for example screen). Color of text in which points were displayed changed simultaneously with the appearance of a stimulus, so that children knew whether each was a reward or non-reward trial at the time of the trial. The experimenter showed toys to children and explained that they would be

able to trade their tickets for toys when they were finished. Twenty-four right-handed males and twenty-eight right-handed females completed the Number Task.
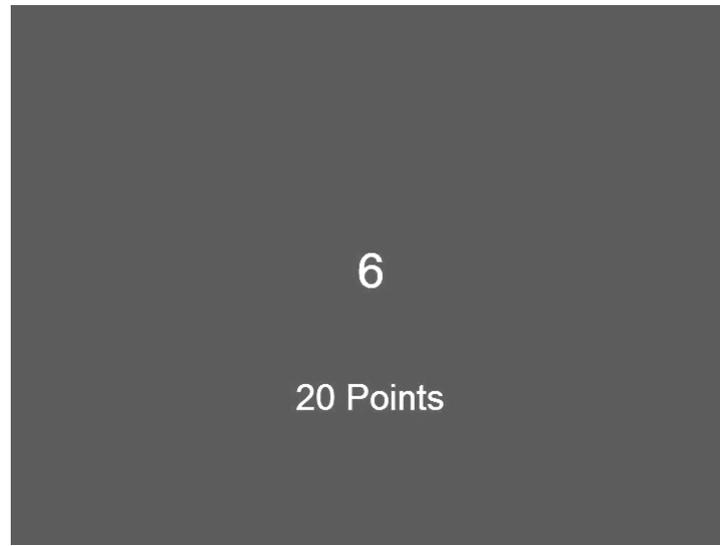
Figure 1

Example of Number Task Screen with a Digit Stimulus
on a Non-Reward (gray text) Trial

Gift Unwrapping

Prior to administration of the temperament questionnaire, children were told that they would receive a gift when they completed the questionnaire. When each child finished all questionnaire items, the experimenter explained to the child, "Okay, you have finished. Now it's time for your present. Could you go and get that white bag over there and bring it to me?" When the child returned, the experimenter said, "Okay, now I'm going to give you your present. Here you go." The experimenter gave the gift to the child and said, "Okay, now you can open it."

At a later point in the session, the research assistant broke a pencil and said to the child, "Oh, no, I broke my pencil. Hey, my friend gave me a present and she hinted that there might be pencils in there. Could you go get that blue bag over there while I check over here (motioning to another area of the room)?" The blue bag was in the same area as the white bag was earlier. When the child returned with the bag, the experimenter took the wrapped box (identical in size/shape to previous gift box) from the bag, handed it to the child and asked the child to unwrap the box so the experimenter could look in a drawer in the table where both were seated, apparently looking for a pencil. The boxes were wrapped with wrapping paper of different colors and patterns. Videotapes of gift unwrapping were coded for the time between the child touching the gift to the time the wrapping paper was removed from the gift.

Videotapes of children unwrapping two different gifts were coded for the time from the moment the child grasped the gift to the time the paper was off of the box. The first gift was the reward condition when the child knew that there was a gift for him or her inside the box. The second gift served as a non-reward control when the child thought that the purpose of opening the experimenter's gift to see if there were pencils inside to replace the one apparently broken by the experimenter.

Gift data was available for 47 participants. Data for the remaining 11 participants was missing due to a range of issues, including experimenter error affecting the child's expectation when opening the gift, child's failure to remove all paper from the gift box, and prior knowledge of pencil breaking from a sibling's previous participation. Ten sets

of video segments showing gift unwrapping were coded by two research assistants for reliability within one second. These segments showed an average of 98.67% agreement.

Card-Arranging Reward Responsivity Objective Task (CARROT).

The card arranging reward responsivity objective test (CARROT) has been used to measure responsiveness to rewards (Powell, Al-Adawi, Morgan, & Greenwood, 1996). The task was devised to measure differences in speed on a psychomotor task between a condition in which a small financial incentive is offered and one in which no incentive is offered. Participants were given a stack of 40 cards, each of which has two colored adhesive dots affixed to it. On each card, one of the colors is one of three designated colors (blue, red, green), with the other color on each card a non-designated color (black, purple, yellow, orange). Participants were asked to sort 40 cards as quickly as possible into three correspondingly colored trays (i.e. blue, red, green). The task consists of three sorting trials (T1–T3), performed with a brief rest period between each trial.

The first trial (T1) required participants to sort 40 cards into the trays. In T2, participants were informed that they would be rewarded with a nickel (5 cents) for every five cards sorted. For this trial, the lab assistant sat across from the participant and placed a stack of 12 nickels in front of him/her. The lab assistant slid a nickel across to the participant after groups of five cards were sorted, for a total of 8 nickels. The final trial (T3) was identical to T1. The final trial was included as a control for the possibility of fatigue or practice effects that could influence card-sorting speed (Al-Adawi & Powell, 1997). The dependent variable was the difference between the time to sort 40 cards in T2 and the average of times in T1 and T3. The CARROT was validated in a group of 80

normal adult participants who showed an average increase in card-sorting rate of about 4% when rewarded ($p < 0.001$; Powell et al., 1996). CARROT scores were positively correlated with clinical motivation in a sample of 54 brain injury patients (Al-Adawi, Powell & Greenwood, 1998).

Videos of children sorting cards in the CARROT task were coded for each deck of 40 cards from the time the first card of the deck crossed the top of the corresponding basket to the time the last card crossed the top of the basket. CARROT videotapes were coded for 45 participants. CARROT videos for 13 children were not coded due to a variety of problems: experimenter error and problems that arose during the task. The most frequent problem was dropped cards. Videos of the CARROT task in which cards were dropped were screened and participants with delays due to card dropping that lasted more than 2 seconds were excluded from analyses. Other problems were trays that were bumped or moved during the task and differences in the way children sat during different sections of the task. Ten sets of CARROT segments were coded by two research assistants for reliability. Percentage agreement for these segments was 99.17% within two seconds of each duration time.

Task Enjoyment Ratings

Prior to the TMCQ, Number Task, Personality Questionnaire, and CARROT, research assistants gave a standardized explanation of the task (see Appendix D) and participants were asked how much they thought they would like the activity based on the description. They were shown a laminated card with five schematic faces representing a 1-5 Likert scale to indicate liking (see Figure 2). By pointing to the card, participants

indicated their level of expected liking for the activity. Research assistants recorded responses in writing. Following completion of each activity, participants were asked how much they liked the activity using the same method.
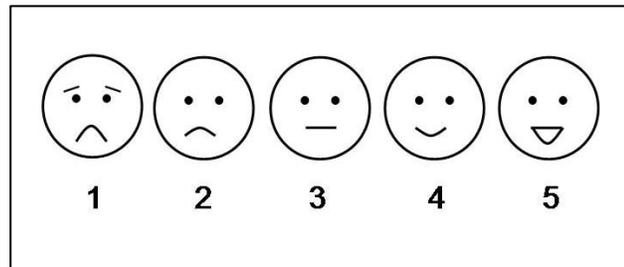
Figure 2

Schematic Faces for Indication of Task Enjoyment

Complete ratings of anticipated task liking were recorded for 53 participants for each of the five experimental tasks. Missing data was due to experimenter error, particularly the failure to collect the final task rating. Task ratings for a decision task conducted for a separate study were included.

CHAPTER III

RESULTS

Questionnaire Measures

Temperament in Middle Childhood Questionnaire (TMCQ)

Internal Consistency Reliability

Cronbach's alpha levels were calculated for the self-report TMCQ and then for the parent-report TMCQ. All internal consistency reliability analyses are reported in Table 2. Alpha levels of self-report scales ranged from .62 to .83 (*Mdn* = .75). Because this study is the first test of a revised version of the TMCQ, items were removed from some scales with initial alphas of less than .70 to improve reliability while maintaining construct representation and specificity. No items were deleted from the Assertiveness/Dominance, Attention Focusing, Discomfort, Impulsivity, and Inhibitory Control scales. One item was deleted from the Activity Level, Affiliation, Anger/Frustration, Fantasy/Openness, Fear, Perceptual Sensitivity, and Sadness scales. Two items were deleted from the Activation Control, High Intensity Pleasure, Low Intensity Pleasure, Shyness, and Soothability scales. Of the 157 original items, 141 items were retained. See Table 2 for the number of items remaining in each scale and Appendix B, which includes items retained after reliability analyses were performed.

Table 2

Temperament (TMCQ) Scales Internal Consistency
(Cronbach's α)

TMCQ Scales	Self-Report Alpha	Parent Alpha	# of Items
Activation Control	.77	.81	13
Activity Level	**.73**	**.84**	**8**
Affiliation	.74	.74	9
Anger/Frustration	.83	.88	6
Assertiveness/Dominance	**.78**	**.77**	**8**
Attention Focusing	.77	.86	7
Discomfort	.77	.76	10
Fantasy/Openness	.75	.75	8
Fear	.74	.73	8
High Intensity Pleasure	**.65**	**.79**	**9**
Impulsivity	**.86**	**.92**	**13**
Inhibitory Control	.67	.80	8
Low Intensity Pleasure	.65	.71	6
Perceptual Sensitivity	.75	.77	9
Sadness	.79	.86	9
Shyness	.62	.88	3
Soothability	.69	.84	6

Note: Extraversion scales in bold type.

Alpha levels for parent-report items that corresponded to the 141 items retained in the self-report analyses were determined through the same item-total analysis process performed on the self-report data. Cronbach's alpha for parent scales ranged from .71 to .92 (*Mdn* = .80; Table 2).

Agreement between Reporters

   TMCQ. Of the 57 parents who completed questionnaires about their children, 51

were mothers and 6 were fathers. The group of fathers was too small to consider

differences between mother- and father-report. Agreement between self- and parent-

report both for the total sample and by gender is reported in Table 3. For all temperament

Table 3

Self-Parent Agreement—Temperament Scales

Scale	Self-Parent Agmt: ALL	Self-Parent Agmt: Boys	Self-Parent Agmt: Girls
Activation Control	.42**	.34+	.43*
Activity Level	**.40****	**.51****	**.36***
Affiliation	.34*	.30	.31
Anger/Frustration	.04	-.21	.36*
Assertiveness/ Dominance	**.07**	**-.06**	**.24**
Attention Focusing	.34**	.00	.59**
Discomfort	.39**	.16	.30+
Fantasy/Openness	.46**	.45*	.40*
Fear	.47**	.18	.49*
High Intensity Pleasure	**.50****	**.31**	**.55****
Impulsivity	**.26***	**-.05**	**.53****
Inhibitory Control	.27*	.23	.38*
Low Intensity Pleasure	.39**	.20	.44*
Perceptual Sensitivity	-.02	.08	-.14
Sadness	.25+	-.25	.04
Shyness	.35**	.44*	.25
Soothability/Falling Reactivity	.30*	.26	.25

Note: + = $p < .10$; * $p = < .05$; ** $p = < .01$; Extraversion scales in bold.

scales, agreement ranged from Pearson's r values of -.02 to .50 (*Mdn* = .34). Parent-child

agreement for surgency/extraversion scales (Activity Level, Assertiveness/Dominance,

High Intensity Pleasure, and Impulsivity) ranged from .07 to .50 (*Mdn* = .33). The

median correlation showing agreement between self-report of girls and parent-report was

higher (*Mdn* = .36) than parent-child agreement for boys (*Mdn* = .20). Because of low

agreement on some of the extraversion scales, individual scales are reported for both self-

and parent-report in subsequent analyses.

Mean Differences by Reporter

Means and Standard Deviations for self- and parent-report scores on TMCQ

scales for the total sample are shown in Table 4 and by gender in Table 5. The largest

differences between parent- and child-reports on extraversion scales were found for both

boys and girls in Assertiveness/Dominance. Parents rated children as significantly more

assertive and dominant than children rated themselves [$t(25) = 5.44$, $p < .00$ (boys) and

$t(30) = 9.22$, $p < .001$ (girls)]. Parents rated both boys and girls higher in

Fantasy/Openness [$t(25) = 3.04$, $p < .01$ (boys) and $t(30) = 3.41$, $p < .01$ (girls)], and in

Low Intensity Pleasure [$t(25) = 2.32$, $p < .05$ (boys) and $t(30) = 3.76$, $p < .01$ (girls)].

Boys rated themselves higher than did their parents in Activity Level [$t(25) =$

3.06, $p < .01$] and Inhibitory Control [$t(25) = 3.54$, $p < .01$]. Despite a .00 correlation

between self- and parent-report, parent-child differences for boys in Attention Focusing,

with boys reporting higher levels, were only marginally significant [$t(25) = 1.80$, $p = .08$].

Parents rated boys, but not girls, higher in Sadness [$t(25) = 2.45$, $p < .05$]. Girls rated

themselves higher than did parents in Discomfort [$t(30) = 2.32, p < .05$] and Shyness

[$t(30) = 2.51\ p < .05$]. Parents rated girls higher in Impulsivity [$t(30) = 3.64, p < .01$] and

Soothability [$t(30) = 2.25, p < .05$].

Table 4

Temperament (TMCQ) Scale Means and
Standard Deviations

TMCQ Scales	Self-Report $N = 58$ Mean (*SD*)	Parent-Report $N = 57$ Mean (*SD*)
Activation Control	3.48 (.62)	3.54 (.56)
Activity Level	**3.93 (.66)**	**3.80 (.58)**
Affiliation	4.11 (.54)	4.27 (.43)
Anger/Frustration	2.45 (.84)	2.69 (.81)
Assertiveness/Dominance	**2.42 (.72)**	**3.54 (.49)**
Attention Focusing	3.85 (.68)	3.64 (.69)
Discomfort	2.55 (.70)	2.27 (.57)
Fantasy/Openness	3.57 (.65)	3.98 (.54)
Fear	2.17 (.77)	2.25 (.63)
High Intensity Pleasure	**3.30 (.69)**	**3.18 (.61)**
Impulsivity	**2.27 (.65)**	**2.67 (.68)**
Inhibitory Control	3.77 (.64)	3.42 (.60)
Low Intensity Pleasure	3.17 (.69)	3.60 (.62)
Perceptual Sensitivity	3.32 (.69)	3.35 (.59)
Sadness	2.04 (.73)	2.37 (.62)
Shyness	2.80 (.97)	2.37 (.95)
Soothability	3.69 (.73)	3.88 (.72)

Note: Extraversion scales in bold type.

Table 5

Temperament (TMCQ) Scale Means and
Standard Deviations by Reporter and Gender

	Self-Report		Parent-Report	
Scale	Males (*n* = 27) M (*SD*)	Females (*n* = 31) M (*SD*)	Males (*n* = 26) M (*SD*)	Females (*n* = 31) M (*SD*)
Activation Control	3.61 (.63)	3.36 (.60)	3.67 (.47)	3.43 (.62)
Activity Level	**4.18 (.57)**	**3.71 (.67)**	**3.84 (.53)**	**3.76 (.62)**
Affiliation	**4.02 (.60)**	**4.20 (.48)**	**4.21 (.43)**	**4.31 (.43)**
Anger/Frustration	2.26 (.91)	2.62 (.75)	2.79 (.83)	2.61 (.79)
Assertiveness/ Dominance	2.59 (.75)	2.27 (.68)	3.54 (.41)	3.55 (.56)
Attention Focusing	3.87 (.68)	3.83 (.70)	3.51 (.64)	3.75 (.73)
Discomfort	2.26 (.59)	2.81 (.69)	1.99 (.43)	2.50 (.56)
Fantasy/Openness	3.55 (.66)	3.58 (.66)	3.96 (.52)	4.00 (.57)
Fear	1.82 (.57)	2.48 (.80)	2.05 (.54)	2.41 (.65)
High Intensity Pleasure	**3.59 (.67)**	**3.05 (.60)**	**3.44 (.60)**	**2.97 (.53)**
Impulsivity	**2.27 (.68)**	**2.27 (.63)**	**2.63 (.62)**	**2.71 (.74)**
Inhibitory Control	3.94 (.76)	3.61 (.49)	3.34 (.54)	3.49 (.64)
Low Intensity Pleasure	3.27 (.62)	3.09 (.75)	3.58 (.50)	3.61 (.72)
Perceptual Sensitivity	3.46 (.59)	3.19 (.75)	3.32 (.57)	3.39 (.61)
Sadness	1.76 (.64)	2.28 (.73)	2.27 (.64)	2.45 (.60)
Shyness	2.44 (.83)	3.12 (.98)	2.15 (.77)	2.56 (1.04)
Soothability	4.01 (.63)	3.41 (.69)	4.00 (.63)	3.77 (.78)

Note: Extraversion scales in bold type.

BFI and Additional Measures

Internal Consistency Reliability

Cronbach's alphas for BFI scales ranged from .61 to .78 for self-report (*Mdn* =

.76) and .83 to .89 for parent-report (*Mdn* = .84). All BFI alphas are shown in Table 6.

Positive Affect had an alpha of .77 for self-report and .83 for parent-report. Alpha levels

for Gregariousness were .64 for self-report and .69 for parent-report. The Behavioral

Inhibition Scale had an alpha of .73 for self-report and .72 for parent-report. The revised

Reward Sensitivity scale had alphas of .64 and .61 for self- and parent-report

respectively.

Table 6

BFI and Other Scales Internal Consistency
(Cronbach's α)

	Self-Report Alpha	Parent Alpha	# of Items
BFI Scales			
BFI Agreeableness	.76	.84	9
BFI Conscientiousness	.76	.88	9
BFI Extraversion	**.61**	**.89**	**8**
BFI Neuroticism	.67	.83	8
BFI Openness	.78	.84	8
Other Scales			
Positive Affect	**.77**	**.83**	**9**
Gregariousness	**.64**	**.69**	**6**
BIS	.73	.72	7
Reward Sensitivity	**.64**	**.61**	**3**

Note: Extraversion scales in bold type.

