The Pennsylvania State University

The Graduate School

College of the Liberal Arts

THE DEVELOPMENT OF EARLY PROFILES OF TEMPERAMENT: CHARACTERIZATION, CONTINUITY, AND ETIOLOGY

A Thesis in

Psychology

by

Charles R. Beekman III

Submitted in Partial Fulfillment
of the Requirements
for the Degree of
Master of Science

August 2012

The thesis of Charles R. Beekman III was reviewed and approved* by the following:

Jenae M. Neiderhiser
Liberal Arts Research Professor of Psychology
Thesis Advisor

Kristin A. Buss
Associate Professor of Psychology

Ginger Moore
Associate Professor of Psychology

Eric Loken
Research Associate Professor of Human Development and Family Studies

Melvin M. Mark
Professor of Psychology
Head of the Department of Psychology

*Signatures are on file in the Graduate School.

ABSTRACT

This study used a person-centered approach to examine the development of child temperament from infancy to toddlerhood. Data from a prospective adoption study, the Early Growth and Development Study (EGDS), was used to estimate latent profiles of child temperament at 9, 18, and 27 months. Results indicated four profiles of temperament best fit the data at 9 months; High Reactive, Low Reactive, Positive Reactive, and Negative Reactive. Three profiles best fit the data at 18 and 27 months; Positive Reactive, Negative Reactive, and Fearful. The structure and characterization of profiles was stable over time. Child membership in profiles was also relatively stable from infancy to toddlerhood. Facets of adoptive parent temperament, specifically levels of harm avoidance, robustly predicted child profile membership at 9, 18, and 27 months. Birth mother temperament was also associated with child profile membership, which indicates specific genetic influences on temperament development. How study results replicate and extend prior findings from temperament literature is discussed.

TABLE OF CONTENTS

List of Tables

List of Figures

Introduction

Understanding how child characteristics measured early in life are associated with future developmental outcomes is a primary goal of developmental science. Child temperament, defined as constitutionally based individual differences in reactivity and regulation that are present early in life and relatively stable across time (Rothbart & Derryberry, 1981; Goldsmith et al., 1987), has proven to be a particularly robust predictor of outcomes in a number of domains of interest to developmental psychologists. With evidence mounting that temperament may be an important mechanism in the development of adaptive and maladaptive functioning in domains like school adjustment (Blair, 2002), psychopathology (Perez-Edgar & Fox, 2005) and resiliency (Eisenberg et al., 2004), understanding the development of child temperament itself is of great importance.

Temperament and Socioemotional Development

Temperament has been studied for millennia (Kagan et al., 1994). Interest in child temperament development in the modern era arose from a desire to link early appearing behavioral predispositions to the development of adult personality (Buss & Plomin, 1975). This focus on linking individual differences in reactivity and regulation early in life to personality traits has continued through efforts to associate child temperament with the Big Five personality traits (Ahadi & Rothbart, 1993; 2005; Rothbart, 2007). Linking child temperament with adult personality was a first step in situating temperament within a socioemotional developmental framework but recent

studies have provided evidence that child temperament may play a more complex role in the socioemotional development of a child.

Temperament has been viewed as a genetically based foundation for the development of more complex forms of socioemotional behavior (Goldsmith et al., 1987; Rothbart, Ahadi, & Evans, 2000; Perez-Edgar & Fox, 2005). Differences in early predispositions to reactivity and regulation may shape development by making certain responses to environmental inputs more likely, which in turn make those same responses more likely in the future (Rothbart, Derryberry, & Hershey, 2000; Rothbart & Bates, 1998, Kagan et al., 1994). These foundational, temperamental differences may also serve as mechanisms for socioemotional development in a different way; by driving differences in how children are affected by their environments. The theory of biological sensitivity to context suggests that children who are more biobehaviorally reactive are more sensitive to their environments (whether they are “good” or “bad”). By contrast, children who are less reactive are less sensitive to their environments (Boyce and Ellis, 2005). There is evidence for differential susceptibility to the effects of environments whether reactivity is conceptualized physiologically (Boyce & Ellis, 2005) or as a negative emotional response (Belsky, 2000; 2005). Thus, the fit between a child’s temperament characteristics and their environments may be vital to our understanding of equifinality and multifinality in trajectories of child socioemotional development (Wachs, 2006). Whether early temperamental differences affect child development directly by making behavioral responses in certain situations more likely or indirectly through affecting sensitivity to context, associations between temperament

characteristics and both adaptive and maladaptive socioemotional outcomes provide evidence for the importance of temperament as a developmental mechanism.

There is strong evidence for consistent, albeit moderate associations between individual differences in child temperament measured early in life and both adaptive and maladaptive socioemotional development. Although a comprehensive review is beyond the scope of this study because downstream outcomes are not being examined, a few key findings will be reviewed. Children who had higher temperamental positive emotionality dealt with stress with more resilience, through the use of more active coping strategies (Wachs, 2006). Children with higher levels of effortful control, or temperamental regulation, in early childhood were more resilient four years later (Eisenberg et al., 2004). Shyness may be an important marker for different trajectories of developing anxiety symptoms (Feng et al., 2008) and for predicting adolescent internalizing behavior (Leve, Kim, & Pears, 2005). Relatedly, children characterized as behaviorally inhibited have been found to be more likely to later develop social anxiety (Biederman et al., 2001; Kagan et al., 1999; Schwartz, Snidman, & Kagan, 1999). Emotional undercontrol has been associated with later aggressive behavior in toddlers (Rubin, Burgess, Dwyer, & Hastings, 2003). The wide range of consistent associations between child temperament and both adaptive and maladaptive behavioral outcomes and processes suggest a better understanding of how child temperament develops may be a good place to start in an effort to elucidate socioemotional developmental pathways.

There is also evidence for the importance of understanding how specific dimensions of temperament co-occur across development. Facets of temperament like

activity level and negative affect can interact and co-occur to provide differential prediction compared to what either facet would predict individually. For example, high activity level combined with low levels of fear in infant boys has been linked to an escalation in childhood externalizing behavior and depressive symptoms (Colder, Mott & Berman, 2002) and there is evidence for an association between the co-occurrence of low levels of approach/withdrawal and high levels of reactivity, and anxiety in children (Merikangas et al., 1998). Results that depended on whether individual versus co-occcuring dimensions of temperament were investigated highlight a gap in the temperament literature. The operationalization of the temperament construct is commonly different across studies and often does not adequately fit with temperament theory.

Operationalizing Temperament: Variable and Person Centered Approaches

Research on child temperament is characterized by a variety of approaches to the operationalization of the temperament construct. Often, a variable centered approach is used that operationalizes temperament as individual differences on a number of theorized temperament dimensions or traits (Goldsmith et al., 1987). For example, measuring how toddlers differ in levels of fear, anger proneness, activity level, and pleasure (Goldsmith, 1996). Dimensional approaches to studying temperament are aimed at capturing a range of facets that together, are thought to make up the child's temperament. These dimensions are often derived through the use of psychometric strategies, usually factor analysis, from both parent report and laboratory assessments (Goldsmith & Campos, 1990, Rothbart, Ahadi, Hershey, & Fisher, 2001). Often, temperament is studied early in life because the links between temperament and

behavior are thought to become more complex with age (Goldsmith et al., 1987). Dimensions are then thought to differentiate as children mature. For example, by age two, distress can be separated into distinct fear and anger components (Buss and Plomin, 1984).

In contrast, typological approaches are concerned with identifying meaningful groups, or types, of temperament. The typological approach to temperament is rooted in a person oriented framework which advocates a more holistic model for child development (Magnusson, 1998). This approach has focused on identifying individuals who exhibit similar patterns of associations between characteristics thought to indicate temperamental differences and has been used in work that has identified two temperament types: the behaviorally inhibited and the behaviorally uninhibited child (Garcia-Coll, Kagan, Reznick, 1984; Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). The behaviorally inhibited child is characterized by apprehension, crying, and clinging to a parent when faced with unfamiliar situations. The uninhibited child is characterized by social, fearless behavior and lower levels of crying in novel contexts. The inhibited and uninhibited temperament types have also proven to be strong predictors of later child problems (Kagan et al., 1999; Schwartz, Snidman, & Kagan, 1999).