Agreement between Reporters

Pearson's correlations for parent-child agreement for the BFI and additional scales are shown in Table 7. Agreement in BFI scales ranged from .26 to .36 (*Mdn* = .27). BFI Extraversion parent and self reports were significantly correlated [$r(55) = .32, p < .05$]. Parent and child scores for Positive Affect showed a marginally significant correlation of .23, Gregariousness was correlated .33 between parent and child report (*p* <.05) and Reward Sensitivity parent- and self-reports were not correlated with each other. BFI Extraversion parent-reports were averaged with self-reports to form one composite measure of BFI Extraversion ($\alpha = .51$).

Table 7

Self-Parent Agreement—Personality and
Additional Scales

Scale	Self-Parent Agmt: ALL	Self-Parent Agmt: Boys	Self-Parent Agmt: Girls
BFI Agreeableness	.26*	.23	.28
BFI Conscientiousness	.26*	.02	.43*
BFI Extraversion	**.36****	**.28**	**.43***
BFI Neuroticism	.27*	.15	.25
BFI Openness	.32*	.30	.26
BIS	.13	-.04	.20
Gregariousness	**.33***	**.43***	**.30**[+]
Positive Affect	**.23**[+]	**.32**	**.14**
Reward Sensitivity	**.02**	**.04**	**-.02**

Note: Extraversion scales in bold type.

Mean Differences between Reporters

Means and standard deviations for the total sample are shown in Table 8. Means for boys' and girls' self- and parent-report BFI and additional scale scores are shown in Appendix D. The largest differences between self- and parent-report were found in BFI Extraversion. Parents rated boys and girls as more extraverted than the children rated themselves [$t(25) = 3.14$, $p < .01$ (boys) and $t(30) = 4.71$, $p < .001$ (girls)]. Parents also rated both boys and girls higher in Behavioral Inhibition [$t(25) = 3.00$, $p < .01$ (boys) and $t(30) = 2.67$, $p < .05$) (girls)] than children rated themselves. Parents rated boys, but not girls, higher in BFI Agreeableness [$t(25) = 2.41$, $p < .05$]. Parents rated girls higher in

Table 8

BFI and Other Scales: Means and Standard Deviations

	Mean (*SD*)	Mean (*SD*)
BFI Scales		
BFI Agreeableness	3.84 (.60)	4.06 (.52)
BFI Conscientiousness	3.72 (.59)	3.47 (.62)
BFI Extraversion	**3.19 (.58)**	**3.75 (.72)**
BFI Neuroticism	2.48 (.60)	2.26 (.59)
BFI Openness	3.79 (.64)	3.62 (.55)
Other Scales		
Positive Affect	**4.13 (.54)**	**4.23 (.47)**
Gregariousness	**3.29 (.63)**	**3.52 (.59)**
BIS	2.66 (.73)	3.14 (.56)
Reward Sensitivity	**4.28 (72)**	**4.58 (.73)**

Note: Extraversion scales in bold)

Gregariousness [$t(30) = 2.64, p < .05$] and Reward Sensitivity [$t(30) = 2.12, p < .05$] than girls rated themselves. Children did not rate themselves higher than parents did on any other BFI or additional scale.

Gender Differences

Means and standard deviations for temperament and personality scales for boys and girls are displayed in Table 5 and Table 9. Boys rated themselves significantly higher than girls in Activity Level [$t(57) = 2.74, p < .01$]. Boys were higher in both self-and parent-reported High Intensity Pleasure [$t(57) = 3.06, p < .01$ (self-report) and $t(56) = 3.28, p < .01$ (parent-report)]. Girls were rated higher than boys by both themselves and parents in Fear [$t(57) = 3.75, p < .001$ (self) and $t(56) = 2.37, p < .05$ (parent)], Discomfort [$t(57) = 3.33, p < .01$ (self) and $t(56) = -3.92, p < .001$ (parent)], Girls rated themselves significantly higher in Sadness [$t(57) = -2.90, p < .01$ and Shyness $t(57) = 2.79, p < .01$ (self)].

Girls rated themselves significantly higher than boys rated themselves in Behavioral Inhibition [$t(57) = 2.60, p < .05$]. Significantly higher scores were found for girls in BFI Neuroticism as rated both by themselves [$t(57) = 2.08, p < .05$] and by parents [$t(56) = 2.15, p < .05$]. No other gender differences were found for personality or additional scales.

Table 9

BFI and Other Scales: Means and
Standard Deviations by Reporter and Gender

	Self-Report		Parent-Report	
	Males	Females	Males	Females
Scale	(*n* = 27)	(*n* = 31)	(*n* = 26)	(*n* = 31)
	M (*SD*)	M (*SD*)	M (*SD*)	M (*SD*)
BFI Agreeableness	3.81 (.66)	3.87 (.56)	4.12 (.52)	4.02 (.53)
BFI Conscientiousness	3.78 (.57)	3.67 (.61)	3.49 (.61)	3.45 (.63)
BFI Extraversion	**3.25 (.61)**	**3.13 (.56)**	**3.72 (.64)**	**3.77 (.80)**
BFI Neuroticism	2.31 (.57)	2.63 (.59)	2.07 (.59)	2.42 (.55)
BFI Openness	3.87 (.71)	3.73 (.57)	3.67 (.49)	3.58 (.61)
Positive Affect	**4.20 (.61)**	**4.06 (.46)**	**4.19 (.47)**	**4.26 (.47)**
Gregariousness	**3.35 (.70)**	**3.24 (.58)**	**3.46 (.59)**	**3.57 (.61)**
BIS	2.41 (.71)	2.88 (.69)	3.02 (.64)	3.24 (.46)
Reward Sensitivity	**4.21 (.81)**	**4.34 (.65)**	**4.49 (.43)**	**4.66 (.48)**

Note: Extraversion Scales in bold type.

Correlations between Extraversion Scales

Correlations among extraversion scales are presented in Table 10. All scales were

significantly correlated with each other except Impulsivity with Positive Affect and

Gregariousness in the self-report scales and Reward Sensitivity with all scales except

Activity Level in the parent scales. Self-reported Reward Sensitivity showed a significant

correlation with Positive Affect and a marginally significant correlation with

Gregariousness. Higher correlations were found for both self- and parent-reported

Activity Level and High Intensity Pleasure. Among the highest correlations in the self-

report scales were Assertiveness/ Dominance with Impulsivity and Positive Affect with

Gregariousness. Correlations between all temperament and personality scales are shown

in Appendix D.

Table 10

Correlations between Extraversion Scales

	1	2	3	4	5	6	7
1- Activity Level	—	.35**	.61**	.25*	.45**	.35**	.14
2- Assertiv. Dom.	.35**	—	.52**	.58**	.19	.35**	.14
3- High Int. Pleas.	.56**	.53**	—	.37**	.36**	.40**	.06
4- Impulsivity	.28*	.54**	.53**	—	.13	.20	.02
5- Positive Affect	.30*	.29*	.12	-.07	—	.58**	.44**
6- Gregariousness	.43**	.47**	.52**	.42**	.49**	—	.23^{+}
7- Reward Sensitivity	.26*	.13	-.05	.08	.33*	.13	—

Self-report values above the diagonal, parent-report below
$^{+}$ $p < .10$, * $p < .05$, ** $p < .01$

Principal Components Analysis of Extraversion Scales

In order to examine the structure of subcomponents, a principal components

analysis with oblique rotation (Oblimin algorithm; Jennrich & Sampson, 1966) was

performed on extraversion scales. The other purpose of this analysis was to determine

whether any composite measures could be formed from the extraversion scales or

whether the scales would need to be treated individually. Oblique rotation was chosen to

allow examination of correlations among extracted components.

Temperament (TMCQ) scales of Activity Level, Assertiveness/Dominance, High

Intensity Pleasure, and Impulsivity were entered into the analysis with Positive Affect,

Gregariousness, and Reward Sensitivity from the Personality Questionnaire.

Results showed that in both the self- and parent-report data, two components each

showed eigenvalues higher than 1.0 and together explained 63% and 62% of the variance

respectively. Principal component loadings are shown in Tables 11 and 12. The first

component for both informants showed the highest loadings from High Intensity

Table 11

Parent-Report Extraversion Scale
Principal Components Analysis

	Component	
	1	2
High Intensity Pleasure	0.857	
Assertiveness/Dominance	0.773	
Impulsivity	0.768	
Gregariousness	0.721	0.478
Activity Level	0.633	0.457
Positive Affect		0.852
Reward Sensitivity		0.721

Note: Loadings >.40 shown

Table 12

Self-Report Extraversion Scale
Principal Components Analysis

	Component	
	1	2
Assertiveness/Dominance	0.816	
High Intensity Pleasure	0.788	
Impulsivity	0.777	
Activity Level	0.591	0.541
Positive Affect		0.884
Gregariousness	0.419	0.720
Reward Sensitivity		0.674

Note: Loadings >.40 shown

Pleasure, Assertiveness/Dominance, and Impulsivity. Activity Level and Gregariousness

loaded on both components. The first component, labeled Unsocialized Stimulation

Seeking, generally describe characteristics similar to those found in a similar factor in

Victor et al. (2006).

The second component describes more socialized extraversion, with Positive

Affect and Reward Sensitivity loading most strongly on this component for parents and

Positive Affect, Gregariousness, and Reward Sensitivity loading most strongly on this

component for self-report. Positive affect and reward sensitivity are likely more

socialized into childhood because of cultural influence. In the United States, but not in

China, smiling and laughter loaded on a factor describing Effortful Control (Ahadi et al.,

1993). It is likely that in a culture where displays of positive affect are expected,

individual differences in expression of happiness are more subject to social influence.

Component scores were calculated through multiplication of standardized scores on each

variable by the factor loading for that variable (Tabachnick & Fidell, 2001). Thus, a

single score reflecting the relative contribution of each variable included in the

component is created. Correlations between Unsocialized Stimulation Seeking and

Socialized Extraversion component scores were .20 for parent-report scales and .24 for

self-report scales.

Correlations between self- and parent-report component scores are shown in

Table 13. In order to create variables that captured both the parent- and child-reports for a

fuller indication of extraversion, parent and child component scores were averaged to

form two composites: Unsocialized Stimulation Seeking (α = .55) and Socialized

Extraversion (α = .27). These two composite component scores were used in subsequent

correlational analyses.

Table 13

Correlations between Self- and Parent-
Extraversion Components

	Parent Unsocialized Stim. Seek.	Parent Socialized Extrav.	Child Unsocialized Stim. Seek.
Parent Socialized Extrav.	.20		
Child Unsocialized Stim. Seek.	.37**	.13	
Child Socialized Extrav.	.16	.16	.28*

Note: N = 57, * = p < .05, ** = p < .01

Boys showed higher scores on Unsocialized Stimulation Seeking than girls. This difference was marginally significant [$t(56) = 1.72$, $p = .09$]. There was no gender difference for Socialized Extraversion and no age differences were found for either component.

Correlations between the composite component scores and BFI Extraversion are shown in Table 14. BFI Extraversion correlated significantly with both composite component scores.

In order to create categorical extraversion variables for use in analyses of variance, Unsocialized Stimulation Seeking (USS) and Socialized Extraversion (SE), component scores and BFI Extraversion scale scores were used to create tertiles by dividing the sample at the 33rd and 66th percentile for each variable. Low, Medium and High extraversion groups were created for each of the three composite measures.

Table 14

*Correlation between Composite Extraversion
Components and BFI Extraversion*

	Unsocialized Stimulation Seeking	Socialized Extraversion
Socialized Extraversion	.30*	
BFI Extraversion	.65**	.56**

Note: N = 57, * = p < .05, ** = p < .01

Multiple Regression Analyses

A multiple regression was performed based on the double loadings of

Gregariousness and Activity Level on both the Unsocialized Stimulation Seeking and

Socialized Extraversion components in both the parent- and self-report analyses. The

analysis was designed to address the issue of whether scales loading on only one

component explained additional variance in broad-level extraversion as measured by the

BFI beyond the two scales that double loaded.

The first analysis was performed on the self-report extraversion scales. BFI

Extraversion was regressed on Gregariousness and Activity Level. The model showed

that the two double-loading scales were significant predictors of BFI Extraversion [$R^2 =$

.22; $F(2, 55) = 7.72$, $p < .01$]. Next, scales that loaded only on the Unsocialized

Stimulation Seeking (USS; High Intensity Pleasure, Assertiveness/Dominance, and

Impulsivity) were entered into the regression analysis with Gregariousness and Activity

Level. The model was significant [$F(5, 52) = 4.28$, $p < .01$], but USS scales did not add

significantly to the prediction of BFI Extraversion [$R^2 = .29$; $R^2 \Delta = .07$; $F \Delta (3, 52) =$

1.77, *ns*]. Third, a model with Gregariousness and Activity Level and scales that loaded

on the Socialized Extraversion (SE) component (Positive Affect and Reward Sensitivity)

as predictors was tested. The model was significant [$F(4, 53) = 4.04$, $p < .01$]; however,

scales that loaded only on the SE component did not significantly improve prediction of

BFI Extraversion [$R^2 = .23$; $R^2 \Delta = .01$; $F \Delta (2, 53) = .49$, *ns*]. Finally, a model with all

scales as predictors was tested and did not significantly improve prediction by

Gregariousness and Activity alone [$R^2 = .31$; $R^2 \Delta = .09$; $F \Delta (5, 50) = 1.38$, *ns*]. These

analyses suggest that self-report Gregariousness and Activity Level alone are adequate to predict broad-level extraversion as measured by the BFI.

The same analyses were performed on parent-report data. Parent-report Gregariousness and Activity Level significantly predicted BFI Extraversion [R^2 = .55, $F(2, 54)$ = 32.86, p < .001]. USS components (Assertiveness/Dominance, High Intensity Pleasure, and Impulsivity) did not add significantly to the prediction of BFI Extraversion by Gregariousness and Activity Level [R^2 = .56; $R^2 \Delta$ = .01; $F \Delta (3, 51)$ = .21, ns]. Socialized Extraversion scales (Positive Affect and Reward Sensitivity) significantly improved prediction of BFI Extraversion by Gregariousness and Activity Level alone [R^2 = .65; $R^2 \Delta$ = .10; $F \Delta (2, 52)$ = 7.10, p < .01]. The analysis with all scales as predictors showed an improvement in prediction of BFI Extraversion over Gregariousness and Activity Level alone [R^2 = .66; $R^2 \Delta$ = .11; $F \Delta (5, 49)$ = 3.31, p < .05]. Among the parent-report scales, those that load on Socialized Extraversion are the strongest predictors of BFI Extraversion.

Self-reported Gregariousness and Activity Level were tested to examine the relative strength of each scale as predictors of BFI Extraversion. Gregariousness alone was a significant predictor of BFI Extraversion [R^2= .15, $F(1, 56)$ = 9.77, p < .01]. When Activity Level was entered second, it added significantly to the prediction by Gregariousness alone [R^2 = .22; $R^2 \Delta$ = .07; $F \Delta (1, 55)$ = 4.98, p < .05]. Activity Level alone was a significant predictor of BFI Extraversion [R^2= .15, $F(1, 56)$ = 9.81, p < .01]. Gregariousness added significant prediction to that of Activity Level [R^2 = .22; $R^2 \Delta$ =

.07; $F \Delta$ (1, 554) = 4.93, $p < .05$]. In self-report data, both Gregariousness and Activity

Level are stronger predictors of BFI Extraversion than either scale alone.

Identical tests were performed on the parent-report data. Parent-reported

Gregariousness alone was a significant predictor of BFI Extraversion [R^2= .54, $F(1, 55)$ =

63.35, $p < .001$]. When Activity Level was entered second, it did not add significantly to

the prediction by Gregariousness alone [R^2 = .55; $R^2 \Delta$ = .01; $F \Delta$ (1, 54) = .72, ns].

Activity Level alone was a significant predictor of BFI Extraversion [R^2= .15, $F(1, 55)$ =

9.59, $p < .01$]. Gregariousness added significant prediction to that of Activity Level [R^2 =

.55; $R^2 \Delta$ = .40; $F \Delta$ (1, 54) = 47.95, $p < .001$].

In parent-report data, Gregariousness without Activity Level is adequate for

predicting BFI Extraversion, but significant prediction is added to that by Gregariousness

when Positive Affect and Reward Sensitivity are used as predictors.

Correlation of Extraversion Scales with Composite Measures

Correlations of extraversion scales with composite component and BFI

Extraversion scores are shown in Table 15. As expected from the principal components

analysis, all scales except Positive Affect and Reward Sensitivity correlated significantly

with Unsocialized Stimulation Seeking. As expected, Assertiveness/Dominance, and

Impulsivity did not correlate significantly with Socialized Extraversion; however, High

Intensity Pleasure did correlate significantly with SE in the self-report data, but not in the

parent-report data. All scales except Reward Sensitivity correlated significantly with BFI

Extraversion in both the self-report and parent-report data.

Table 15

Correlation of Extraversion Scales with Extraversion
Composite Components and BFI Extraversion

	Self-Report (*N* = 58)			Parent-Report (*N* = 57)		
	Unsoc. Stim. Sk.	Soc. Extrav.	BFI Extrav.	Unsoc. Stim. Sk.	Soc. Extrav.	BFI Extrav.
Activity Level	.58**	.51**	.39**	.55**	.46**	.39**
Assertiv./ Dominance	.63**	.21	.41**	.61**	.15	.42**
High Intensity Pleasure	.76**	.34**	.40**	.76**	.19	.42**
Impulsivity	.54**	.01	.34**	.63**	-.09	.31*
Positive Affect	.19	.71**	.34**	.23	.67**	.64**
Gregariousness	.43**	.56**	.39**	.58**	.45**	.74**
Reward Sensitivity	.00	.41**	.02	.10	.48**	.16

Note: $^+ = p < .10$; $* = p < .05$; $** = p < .01$

Relations of Shyness with the composite extraversion measures were also
examined. Correlations between extraversion component scores and BFI Extraversion
showed that the strongest negative relations of Shyness were with BFI Extraversion
[$r(55) = -.47, p < .001$ (self-report) and $r(55) = -.62, p < .001$ (parent-report)]. Negative
correlations with Unsocialized Stimulation Seeking were significant [$r(55) = -.33$ (self-
report) and $r(55) = -.36$ (parent-report)]. Correlations between Shyness and Socialized
Extraversion were not significant [$r(55) = -.21$, *ns* (self-report) and $r(55) = -.13$, *ns*
(parent-report)].