Another temperament type that has proven to be particularly robust is the “difficult” temperament (Thomas & Chess, 1977). The operationalization of difficult temperament provides an example of how dimensional and typological taxonomies can be used together in temperament research. Thomas and Chess (1977; 1984) considered nine dimensions of child temperament (e.g., activity level, intensity of

reaction, distractibility) that they then reduced into three types of children; the easy, difficult, and slow-to-warm-up. Children with an easy temperament in childhood, characterized by positive approach to new stimuli, smiling, and low levels of fussiness, were less likely than difficult children to develop behavior disorders fifteen years later (Thomas & Chess, 1984). Furthermore, children who were rated by parents as having "difficult" temperaments, characterized by frequent negative mood and intense emotional expression, exhibited elevated symptoms of behavior problems (Guerin, Gottfried, & Thomas, 1997).

Typological approaches that provided temperament types like the inhibited child elegantly characterized children into conceptually meaningful groups. The drawback to these groups is that their construction can be relatively subjective due to relying on selected a priori theory and opinions of the researcher (Woodward et al., 2000). For example, Kagan (1994) used clinical cut scores to classify children into temperament groups. When dimensional methods are used, temperament dimensions are often individually associated with outcomes and can provide unique and specific predictions. However, these dimensions are not conceptually orthogonal (Goldsmith et al., 1987). For example, facets of negative affect and effortful control are consistently negatively associated (Rothbart et al., 2001). Evidence of differential prediction from the co-occurrence of dimensions of temperament (Colder, Mott, & Berman, 2002) indicates how the full constellation of temperament dimensions may associate differently from person to person, and how these differences may be important for predicting developmental outcomes (Magnusson, 1998). Small to moderate effect sizes found when predicting future behavior from temperament suggest a different

operationalization may be useful. Combining the strengths and minimizing the weaknesses of the typological and dimensional approaches to studying early temperament development was a primary goal of this study.

Types from Dimensions: Latent Profiles of Temperament

One way to integrate the strengths of dimensional and categorical approaches to studying temperament development would be to use a complete set of dimensional indicators, meant to encompass the entire temperament construct, to form meaningful groups; much like Thomas and Chess (1984) did decades ago. A less subjective way to determine the structure of temperament groups would be vital to strengthening this combination framework. A statistical technique called Latent Profile Analysis (LPA; Muthen, 2001), a type of latent class analysis (LCA; Lazarsfeld & Henry, 1968) could be used to identify profiles of child temperament less subjectively. LCA is used with categorical indicators but LPA could accommodate continuous variables like temperament dimensions measured from a questionnaire. Using the LPA approach would also allow for a more theory-neutral estimation (Loken, 2004) of latent profiles of temperament based on the full range of temperament dimensions being considered. While the estimation of profiles can be theory-neutral, the indicators included are inherently not, as the temperament domains that are of interest are still subject to the a priori preferences of the investigator.

Latent profiles can be used as either independent variables or dependent variables in analysis. This approach has been used previously in child temperament research. Loken (2004) used the LCA approach with the goal of replicating earlier work

of Kagan (1994), specifically by characterizing types of temperament using the same indicators of temperament that Kagan used, categorical variables measuring smiling, motor activity, crying, and vocalizations from a battery of laboratory assessments at four months. Using LCA, three classes of infant temperament emerged that corresponded to those found previously by Kagan (1994), who had created groups based on clinical cut scores. This work directly informs this study through the use of the LCA approach on infant temperament data and provides a model for an LCA estimation of temperament at a single point of assessment.

Profiles of temperament could provide a picture of how dimensions of temperament similarly co-occur across individuals, information that can be lost when averaging (Loken, 2004). Latent profiles of temperament have been studied in young children. Based on maternal ratings of child sociability, activity level, and anger proneness, van den Akker and colleagues (2010) found evidence for three temperament profiles; labeled “typical”, “expressive”, and “fearful”. Membership in these profiles was found to be highly stable from 30 to 36 months. Profiles of temperament were also found to be associated with well-being and psychopathology in early adolescence. Three profiles of temperament were also indicated in a sample of adolescents that were consistent with those found in young children. Members of the “disengaged” profile had poorer functioning and higher levels of psychopathology (Rettew et al., 2010). To the author’s knowledge, there has been no systematic study of latent profiles of child temperament over time from infancy to toddlerhood.

Continuity and Change in Child Temperament

The continuity of child temperament early in life has been investigated using both categorical and dimensional characterizations. Both the uninhibited and inhibited temperament types have been shown to be remarkably stable; three-quarters of children retained their classification from toddlerhood to middle childhood (Kagan et al., 1994). Inhibited toddlers were more likely than uninhibited toddlers to continue to be classified as inhibited in middle and late childhood and children who remained inhibited from toddlerhood to middle childhood were more likely to have higher levels of inhibition in late childhood (Scarpa, Raine, Venables, et al., 1995). Further, extreme subgroups of children classified as behaviorally inhibited or uninhibited, as opposed to those closer to the middle of the distribution of measured behaviors, were more likely to retain their classification from toddlerhood to middle childhood (Pfeifer, Goldsmith, Davidson, & Rickman, 2002). This suggests stability may be greater for more extreme temperament groups and that the stability found may be heavily dependent on the way that temperament groups are constructed.

The stability of individual dimensions of temperament, as opposed to types of temperament, has also been extensively studied. Temperament dimensions like activity level and smiling and laughter showed continuity (r=.33-.63) across four measurements in infancy (Carranza et al., 2000). Fear and activity level were substantially correlated (r=.42-.59) with their respective dimensions in middle childhood (Rothbart, Derryberry, & Hershey, 2000) and stabilities of similar dimensions were even higher (r=.55-.77) when considered from early to middle childhood (Goldsmith, Lemery, Aksan, & Buss, 2000). These stabilities were robust within informant and high relative to other socioemotional

constructs, but they may be domain specific. For example, there is little evidence for longitudinal stability of infants' levels of alertness (Rothbart, Derryberry, & Hershey, 2000).

Given the varying levels of continuity in child temperament discussed above, there is still evidence for a substantial amount of change, as rarely were stability coefficients greater than .6. Evidence for stability of parent reported temperament in infancy has been found without corroborating stability of temperament ratings from laboratory assessment in the same study (Stifter & Jain, 1996) and there is evidence for a more moderate level of temperamental stability from the neonatal period to toddlerhood (Riese, 1987). Individual differences in maturation of certain brain systems, for example the attentional network, have been hypothesized as one possible reason for lower levels of stability for related dimensions of temperament, like alertness (Johnson, Posner & Rothbart, 1991).

The stability of temperament early in life is of particular interest because *stability* of temperament dimensions, for example shyness, may be more indicative of risk for later psychological problems than shyness at any given point in development (Biederman et al., 1995) which suggests investigating mechanisms driving temperamental continuity and change is vital (McCall, 1986). Two sets of possible mechanisms for child temperament development are genetic influences and influences from the rearing environment.

Genetic and Environmental Influences on Child Temperament

Genetically informative research designs have provided a large body of evidence for the importance of genetic influences on child temperament development. Results from a number of twin studies, each with different operationalizations of the temperament construct, have reported substantial genetic influences on child temperament. A study of 14-month old twins found that genetic influences accounted for 27 to 28 percent of the variance in parental report and 39 to 56 percent of the variance in observational measures of temperament (Emde et al.,1992). Goldsmith, Buss, & Lemery (1997) found moderate to substantial genetic influences for the temperament dimensions of activity level, pleasure, social fearfulness, anger proneness, and interest. Genetic influences on the uninhibited temperament type explained from 50 to 65 percent of the variance of infants from 14 to 24 months, assessed three times (Robinson et al., 1992). A review by Saudino (2005) that consolidated temperament findings across childhood using a variety of methods reported that genetic influences account for 20 to 60 percent of the variance in child temperament. These findings suggest that individual differences in child temperament are moderately to substantially explained by genetic influences.

It is important to note here that genetic influences on temperament should not translate to a theoretical immutability of the construct over time, as even behaviors that are substantially influenced by genes are affected by the environment. On a micro level, there is room conceptually for the importance of context in how temperament may be expressed differently across situations (Rothbart, Derryberry, & Hershey, 2000; Rothbart & Bates, 1998, Kagan et al., 1994). This context specificity has been directly

studied by temperament researchers (Kagan et al., 1994; Buss et al., 2004; Buss, 2011) and there is evidence for context-specificity in the stability of some dimensions of temperament (Kim, Deater-Deckard, Mullineaux, & Beekman, 2010; Majdandzic & van den Boom, 2007; Wachs, Pollitt, Cueto, & Jacoby, 2004). On a macro level, a child's environment is thought to be able to shape their temperament, thereby either changing or stabilizing their temperamental response to a similar situation in the future. Evidence for the importance of environmental influences on temperament can also be found in genetically informative research designs. Shared environmental influences (non-genetic influences that make members of a family more similar) have been found for temperament dimensions of positive affect (Goldsmith et al., 1999; Goldsmith et al., 1997). Nonshared environmental influences (non-genetic influences that make members of a family different) often explain more variance in temperament than genetic influences. These findings taken together suggest that temperament development is a complex process. While genetic influences seem to explain a moderate to substantial amount of variance in child temperament, the relative influences of genes and environments may vary depending on when temperament is being studied and which dimension or type of temperament is of interest.