Summary of Principal Component Analysis,
Multiple Regression, and Scale Correlations

Two components were found in both the parent- and self-report data, one with loadings from Assertiveness/Dominance, High Intensity Pleasure, Impulsivity, and Activity Level, as well as Gregariousness. This factor was labeled Unsocialized Stimulation Seeking (USS). Activity Level and Gregariousness also loaded on a second factor with Positive Affect and Reward Sensitivity. This factor was labeled Socialized Extraversion (SE). A composite score was created with the mean of parent- and self-report component scores for USS and SE.

A multiple regression testing prediction of scales that loaded on both components relative to groups of scales that loaded on only one component showed that Gregariousness and Activity Level together are the strongest predictors of BFI Extraversion, a broad measure of the trait, in the self-report data. Scales that loaded on either USS or SE did not add significantly to prediction by Gregariousness and Activity Level together. In the parent report-data, however, scales that loaded only on SE did add significant prediction of BFI by Gregariousness and Activity Level.

Expected correlations were found between individual extraversion scales and composite component scores and BFI Extraversion. An exception was that Reward Sensitivity did not correlate significantly with BFI Extraversion. Negative correlations of Shyness were highest for BFI Extraversion and were significant for USS. Shyness did not correlate significantly with SE.

Number Task

Detailed reaction time and error findings for the Number Task are shown in Appendix F. Direct hypothesis tests are explained in this section.

Reward, Response Hand, and Extraversion

Number Task Points

A reward point score variable was created by subtracting points earned in non-reward trials from points earned in non-trials, such that a positive points score reflected more points in reward than non-reward trials. The minimum reward point score was -260 and the maximum was 180 ($M = 4.04$, $SD = 93.98$). Points reflected children's success in the Number Task in which both speed and accuracy were required for accumulation of points. As shown in Appendix F, children apparently used different strategies to achieve points in the task. Some were slower, but more accurate and others were faster but less accurate. Reaction times and error results are presented separately in the following section. Analyses of variance were performed on the points with extraversion groups as a between-subjects factor for each of the broad extraversion measures.

A significant effect of Unsocialized Stimulation Seeking was found for points [$F(2, 49) = 3.63$, $p < .05$]. A difference contrast comparing high USS to low and medium USS was also significant [$t(49) = 2.70$, $p < .05$]. Children high in USS earned significantly more points in the reward condition relative to the non-reward condition (see Figure 3).

NT Reward Point Score by Unsocialized Stimulation Seeking

	Low USS	Med USS	High USS
Rew-NoRew Pts.	-20.0	-20.6	50.0
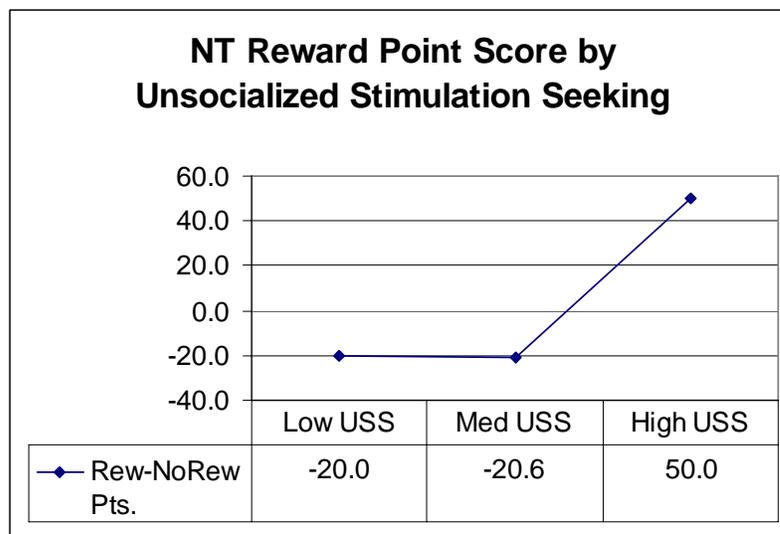
Figure 3

Reward Point Score by Unsocialized Stimulation Seeking

An analysis of variance for points with Socialized Extraversion (SE) as a between-subjects factor was not significant [$F(2,49) = .42$, *ns*]. Children low in SE had higher reward point scores than children at middle levels or high in SE (see Figure 4). A Helmert contrast testing this difference was not significant.

A marginally significant effect of BFI Extraversion was found on the reward point score [$F(2, 49) = 2.46$, $p = .096$]. Children who were both low and high on the BFI Extraversion measure had higher reward point scores than children with a medium level of BFI Extraversion (see Figure 5). A quadratic contrast was significant for this pattern [$t(49) = 2.21$, $p < .05$].
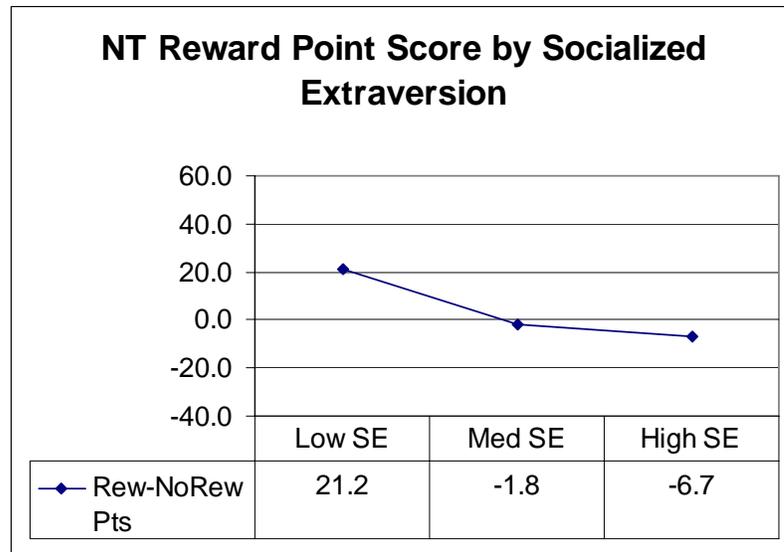
Figure 4

Reward Point Score by Socialized Extraversion
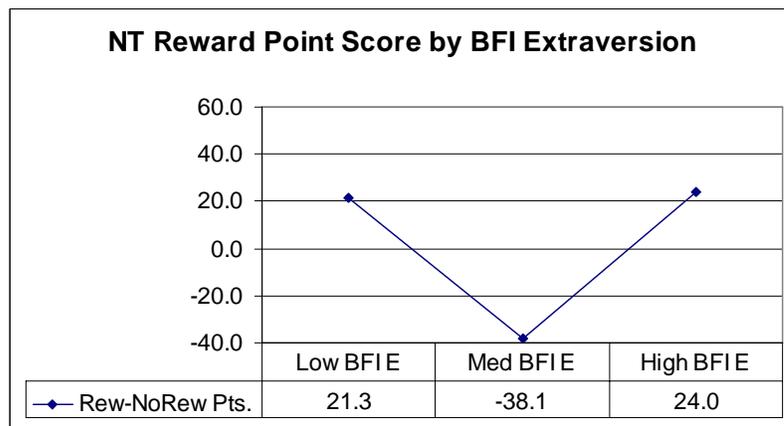
Figure 5

Reward Point Score by BFI Extraversion

Reaction Times and Errors

Median reaction time data were calculated for each Number Task condition: Notation (text or digit), Distance (near to or far from 5), Response Hand (left or right hand response), and Reward (non-reward or reward points). Means of these median values for reaction times were calculated and are presented in Table 16. Means of median errors are shown in Table 17. Additional analyses of Number Task properties are included in Appendix F.

Table 16

*Number Task Reaction Times in
Milliseconds by Condition*

Condition	Means (*SD*s) of Median Reaction Times in milliseconds(ms)
Non-Reward	593 (123)
Reward	599 (130)
Digit	590 (132)
Text	601 (121)
Far	585 (116)
Near	607 (137)
Right	576 (125)
Left	615 (127)

Note: N = 52

Table 17

Number Task Errors by Condition

Condition	Means (*SD*s) of Median Number of Errors
Non-Reward	1.6 (1.4)
Reward	1.5 (1.3)
Digit	1.4 (1.3)
Text	1.7 (1.4)
Far	1.2 (1.3)
Near	1.9 (1.5)
Right	1.3 (1.4)
Left	1.8 (1.4)

Note: N = 52

Reaction Time Extraversion Analyses

Three mixed analyses of variance with Number Task factors (reward, notation, distance, and response hand) as within-subjects variables and categorical extraversion variables as a between-subjects variable were performed on Number Task reaction time (RT) data for each of the composite extraversion measures: Unsocialized Stimulation Seeking, Socialized Extraversion, and BFI Extraversion.

No main effect for reward was found in any of the analyses [$F(1, 50) = 1.05$, *ns* for USS; $F(1, 50) = 1.15$, *ns* for SE; $F(1, 50) = 1.12$ for BFI E]. No main effect of extraversion was found for any of the extraversion measures [$F(2, 50) = .30$, *ns* for USS; $F(2, 50) = .11$ for SE; $F(2, 50) = 1.05$ for BFI E]. Reward by extraversion interactions were not significant for any of the extraversion components [$F(2, 50) = .43$, *ns* for USS; $F(2, 50) = .91$, *ns* for SE; $F(2, 50) = 1.19$, *ns* for BFI E]. No extraversion by hand

interactions were significant [$F(2, 50) = .72$, *ns* for USS; $F(2, 50) = 1.24$, *ns* for SE; $F(2, 50) = .50$, *ns* for BFI E].

A three-way Reward x Hand x Extraversion interaction was marginally significant for USS [$F(2, 50) = 3.00$, $p = .06$] and significant for BFI Extraversion [$F(2, 50) = 4.08$, $p < .05$]. No significant Reward x Hand x Extraversion interaction was found for SE [$F(2, 50) = .33$, *ns*]. The interaction for BFI Extraversion is shown graphically in Figure 6.

Non-Reward Hand Differences by BFI Extrav.

	Left Non-Reward	Right Non-Reward
– ◆ – Low Big 5	642	584
—■— Med Big 5	620	579
···▲··· High Big 5	573	552

Reward Hand Differences by BFI Extraversion

	Left Reward	Right Reward
– ◆ – Low Big 5	620	594
—■— Med Big 5	643	594
···▲··· High Big 5	591	550
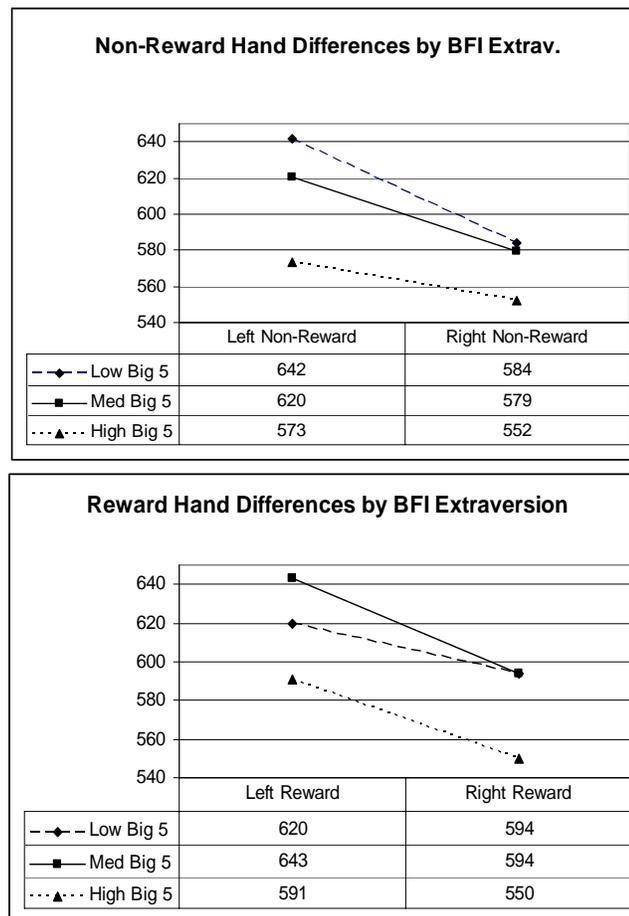
Figure 6

Reward x Hand x BFI Extraversion (RTs)

Children high in USS and BFI Extraversion had more left-right differences on reward trials compared to on non-reward trials. Children low in USS and BFI Extraversion had more left-right differences on non-reward trials compared to reward trials. Children with middle extraversion scores showed more similar left-right hand differences between non-reward and reward conditions.

Extraversion and Errors

Errors committed during the Number Task (NT) were examined for interactions of NT factors with extraversion. No significant interactions were found between reward or response hand and Unsocialized Stimulation Seeking or Socialized Extraversion. Interactions were found between reward and response hand errors with BFI Extraversion [$F(2, 49) = 5.59, p < .01$ (reward x BFI E); $F(2, 49) = 5.22, p < .05$ (Hand x BFI E)]. Children with high or low BFI Extraversion scores showed fewer errors in the reward than non-reward condition; children with medium BFI Extraversion scores made more errors in the reward than non-reward condition (see Figure 7). Interaction by response hand was caused by differences in errors made with the left hand. High BFI Extraversion scores were associated with the most errors with the left hand, with middle scores showing fewer errors with the left hand and low scores associated with the fewest left hand errors. There was no difference in right hand errors by BFI Extraversion group (see Figure 8).

A significant three-way reward x response hand x extraversion interaction was found for Socialized Extraversion [$F(2, 49) = 3.44, p < .05$] on errors, but not USS or BFI Extraversion. Children with high scores in SE committed more errors overall and showed

NT Errors by Reward and BFI Extraversion

	No Rew	Rew
– ◆ – Low BFI E	1.5	1.3
—■— Med BFI E	1.4	1.7
····▲··· High BFI E	1.8	1.6
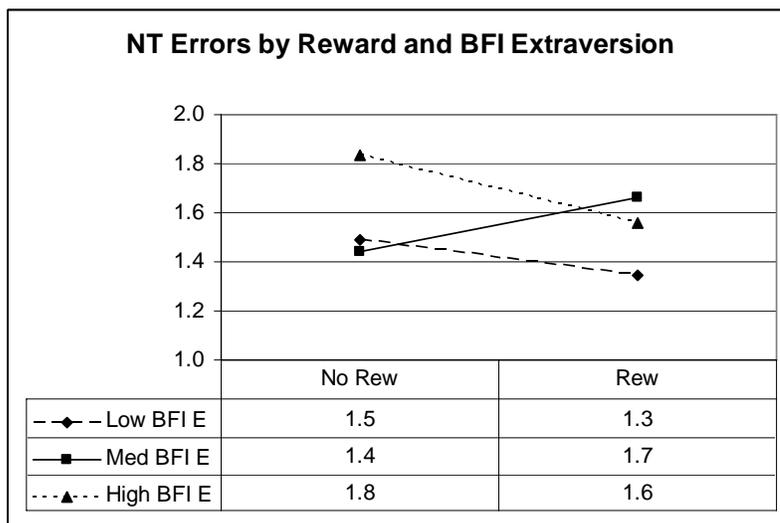
Figure 7

NT Errors by Reward and BFI Extraversion

NT Errors by Hand and BFI Extraversion

	Left	Right
– ◆ – Low BFI E	1.5	1.4
—■— Med BFI E	1.8	1.3
····▲··· High BFI E	2.1	1.3
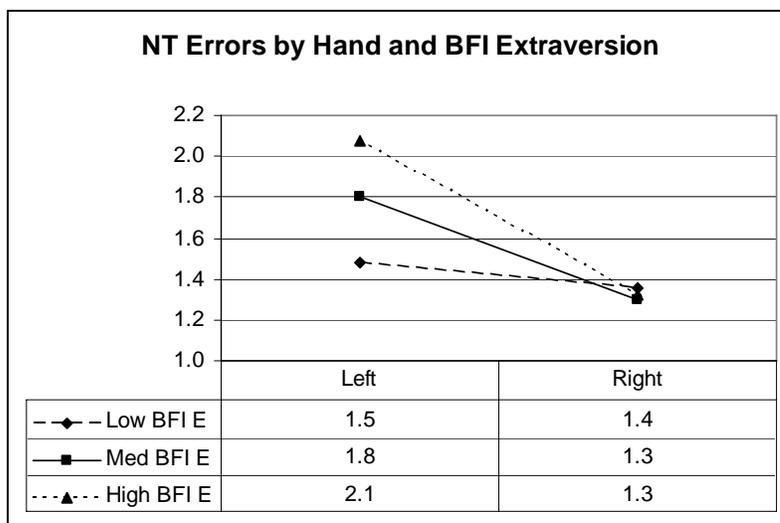
Figure 8

NT Errors by Hand and BFI Extraversion

a larger difference between left and right hand errors in the reward than non-reward condition (see Figure 9) than children with medium or low SE scores. In the reward condition, errors were similar for the right hand among the SE groups. Children higher in SE made more errors with the left hand than did children in the other SE groups.