The findings summarized above suggest genetic and environmental influences on temperament differ over time but do not provide any information regarding possible mechanisms behind temperamental stability and change. Longitudinal, genetically informative studies have investigated how genes and environments influence developmental continuity in child temperament. To this point, results addressing this issue have been mixed. There is evidence that genetic influences account for both

continuity (Ganiban et al., 2008; Plomin et al., 1993; Plomin, 1986; Saudino, DeFries, & Plomin, 1996) and change (Plomin et al., 1993; Matheny, 1989) in temperament over time. Change in temperament and cross-situational differences in temperament expression have also been found to be due to mostly shared and nonshared environmental factors (Ganiban et al., 2008; Cherny, Fulker, Corley, Plomin, & DeFries, 1994). These findings suggest that heritable characteristics may be responsible for a child's temperament being similar over time, whereas their rearing environment and unique experiences may drive differences across time.

There are still many unanswered questions about the role that genetic and environmental influences play in the development of temperament. Research using twin designs discussed above have reported moderate genetic influences and moderate to substantial nonshared environmental influences on temperament dimensions across infancy and early childhood. This evidence is not without limitations; contrast effects in twin research may have artificially inflated estimates of genetic influences (Saudino et al., 1995; Plomin et al., 1993; Emde et al., 1992; Plomin & Rowe, 1977). Inconsistencies that are linked to twin methodological issues suggest that further work on temperament utilizing different genetically informative research designs should be considered.

One such alternative, a sibling adoption design, compares non-adopted and adopted siblings who differ in genetic relatedness to estimate genetic influences on a given phenotype. Evidence from temperament research utilizing the sibling adoption design has been inconsistent with twin studies in that they suggest no genetic influences on child temperament (Plomin et al., 1991; Schmitz, 1994). These inconsistencies may be due to contrast effects discussed above, or non-additive genetic

influences on temperament that would not be captured using traditional twin methods (Schmitz et al., 1996). Recent research using a parent-offspring prospective adoption design has, by contrast, found evidence for indirect genetic influences on child behavior (Brooker, Neiderhiser, Kiel, et al., 2011; Pemberton, Neiderhiser, Leve, et al., 2010; Natsuaki, Leve, Neiderhiser, et al., 2011). Temperament theorists have suggested that evidence of genetic influences from adoption studies would be vital supporting evidence that should corroborate evidence from twin designs (Goldsmith et al., 1987).

The Current Study

Temperament is thought to be a structurally stable construct that is evident early in life (Goldsmith et al., 1987) and evidence from genetically informative temperament literature suggests individual differences in temperament and the continuity of temperamental reactivity and regulation are likely influenced by genetic and environmental influences (Saudino, 2005). This study attempts to unify and extend the temperament literature by investigating these theoretical facets of the development of temperament in a person-centered conceptual framework meant to capture the development of a more complete, generalizable temperament construct early in life. This framework considers there to be different types, or profiles, of child temperament that can be derived from a set of dimensional indicators. By using Latent Profile Analysis (LPA), these profiles can be derived with limited bias from the experimenter compared to cluster-analytic approaches used in prior temperament research. This facet of the study design is intended to characterize temperament development in a way that more adequately fits method to theory by estimating profiles of child temperament from infancy to toddlerhood (child ages 9, 18, and 27 months).

How profile membership changes from infancy to toddlerhood was also of interest. Children who were members of the same temperament profile at 27 months may have had unique trajectories into that profile. Were they members of the same profiles at 9 and 18 months or did they move from different profiles over time? Certain profiles of temperament may be more stable than others, and children who continually move into and out of profiles may have different trajectories of development than those who remain in the same temperament profiles from infancy to toddlerhood. For example, how children transitioned through latent classes of risky sexual behavior over time was found to be differentially associated with substance abuse in adolescence. Adolescents who had been drunk once in the past year were 19 times more likely to be members of a more risky sexual and dating transition status from late adolescence to young adulthood (Lanza & Collins, 2008). Describing how child temperament develops from infancy to toddlerhood is important given evidence that the stability of temperament can provide additional meaningful information with regard to future outcomes. For example, Biederman and colleagues (1995) found that the stability of shyness was a better predictor of future outcome than shyness measured at any given point. Understanding the processes and mechanisms behind temperament development is also crucial. By utilizing a prospective adoption design, this study will be able to test whether specific genetic (birth mother temperament) and environmental (adoptive parent temperament) factors influence the probability of a child's membership in a given temperament profile at 9, 18, and 27 months.

An adoption study that includes data on birth parents as well as adopted children is a unique quasi-experimental design that allows for the estimation of genetic and

environmental influences on a behavior, or set of behaviors. The power of the adoption design lies in the fact that children are being reared by parents who are genetically unrelated to them. When birth parents are also assessed there is also information on genetic influences independent of rearing environment (and prenatal factors in the case of birth mothers). Thus, an association between an adopted child's characteristics and their birth parents' characteristics suggests genetic influences. In the absence of selective placement into the adoptive home (e.g. when birth parent and adoptive parent characteristics are uncorrelated), an association between an adopted child's characteristics and their adoptive parents' characteristics reflects environmental influences because the adoptive parents provide the rearing environment but are not genetically related to the child.

This study aims to address gaps in the literature by asking three questions regarding early child temperament development using an LPA framework and a genetically informative research design. First, how are profiles of child temperament characterized from infancy to early toddlerhood? Second, how does this profile structure change and to what extent do children transition between profiles over time? Third, how do genetic and environmental factors influence membership in profiles across time?

Hypotheses

The combination of research questions in this study provides a novel study of child temperament and its development. For this reason, study hypotheses are informed by prior temperament research but are more exploratory in nature.

1) There will be three identifiable profiles of child temperament and profiles may be more complex at 18 and 27 months.
2) Two of the profiles may be similar to the inhibited and uninhibited child and be characterized by:
    a) High levels of negative affect along with low levels of approach and positive affect, the inhibited type.
    b) High levels of approach and positive affect along with low levels of negative affect, the uninhibited or possibly exuberant profile.
3) A third profile is likely to be characterized by moderate to low levels of negative affect, positive affect, and approach, the moderate profile.
4) There will be modest to substantial stability in the *structure* of profiles of child temperament from infancy to early toddlerhood.
5) There will be moderate to substantial stability in *profile membership* across time. Stability in profile membership will be higher for profiles characterized by more extreme levels of negative and positive affect and approach, which would include the hypothesized inhibited and uninhibited profiles.
6) There will be evidence of genetic and environmental influences on profile membership and possibly on the extent to which children transition between profiles across time. Surgency in the birth parents and novelty-seeking and harm avoidance in birth and adoptive parents, which may reflect trait impulsivity, are expected to be associated with a greater probability of membership in an uninhibited versus an inhibited temperament profile.

Methods

Sample

Participants were drawn from the first cohort (n = 361) of the Early Growth and Development Study, a multisite longitudinal study of 561 linked families that includes physically healthy, domestically adopted children, adoptive mothers (AM), adoptive fathers (AF), birth mothers (BM), and birth fathers (BF).In order to be eligible, a linked family had to meet the following criteria: (a) the adoption placement was domestic, (b) the adopted child was placed with their adoptive family within three months of their birth, (c) the adoptive family was not related to the adopted child in any way, (d) the adopted child had no known major medical conditions prior to being placed with their adoptive family, and (e) both the birth parents and adoptive parents were required to be able to read or understand English at an eighth-grade level. Study participants were found to be representative of adoptive populations who completed adoption plans during the same time period (Leve et al., 2008).

The mean age of adopted children at placement was 3 days (*SD* 13 days) and children were 57% male. Adoptive parents were primarily White (91%) and college-educated with middle-class household incomes. Birth parents were on average, more racially and ethnically diverse, had high school educations, and averaged less than $25,000 in household income. Additional demographic information can be found in Table 1. Nineteen linked families had missing data on all study variables and were not included in subsequent analysis. These families showed no significant differences on key demographic variables (household income, education, and parent age). Attrition levels were modest (12%; 342 at T1 to 300 at T3) considering the nature of the data

(e.g., longitudinal and linked family study design) and families of children who attritted did not significantly differ from those who remained in the primary study analysis with regard to demographic or temperament variables used in the study.