NT Non-Reward Errors by Hand and Socialized Extraversion

	Left Non-Reward	Right Non-Reward
Low SE	1.6	1.4
Med SE	1.8	1.1
High SE	2.1	1.6

NT Reward Errors by Hand and Socialized Extraversion

	Left Reward	Right Reward
Low SE	1.6	1.1
Med SE	1.6	1.3
High SE	2.2	1.3
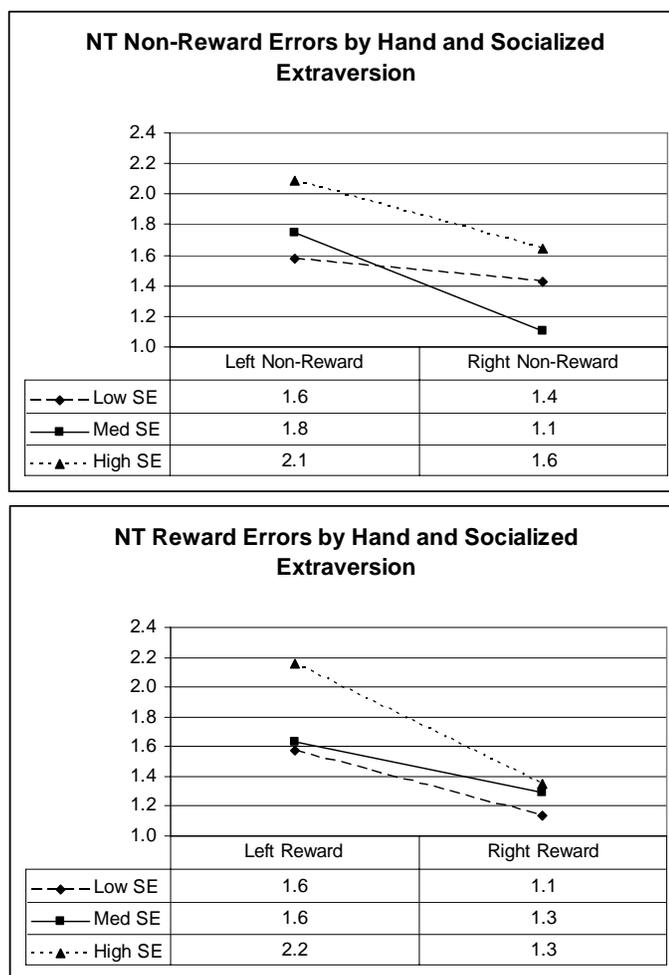
Figure 9

Reward x Response Hand x Socialized Extraversion (Errors)

Number Task Distance and Notation Scores with Extraversion

The mixed analyses of variance with Number Task factors (reward, notation, distance, and response hand) as within-subjects factors and extraversion groups as a between subjects factor in reaction times were examined for interactions between extraversion and notation and distance, factors not hypothesized to interact with extraversion. No significant notation (text or digit stimuli) or distance (close to or far from 5) reaction time or error interactions with extraversion were found for any of the extraversion measures.

Summary of Number Task Findings

Extraversion was related to the reward point scores, with children high in USS earning significantly more reward points compared to non-reward points than children with low or medium USS composite component scores. Points showed a quadratic pattern for BFI Extraversion; children low and high on the BFI extraversion scale earned more points in the reward condition than children with medium BFI Extraversion scores. No interaction of Reward x Extraversion or Response Hand x Extraversion was shown for reaction times (RTs), but Reward x BFI Extraversion and Response Hand x BFI Extraversion interactions were significant in the error data. Children with high scores on BFI Extraversion had more overall errors. Both low and high BFI Extraversion scores were associated with fewer errors in the reward condition than non-reward condition. Children with medium BFI scores had more errors on the reward trials than non-reward trials. The predicted Reward x Response Hand x Extraversion interaction for USS and BFI Extraversion was significant in the RT data. Children high in USS and BFI

Extraversion had larger left-right hand differences in RTs in the reward than non-reward condition. The same interaction pattern was present for errors for SE.

Observer Ratings

Observer ratings for each of the five subscales from mid-session (Time1) and end-of-session (Time2) were added together to create one observer rating total for each of the five subscales: talkativeness, physical activity, eye contact, positive mood, and excitement about incentives. Correlations between Time1 and Time2 observations are shown with means and standard deviations for observer rating totals in Table 18. Combined ratings from each 1 to 5 Likert-scales in Time1 and Time2 ranged from 2.00 to 10.00, with lower scores indicating less extraversion.

Table 18

Observer Rating Means, Standard Deviations,
and Time1-Time2 Correlations

	Mean	*SD*	Time1-Time2 Correlation
Talkative	5.93	1.97	.85**
Physically Active	4.90	2.30	.91**
Eye Contact	6.44	1.44	.87**
Positive Mood	6.13	2.00	.82**
Excitement to Incentives	6.54	2.34	.89**

Note: $N = 54$; $^+ = p < .10$; $* = p < .05$; $** = p < .01$

Correlations between observer ratings of different aspects of extraversion ranged from .59 to .82 (see Table 19). All observer ratings were averaged to form one composite observed extraversion score. Cronbach's alpha for the internal consistency of the composite score was .91

Correlations between questionnaire measures of extraversion and behavioral measures of extraversion were examined. Correlations between the composite observer rating with Unsocialized Stimulation Seeking and Socialized Extraversion are shown in Table 20. Observer ratings of extraversion correlated significantly with Unsocialized Stimulation Seeking [$r(53) = .29, p < .05$] and BFI Extraversion [$r(53) = .41, p < .01$]; however, no significant correlation was found between Socialized Extraversion and observer ratings. Correlations of the observer composite rating with extraversion scales are shown in Table 21.

Table 19

Correlations between Observer Ratings of
Different Aspects of Extraversion

	Phys. Active	Eye Contact	Positive Mood	Excited by Incentives
Talkative	.66**	.62**	.69**	.74**
Phys. Active		.59**	.68**	.78**
Eye Contact			.64**	.69**
Positive Mood				.82**

Notes: $N = 54$; $^+ = p < .10$; $^* = p < .05$; $^{**} = p < .01$

Table 20

Observer Ratings with Extraversion Components

	Observer Composite
Unsocialized Stimulation Seeking	.29*
Socialized Extraversion	.13
BFI Extraversion	.41**

Note: $N = 54$; $^+ = p < .10$; $* = p < .05$; $** = p < .01$

Table 21

Observer Ratings with Extraversion Scales

	Observer Composite with Self-Report	Observer Composite with Parent-Report
Activity Level	.07	.20
Assertiveness/ Dominance	.33*	.06
High Intensity Pleasure	.11	.25$^+$
Impulsivity	.16	.20
Positive Affect	.07	.19
Gregariousness	.15	.27*
Reward Sensitivity	.03	-.01

Note: $N = 54$; $^+ = p < .10$; $* = p < .05$; $** = p < .01$

Task Liking Anticipation

Descriptive statistics for ratings of anticipated and actual task enjoyment are shown in Table 22. Internal consistency for pre-task (anticipated) liking scores was α = .60 and was α = .62 for post-task liking scores. A score for total pre-task ratings (anticipated liking) was computed by adding all pre-task ratings together.

In the current sample, 10 participants liked the CARROT task more than expected. The other 43 participants gave initial expected liking ratings of 4 or 5 (on 1-5 scale) and found the task as enjoyable as expected (pre-/post- difference score of 0). None of the participants found the task less enjoyable than expected. It was not possible to conduct an analysis similar to that performed by Kambouropoulos and Staiger (2004) by groups of participants who found the task more or less rewarding than expected. Differences between initial ratings were not analyzed because of a ceiling effect (all 4 and 5 on a 1-5 scale; $M = 4.69$, $SD = .57$).

Correlations between anticipated task liking and extraversion measures are shown in Table 23. A significant positive correlation was found between total anticipated task

Table 22

Ratings of Task Enjoyment

	TMCQ		Number Task		Decision Games		Personality Questionnaire		CARROT Card Sort	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mean	4.33	4.31	4.33	4.11	4.57	4.19	4.13	4.25	4.69	4.89
SD	0.65	0.69	0.83	0.96	0.57	0.83	0.90	0.61	0.57	0.32

liking and Socialized Extraversion [$r(51) = .31, p < .05$]. Within individual scales, self-reported Positive Affect correlated significantly with total anticipated enjoyment (see Table 24).

Table 23

*Task Liking Anticipation with
Extraversion Components*

	Total Anticipation
Unsocialized Stimulation Seeking	-.18
Socialized Extraversion	.31*
BFI Extraversion	-.08

*Notes: N = 53; + = p <.10; * = p <.05; ** = p < .01*

Table 24

*Correlation of Total Task Anticipated Liking
with Extraversion Scales*

	Total Anticipation with Self-Report	Total Anticipation with Parent-Report
Activity Level	.11	.22
Assertiveness/Dominance	-.21	-.15
High Intensity Pleasure	-.04	-.04
Impulsivity	-.22	-.23[+]
Positive Affect	.42**	.05
Gregariousness	.19	-.05
Reward Sensitivity	.19	-.13

*Notes: N = 53; + = p <.10; * = p <.05; ** = p < .01*

Gift Unwrapping

The mean time for unwrapping the rewarding gift was 21.97 seconds (*SD* = 11.89 sec.) and the mean time for removing paper from the box containing the experimenter's gift was 18.95 (*SD* = 10.08 seconds). Contrary to predictions, children were faster to unwrap the non-reward gift.

A difference score was calculated based on the original prediction that the rewarding gift would be unwrapped faster than the experimenter's gift. A subtraction score was created by subtracting the time to unwrap the non-rewarding gift from the time to unwrap the rewarding gift. The mean difference was -3.02 seconds (*SD* = 10.60 sec.), showing faster unwrapping time for the experimenter's gift (non-reward) than the gift for the child (reward).

No significant correlations were found between the gift difference score (non-incentive gift unwrapping time–incentive gift unwrapping time) and extraversion components (see Table 25). Because children higher in agreeableness who place more

Table 25

Gift Difference Scores with Composite
Extraversion Measures

	Gift Difference Zero Order	Gift Difference Partial
Unsocialized Stimulation Seeking	-.10	-.14
Socialized Extraversion	-.13	-.11
BFI Extraversion	-.05	-.09

Notes: N = 47; $^{+}$ = *p* <.10; * = *p* <.05; ** = *p* < .01

priority on harmonious relations with others (Tobin & Graziano, 2006) might have been more motivated to unwrap the gift to help the experimenter, correlations between the gift difference score and extraversion variables were examined when controlled for BFI Agreeableness. Self-reported Agreeableness correlated -.15 (*ns*) with the gift score and .09 (*ns*) with the parent score. Partial correlations controlled for both parent- and self-report Agreeableness. None of the gift-extraversion correlations was significant and partial correlations were similar to those with no controls applied. No significant bivariate or partial correlations between extraversion components and gift differences were found by age or gender.

CARROT Card Sort

A difference score between the trial in which children received a nickel for every 5 cards sorted and non-nickel trials was calculated by subtracting the nickel trial sort time from the average of the first and third (non-nickel) sorting times. Higher scores indicated faster sorting when nickels were given compared to the non-nickel trials. Means and standard deviations of each CARROT trial and CARROT difference scores are displayed in Table 26. Difference scores ranged from -8.76 seconds to 7.10 seconds (M = -0.17 sec., SD = 3.35 sec.). Approximately half of the participants were faster on nickel trials than non-nickel trials. An analysis of variance showed no significant effect of Number Task strategy group on CARROT scores.

Correlations between CARROT scores and extraversion appear in Table 27. CARROT scores showed a significant correlation with Socialized Extraversion [$r(43) =$ 36, $p < .05$]. Correlations between Unsocialized and BFI Extraversion were not significant.

Table 26

CARROT Card-Sort Time in Seconds

	Mean	*SD*
CARROT1 (no nickels)	45.28	45.28
CARROT2 (nickels)	44.09	44.09
CARROT3 (no nickels)	42.57	42.57
CARROT Difference	-0.17	-0.17

Note: N = 45

Table 27

CARROT Score Correlations with
Composite Extraversion Measures

	CARROT Score
Unsocialized Stimulation Seeking	.20
Socialized Extraversion	.36*
BFI Extraversion	.20

*Notes: N = 45; * = p < .05*

Summary of Correlations between Multiple
Extraversion Measures

Composite observer ratings correlated significantly with Unsocialized Sensation Seeking (USS) and BFI Extraversion, but not with Socialized Extraversion (SE). No correlations were found between extraversion measures and gift unwrapping time differences between incentive and non-incentive gifts, or between extraversion and overall gift unwrapping time. Anticipation of task liking was related to SE, but not USS or BFI Extraversion. The CARROT card sort difference between incentive and non-incentive conditions showed that children who were faster on the incentive than non-incentive trial were higher in SE, but not USS or BFI Extraversion.

CHAPTER IV

DISCUSSION

The first major aim of the current study was to define extraversion in middle childhood by identifying the empirical structure of the trait in a componential analysis. This involved measurement issues, such as examination of the degree to which parent and self reports of personality and temperament corresponded to each other and the reliability of children's self-reports. Behavioral assays were used to validate measures of reward sensitivity and broader extraversion and to examine relations between extraversion and reward as well as extraversion and response execution.

Questionnaire Measurement of Temperament and Personality

Internal Consistency, Parent-Child Agreement, and Gender Differences

An important finding from this study was that all child self-report scales reached levels of internal consistency reliability considered adequate for research. With previous results, this suggests that children are a reliable source for reports of their own temperament and personality. Also found were higher levels of agreement than comparable studies for some aspects of extraversion. The design of some studies poses difficulties for making comparison of levels of self- and parent-agreement because correlations reflecting parent- and self-report agreement are derived from different

measures of the same construct. For example, in Measelle et al. (2005), children's extraversion scores from a puppet interview questionnaire were correlated with adult observation of social skills and (reversed) social isolation. Correlations ranged in strength from .20 to .26. In two studies that used identical items for parents and children, however, agreement levels for extraversion were .23 as measured by the NEO Five Factor Inventory (Markey, Markey, Tinsley, & Ericksen, 2002) and .26 as measured by a phrase-based questionnaire designed to measure the Big Five personality factors in an Italian sample of 4th and 5th grade students (Barbaranelli et al., 2003). Results from the current study suggest that a combination of age-appropriate methods and the specific items used may have allowed for better parent-child agreement with a median correlation for temperament scales of .34 and a correlation of .36 for BFI Extraversion. Future studies should test measurement of extraversion with multiple measures and multiple methods to determine the amount of item and method variance and the most optimal way of measuring temperament and personality utilizing child self-report.

Of all of the extraversion scales, the lowest level of agreement was found for Assertiveness/Dominance. Low agreement found for this scale highlights the importance of including multiple perspectives in measuring individual differences. It is likely that from parents' perspectives, children are "in charge" at home. Children, on the other hand, are rating themselves not only on their behavior at home, but also their behavior relative to peers at school when parents are not present. While they may be more assertive with family members, they may not assert themselves or take charge as much in groups of children, most of whom may be more dominant with parents and siblings in the home

setting. Future studies should include teacher reports to gain more insight how behavior at home as observed by parents may differ from that at school observed by teachers.

In addition to Assertiveness/Dominance, parents rated both boys and girls higher in Fantasy/Openness and Low Intensity Pleasure than the children rated themselves. As with Assertiveness/Dominance, this difference may come from a home/school environment difference. Children may compare themselves to other children in school where students take classes in the arts and with peers, and where children engage in pretend play unsupervised by parents. Differences in Low Intensity Pleasure may arise out of the internal nature of the experience of enjoying low intensity stimuli.

In the current study, self-report internal consistency reliability was lower than that for parent-report. This could reflect a difference in semantic understanding of items. For instance, questionnaire items in the Temperament in Middle Childhood Questionnaire (TMCQ) are written at a third-grade reading level (Microsoft Word®, 2000). Although items were read to children to eliminate the possibility that reading skill would influence the ability to complete the questionnaires, some words may be less familiar to children than to parents. Less familiarity may have created more opportunity for different interpretations of items by children.

A general pattern of higher reports of negative affect for girls than boys was found. Girls were rated higher than boys by themselves and parents in Fear, Discomfort, BFI Neuroticism, and by themselves in Sadness, Shyness, and Behavioral Inhibition. A meta-analysis of findings of scores on the Children's Depression Inventory (CDI) in children ages 8-16 showed that girls' depression scores were stable from ages 8-11 and

increased after age 12 and that they were higher than boys' scores from ages 13-16

(Twenge & Nolen-Hoeksema, 2002). The earlier age found in the current study may

reflect a trend of a decrease in the age of puberty (e.g., Chodick, Huerta, Davidovitch &

Grotto, 2005) and the relations between pubertal status and negative affect (Ellis, 2003).

Boys rated themselves higher than parents rated them in Sadness. It may be that the

privacy of the measure allowed boys, who are subject to cultural expectations to express

less sadness (Fabes & Martin, 1991), to report more honestly about levels of sadness that

are not expressed in the presence of other people. Tendencies to express fewer negative

emotions may also explain lower parent-self agreement levels for boys. Boys rated

themselves higher in Activity Level and Inhibitory Control than parents rated them. It

may be that they engage in more active play with peers than in the family setting. The

difference in ratings of ability to inhibit undesired behaviors may be a result of a

discrepancy in parents' expectations of inhibitory control in boys with boys' expectations

for themselves.

Principal Components: Unsocialized Stimulation Seeking
and Socialized Extraversion

An exploratory principal components analysis was used to investigate the

structure of extraversion. The analysis resulted in two components similar to those found

by Victor et al. (2006) when temperament and personality scales were included in the

same study. The first component for both self- and parent-report is labeled Unsocialized

Stimulation Seeking with loadings from Assertiveness/Dominance, High Intensity

Pleasure, Impulsivity, Gregariousness, and Activity Level. These scales describe active

approach to situations that involve high intensity physical stimuli, groups of people and social situations in which one asserts oneself.

The second component is labeled Socialized Extraversion with loadings from Positive Affect, Reward Sensitivity, Gregariousness, and Activity Level. These scales describe the active expression and enjoyment of pleasant/positive emotions, tangible incentive objects, and social stimuli. Based on findings of Ahadi et al., 1993, it is thought that positive affect becomes more socialized as children develop, as smiling and laughter has loaded with a Surgency factor in infancy (Putnam et al., 2001), but with Effortful Control in childhood.

Finding two components confirms and expands upon findings by Victor et al. (2006) showing a similar pattern of loadings for extraversion factors labeled Sociable Extraversion (SE) and Unsocialized Stimulation Seeking (USS) found in parent-report data for 3- to 12-year-old children, including a finding that Activity Level loaded on both factors.

Big Five Inventory (BFI) Extraversion was significantly correlated with both USS and SE. This suggests that, as intended, the BFI extraversion scale serves as a broad-level measure of the trait. An important finding from the principal components analysis was that Gregariousness and Activity level loaded on both components. The BFI measure allowed for multiple regression analysis to test the relative strength of the double-loading scales (Gregariousness and Activity Level) with scales that loaded on only one or the other component. Multiple regression showed that Gregariousness and Activity Level were significant predictors of BFI Extraversion by themselves in the self-report data and

that scales that loaded on one component only did not add significantly to prediction. In parent-report scales, the model that best predicted BFI Extraversion was Gregariousness and Activity Level with the scales that loaded only on Socialized Extraversion (Positive Affect, Reward Sensitivity).

The finding of the strength of Gregariousness and Activity level as predictors of broad extraversion is more unexpected with respect to Activity Level than it is for Gregariousness. A closer examination of BFI Extraversion items (see Appendix B) reveals that of the nine items in the scale, six items address gregariousness (e.g., "I like to talk with other people," and "I like to meet new people.") while only one addresses an indirect aspect of activity level ("I have trouble sitting still."). This suggests that activity level may be more central to extraversion than previously thought and that either gregariousness or activity level, rather than reward sensitivity, could be the core feature of extraversion. The activity level finding is revisited later in the discussion. The weakness of the reward sensitivity scale and its implications for drawing conclusions with respect to the core feature hypothesis is also discussed later.

An examination of relations of Shyness to composite extraversion components and BFI Extraversion showed that expected negative correlations were highest for BFI Extraversion, and second highest for Unsocialized Stimulation Seeking (USS). Negative correlations between Shyness and Socialized Extraversion (SE) were not significant. Of the two components, USS showed the higher negative correlations with Shyness , which is a part of the fear system. Low shyness found in many extraversion models (e.g., Shiner

& Caspi) is likely more a reflection of an approach-withdrawal opposition than low positive affect, gregariousness, activity level, and reward sensitivity.

Reward Sensitivity Scale

One of the major problems with this study was that the scale selected to measure reward sensitivity, the Behavioral Activation Scales (BAS), did not hold up to conceptual scrutiny after the fact. A thorough examination of all items on the BAS revealed that multiple constructs were included in items from the Drive, Fun Seeking, and even in the Reward Responsiveness subscale. Only three items remained that directly addressed the definition of reward sensitivity, i.e., increased physiological, emotional, and cognitive reactivity to the prospect of obtaining tangible incentive objects and increased behavioral responsiveness to tangible incentive objects, with low but acceptable internal consistency reliability. The median correlation of the reward sensitivity scale with other extraversion components was .13 for parent-report and .14 for self-report. A scale with similar internal consistency, Gregariousness, however, showed much stronger relations with other extraversion scales with a median correlation of .47 for parent-report and .35 for self-report. The difference between the way Reward Sensitivity and Gregariousness correlated with other components may lie in the degree to which each scale was a full representation of the construct measured. The gregariousness scale contained six items (see Appendix B) that address multiple aspects of preferences for interacting with others, whereas the reward sensitivity scale was limited to two items that referred to getting what one wants, and one item that addressed winning a contest. These items provide limited

representation of reactivity to the potential of tangible incentive objects and responsiveness to incentives.

Weakness of this measure makes conclusions about reward sensitivity highly tentative. Without a strong measure of reward sensitivity, it is not possible to draw any conclusions of the relative strength of a questionnaire measure of the construct as a core feature of extraversion. The measurement deficiency also prohibits drawing conclusions about relations between behavioral assays and the questionnaire measure.

At present, none of the existing measures of reward sensitivity (e.g., Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ); Torrubia et al., 2001) is conceptually adequate or appropriate for adaptation for children. Development of a new measure with adaptations for different age groups is needed to address the reward sensitivity construct in the way it has been defined, with little to no overlap with High Intensity Pleasure and related constructs.

<div align="center">Behavioral Measures</div>

<div align="center">*Number Task Findings: Reward and Extraversion*</div>

Reward point scores (reward – non-reward points) showed the expected relationship with Unsocialized Stimulation Seeking (USS). Children with higher USS scores had significantly higher reward point scores than children with low or middle USS scores. One of the most surprising findings was the quadratic pattern in the analysis of reward points by BFI Extraversion; children low and high in BFI Extraversion had a higher reward point score than children with a medium extraversion score. Scores could

be examined further to see whether children low in BFI Extraversion and high in USS, and low in BFI Extraversion and low in USS, show the same pattern of points.

Because the accumulation of points depended on both speed and accuracy, Number Task (NT) results were analyzed by reaction times (RTs) and errors. The RT and error data revealed that different children used different strategies to obtain points; some were faster but less accurate, and others were slower and more accurate. Speed and accuracy should be considered separately in future studies.

Reward x extraversion and response hand x extraversion interactions were not significant in the RT data; however, an interaction between reward and extraversion was found for BFI Extraversion scores in errors. High BFI scores were associated with more errors. Both high and low BFI extraversion scores were related to fewer errors in the reward than non-reward condition. The middle BFI extraversion group showed more errors in the reward than non-reward condition. More investigation is needed in order to understand the unexpected findings that low, but not medium, BFI Extraversion scores were associated with more reward points, and that the medium BFI group showed a different pattern of errors than the groups with low and high scores.

Number Task Findings: Response Execution,
Reward, and Extraversion

Effects were found for response hand in interactions with BFI Extraversion in NT error data and in three-way reward x response hand x extraversion interactions for USS and BFI Extraversion for RTs and SE for errors. The response hand by BFI Extraversion interaction showed that the difference was found in left-hand errors: The group with high

scores on BFI Extraversion committed the most errors with the left hand, the low BFI Extraversion group with the lowest number of errors, and the middle extraversion group with a left-hand error level between that of the other two groups. The effect appears not to come from committing errors with right hand so much as it comes from more errors committed with the left hand. Conclusions that can be drawn by results of the current exploratory study are limited to finding differences between response hands. Event-related potentials (ERPs) that measure brain activity before, during, and after responses to different stimuli could assist in understanding what patterns of activation may be underlying these response hand RT and error differences.

The predicted reward x hand x extraversion interaction was found for BFI Extraversion and marginally significantly for USS. The reward condition did amplify hand differences in the more extraverted children such that more difference between the left and right hand showed in children high in extraversion in the reward condition. The result suggests that a motor difference between more and less extraverted children may depend on reward. An interaction of motor and reward systems in extraversion is suggested in Depue and Collins's (1999) definition of the behavioral facilitation system underlying extraversion as "behavioral approach based on incentive motivation." Behavioral approach implies motor movement and incentive motivation describes the engagement of the reward system. Together with the finding that Activity Level loaded on both the Unsocialized Stimulation Seeking and Socialized Extraversion components, the finding that hand differences interacted with reward and extraversion in task

performance suggests a more important role for motor activity in extraversion than has been suggested by other theorists.

Previous studies with findings of motor differences in extraverts were examined for the presence or absence of feedback or reward in tasks used to measure motor differences. Doucet and Stelmack (1997, 2000) did not use feedback in the task in which movement times (time from lift off from a home key to time of response on response key) were found to be faster for extraverts. However, in the go/no-go task used in Rammsayer and Stahl (2004), in which lateralized readiness potentials (LRPs) were found to be faster in extraverts, feedback was given to participants after every trial. The feedback may have served as an incentive in itself, even if feedback was not connected to any tangible reward. An element of incentive motivation may have interacted with motor preparation and may have contributed to LRP differences. Future studies should combine the measurement of LRPs with use of the Number Task in which feedback is present in all conditions, but in which some feedback is connected to a tangible incentive. Such a study would separate reward from hand differences.

Behavioral differences suggesting an interaction between reward and motor systems in relations with extraversion may reflect differences in genes that influence the development and functioning of these systems. Future work should identify candidate genes and examine associations between phenotypic differences and genotype.

Because the task for children was limited to response to numbers lower than 5 by the left hand and numbers higher than 5 by the right hand, it is not possible to know whether hand effects found in the current study are due to number line differences or to

motor preparation. A next step would be counterbalancing numbers with hands so that numbers lower and higher than 5 are responded to with both hands. With a larger sample, left-handed children could be included in the study and/or specifically recruited to examine whether the same patterns of preferred vs. non-preferred hand responding exist in left-handed children as well.

<center>*Observer Ratings and Task Anticipation*</center>

Experimenter ratings of five behavioral characteristics: talkativeness, physical activity, eye contact, positive mood, and excitement about incentives showed good reliability and formed one reliable composite score reflecting observed extraversion. The composite observer ratings were correlated with Unsocialized Stimulation Seeking (USS), and BFI Extraversion, but not Socialized Extraversion. The experimental session took place over an hour and a half, so that experimenter's ratings included children's behavior both during social interaction and when children were completing tasks in the presence of the experimenter, but not while interacting (e.g., Number Task). Observing children in this setting may have highlighted their less socialized differences because of the unusual type of situation the experimental posed compared to more natural situations a school-age child encounters.

Anticipation of task liking scores comprised of children's ratings of how much they thought they would like each task based on a standardized description, showed acceptable, but not strong, reliability. It correlated with SE, but not USS or BFI Extraversion. In fact, task anticipation was correlated negatively but non-significantly with USS. The correlation with SE may have been caused by the ratings collected by the

experimenter telling children about the tasks and then asking them how much they thought they would like the task. The child may have perceived that it was the experimenter's own personal task and the task anticipation ratings were likely subject to social desirability. Future studies could include naturalistic observations of children interacting with peers, one of the potential references children likely when answering questions about themselves, and a reference parents likely used when responding about their children with respect to more socialized aspects of extraversion. Future studies should use less interpersonally oriented measures of anticipation of task liking to see whether any differences would exist for USS vs. SE in the way anticipation correlates with extraversion.

Gift Unwrapping and CARROT Card-Sort Findings

A new task testing differences in time to unwrap a gift between conditions in which a child knew he or she would be receiving the gift (incentive gift) and in which a child believed that the gift needed to be unwrapped for the experimenter (non-incentive gift). The time to unwrap the non-incentive gift was actually faster than the time to unwrap the incentive gift. It was expected that children would be more excited to receive a toy than to unwrap a gift for another person and that that excitement would translate into faster unwrapping times. Structuring a plausible situation in which a child would need to unexpectedly unwrap a gift for another person was a challenge for task development. The scenario created for non-incentive gift unwrapping was that the experimenter had broken a pencil, needed a new pencil to continue, and knew that there were likely pencils in an unwrapped gift from a friend.

One reason that the non-incentive gift was unwrapped faster than the incentive gift was that it came in the middle of two decision tasks being conducted for a separate study and children may have been anxious to continue. Pre-task anticipation scores for the decision task were higher than those for all but one other task (see Table 12). Children's desire to continue the decision task games may have motivated them to unwrap the "pencil" gift faster in order to continue playing. In the end, the "non-incentive" gift still presented an incentive: that of continuing on with the task in progress. If such a scenario is possible, it would be ideal to include a truly non-incentive gift unwrapping condition in a future study to improve upon the first test of the task in this study. Because the box used was the same shape and size, the faster unwrapping of the second gift may be a practice effect.

The CARROT card sort task was more successful, in terms of presenting a natural situation in with non-incentive and incentive trials. However, there were a number of problems in the running of the task. Cards used for the task were too big for children's hands and hard plastic used for lamination of the card may have felt uncomfortable to the children. This discomfort may have made the sorting process less natural and did cause a number of children to drop cards to the extent that their CARROT task performance was not included in coding or analysis. Solving logistical problems that occurred in this first test of an adaptation of a child version of the CARROT is essential for its future testing and use.

The CARROT scores correlated significantly with Socialized Extraversion and showed non-significant positive correlations with USS and BFI Extraversion. As with

task anticipation ratings, the incentives in the CARROT task were presented by the experimenter when the experimenter gave children nickels directly upon each set of 5 cards being sorted. Children's reactions to sorting the cards may have been influenced by more socialized aspects of extraversion.

<center>Limitations, Future Directions, and Conclusions</center>

Extraversion has long been considered an important dimension of individual differences and has been included in nearly all temperament and personality models and taxonomies put forth by theorists. Biological models and emerging investigations of brain activation patterns support a theory that places tendencies to react and respond to rewards at the center of the extraversion construct. The current study included a componential analysis of extraversion and behavioral tests of two subcomponents: reward sensitivity and motor activity.

The major finding in this study was that when included in the same analysis, temperament and personality extraversion scales formed two components: Unsocialized Stimulation Seeking and Socialized Extraversion. This finding partially replicates those in one other study and suggests that two aspects of extraversion must be considered when examining its relations with other aspects of psychosocial functioning. One component describes approach behaviors to higher intensity stimuli (physical stimuli and social situations that require assertion of one's opinions and exertion of one's influence over others) and other aspects of extraversion believed to be more socialized in childhood. Gregariousness and Activity Level were found to load on both components and warrant further consideration as potential core features of extraversion.

One of the major limitations in this study posed problems for the questionnaire measurement of reward sensitivity; however, partial support was found for the hypothesis that larger behavior differences between reward and non-reward conditions would be found in more extraverted children. A lack of good construct representation prevented the reward sensitivity scale from providing a good basis from which conclusions about reward measured by questionnaire and reward measured in behavior could be drawn. The lacking reward sensitivity scale also made drawing conclusions about its correlations with other extraversion scales only highly tentative. Despite the weakness of the scale; however, it did load highly on the Socialized Extraversion factor.

A number of new tasks and adaptations of tasks were used in this study, with varying degrees of success. The card sort task is promising as a behavioral measure of extraversion. The gift unwrapping task showed results opposite to those expected and the relative incentives attached to unwrapping a gift would need to be considered in future studies. Most successful were adaptations of previous and new measures to child self-report format. This study provides support for the idea that children are capable of reporting about their own temperament and personality and that the child perspective is important to include in studies of these individual differences.

Hypotheses about differences in response execution in more extraverted children were partially supported and the main finding from this study about motor behavior was a three-way interaction that showed more extraverted children to show more motor differences in reward conditions. This suggests that the motor and reward systems may interact as important underlying systems that influence differences in extraversion.

Activity level has not been considered by previous theorists as a central feature or system with respect to the broad trait. Some adult models include social activity or talkativeness as a behavioral expression of activity level beyond childhood and adolescence (Shiner & Caspi, 2003). Longitudinal studies would help toward an understanding of whether motor activity differences continue to relate to extraversion from infancy to adulthood.

A major limitation of the measurement aspect of this study is sample size. A larger sample size would allow for finer statistical analysis using structural equation modeling. Another limitation of the sample in this study was that only children living close enough to the university laboratory where the study was held and whose parents were willing to participate in a 1.5 hour long study participated. The geographic limitation meant that almost all children in the study were similar in racial/ethnic and socioeconomic status. Financial incentive for participation may have introduced a selection bias. Parents who are higher in reward sensitivity may have chosen to participate more frequently than parents who are less responsive to monetary rewards.

An issue that is important with respect to the sample used is that the findings are limited to children who are part of the culture of the United States. Some of the findings in this study are very likely influenced by culture, as positive affect and reward sensitivity were part of the more socialized extraversion component. Because of cultural expectations in the United States to express positive emotions, it is very likely that the structure of extraversion may look different when tested in cultures where the expression of happiness is not socially expected.

Understanding temperament and personality and its connections to other aspects of psychosocial functioning can help us understand how individual differences influence people's behaviors and thoughts. Essential to this understanding is clear definition of and examination of influences behind broad traits that are subject to multiple conceptualizations by multiple theorists. Adding behavioral validation to these conceptualizations will strengthen the way we understand temperament and personality from infancy through adulthood.

APPENDIX A

Temperament Scales and Definitions

Scale	Definition
Activity Level	Level of gross motor activity including rate and extent of locomotion
Affiliation	The desire for warmth and closeness with others, independent of shyness or extraversion.
Anger/Frustration	Amount of negative affect related to interruption of ongoing tasks or goal blocking.
Assertiveness/Dominance	Tendency to speak without hesitation and to gain and maintain control of social situations.
Attentional Focusing	Tendency to maintain attentional focus upon task-related channels.
Discomfort	Amount of negative affect related to sensory qualities of stimulation, including intensity, rate or complexity of light, movement, sound, texture.
Fantasy/Openness	Active imagination, aesthetic sensitivity, intellectual curiosity.
Fear	Amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations.
High Intensity Pleasure	Amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty and incongruity.
Impulsivity	Speed of response initiation.
Inhibitory Control	The capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations.
Low Intensity Pleasure	Amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty and incongruity.

Appendix A (Continued)

Perceptual Sensitivity	Amount of detection of slight, low intensity stimuli from the external environment
Sadness	Amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment and object loss.
Shyness	Slow or inhibited approach in situations involving novelty or uncertainty.
Soothability	Rate of recovery from peak distress, excitement, or general arousal.

APPENDIX B

Questionnaire Items

Temperament in Middle Childhood Questionnaire
(Simonds & Rothbart, 2006)

Reversed items are in italics type. Scales used in extraversion analyses are in **bold** type.

Activation Control

Self-Report Item	Parent Item
I can make myself get out of bed when it's time to wake up, even if I'm really tired.	Can make him/herself get out of bed, even when tired.
I smile at people even when I don't like them.	Can make him/herself smile at someone, even when s/he dislikes them.
I can make myself do my homework first, even when I want to play.	Can make him/herself do homework, even when s/he wants to play.
I can make myself run as fast as I can, even when I'm really tired.	Can make him/herself run fast, even when tired.
I can say "I'm sorry" or shake hands with someone I had a fight with.	Can apologize or shake hands after a fight.
It's hard for me to make myself clean my room even when I know I should.	*Has a hard time making him/herself clean own room.*
I can still make myself take a band-aid off, even though it hurts a lot.	Can take a band-aid off when needed, even when painful.
I do something fun for awhile before starting my homework, even though I'm not supposed to.	Does a fun activity when s/he is supposed to do homework instead.
If I see a kid being left out, I can ask him or her to play with me and my friends.	When a child is left out, can ask that child to play.

Appendix B (Continued)

It's hard for me to keep working on an assignment when it gets boring.	*Has a hard time working on an assignment s/he finds boring.*
It's hard for me to get moving when I'm tired.	*Has a hard time getting going(moving) when tired.*
I can say hello to a new kid in my class even if I'm feeling shy.	Can say hello to a new child in class, even when feeling shy.
Even when I know something will taste terrible, I can make myself eat it anyway.	Can make him/herself take medicine or eat food that s/he knows tastes bad.
I can make myself pick up something dirty to throw it away.	Can make him/herself pick up something dirty in order to throw it away.