Overall Study Procedures

In-home assessments were administered by interviewers who completed at least 40 hours of training. All in-home assessments lasted 2-3 hours and included the collection of completed questionnaires mailed previously. Interviews of the adoptive family were completed at 9, 18, and 27 months and interviews of birth parents were completed between 3 and 6 months postpartum and18 months.

Measures

Dimensions of child temperament were created using the recommended scaling of item level temperament questionnaire data. These dimensions were used as indicators for the estimation of profiles of child temperament at each point of assessment. Profiles were differentiated by scores on temperament dimensions across the constellation of measured temperament indicators. Dimensions of adoptive parent and birth parent temperament were then used as predictors of child temperament profile membership status.

Child Temperament. Adoptive parents' reports of child temperament at 9 months were assessed using the Infant Behavior Questionnaire (IBQ; Rothbart, 1981). Six scales of child temperament were computed from the IBQ items; activity level, distress to novelty, distress to limitations, duration of orienting, and smiling and laughing. Adoptive parents' reports of child temperament at 18 and 27 months were assessed using the Toddler

Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1996). Five scales of child temperament were computed from TBAQ items; activity level, fear, anger proneness, interest, and pleasure. The TBAQ was developed to be a developmentally appropriate measure for toddlers with constructs that map directly onto constructs from the IBQ.

Birth Mother Temperament. Birth mothers' reports of their own temperament were assessed using two questionnaires; the Adult Temperament Questionnaire (ATQ; Rothbart, Ahadi, & Evans, 2000) and the Temperament and Character Inventory (TCI; Cloninger, Svaric, & Przybeck, 1993). Four higher order factors were computed from the ATQ items; negative affect, surgency, effortful control, and orienting sensitivity. Each of these factors is comprised of a number of corresponding facets. For example, the fear, frustration/anger, sadness, and discomfort facets make up the negative affect factor. The ATQ is part of the family of temperament measures designed by Rothbart and colleagues that also includes the IBQ. Three scales were computed from the TCI items; novelty seeking (higher scores indicate greater levels of impulsivity and excitability), harm avoidance (higher scores indicate more caution, insecurity, fearfulness) and reward dependence (higher scores indicate more dedication, tender-hearted, warm, sociable) (Cloninger, Svaric, & Przybeck, 1993).

Adoptive Parent Temperament. Adoptive parents' reports of their own temperament were assessed using the TCI. The same three scales computed for birth mothers were computed for adoptive parents; novelty seeking, harm avoidance, and reward dependence. The ATQ was not administered to adoptive parents at 9, 18, or 27 months and was unavailable for use in this study.

Statistical Controls

Additional variables were added to control for possible factors that may confound results or lead to misinterpretation of study findings. These controls are used to strengthen confidence in the interpretation of results utilizing the adoption design by further disentangling genetic and environmental influences. Other controls were used in an effort to ensure a more accurate measurement of child temperament.

Openness in adoption. The level of openness in the adoption may contaminate the quasi-experimental power of the adoption design. In a very open adoption, the birth parent may influence the child's development through increased contact with either the child or the adoptive parents. This would mean that associations between adoptive parent characteristics and child characteristics are not due just to the rearing environment provided by the genetically unrelated adoptive parents but is also influenced, to some extent, by birth parent characteristics (which may be correlated with the child characteristics because of shared genes). The variable used to control for adoption openness in this study was created according to the method presented in Ge and colleagues (2008) and collected at the 9 month assessment. This variable was constructed from direct report by birth and adoptive parents on perceived openness in the adoption, the degree of knowledge that birth and adoptive parents had about each other, and the amount of contact birth and adoptive parents had with each other.

Child Sex. There is evidence that there may be gender differences in facets of temperament related to activity level and effortful control as early as 3 months (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006) and in distress to novelty at 6 months

(Martin, Wisenbaker, Baker, & Huttunen, 1997). Because these differences have been found in infancy, child sex was included as a covariate so that results were not a function of differences due to gender.

Adoptive Parent Age. The age of the adoptive parents may have systematically biased their report of their child's temperament through age-based cohort effects. Cohort effects could lead to differences in the way parents feel about, and therefore rate, their child's behavior. Controlling for adoptive parent age reduced the possibility that differences in parent rated child temperament are due to historical differences experienced by adoptive parents.

Prenatal Complications. Prenatal complications may be associated with individual differences in the reactivity and regulation of a child early in life. Pemberton and colleagues (2010) found that associations between birth parent psychopathology and child behavior problems were mediated by prenatal complications in a sample similar to that used in this study, also from the Early Growth and Development Study. Thus, prenatal complications were added as a control in this study in an attempt to separate the possible effects of the prenatal environment from genetic influences. An index of total obstetric complications was created from items from a perinatal index with scoring designed to parallel the McNeil-Sjostrom Scale for Obstetric Complications (Kotelchuck, 1994; McNeil et al., 1994). The total obstetric complications score is a combination of scores measuring, pregnancy difficulties, toxin exposure, drug and alcohol use, maternal psychopathology, labor and delivery difficulties, and neonatal complications.

Data Preparation

Reports from both adoptive parents were combined in order to obtain a more comprehensive, reliable, measure of child temperament. Correlations between adoptive parent report for the same temperament dimensions at the same points of assessment suggested composites would be warranted (r = .27-.62). These composites were formed in the following manner. The control variables described above (child sex, adoptive parent age, adoption openness, and obstetric complications) were first regressed out of adoptive parent reported child temperament dimension variables. The unstandardized residuals from these regressions were saved and averaged to form a single temperament score for each measured dimension that reflected reports from both adoptive parents. These composited scores were then used as indicators for the subsequent latent profile analysis.

Results

Temperament Development

Descriptive statistics for the temperament dimensions assessed at 9, 18, and 27 months can be found in Table 2. Descriptives are organized by dimension of temperament and are then sequenced by the child's age at assessment (e.g., 9 months, followed by 18 months, followed by 27 months). Infant fear, anger, interest, and pleasure all showed mean level increases (albeit minor) from 18 to 27 months and activity level showed a mean level decrease. All measured dimensions of temperament approximated a normal distribution with acceptable levels of skewness.

Bivariate Pearson correlations of temperament dimensions over time are reported in Table 3. All measured temperament dimensions showed modest to moderate cross-measure and cross-time stability from 9-18 months (r = .27-.63) with the highest stability found between smiling and laughing at 9 months and pleasure at 18 months (r = .63). Stability correlations from 18 to 27 months were moderate to robust (r = .61-.70). Correlations between facets of negative affect and positive affect were significantly negatively correlated at each assessment, usually between dimensions related to fear (or distress to limitations at nine months) and pleasure (or smiling and laughter at nine months). The direction and magnitude of these associations are in line with those found in previous research utilizing these measures (Rothbart, 1981; Goldsmith, 1996).

Latent profiles of child temperament were estimated for each time of assessment using temperament dimensions (scaled in the standard manner for each measure) as

indicators and the statistical package Mplus (Muthen & Muthen, 2000). The best fitting model was chosen using the Bayesian Information Criterion (BIC; Schwarz, 1978), a fit statistic that prefers the most parsimonious solution. The number of profiles is estimated in an iterative fashion, starting at one profile, until the BIC reaches a minimum. Fit statistics for this process, including BIC and entropy are reported in Table 4. Model entropy values range from 0 to 1, values closer to 1 typically indicate better membership classification. Entropy greater than .80 is desirable; however, the dependence of the entropy statistic on the number of profiles that are estimated can sometimes make it a poor statistic for model selection (Lanza & Collins, 2009). Four latent profiles of temperament best fit the data at 9 months, and three latent profiles of temperament best fit the data at 18 and 27 months.

Profiles of Child Temperament at 9 Months

The estimated characteristics for each temperament profile at 9 months are reported in Figure 1. The temperament dimensions used as indicators can be found along the x-axis. Each line represents a temperament profile with the levels for each profile expressed as standard deviations from the sample mean for each respective dimensional indicator. The profile describing the most children (n=215) was characterized by close to average values across all indicators of child temperament compared to other children (Low Reactive Profile). The next temperament profile (n = 61) was characterized by below average levels of activity level and distress to limitations as well as above average levels of duration of orienting, smiling and laughter, and soothability (Positive Reactive Profile). The next temperament profile (n = 35) was characterized by well above average activity level, distress to novelty and distress to

limitations along with below average levels of duration of orienting, smiling and laughter, and soothability (Negative Reactive Profile). The final temperament profile (n = 28) was characterized by above average values across all indicators of child temperament compared to other children (High Reactive Profile).