Activity Level

Self-Report Item	**Parent Item**
I like to run around at recess.	**Likes to run around outside.**
I like PE.	**Likes active games.**
I would rather play a sport than watch TV.	**Would rather play a sport than watch TV.**
I have lots of energy.	**Is energetic.**
I am always on the move.	**Is always on the move.**
I like to get out of the house and do something physical.	**Likes to get out of the house and do something physical.**
I like to do active things like sports or dancing.	**Likes to be physically active.**
I like to run.	**Likes to run.**

Affiliation

Self-Report Item	Parent Item
I like just being with other people.	Likes just being with other people.
I like to feel close to other people.	Likes to feel close to other people.
I like hugs and kisses.	Likes hugs and kisses.
I love pets and other small animals.	Loves pets and other small animals.
My friends are very important to me.	Places great importance on friends.

Appendix B (Continued)

I would like to be friends with lots of people	Would like to be friends with lots of people.
I would like to be able to spend time with a good friend every day.	Would like to spend time with a good friend every day.
I am a warm and friendly person.	Is warm and friendly.
I like to make others feel good.	Likes to make others feel good.

Anger/Frustration

Self-Report Item	Parent Report Item
I get mad when recess is over.	Gets angry when called in from play before s/he is ready to quit.
I get mad when I don't know how to do something.	Gets angry when s/he has trouble with a task.
I get mad when another kid takes one of my things.	Gets very angry when another child takes his/her toy away.
When another kid says something mean to me, I get mad.	Gets mad when provoked by other children.
I get angry when I can't find something I'm looking for.	Gets angry when s/he can't find something s/he is looking for.
I get mad when I make a mistake.	Gets angry when s/he makes a mistake.

Assertiveness/Dominance

Self-Report Item	**Parent Report Item**
I like beating other kids at games.	**Greatly enjoys playing games where s/he can win.**
I like to be in charge.	**Likes to be in charge.**
Other kids do what I do.	**Is followed by other children.**
I like to make my own decisions.	**Enjoys making her/his own decisions.**
I like winning arguments.	**Enjoys winning arguments.**
When I argue with another kid, I usually win.	**Usually wins arguments with other children.**

Appendix B (Continued)

When I'm in a group, I am the first one to speak up.	**Is first to speak up in a group.**
When I'm with other kids, I usually pick what we're going to do.	**When with other children, is the one to choose activities or games.**

Attention

Self-Report Item	Parent Report Item
It's hard for me to work on one thing for a long time.	*When working on an activity, has a hard time keeping her/his mind on it.*
I look around the room when doing my schoolwork.	*Looks around the room when doing homework.*
When I try to pay attention, I get distracted.	*Gets distracted when trying to pay attention in class.*
When someone's reading me a story, I have trouble paying attention.	*Is easily distracted when listening to a story.*
My teacher tells me to pay attention.	*Needs to be told by teacher to pay attention.*
My mom or dad tells me to pay attention.	*Needs to be told to pay attention.*
I have a hard time paying attention	*Has a hard time paying attention.*

Discomfort

Self-Report Item	Parent Report Item
It bothers me when the bath or shower water is too hot or too cold.	Is bothered by bath water that is too hot or too cold.
It bothers me when lights or colors are too bright.	Is bothered by light or color that is too bright.
I cry when I get a little bit hurt.	Is likely to cry when even a little bit hurt.
I feel like crying when I get a shot.	Cries when given an injection.
It hurts when I fall down.	Is bothered by pain when s/he falls down.
I feel uncomfortable when I'm cold or wet.	Becomes quite uncomfortable when cold or wet.

Appendix B (Continued)

It bothers me when sounds are too loud or scratchy.	Is bothered by loud or scratchy sounds.
It hurts a lot when I have a little cut.	Is quite upset by a little cut or bruise.
I go to the nurse's office when I have a little stomachache.	Goes to school nurse's office for very minor complaints.
I get upset when someone combs my hair.	Becomes upset when hair is combed.

Fantasy/Openness

Self-Report Item	Parent Report Item
I like to draw.	Enjoys drawing pictures.
I like to make things.	Likes to make things.
I like reading or listening to make-believe stories.	Likes reading or listening to make believe stories.
I like to make up stories.	Likes to make up stories.
I like poems.	Likes poems
I like to think about things no one else thinks about.	Likes to think of new ideas.
I like to pretend.	Likes to pretend.
I have a big imagination.	Has a big imagination.

Fear

Self-Report Item	Parent Item
I'm afraid of fire.	Is afraid of fire.
I'm afraid of monsters in the house.	Is afraid of burglars or the "boogie man."
I'm afraid when I sleep over at someone's house.	Is afraid of sleeping over at someone's house.
I'm afraid of loud noises.	Is afraid of loud noises.
I get scared before a doctor gives me a shot.	Is scared of injections by the doctor.
I'm afraid of the dark.	Is afraid of the dark.
I'm afraid of heights.	Is afraid of heights.
I get scared by nightmares.	Is very frightened by nightmares.

Appendix B (Continued)

High Intensity Pleasure

Self-Report Item	**Parent Item**
I like to play chase.	Enjoys playing chase.
I like going high and fast on the swings.	Likes to go high and fast on the swings.
Sometimes I play so hard people think I might get hurt.	Likes to play so wild and recklessly that s/he might get hurt.
I like playing fast, noisy games.	Likes rough and rowdy games.
I like to ride my bike really fast down hills.	Enjoys riding bicycle fast and recklessly.
I like TV shows with lots of action.	Enjoys exciting and suspenseful TV shows.
I enjoy going places where there are big crowds and lots of excitement.	Enjoys exciting places with big crowds.
I think it would be exciting to move to a big city I've never seen.	Would find moving to a new, big city exciting.
Skiing or snowboarding down a steep hill really fast sounds scary to me.	Would think that skiing or snowboarding fast sounds scary.

Impulsivity

Self-Report Item	**Parent Item**
I do things without thinking about them first.	Usually rushes into an activity without thinking about it.
I decide what to do quickly then go and do it right away.	Decides what s/he wants very quickly and then goes after it.
When I see something I like, I go for it right away.	When s/he sees a toy or a game s/he wants, is eager to have it right away.
I rush into doing new things.	Often rushes into doing new things.
I interrupt people when they're talking.	Interrupts others when they are talking.
I stop and think before I decide to do something.	*Usually stops and thinks things over before deciding to do something.*

Appendix B (Continued)

	Tends to say the first thing that comes to mind, without stopping to think about it.
I talk before thinking about it.	
I call out answers in class before the teacher calls on me.	**Calls out answers before being called on by a teacher or group leader.**
I can't help it, but I touch things without getting permission.	**Can't help touching things without getting permission.**
I grab what I want.	**Grabs what s/he wants.**
I make up my mind to do things all of a sudden.	**Makes up mind suddenly.**
I get into trouble because I do things without thinking first.	**Gets into trouble because s/he does things without thinking first.**
I say the first thing that comes into my head.	**Says the first thing that comes to mind.**

Inhibitory Control

Self-Report Item	Parent Item
It's easy for me to wait to open a present.	Has an easy time waiting to open a present.
When someone tells me "Stop," I can stop.	Can stop him/herself when s/he is told to stop.
I am careful when I cross the street.	Is very careful and cautious when crossing the street.
When I'm excited, it's hard for me to wait my turn to talk.	*Has a hard time waiting his/her turn to talk when excited*
It's easy for me to keep a secret.	Is able to keep secrets.
It's hard to slow down in the school hallways when I want to run.	*Has a hard time slowing down when rules say to walk.*
I like to plan carefully before I do something.	Likes to plan carefully before doing something.
I can stop myself from doing things too quickly.	Can stop him/herself from doing things too quickly.

Appendix B (Continued)

Low Intensity Pleasure

Self-Report Item	Parent Item
I like to sit under a blanket.	Likes to sit under a blanket.
I like looking at books.	Enjoys looking at books.
I like quiet reading time.	Likes quiet reading time.
I like to look at trees.	Likes to look at trees.
I like the crunching sound of leaves in the fall.	Likes the crunching sound of leaves in the fall.
I like the sound of poems.	Likes the sound of poems.

Perceptual Sensitivity

Self-Report Item	Parent Item
I like to run my hand over things to see if they are smooth or rough.	Likes to run his/her hand over things to see if they are smooth or rough.
I usually notice when my mom or dad is wearing something different.	Notices when parents are wearing new clothing.
I notice the sound of birds.	Notices the sound of birds.
I can tell if another person is sad or angry by the look on their face.	Can tell if another person is sad or angry by the look on their face.
I notice when there are little bits on dirt on things.	Notices even little specks of dirt on objects.
I notice smells like perfume, smoke, and cooking smells.	Notices odors like perfume, smoke, and cooking smells.
I touch fabric or other soft material.	Touches fabric or other soft material.
I notice things that other people don't notice.	Notices things others don't notice.
I notice the color of people's eyes.	Notices the color of people's eyes.

Sadness

Self-Report Item	Parent Item
I feel sad even when other people feel happy.	Tends to feel sad even when others are happy.
I feel sad a lot.	Feels sad frequently.

Appendix B (Continued)

If I don't get to do something, I get sad.	Tends to become sad if plans don't work out.
When I'm tired, I cry.	Becomes tearful when tired.
When I can't finish something, I feel sad.	Seems to feel down when unable to accomplish a task.
When I have to do something I don't want to do, I feel sad.	Becomes sad when told to do something s/he does not want to do.
I cry when my toy is lost or broken.	Cries sadly when a favorite toy gets lost or broken.
It's easy for people to hurt my feelings.	Her/his feelings are easily hurt.
Sometimes I feel sad for no reason.	Sometimes appears to be downcast for no reason.

Shyness

Self-Report Item	Parent Item
I feel shy around new people.	Is shy with new people.
I am shy.	Is shy.
I feel uncomfortable around others.	Acts insecure with others.

Soothability

Self-Report Item	Parent Item
When I cry, I cry for a long time.	*When s/he cries, tends to cry for more than a couple of minutes at a time.*
When I'm mad or sad, nothing helps me feel better.	*Is very difficult to soothe when s/he has become upset.*
When I'm angry, I stay angry for a long time.	*When angry about something, s/he tends to stay upset for five minutes or longer.*
When someone hurts my feelings, it feels bad for a long time.	*Remains upset for hours when someone hurts his/her feelings.*
It's easy for me to cheer up right away after feeling bad.	Cheers up quickly.
When I get scared, I feel nervous for a long time.	*Feels nervous for a long time after being scared.*

Appendix B (Continued)

**Big Five Inventory (BFI; John & Srivastava, 1999)
and Big Five Inventory for Children (BFI-C)**

Extraversion

Parent Item (BFI)	**Self-Report Item (BFI-C)**
Is talkative.	**I like to talk with other people.**
Has an assertive personality.	**I speak up and let others know what I think.**
Is full of energy.	**I have trouble sitting still.**
Is outgoing, sociable.	**I like to meet new people.**
Is reserved.	*I keep my feelings to myself.*
Generates a lot of enthusiasm.	**I get other people excited about things.**
Is sometimes shy, inhibited.	*I am shy.*
Tends to be quiet.	*I am quiet.*

Agreeableness

Parent Item (BFI)	Self-Report Item (BFI-C)
Starts quarrels with others.	*I argue with others.*
Can be cold and aloof.	*I ignore people I don't like.*
Is helpful and unselfish with others.	I do things for other people.
Likes to cooperate with others.	I like to cooperate with other people.
Is generally trusting.	I trust other people.
Is considerate and kind to almost everyone.	I am kind to almost everyone.
Tends to find fault with others.	*I look for people's mistakes.*
Has a forgiving nature.	If someone tells me they're sorry, I stop being mad at them.
Is sometimes rude to others.	*I am sometimes rude to people.*

Appendix B (Continued)

Conscientiousness

Parent Item (BFI)

Self-Report Item (BFI-C)

Does a thorough job.

I do a complete job.

Can be somewhat careless.

I can be careless.

Makes plans and follows through with them.

I make plans and I finish what I plan to do.

Tends to be lazy.

I am lazy.

Is a reliable worker.

Other people can count on me to get a job done.

Does things efficiently.

I get things done without wasting a lot of time.

Perseveres until the task is finished.

I work until a job is done.

Is easily distracted.

It is easy for me to get distracted.

Tends to be disorganized.

My things are messy.

Neuroticism

Parent Item (BFI)

Self-Report Item (BFI-C)

Is relaxed, handles stress well.

I am usually relaxed and calm.

Can be moody.

I can be cranky and grumpy.

Is emotionally stable, not easily upset.

It is hard to make me sad or angry.

Can be tense.

I can feel stressed or tense.

Gets nervous easily.

It doesn't take much to make me nervous.

Remains calm in tense situations.

I stay calm when others get upset.

Is depressed, blue.

I often feel sad or down.

Worries a lot.

I worry a lot.

Appendix B (Continued)

Openness

Parent Item (BFI)
Is sophisticated in art, music, or literature.

Is curious about many different things.

Is inventive.
Is original, comes up with new ideas.
Prefers work that is routine.

Is ingenious, a deep thinker.

Has few artistic interests.
Likes to reflect, play with ideas.

Has an active imagination.
Values artistic, aesthetic experiences.

Self-Report Item (BFI-C)
I know a lot about art, music, and books.

I want to know more about a lot of things.

I find new ways to solve problems.
I like to come up with new ideas.
I like work that is the same over and over.

I think up new things and new ways to do things.

I think art and music are boring.
I like to think about ideas in different ways.

I have a big imagination.
I like to see new pictures and hear new songs.

Gregariousness / Sociability
(Developed for study by Simonds & Rothbart)

*Based on constructs represented by Gregariousness/Sociability items
from the International Personality Items and the Child
Temperament & Personality Questionnaire.*

Parent Item

Makes friends easily.

Likes to be the center of attention.

Likes parties.

Likes things to be quiet.

Likes to be in big groups of people.

Likes to play by him/herself.

Self-Report Item

It's easy for me to make friends.

I like to be the center of other people's attention.

I like parties.

I like it when things are quiet.

I like to be in big groups of people.

I like to play by myself.

Appendix B (Continued)

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Positive Affect Scale
(Developed for study by Simonds & Rothbart)

Based on adjectives from the PANAS
(Positive Affect / Negative Affect Scales)

</div>

Parent Item	**Self-Report Item**
Is a happy child overall.	**I usually feel happy.**
Is active.	**I am usually active.**
Feels happy.	**I am a happy kid.**
Feels cheerful.	**I usually feel cheerful.**
Is interested in many things.	**I feel interested in many things.**
Often feels joyful.	**I often feel joyful.**
Feels energetic.	**I have a lot of energy.**
Feels alert.	**I usually feel wide awake.**
Is happy with his/her accomplishments.	**I am happy when I do something well.**

Reward Sensitivity

Self-Report Item	Parent-Report Item
I would feel excited if I won a contest.	**Would feel excited if s/he won a contest.**
When I have a chance to get something I like, I get excited.	**Gets excited if s/he has a chance to get something s/he likes.**
When I get something I want, I feel excited and full of energy.	**Feels excited and full of energy when s/he gets something s/he wants.**

Appendix B (Continued)

Behavioral Inhibition Scale

Self-Report Item	Parent-Report Item
When s/he thinks something bad is going to happen, becomes upset.	When I think something bad is going to happen I get upset.
Gets upset when someone is angry at him/her.	When somebody is angry at me, I get pretty upset.
Stays calm even when something bad is about to happen to him/her.	Even when something bad is about to happen to me, I stay calm.
Worries if s/he thinks s/he has done something poorly.	When I think I have done something poorly, I feel worried.
Worries about making mistakes.	I worry about making mistakes.
Gets feelings hurt when someone scolds him/her.	When someone tells me I did something wrong, it hurts my feelings.

APPENDIX C

Behavioral Activation Scales
(Carver & White, 1994) Item Analysis

Working Definition of Reward Sensitivity: Increased
physiological, emotional and cognitive reactivity,
and behavioral responsiveness to incentives.

Self-Report Item	Parent-Report Item	Subscale	Item Analysis
When I want something I do whatever it takes to get it.	Does whatever it takes to get something s/he wants it.	Drive	(Delete - Behavioral response to non-object)
When I see a chance to get something I want, I go for it right away.	Goes for something s/he wants right away when given the chance.	Drive	(Delete - Behavioral response to non-object)
Nobody can stop me when I want something.	Cannot be stopped by anyone when s/he wants something.	Drive	(Delete – includes compliance to demands of others)
I will do a lot to get what I want.	Will do a lot to get what s/he wants.	Drive	(Delete – Includes persistence)
I often do some things just because they're fun.	Often does some things just because they are fun.	Fun Seeking	(Delete – Beh. response to non-object)
I'm always willing to try something new if I think it will be fun.	Is always willing to try something new if s/he thinks it will be fun.	Fun Seeking	(Delete – includes risk taking and/or sensation seeking)
I like excitement and new experiences.	Likes excitement and new experiences.	Fun Seeking	(Delete – high pleasure)
When I think of something fun to do, I do it right away.	Does something right away when s/he thinks of something fun to do.	Fun Seeking	(Delete - Behavioral response to fun incentive, not object)
When good things happen to me, I feel very positive.	Feels very positive when good things happen to him/her.	Reward Respons.	(Delete – this is an emotional response after the fact)

Appendix C (Continued)

I would feel excited if I won a contest.	**Would feel excited if s/he won a contest.**	**Reward Respons.**	**Emotional response to attained incentive object**
When I have a chance to get something I like, I get excited.	**Gets excited if s/he has a chance to get something s/he likes.**	**Reward Respons.**	**Emotional response to potential incentive object**
When I get something I want, I feel excited and full of energy.	**Feels excited and full of energy when s/he gets something s/he wants.**	**Reward Respons.**	**Emotional/physiological response to attained incentive object**
When I am doing something well, I like to keep doing it.	Likes to keep doing something s/he is doing well.	Reward Respons.	(Delete – Elements of mastery and self-esteem)

APPENDIX D

Task Instruction Scripts

Temperament in Middle Childhood Questionnaire (TMCQ)

"Okay, (child's name), the first thing you'll be doing is answering some questions about yourself. Once the program starts, a character named Ducky will explain how it works. You'll be answering questions about yourself by clicking on some boxes. The questions are about what you're like – things like how active you are, how you feel, and other things like that. When you're done, you'll get a present."

Number Task

"Now you're going to do an activity at the computer. You'll need to figure out if the number you see is higher than five or lower than 5. If you go fast enough, you'll get points. If you go too slowly, you'll lose points. Points that are in gray show you how you're doing. Points that are in orange show you how you're doing, but the orange points are special. If you have orange points at the end, you'll get tickets. You trade the tickets for toys. You only get tickets if you have positive points, not negative ones. I'll go get the toys. (Roll toy cart over and show toys to children) Here are some of the toys you can win. I'll let you know how many tickets they cost at the end. So, remember, you're going to be deciding if the number you see is higher than 5 or lower than 5. You'll do this a lot of times, and there will be breaks. You might win some toys at the end. You'll get to choose at least one sticker or tattoo."

Appendix D (Continued)

Personality Questionnaire

"(Child's name), you've got two more activities to go. For this one, you're going to answer some questions. This one is shorter. Some of the questions might be a lot like ones you answered before, but just do your best to give the answer that is right for you. Ducky will read you the questions on a tape recorder and you will use a pen to mark your answers. (Get out Bingo markers). Which color pen would you like to use?."

CARROT Card Sort

"Now you're going to play a game where you sort cards. We're interested in how fast kids are at sorting groups of things. I will put three colored trays on the table. If a card has a blue dot on it, you'll put it in the blue tray. If it has a green dot on it, it will go in the green tray and so on. You'll practice then sort once with a deck of cards. Then you'll do it again with a second deck but that time I'll give you a nickel for every five cards you sort. Then you'll do it one more time just the regular way."

Appendix E *All Temperament and Personality Scale Correlations*

Scales	1	2	3	4	5	6	7	8	9	10	11	12
1- Activation Control	-	.27*	.39**	-.27*	-.03	.31*	-.18	.26*	-.30*	.17	-.15	.60**
2- Activity Level	.12	-	.31*	.01	.35**	-.03	-.16	.21	-.17	.55**	.23+	.05
3- Affiliation	.28*	.30*	-	.14	.28*	.00	.22+	.44**	.10	.30*	.26+	.19
4- Anger/Frustration	-.46**	.12	-.28*	-	.28*	-.53**	.65**	.22+	.52**	-.03	.40**	-.50**
5- Assertiveness/Dominance	-.04	.35**	.36**	.31*	-	-.27*	-.04	.20	-.06	.48**	.57**	-.23+
6- Attention	.40**	-.16	-.04	-.31*	-.21	-	-.43**	-.25+	-.26*	-.17	-.58**	.63**
7- Discomfort	-.59**	-.14	-.36**	.43**	-.16	-.14	-	.21	.66**	-.19	.29*	-.33*
8- Fantasy	.32*	.21	.42**	-.18	.20	.11	-.06	-	.08	.25*	.36**	.04
9- Fear	-.26*	-.16	-.11	.16	-.24+	.10	.39**	-.11	-	-.30*	.18	-.32*
10- High Intensity Pleasure	.06	.56**	.21	.29*	.53**	-.42**	-.22+	.29*	-.30*	-	.41**	-.05
11- Impulsivity	-.35**	.28*	.09	.51**	.54**	-.72**	.17	.05	-.07	.53**	-	-.53**
12- Inhibitory Control	.44**	-.24	.10	-.54**	-.35**	.63**	-.16	.06	.15	-.48**	-.76**	-
13- Low Intensity Pleasure	.14	.16	.21	-.14	-.15	.13	.07	.55**	-.10	-.05	-.15	.12
14- Perceptional Sensitivity	.23**	.09	.07	.03	.02	.14	-.02	.14	-.04	-.09	-.12	.08
15- Sadness	-.58**	-.09	-.30*	.70**	.21	-.27*	.62**	-.33*	.33*	.02	.37**	-.37**
16- Shyness	-.41**	-.14	-.48**	.36**	-.27*	.24+	.48**	-.36**	.48**	-.34**	-.17	.08
17- Soothability	.67**	.03	.45**	-.61**	-.03	.12	-.62**	.32*	-.35**	.03	-.22+	.30
18- Positive Affect	.53**	.30	.62**	-.43**	.29*	.20	-.41**	.60**	-.13	.12	-.07	.1*9
19- Gregariousness	.17	.43**	.62**	-.11	.47**	-.26*	-.33*	.36*	-.14	.52**	.42+	-.32*
20- Behavioral Inhibition	-.32*	-.13	-.02	.46**	.15	-.05	.41**	-.08	.35**	-.25+	.13	-.03
21- BFI Agreeableness	.59**	-.06	.42**	-.65**	-.39**	.24+	-.43**	.24+	-.14	-.22+	-.52**	.53**
22- BFI Conscientiousness	.56**	.04	-.17	-.24+	-.26*	.65**	-.18	-.04	-.03	-.20	-.54**	.46**
23- BFI Extraversion	.34**	.43	.61**	-.18	.56**	-.23+	-.42**	.54**	-.30*	.45**	.41**	-.23+
24- BFI Neuroticism	-.63**	.08	-.26*	.64**	.19	-.25+	.54**	-.22+	.27*	.05	.40**	-.44**
25- BFI Openness	.30*	.19	.38**	-.10	.27*	.01	-.12	.81**	-.30*	.28*	.10	-.04
26- Reward Sensitivity	-.10	.26*	.23+	.06	.13	.00	.04	.23+	.10	-.05	.08	-.12

Self-report on top diagonal, Parent on bottom diagonal   + = *p* < .10 , * = *p* < .05, ** *p* > .01

Appendix E. *All Temperament and Personality Scale Correlations*

Scales	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1- Activation Control	.32*	.30*	-.13	-.24	.36**	.30*	.14	-.27*	.56**	.39**	.18	-.26*	.41**	.01
2- Activity Level	.28*	.22+	.00	-.28	.10	.45**	.36**	-.10	.09	.09	.37**	-.15	.24+	.14
3- Affiliation	.29*	.26+	.23+	-.12	-.12	.48**	.44**	.17	.36**	.06	.48**	-.08	.54**	.32*
4- Anger/Frustration	-.02	.15	.72**	.15	-.61**	-.08	.04	.59**	-.28**	-.40**	.23+	.57**	.10	.30*
5- Assertiveness/Dominance	.14	.29*	.18	-.18	-.13	.18	.35**	.18	-.33**	-.22	.49**	.11	.29*	.14
6- Attention	.08	-.14	-.48**	-.11	.48**	.11	.08	-.48**	.36**	.52**	-.35**	-.44**	-.10	.08
7- Discomfort	.12	.16	.66**	.41	-.53**	.05	.01	.68**	.06	-.26*	.09	.39**	.08	.32*
8- Fantasy	.49**	.42**	.40**	.00	-.15	.43**	.17	.27	.13	-.08	.40**	.12	.75	.27*
9- Fear	-.05	-.08	.56**	.50	-.54**	.00	.00	.59**	.03	-.13	.02	.40**	-.06	.13
10- High Intensity Pleasure	.16	.23*	-.07	-.32	.12	.24+	.34**	-.04	-.19	-.11	.36**	-.06	.19	.05
11- Impulsivity	.05	.15	.45**	.08	-.34**	.08	.18	.48**	-.47**	-.50**	.44**	.34**	.27*	.02
12- Inhibitory Control	.27*	.20	-.37**	-.07	.39**	.13	-.03	-.46**	.53**	.49**	-.26*	-.45**	.20	-.07
13- Low Intensity Pleasure	-	.51**	.27*	.20	-.01	.47**	.00	.07	.33*	.26*	.14	-.06	.44**	.27*
14- Perceptional Sensitivity	.16	-	.26*	.00	.00	.23+	.05	.20	.09	.06	.17	.13	.49**	.24+
15- Sadness	-.08	-.04	-	.40	-.74**	-.03	-.10	.67**	-.15	-.36**	.16	.51**	.22+	.22+
16- Shyness	.00	-.12	.53**	-	-.41**	-.14	-.31*	.39**	.00	-.15	-.43**	.27*	-.12	.06
17- Soothability	.14	.06	-.71**	-.53	-	.25+	.17	-.55**	.21	.28*	.02	-.58**	.01	-.03
18- Positive Affect	.25*	.18	-.53**	-.40	.55**	-	.58**	.06	.47**	.34**	.55**	-.31*	.59**	.43**
19- Gregariousness	-.11	-.01	-.27*	-.57	.32*	.49**	-	.04	.24+	.26*	.59**	-.16	.38**	.23+
20- Behavioral Inhibition	-.04	.00	.54**	.28	-.30*	-.27*	-.11	-	-.18	-.37**	.18	.55**	.10	.25+
21- BFI Agreeableness	.14	.07	-.70**	-.38	.68**	.48**	.16	-.16	-	.67**	.12	-.32*	.35**	.17
22- BFI Conscientiousness	.08	.29*	-.17	.23	.10	.20	-.31*	-.19	.27*	-	-.05	-.41**	.13	.06
23- BFI Extraversion	.07	.09	-.41**	-.69	.44**	.71**	.78**	-.15	.22+	-.19	-	-.08	.50**	.20
24- BFI Neuroticism	-.11	.05	.69**	.39	-.70**	-.50**	-.05	.51**	-.69**	-.28*	-.21	-	-.04	.05
25- BFI Openness	.46**	.34**	-.28*	-.36	.31*	.56**	.28*	-.10	.21	.04	.54**	-.14	-	.28*
26- Reward Sensitivity	.20	.03	-.02	.07	.05	.33*	.13	.20	.01	.05	.27*	.05	.17	-

Self-report on top diagonal, Parent on bottom diagonal   + = *p* < .10 , * = *p* < .05, ** *p* > .01

APPENDIX F

Number Task Properties

A 2 x 2 x 2 x 2 (Reward x Notation x Distance x Hand) repeated measures analysis of variance was performed. The difference between overall reaction times (RTs) for non-reward and reward trials was not significant (see Table F1 in text). A significant effect was found for notation [$F(1, 53) = 5.90, p < .05$; see Table F3 in text]. A significant effect was also found for response hand. Responses with the right hand were significantly faster than those with the left hand [$F(1, 53) = 44.38, p < .001$; see Table F6 in text]. RTs were significantly faster for number stimuli that appeared in word format (e.g., "six") than digit stimuli (e.g., "6"). RTs to numbers closer to 5 were significantly slower than to numbers farther from 5 [$F(1, 53) = 12.01, p < .01$; see Table F7 in text].

A significant interaction was found for Distance x Hand [$F(1, 53) = 6.64, p < .05$]. Larger differences were found for stimuli closer to 5 than farther from 5 in the left hand than in the right (See Figure F1). A marginally significant interaction was found for Notation x Hand [$F(1, 53) = 3.77, p = .06$] such that reaction times were slower to stimuli presented in text and responded to with the left, but not right, hand (see Figure F2). These interactions show violation of the assumption that processing stages are orthogonal. The predicted reward x hand effect was not significant.

Appendix F (Continued)

Overall RTs by Distance & Hand

	Near	Far
Left	633	597
Right	580	573
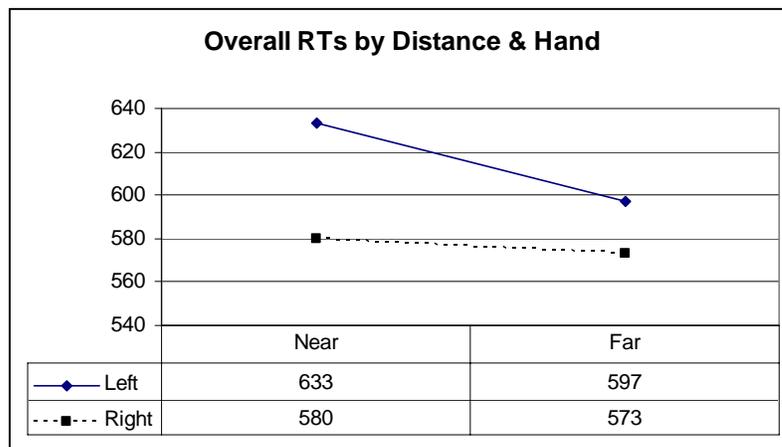
Figure F1

Distance x Hand

Overall RTs by Notation & Hand

|	Text	Digit
Left	626	605
Right	577	576
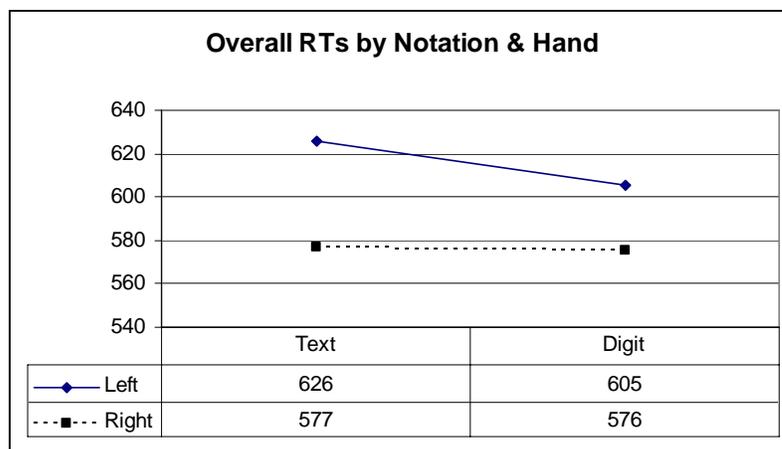
Figure F2

Notation x Hand

Repeated measures analyses of variance were performed with age and then gender

as between-subject variables. No age effect was found for reaction times. Gender

Appendix F (Continued)

differences in reaction times are shown in Table F1. Reaction times showed a marginally

significant gender effect [$F(1, 52) = 3.72, p = .07$]. Boys had faster overall reaction times

($M = 566$ ms, $SD = 128$ ms) than girls ($M = 620$ ms, $SD = 117$ ms). A significant

notation x gender interaction was found [$F(1, 52) = 6.56, p < .05$] with girls showing

more slowing to stimuli presented in text relative to digit stimuli than boys. A three-way

interaction of Notation x Distance x Gender was significant [$F(1, 52) = 5.13, p < .05$; see

Figure F3]. Boys showed no reaction time differences by distance to text vs. digit stimuli,

while girls had slower reaction times to text stimuli relative to digit stimuli.

Table F1

Number-Task Reaction Time
Gender Differences

	No Rew	Rew	Digit	Text	Far	Near	Right	Left	Total
Boys (*N* = 24)	562 (135)	569 (125)	566 (141)	565 (119)	558 (121)	573 (139)	547 (126)	585 (134)	566 (130)
Girls (*N* = 28)	618 (107)	622 (128)	610 (122)	630 (114)	607 (108)	633 (128)	600 (118)	640 (117)	620 (118)

Appendix F (Continued)

Reaction Times - Boys, Notation X Distance

	Digit	Text
Near	580	567
Far	553	563

Reaction Times - Girls, Notation X Distance

|	Digit	Text
Near	618	649
Far	602	612
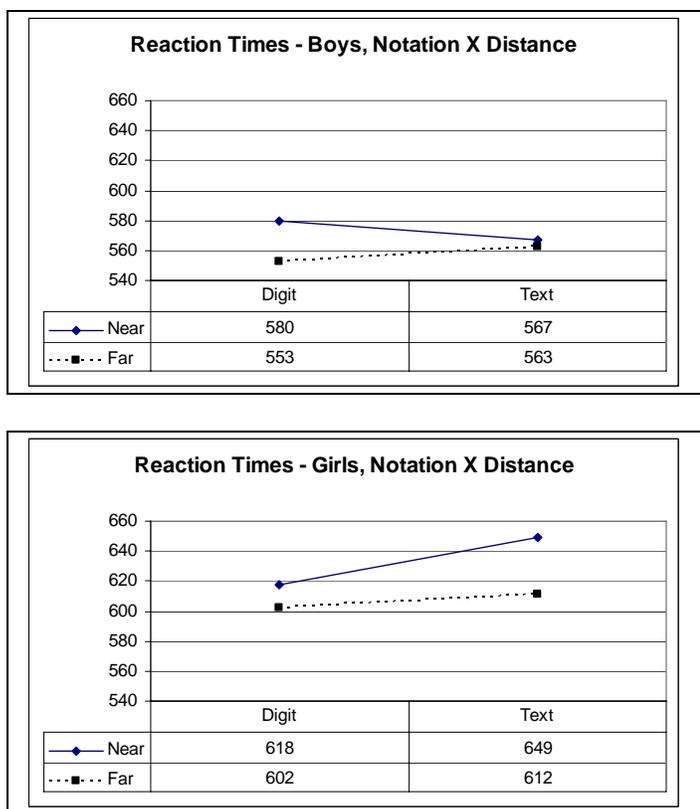
Figure F3

Notation x Distance x Gender Interaction

Number Task Errors

A repeated measures analysis of variance was performed for errors and showed no significant effect for reward or significant interaction between reward and other conditions. Mean number of errors by condition are displayed in Table F5 in the text. Significant effects were found for notation [$F(1, 52) = 8.69$, $p < .01$], distance [$F(1, 52) = 37.13$, $p < .001$], and response hand [$F(1, 52)$, $p < .001$]. More errors were made in

Appendix F (Continued)

conditions theorized to be more difficult: text stimuli, numbers closer to 5, and left hand

responses. Significant interactions were found for Notation x Hand and Distance x Hand.

For notation and distance, more errors were committed by the left hand in the

theoretically more difficult condition (text stimuli and stimuli closer to 5) compared to

the easier condition.

Reward Difference Score

A reward sensitivity variable was created by subtracting reaction time for reward

trials from reaction time for non-reward trials. Because it was predicted that children

would respond faster on reward than non-reward trials, it was expected that this

subtraction variable would consist of positive numbers. The actual data, however, showed

a split between participants who were faster on non-reward trials (negative subtraction

scores) and those who were faster on reward trials (positive subtraction scores). Because

both speed and accuracy were required to earn points on the number task, these groups of

positive and negative reaction time subtraction scores likely represent different strategies,

either slowing down to be more accurate on reward trials or speeding to gain points for a

fast speed of response.