Profiles of Child Temperament at 18 months

The estimated characteristics for each child temperament profile at 18 months can be found in Figure 2. The profile describing the most children at 18 months (n= 144) was characterized by below average levels of activity level, fear, and anger as well as above average levels of pleasure and interest (Positive Reactive Profile). The next profile (n=117) was characterized by above average levels of activity and anger, slightly above average fear, an average level of pleasure and a slightly below average level of interest (Negative Reactive Profile). The final temperament profile (n=66) was characterized by well below average values for activity level and pleasure, an above average level of fear and a below average level of interest (Fearful Profile).

Profiles of Child Temperament at 27 months

The estimated characteristics for each child temperament profile at 27 months can be found in Figure 3. The profile with the most members at 27 months (n=151) was characterized by below average levels of activity level, fear and anger, and above average levels of pleasure and interest (Positive Reactive Profile). The next profile (n=100) was characterized by above average levels of activity level and anger, slightly above average fear, average levels of pleasure and slightly below average levels of interest (Negative Reactive Profile). The final child temperament profile (n=55) was

characterized by below average levels of activity level, anger, and pleasure as well as above average fear and average interest (Fearful Profile).

Transitions in Temperament Profile Membership over Infancy

Transitions in child temperament profiles are described in Table 5 and depicted in Figures 4 and 5. Table 5 contains crosstabulations between transitions from 9 to 18 months, 9 to 27 months, and 18 to 27 months. Figure 5 contains graphical depictions of the proportion (on the y-axis) of members of each temperament profile (on the x-axis) that transitioned *to* each temperament profile at a later age. Figure 6 contains graphical depictions of the proportion of members of each profile who transitioned *from* a given temperament profile at an earlier age.

Transitions from 9 to 18 Months

Children who were members of the Positive Reactive Profile at 9 months were significantly more likely to remain in the Positive Reactive Profile (74%) at 18 months as opposed to transitioning to the Fearful Profile (14%) or the Negative Reactive Profile (12%) (Figure 4, Panel A.1). High Reactive Profile members were equally likely to transition to the Fearful (13%), Positive Reactive (50%) and Negative Reactive (38%) Profiles (Figure 4, Panel A.2). Children who were members of the Low Reactive Profile were equally likely to transition to the Negative Reactive (35%), Positive Reactive Profiles (41%), and Fearful Profiles (23%) (Figure 4, Panel A.3). Children who were members of the Negative Reactive profile at 9 months were more likely to have remained in the Negative Reactive Profile at 18 months (77%) with 17% transitioning to

the Fearful Profile and the remaining 6% transitioning to the Positive Reactive Profile (Figure 4, Panel 5.4).

Transitions from 9 to 27 Months

Members of the Positive Reactive Profile at 9 months were more likely to be in the Positive Reactive Profile (71%) than the Negative Reactive Profile (17%) at 27 months (Figure 4, Panel B.1). Children who were in the High Reactive Profile at 9 months were equally likely to be in the Positive Reactive (52%), Negative Reactive (38%), and Fearful Profile (10%) at 27 months (Figure 4, Panel B.2). Members of the Low Reactive Profile at 9 months were more likely to have transitioned to the Negative Reactive Profile (30%) as opposed to the Fearful Profile (20%) at 27 Months (Figure 4, Panel B.3). Members of the Negative Reactive Profile at 9 months were more likely members of the Negative Reactive Profile (73%) as opposed to either the Fearful (15%) or Positive Reactive Profile (12%) at 27 months (Figure 4, Panel B.4).

Transitions from 18 to 27 Months

Children who were members of the Fearful Profile at 18 months were more likely to remain members of the Fearful Profile (51%) at 27 months as opposed to either the Positive Reactive (29%) or Negative Reactive Profiles (21%) (Figure 4, Panel C.1). Members of the Positive Reactive Profile at 18 were most likely to remain in the Positive Reactive Profile at 27 months (79%) with the remaining 21% transitioning to the Negative Reactive (13%) and Fearful (8%) Profiles (Figure 4, Panel C.2). Children who were members of the Negative Reactive Temperament Profile at 18 months were most likely to remained members of the Negative Reactive profile at 27 months (63%). The

remaining 37% transitioned to the Positive Reactive Profile (26%) and the Fearful (11%) Profiles at 27 months (Figure 4, Panel C.3).

Adoptive Parent Temperament Influences on Child Temperament Profile Membership

Environmental influences on child temperament profile membership were tested using multinomial logistic regression with profile membership as the dependent variable and adoptive parent temperament characteristics as predictor variables. Adoptive mothers' and fathers' temperament characteristics were each entered into their own separate multinomial logistic regression equations predicting child temperament profile membership at 9, 18, and 27 months. Adoptive mothers' temperament characteristics were robust predictors of child temperament profile membership at 9 months, X^2 (9, N = 331) = 38.01, p<.01 (Table 6). For every standard deviation increase in AM harm avoidance, children were 1.7 times *less* likely to be members of the Positive Reactive profile, 2.0 times *less* likely to be members of the High Reactive profile, and 1.5 times *more* likely to be members of the Negative Reactive profile as opposed to the Low Reactive profile. For every standard deviation increase in AM novelty seeking, children were 1.6 times *less* likely to be members of the Positive Reactive profile and for every standard deviation increase in AM reward dependence children were 1.4 times *more* likely to be members of the Positive Reactive profile as opposed to the Low Reactive temperament profile. Prediction of profile membership at 9 months by AF temperament characteristics was not significant.

The prediction of child temperament profile membership at 18 months by AM temperament characteristics was also significant, X^2 (6, N = 320) = 26.4, p<.01 (Table 7). For every standard deviation increase in adoptive mothers' harm avoidance, children were 1.6 times *more* likely to be in the Negative Reactive temperament profile and 1.6 times *more* likely to be in the Fearful profile as opposed to the Positive Reactive temperament profile. Children were 1.4 times more likely to be in the negative reactive temperament profile and 1.6 times more likely to be in the Fearful temperament profile as opposed to the Positive Reactive profile at 18 months. Prediction of child temperament profile membership at 18 months by AF temperament characteristics was not significant. At 27 months the prediction of child temperament profile membership by AF temperament characteristics was significant, X^2 (6, N = 298) = 15.3, p<.05 (Table 8) while prediction by AM temperament characteristics was not. For every standard deviation increase in AF harm avoidance, children were 1.6 times more likely to be members of the Negative Reactive profile as opposed to the Positive Reactive temperament profile.

Birth Mother Temperament Influences on Child Temperament Profile Membership

Genetic influences on child temperament profile membership were tested using multinomial logistic regression with child profile membership as the dependent variable and birth mother temperament characteristics as predictor variables. Each birth mother temperament characteristic was used to predict child temperament profile membership individually. For every standard deviation increase in BM temperamental discomfort, children were 1.9 times *more* likely to be members of the High Reactive profile as opposed to the Low Reactive temperament profile at 9 months X^2 (3, N = 275) = 8.7,

p<.05 (Table 9). At 18 months, for every standard deviation increase in birth mothers' reward dependence, children were 1.4 times *less* likely to be members of the Fearful profile as opposed to the positive reactive temperament profile, X^2 (2, *N* = 315) = 6.1, *p*<.05 (Table 10). For every standard deviation increase in birth mothers' positive affect, children were 1.6 times *more* likely to be in the Positive Reactive profile as opposed to the Fearful temperament profile at 27 months, X^2 (2, *N* = 254) = 6.8, *p*<.05 (Table 11).

Discussion

The focus of this study was to provide a description of child temperament development in infancy that addressed gaps in the current temperament literature by capturing temperament development in a manner that more closely matched temperament theory. Most temperament research to date has utilized variable-centered approaches to temperament that focus on individual dimensions of temperament. The problem with the dimensional approach to studying temperament is that it does not adequately match temperament theory. Individual temperament dimensions are meaningful, but they are not conceptually (Goldsmith et al., 1987) or empirically (Rothbart et al., 2001) orthogonal. A person centered, data-driven approach to analysis was used in order to identify children who shared similar patterns of associations between the full constellation of temperament indicators as opposed to focusing on individual temperament dimensions. In this framework, the development of temperament is no longer a question of the stability of individual dimensions. The question of development becomes one of the stability of *patterns of associations* between dimensions that make up the temperament profile structure, stability in the characterization of profiles, and continuity and change in transitions in child membership

from infancy to toddlerhood. This conceptualization of temperament, along with a genetically informative adoption design, also allowed for a novel investigation of possible environmental and genetic influences on membership of child temperament profiles from infancy to toddlerhood.

Temperament Development: Structure and Characterization

Temperament at 9 Months

The structure and characterization of the temperament profiles estimated at 9 months partially supported study hypotheses. The number of profiles estimated was somewhat surprising given previous literature that had found evidence for three profiles of temperament at 30 months (van den Akker et al., 2010) and in early adolesence (Rettew et al., 2010). At 9 months, the Low Reactive profile, which had the highest proportion (63%) of members, was characterized by slightly below average values of activity level, distress, orienting, smiling/laughing, and soothability. The presence of this profile, the lack of differentiation across indicators, and the prevalence of its membership are consistent with the developmental time course of the biological systems thought to underlie the indicators being measured. For example, most infants can crawl by 7 months of age (Richards & Rader, 1983), but individual differences in crawling experience exist, and have been associated with cortical development as early as 8 months of age (Bell & Fox, 1996). Infant attentional systems are also thought to be coming online for most infants during this time period (Posner & Rothbart, 1998) but individual differences in infant attention have been associated with future outcomes like emotion regulation in toddlerhood (Morales et al., 2005). The Low Reactive Profile may

be capturing infants who are following normative developmental patterns while the remaining three profiles characterize infants who share patterns of individual differences in the indicators of infant temperament used in this study. The High Reactive profile was also marked by a lack of differentiation across indicators (i.e., similar levels of deviation from the sample mean for all indicators) but was characterized by *above average* values across said indicators. These infants are more prone to negative *and* positive affect and easier to sooth than the average infant in the sample.

These two characterizations of infants (Low Reactive and High Reactive Profiles) are not new to temperament literature. Kagan and Snidman (1991) classified infants into high and low reactive groups at four months and found high reactive children were more likely to later be classified as behavioral inhibited. Another study of the same infants found evidence for a latent high reactivity profile that contained about 10% of the sample (Woodward, Lenzenwerger, Kagan, et al., 2000). However, these classifications were based primarily on observations of motor activity and distress to novelty (Kagan & Snidman, 1991; Woodward, Lenzenwerger, Kagan, et al., 2000), while the profiles estimated in this study contain additional information concerning positive affect, orienting, and soothability, which makes direct comparison difficult. It is interesting however, that these two temperament types were found when using different methods of measurement and analysis of infant temperament.

Infants who were more active, more distressed, less prone to positive affect and had lower levels of attention than the rest of the sample were likely members of the Negative Reactive Profile. This profile, marked by high levels of activity level and distress and lower levels of positive affect may be more comparable to the high reactive

profile found in previous work. Interestingly, the prevalence of membership in the Negative Reactive Profile (10%) in this study was similar to the 10% prevalence for the high reactive group of infants in previous studies that utilized different measurement and analytical methods (Kagan & Snidman, 1991; Woodward et al., 2000). Infants in the Positive Reactive profile were less active and exhibited lower levels of negative reactivity and had higher levels of orienting and smiling and laughter compared to the rest of the sample. Although speculative, one possible developmental explanation for the presence of the Positive Reactive Profile is that these infants may be developing an early regulatory system. The attention system is thought develop early in life primarily to regulate distress (Posner & Rothbart, 1998). The high levels of duration of orienting (thought to capture attentional control) and low levels of distress that characterize the Positive Reactive profile might reflect a group of infants who have developed an early capacity to regulate emotional reactivity through attention.

The profiles of temperament found at 9 months describe four very different types of infants. The characterizations of these profiles replicated temperament types found using different measurement techniques and data analysis strategies and at the same time provided novel information. For example, levels of attention and positive affect differentiated the High Reactive Profile from the Negative Reactive Profile. These two profiles had similar characterizations for distress and activity level and both would have resembled the high reactive temperament type found in previous research had attention and positive affect not been included.

Temperament at 18 and 27 Months

The structure and characterization of temperament profiles at 18 and 27 months also partially supported study hypotheses. Three profiles best fit the data and the deviations from the sample mean for indicators within profiles were consistent at both points of assessment. The Positive Reactive Profile was characterized by low levels of activity level, fear, and anger as well as above average pleasure and interest. This characterization of the Positive Reactive profile at 18 and 27 months was very similar to the characterization of the Positive Reactive profile at 9 months, although different measures of temperament were used, which may be evidence for the developmental salience of this temperament profile. The Negative Reactive profile was characterized by higher than average levels of activity and negative affect (specifically anger) and lower than average interest. This characterization was similar at both 18 and 27 months. The remaining profile that was estimated at both 18 and 27 months did not resemble any of the profiles estimated at 9 months. The Fearful profile was marked by below average activity level, above average fear, and below average pleasure. The profile structure and characterizations of all three profiles were very similar at 18 and 27 months. The characterization of the Positive Reactive profile was consistent with the hypothesized estimation of an uninhibited, or exuberant profile (Fox et al., 2001; Stifter, Putnam, & Jahroni, 2008), as the interest indicator is thought to reflect levels of task engagement (Goldsmith, 1996) and could be considered as a measure of approach tendencies. The inclusion of interest in characterizing types of temperament is new, but dimensional approaches to temperament have commonly included the interest dimension. The characterization of the Fearful profile is consistent with the

hypothesized estimation of a behaviorally inhibited temperament type (Garcia-Coll, Kagan, Reznick, 1984; Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984).

The structure and characterization of all three temperament profiles, Positive Reactive, Negative Reactive, and Fearful, may reflect individual differences in how children transition from more biologically based, reactivity profiles at 9 months to behavioral tendencies related to the development of the behavioral approach and behavioral inhibition systems (BAS/BIS; Gray, 1982) that are evident at 18 and 27 months. The high levels of activity and anger found in the Negative Reactive profile may be indicative of children who are more actively seeking out goals, and who respond with anger when those goals are thwarted. Approach and anger, are often associated in temperament research (Derryberry & Rothbart, 2001; Deater-Deckard et al., 2010) and are components of a more dominant BAS (Gray, 1982). Similarly, the combination of positive affect, engagement/approach, and lower levels of fear found in the Positive Reactive profile parallel the exuberant or uninhibited temperament type (Fox et al., 2001; Stifter, Putnam, & Jahroni, 2008), which is also associated with the development of a more dominant behavioral approach system (Gray, 1982). The high levels of fear and low levels of activity level that characterize the Fearful profile parallel the classic behaviorally inhibited child (Garcia-Coll, Kagan, Reznick, 1984; Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984).

As hypothesized, the structure and characterization of the profiles estimated at 18 and 27 months were remarkably stable. The Fearful profile that was estimated replicated findings from prior research that found a behaviorally inhibited type of temperament. With that in mind, two additional points bear notice. First, the Fearful

profile also included information on pleasure (lower than average) and interest (average). The observation that children in the Fearful profile had lower than average levels of positive affect parallels the behaviorally inhibited temperament type as it is unlikely that children who were crying and distressed when exposed to a novel situation in a laboratory setting would also show positive affect during the same episode. Second, the observation that Fearful children showed average levels of engagement/approach suggests that maybe these children are in fact engaged, or desire to engage but are too fearful to do so. For both the Positive Reactive and the Fearful profiles it is also vital to note that while these profiles may mirror the exuberant and inhibited temperament types found previously, they were estimated using an entirely different method of measurement. Differences between the Negative Reactive and Fearful Profiles point to the importance of conceptually separating negative affect into fear and anger components. The additional information provided by including the entire constellation of temperament dimensions as well as the more global nature (compared to observations) of temperament ratings that are implied by questionnaire measurement provides further evidence for the replication and expansion of previous temperament literature.