Appendix F (Continued)
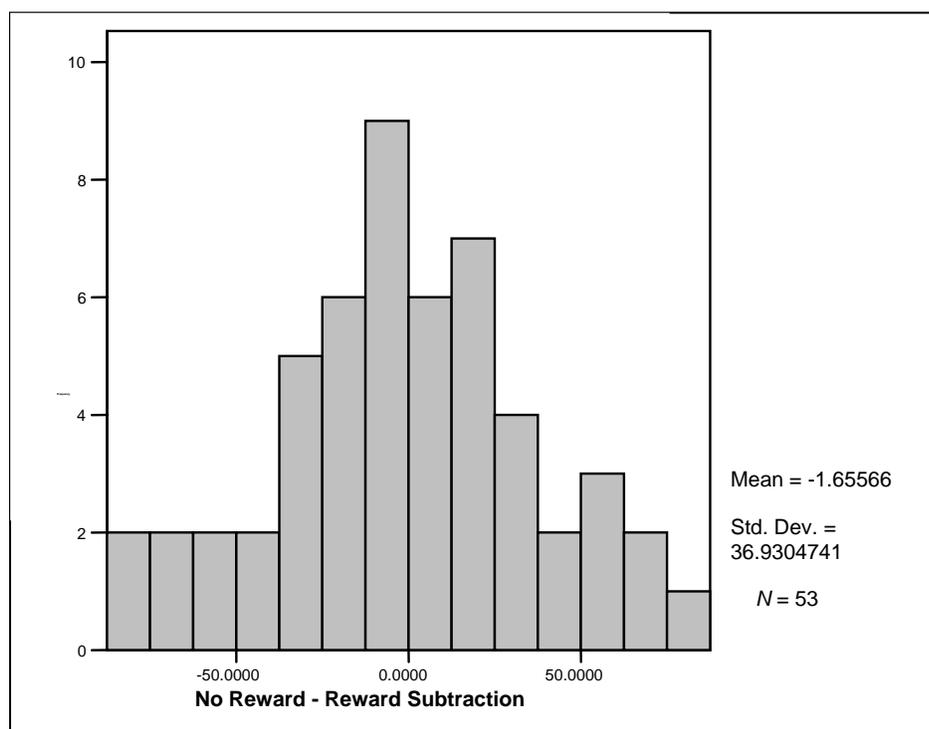
Figure F4

Distribution of No-Reward—Reward Subtraction Scores

Reaction Times and Errors by Strategy Group

In order to examine the data with respect to the different strategies, the data was

divided into tertiles by apparent strategy using non-reward—reward subtraction scores.

These were named to reflect behavior on reward trials relative to non-reward trials:

speeding group, middle group, and slowing group. Non-reward—reward difference score

ranges, means, and standard deviations for each group are shown in Table F2. RTs by

Condition and Strategy group are shown in Table F3. Figure F5 illustrates RT differences

Appendix F (Continued)

between Reward and Non-reward conditions among these groups. The speeding group

showed higher overall reaction times than the other two groups across conditions.

Table F2

Non-Reward—Reward Difference
Scores by Strategy Group

	Mean	SD	Minimum	Maximum
Speeding	35.02	19.71	13.18	79.31
Middle	-0.47	7.77	-16.13	12.75
Slowing	-41.22	21.65	-81.19	-17.25

N = 52

Table F3

Reaction Times by Condition and Strategy Group

	No Rew	Rew	Digit	Text	Far	Near	Right	Left	Total
Speeding	641 (108)	604 (94)	616 (107)	629 (96)	606 (94)	639 (108)	603 (99)	642 (103)	623 (101)
Middle	572 (93)	573 (100)	568 (104)	577 (90)	567 (78)	578 (116)	547 (88)	598 (106)	573 (97)
Slowing	548 (122)	589 (125)	562 (123)	576 (125)	559 (119)	579 (128)	554 (128)	584 (120)	569 (124)

N = 52

Appendix F (Continued)

Figure F6 displays reaction times by Hand and Strategy group. The pattern shown in this figure was similar for notation and distance as well, with the speeding group showing slower reaction times than the middle and slowing groups.

Overall RTs by Reward and Strategy Group

	No Rew	Rew
Speeding	640.9	604.1
Middle	572.3	572.8
Slowing	548.1	589.3
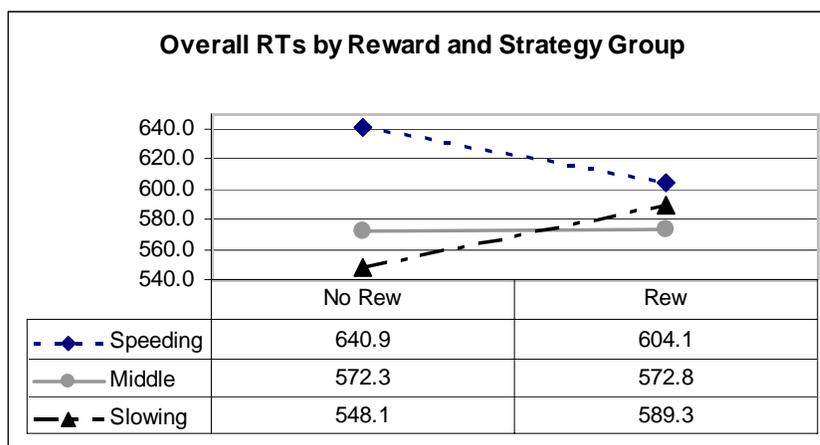
Figure F5

Non-reward and Reward Reaction Times
by Strategy Group

Overall RTs by Hand and Strategy Group

|	Right	Left
Speeding	603.4	641.6
Middle	547.4	597.7
Slowing	553.6	583.9
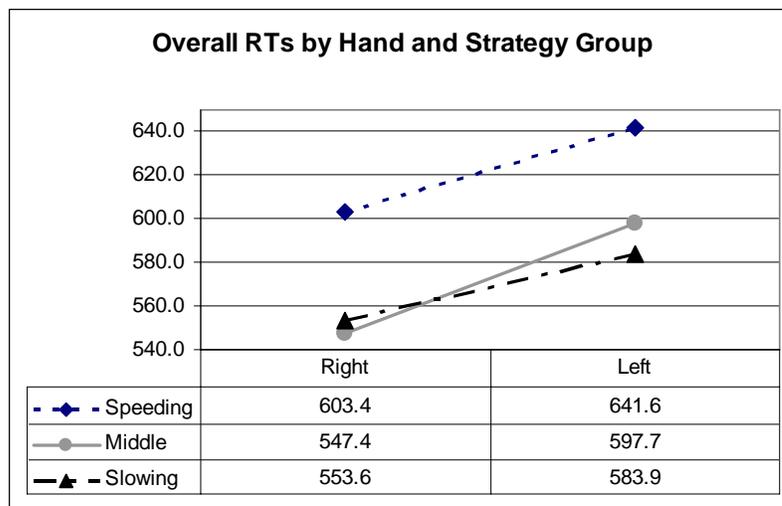
Figure F6

Reaction Times by Response Hand and Strategy Group

Appendix F (Continued)

Reward by Hand Differences

Number Task reaction times by Hand and Reward condition are shown in Figure F7. A hand effect was present (see previous section), but there was no reward x hand effect. In order to examine reward by hand results further, two difference scores were computed by subtracting the reward condition from the non-reward condition score for each hand (Left/Non-Reward-Left/Reward and Right/Non-Reward-Right/Reward). A paired samples *t*-test showed no significant difference between the two scores [$t(52) = .43$, *ns*].

	Left	Right
Non-Reward	613	573
Reward	618	580
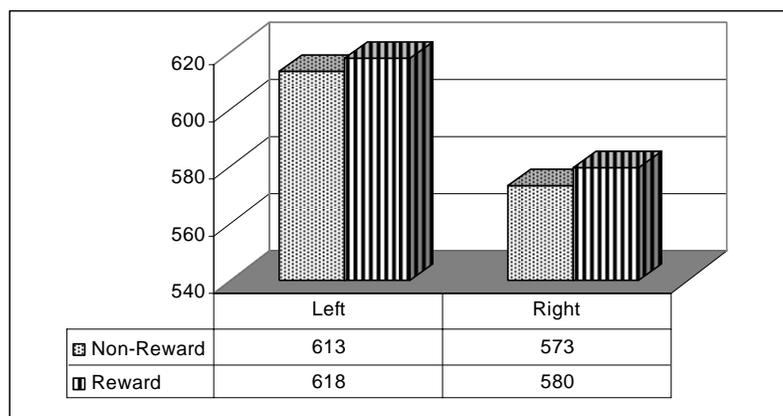
Figure F7

Reaction Times by Hand and Reward Condition

Figure F8 shows these subtraction scores by Hand for each strategy group and showed No-reward x Hand effects when examined by group.

Appendix F (Continued)

	Speeding	Middle	Slowing
Left	39	-1	-38
Right	34	0	-45
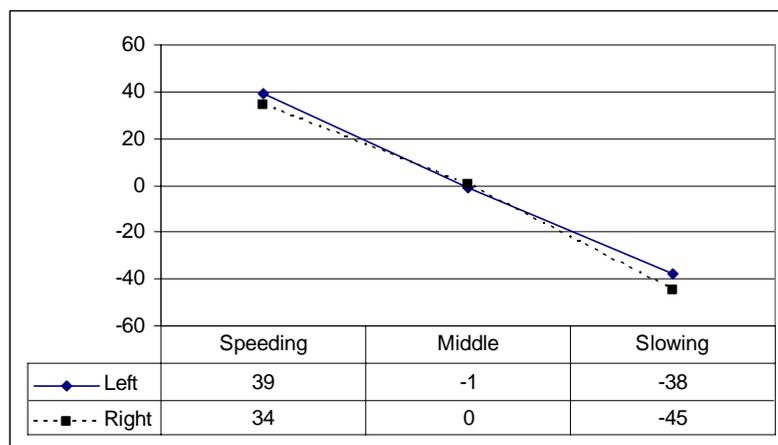
Figure F8

Hand x Reward Subtraction Scores by Strategy Group

Age and Gender Differences in Strategy Groups

Nearly twice as many girls as boys were in the speeding group; other strategy groups were comprised of roughly or exactly equal numbers of boys and girls (see Table F4). An examination of strategy group by age showed that 8-year-olds were more likely to slow to reward trials and 9-year-olds were more likely to speed to reward trials. No differences were found in strategy in 10-year-olds (see Figure F9). A Chi-Square test showed no statistically significant association between age and strategy group.

Appendix F (Continued)

Table F4

Strategy Group by Gender

| | Strategy Group | | |
	Speeding	Middle	Slowing
Male	6	9	9
Female	11	8	9
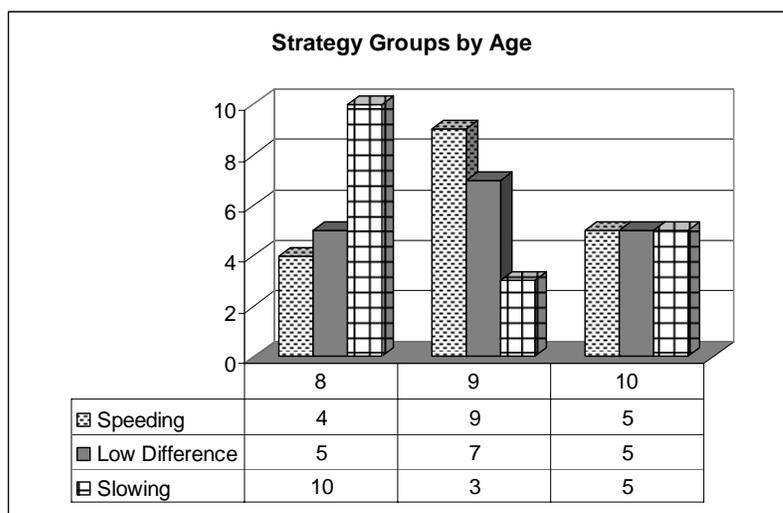
Figure F9

Strategy Group by Age

Number Task Errors by Reward Condition

Errors by condition and strategy group are displayed in Table F5. One case was

excluded from error analyses due to an extreme number of errors (42% errors overall)

Appendix F (Continued)

Table F5

Errors by Condition and Strategy Group

	No Rew	Rew	Digit	Text	Far	Near	Right	Left	Total
Speeding	1.4	1.3	1.2	1.4	1.0	1.6	1.1	1.6	1.3
	(1.4)	(1.2)	(1.2)	(1.4)	(1.2)	(1.5)	(1.3)	(1.4)	(1.3)
Middle	1.7	1.7	1.5	1.9	1.5	2.0	1.5	1.9	1.7
	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)
Slowing	1.7	1.5	1.5	1.8	1.2	2.0	1.4	1.9	1.6
	(1.4)	(1.3)	(1.4)	(1.3)	(1.2)	(1.5)	(1.3)	(1.4)	(1.4)

$N = 51$

with an extreme difference in errors between reward and non-reward conditions (11). An examination of errors by condition and strategy group showed fewer errors in the speeding group than in the other two groups. It appears that there was a small speed-accuracy tradeoff: the speeding group showed slower reaction times overall, but fewer errors and the middle and slowing groups showed faster reaction times, but more errors. A repeated measures analysis of variance showed that the difference in errors by strategy group was not significant. Figures F10 and F11 show errors by reward and hand conditions and strategy group.

Appendix F (Continued)

Errors by Reward and Strategy Group

	No Rew	Rew
Speeding	1.4	1.3
Middle	1.7	1.7
Slowing	1.7	1.5
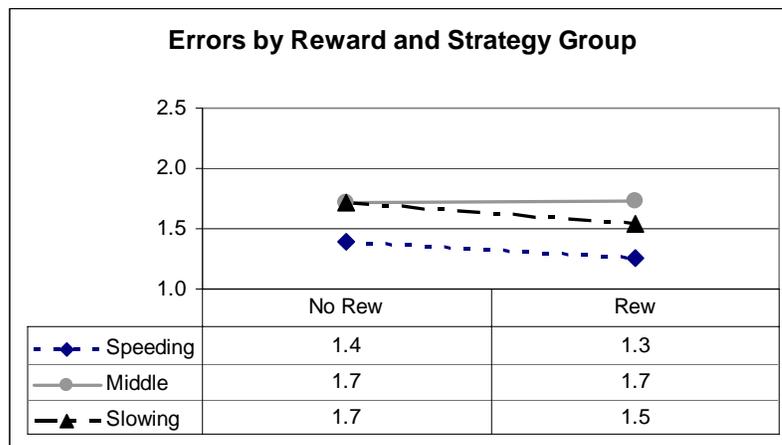
Figure F10

Non-Reward and Reward Condition Errors
by Strategy Group

Errors by Hand and Strategy Group

|	Right	Left
Speeding	1.1	1.6
Middle	1.5	1.9
Slowing	1.4	1.9
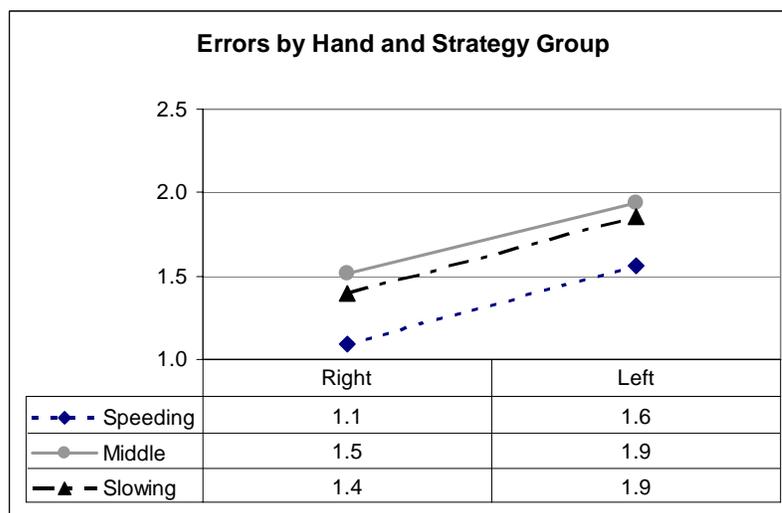
Figure F11

Errors by Response Hand

Appendix F (Continued)

Response Hand Scores

      Difference scores were computed by subtracting right hand responses from left

hand responses for both reaction times and errors. Descriptive statistics for these

variables are shown in Table F6. A univariate analysis of variance showed no relationship

between strategy group and left–right reaction time differences [$F(2, 49) = .94$, *ns*].

Therefore, no subsequent analyses by strategy group were performed on response hand

variables.

Table F6

Left—Right Difference Scores

	Left—Right Reaction Time Difference ($N = 52$)	Left—Right Errors ($N = 51$)
Mean	38.90	0.46
SD	44.23	0.63
Min.	-64.56	-0.75
Max.	218.56	1.88

Number Task Correlations

      Correlations between difference scores for Number Task RTs and errors are

displayed in Table F7. Non-reward—reward RT and error subtractions did not correlate

with each other, but both scores correlated with the subtraction of reward—non-reward

Appendix F (Continued)

points achieved in the task. The reaction time difference score of notation (text—digit)

correlated negatively with the difference of left and right hand reaction times.

Table F7

Number Task Difference Score Correlations

	1	2	3	4	5	6	7	8	9
1- Non-Reward— Reward RT Difference	-	.00	.35**	-.12	.02	.00	-.17	.22	-.04
2- Non-Reward— Reward Error Difference			.39**	-.14	.02	-.16	.27$^+$	.10	.12
3- Reward—Reward Points				-.02	-.01	.09	.06	-.12	-.13
4- Text—Digit RT Difference					.07	.02	.03	-.40**	-.12
5- Text—Digit Error Difference						.03	.00	.16	.13
6- Near—Far RT Difference							-.13	-.07	.06
7- Near—Far Error Difference								-.20	.13
8- Left—Right RT Difference									.16
9- Left—Right Error Difference									-

$N = 51$ w/listwise deletion; $^+ = p < .10$; $* = p < .05$; $** = p < .01$

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