Transitions in Child Membership

Results concerning the structure and characterization of profiles of temperament were consistent with hypotheses, as both were stable over time. Child membership in the estimated profiles showed evidence of considerable continuity and change. The small number of children who were members of either the Positive Reactive or Negative Reactive profiles at 9 months were significantly more likely to remain members of their

respective profiles at 18 months. Children who were members of the Low Reactive profile (which had the largest membership) were equally likely to transition to the Fearful, Negative Reactive, or Positive Reactive profiles at 18 months. These results are consistent with the large body of temperament literature that has shown greater stability for children in extreme temperament groups (Pfeifer, Goldsmith, Davidson, & Rickman, 2002). Profile membership at 18 months was predictive of profile membership at 27 months; children were significantly more likely to remain members of their respective profiles as opposed to transitioning to a different temperament profile. The percentage of children who retained their profile classification was consistent with previous typological temperament research (Kagan et al., 1994). These results suggest that prediction of later temperament profile membership from early infancy would likely be more difficult for children that were not members of a more extreme early temperament profile. By 18 months, most children in this study settled in to a temperament profile that was indicative of where they would be 9 months later.

But what about the children who were not members of the same profile from 18 to 27 months, should we expect them to be? These infants may be more susceptible to their environments (Boyce & Ellis, 2005; Belsky, 2000; 2005) which could cause them to have more variable temperament profile membership over time. Variable profile membership may be a normative developmental transition in itself, within the scope of this study, it is impossible to tell. Even with a certain degree of change in child membership, there was still substantial stability in the structure of temperament profiles (e.g., the number of profiles and characterization of profiles) at 18 to 27 months. This

result suggests that for this set of temperament indicators, the estimated profiles may reflect normative and highly meaningful developmental patterns of associations.

Genetic and Environmental Influences on Profile Membership

This study provided evidence for specific genetic and environmental influences on child temperament profile membership. While there has been a plethora of evidence for genetic influences on child temperament development from twin studies, sparse evidence from adoption studies and concerns about possible contrast effects in twin designs have warranted a call for more research utilizing adoption designs (Goldsmith et al., 1987). One large scale adoption study that used a dimensional temperament approach, found no evidence for genetic influences on child temperament (Plomin et al., 1991). Utilizing a person centered framework that more adequately captured child temperament, this study found direct evidence for genetic influences on child temperament profile membership.

Children of birth mothers who had higher levels of discomfort were more likely to be members of the High Reactive temperament profile at 9 months. Higher levels of birth mother temperamental reward dependence (e.g., more sociable, warm and tender-hearted) predicted children to be less likely to be in the Fearful profile at 18 months and higher levels of birth mother positive affect predicted children to be more likely to be members of the Positive Reactive profile at 27 months. Confidence in these results is strengthened by the direction of effects. Birth mothers with more discomfort had children who were more likely to be members of a profile marked by higher distress and birth

mothers who were more positive, sociable, and impulsive had children who were more likely to be members of a profile characterized by more approach and positive affect.

The most robust environmental predictor of temperament profile membership in this study proved to be the level of adoptive parents' harm avoidance. People who score higher in harm avoidance tend to be more cautious, fearful, pessimistic, and insecure (Cloninger, Svaric, & Przybeck, 1993). Children whose adoptive mothers had higher than average levels of harm avoidance were more likely to be members of the Negative Reactive profile at 9 months as opposed to the Low Reactive profile and more likely to be in the Negative Reactive or Fearful profiles than the Positive Reactive profile at 18 months. Adoptive fathers' harm avoidance was also observed to be predictive of child temperament profile membership at 27 months in the same direction as adoptive mothers.

A heightened level of harm avoidance in adoptive parents may be indicative of a more fearful temperament, which could lead to parents restricting the environments that their child is exposed to which may affect the development of their predispositions to reactivity and regulation. This high level of harm avoidance in parents may also be consistent with a protective or restrictive parenting style, which has been linked to the development of internalizing problems (Bayer, Sanson, & Hemphill, 2006; Chorpita & Barlow, 1998). Interestingly, there is not a consensus in the literature on the direction of this effect; it is equally possible that temperamental characteristics of the child may actually drive parenting behavior (Kennedy, Rubin, Hastings, & Maisel, 2004).

This study provided novel evidence for specific genetic (birth mother temperament) and environmental (adoptive parent temperament) influences on temperament profile membership from infancy to toddlerhood. The association between birth mother temperament characteristics and child temperament profile membership are in stark contrast to the null findings from a previous large scale adoption study (Plomin et al., 1991). The lack of findings may be due to the dimensional operationalization of the temperament construct used previously. This interpretation is strengthened by the observation that in the present study, birth mother temperament was only significantly correlated with three temperament dimensions (out of 48 possible bivariate correlations).

Limitations

This study provided a novel description of temperament development by utilizing a person-centered approach and a genetically informative study design but was not without certain limitations. First, the reliance on adoptive parents' reports of both their child's temperament and their own temperament could be an issue because there may be rater effects. Compositing adoptive mother and adoptive father reports of child temperament was a step towards less biased measurement but additional ratings of child temperament from observations would have been ideal. This observational data is present in EGDS and could be incorporated to validate parental reports but that analysis was beyond the scope of the current study. The temperament measures that were chosen are also widely used and have excellent internal and external validity. Second, adoptive parent reports of their own temperament from the 9 month assessment were used in this analysis so the direction of effects for the association between adoptive

mother temperament and 9 month profile membership is unclear. This issue would have been more problematic if adoptive parent temperament from a later assessment was used and due to the large scale nature of data collection for EGDS, this issue was likely unavoidable.

Future Directions

The results of this study have raised a number of new research questions. First and foremost, how are the temperament profiles estimated in this study associated with future outcomes? EGDS is an ongoing study so future work can investigate how membership in the profiles estimated in this study are associated with both concurrent and future child behavior problems, school adjustment, and family relationships. Second, are the structure and characterization of temperament profiles from this study stable through middle childhood? EGDS will eventually have assessments of child temperament at 54, 72, and 84 months, which will allow for an extension of this study that can estimate temperament profile structure and membership continuity from 9 months to 7 years. Third, taking in to account prior evidence for the possibility that the stability of temperament dimensions can be more predictive than a rating at a single time of assessment (e.g., shyness; Biederman et al., 1995), does the level of continuity of profile membership differentially predict outcomes? For example, are children who remain in a negative reactive profile over time more or less likely to exhibit behavior problems in the future? Future work should also investigate pathways for how adoptive parent temperament affects child temperament profile membership. Results from this study suggest that adoptive parent temperament influences child temperament development but it is not clear how this happens; it could be through the structuring of

the environment, parenting practices, or through interpersonal relationships. Birth parent temperament was a starting domain for investigating specific genetic influences on temperament profile membership and future work can extend this study by investigating whether birth parent psychopathology influences temperament profile membership.

Conclusion

This study has provided a novel description of temperament development from infancy to toddlerhood that was strengthened by the use of a person-centered approach that more adequately fit method to theory. Results were further strengthened through the replication and extension of findings from prior temperament literature that employed different methods of measurement and analysis to ask similar questions about temperament development. Preliminary evidence for specific genetic and environmental influences on temperament development was provided as both adoptive parent temperament and birth parent temperament were associated with child temperament profile membership. Hopefully these findings can be a starting point and future research may begin to elucidate critical mechanisms driving differences in trajectories of socioemotional development. Results from this study suggest that these pathways may start with genetic and environmental influences on temperament profile membership but future work will be needed to determine where, and how, these developmental pathways end.

References

Bell, M. A. & Fox, N. A. (1996). Crawling experience is related to changes in cortical organization during infancy: Evidence from EEG coherence. *Developmental Psychobiology, 29*(7), 551-561.

Belsky, J. (2000). Conditional and alternative reproductive strategies: Individual differences in susceptibility to rearing experiences. In J. L. Rodgers, D. C. Rowe & W. B. Miller (Eds.), *Genetic influences on human fertility and sexuality: Theoretical and empirical contributions from the biological and behavioral sciences* (pp. 127-145). Boston: Kluwer Academic.

Belsky, J. (2005). Differential susceptibility to rearing influence: An evolutionary hypothesis and some evidence. In B. J. Ellis & D. F. Bjorklund (Eds.), *Origins of the social mind: Evolutionary psychology and child development* (pp. 139-163). New York: Guildford Press.

Biederman, J., Rosenbaum, J., Chaloff, J. & Kagan, J. (1995). Behavioral inhibition as a risk factor. In March J. S. (Ed.), *Anxiety Disorders in Children and Adolescents* (pp. 61-81). New York: Guilford.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist*, *57*, 111-127.

Boyce, W. T. & Ellis, E. J. (2005). Biological sensitivity to context: I. An evolutionary-developmental theory of origins and functions of stress reactivity. *Development and Psychopathology, 17*, 271-301.

Brooker, R. J., Neiderhiser, J. M., Kiel, E. J., Leve, L. D., Shaw, D. S., & Reiss, D. (2011). The association between infants' attention control and social inhibition is moderated by genetic and environmental risk for anxiety. *Infancy*. Advance online publication. doi: 10.1111/j.1532-7078.2011.00068.x

Buss, A. H., & Plomin, R. (1984). *Temperament: Early developing personality traits*. Hillsdale, NJ: Erlbaum.

Buss, K. A., Davidson, R. J., Kalin, N. H., & Goldsmith, H. H. (2004). Context-Specific freezing and associated physiological reactivity as a dysregulated fear response. *Developmental Psychology, 40*(4), 583-594.

Carranza, J.A., Perez-Lopez, J., Gonzalez, C., & Martinez-Fuentes, M. T. (2000). A longitudinal study of temperament in infancy: Stability and convergence of measures. *European Journal of Personality, 14,* 21-37.

Cherny, S. S., Fulker, D. W., Corley, J. C., Plomin, R., & DeFries, J. (1994). Continuity and change in infant shyness from 14 to 20 months. *Behavioral Genetics, 24*, 723-733.

Cloninger, C. R., Svaric, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 44,* 573-588.

Colder, C. R., Mott, J. A., & Berman, A. S. (2002). The interactive effects of infant activity level and fear on growth trajectories of early childhood behavior problems. *Development and Psychopathology, 14,* 1-23.

Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M. Cumberland, A., et al. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development, 75*(1), 25-46.

Emde, R. N., Plomin, R., Robinson, J., Corley, R., DeFries, J., Fulker, D., Reznick, J. S., Campos, J., Kagan, J., & Zahn-Waxler, C. (1992). Temperament, emotion, and cognition at fourteen months: The MacArthur longitudinal twin study. *Child Development, 63,* 1437-1455.

Evans, D. E., & Rothbart, M. K. (2007). Development of a model for adult temperament. *Journal of Research in Personality, 41,* 868-888.

Feng, X., Shaw, D. S., & Silk, J. S. (2008). Developmental trajectories of anxiety symptoms among boys across early and middle childhood. *Journal of Abnormal Psychology, 117*(1), 32-47.

Ganiban, J. M., Saudino, K. J., Ulbricht, J., Neiderhiser, J. M., & Reiss, D. (2008). Stability and change in temperament during adolescence. *Journal of Personality and Social Psychology, 95*(1), 222-236.

Garcia-Coll, C., Kagan, J., & Reznick, J. S. (1984). Behavioral inhibition in young children. *Child Development, 55,* 1005-1019.

Ge, X., Natsuaki, M. N., Martin, D. M., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Villareal, G., Scaramella, L., Reid, J. B., & Reiss, D. (2008). Bridging the divide: Openness in adoption and postadoption psychosocial adjustment among birth and adoptive parents. *Journal of Family Psychology, 22*(4), 529-540.

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., & Chess, S. (1987). What is temperament? Four approaches. *Child Development, 58,* 505-529.

Goldsmith, H. H. & Campos, J. J. (1990). The structure of temperamental fear and pleasure in infants: A psychometric perspective. *Child Development, 61*, 1944-1964.

Goldsmith, H. H. (1996). Studying temperament via construction of the toddler behavior assessment questionnaire. *Child Development, 67*, 218-235.

Goldsmith, H. H., Buss, K. A., & Lemery, K. S. (1997). Toddler and childhood temperament: Expanded content, stronger genetic evidence, new evidence for the importance of environment. *Developmental Psychology, 33*(6), 891-905.

Goldsmith, H. H., Lemery, K. S., Aksan, N., & Buss, K. A. (2000). Temperamental substrates of personality development. In V. J. Molfese & D. L. Molfese (Eds.), *Temperament and personality development across the life span* (pp. 1-32). New Jersey: Erlbaum.

Guerin, D. W., Gottfried, A. W., & Thomas, C. W. (1997). Difficult temperament and behavior problems: A longitudinal study from 1.5 to 12 years. *International Journal of Behavioral Development, 21,* 71-90.

Johnson, M., Posner, M. I., & Rothbart, M. K. (1991). Components of visual orienting in early infancy: Contingency learning, anticipatory looking, and disengaging. *Journal of Cognitive Neuroscience, 3*(4), 335-344.

Kagan, J., Reznick, J. S., Clarke, C., Snidman, N., Garcia-Coll, C. (1984). Behavioral inhibition to the unfamiliar. *Child Development, 55,* 2212-2225.

Kagan, J. (1994). Galen's prophecy: Temperament in human nature. New York: Basic Books.

Kagan, J. (1998). Biology and the child. In N. Eisenberg (Ed.) & W. Damon (Series Ed.), *Handbook of child psychology: Vol. 3, Social, emotional, and personality development* (pp. 177-235). New York: Wiley.

Kagan, J., Snidman, N., Zentner, M., & Peterson, E. (1999). Infant temperament and anxious symptoms in school age children. *Development and Psychopathology, 11,* 209-224.

Kennedy, A. E., Rubin, K. H., Hastings, P. D., & Maisel, B. (2004). Longitudinal relations between child vagal tone and parenting behavior: 2 to 4 years. *Developmental Psychobiology, 45*(1), 10-21.

Kim, J., Deater-Deckard, K., Mullineaux, P. Y., & Beekman, C. (2010). Context specificity in stability of hyperactivity-impulsivity. *European Journal of Personality, 24*(8), 656-674.

Kotelchuck, M. (1994). An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization Index. *American Journal of Public Health, 84*(9), 1414-1420.

Lanza, S. T. & Collins, L. M. (2008). A new SAS procedure for latent transition analysis: Transitions in dating and sexual risk behavior. *Developmental Psychology, 44*(2), 446-456.

Lazarsfeld, P. F. & Henry, N. W. (1968). *Latent structure analysis.* New York: Houghton Mifflin.

Leve, L. D., Neiderhiser, J. M., Scaramella, L. V., & Reiss, D. (2008). The Early Growth and Development Study: using the prospective adoption design to examine genotype-environment interplay. *Acta Psychol Sin.,40*, 1106-1115.

Leve, L. D., Kim, H. K., & Pears, K. C. (2005). Childhood temperament and family environment as predictors of internalizing and externalizing trajectories from ages 5 to 17. *Journal of Abnormal Child Psychology, 33*(5), 505-520.

Loken, E. (2004). Using latent class analysis to model temperament types. *Multivariate Behavioral Research, 39*, 625-652.

Magnusson, D. (1998). The logic and implications of a person-centered approach. In R. B. Cairns, L. R. Bergman, & J. Kagan (Eds.), *Methods and models for studying the individual* (pp. 33-64). Thousand Oaks, CA: Sage.

Majdandzic, M. & van den Boom, D. C. (2007). Multimethod longitudinal assessment of temperament in early childhood. *Journal of Personality, 75*(1), 121-168.

McCall, R. B. (1986). Issues of stability and continuity in temperament research. In R. Plomin & J. Dunn (Eds.), *The study of temperament: Changes, continuities, and challenges* (pp. 13-25). Hillsdale, NJ: Erlbaum.

McNeil, T. F., Cantor-Graae, E., & Sjostrom, K. (1994). Obstetric complications as antecedents of schizophrenia: Empirical effects of using different obstetric complication scales. *Journal of Psychiatric Research, 28*(6), 519-530.

Merikangas, K. R., Swendsen, J. D., Preisig, M. A., & Chazan, R. Z. (1998). Psychopathology and temperament in parents and offspring: results of a family study. *Journal of Affective Disorders, 51*(1), 63-74.

Morales, M., Mundy, P., Crowson, M. M., Neal, A. R., & Delgado, C. E. F. (2005). Individual difference in infant attention skills, joint attention, and emotion regulation behaviour. *International Journal of Behavioral Development, 29*(3), 259-263.

Muthen, B. (2001). Latent variable mixture modeling. In G. A. Marcoulides & R. E. Schumacker (Eds.), *New developments and techniques in structural equation modeling* (pp. 1-33). Mahaw, NJ: Lawrence Erlbaum Associates.

Natsuaki, M. N., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Scaramella, L. V., Ge, X., & Reiss, D. (in press). Intergenerational transmission of risk for social inhibition: The interplay between parental responsiveness and genetic influences. *Development and Psychopathology.*

Pemberton, C. K., Neiderhiser, J. M., Leve, L. D., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Ge, X. (2010). Influence of parental depressive symptoms on adopted toddler behaviors: An emerging developmental cascade of genetic and environmental effects. *Development and Psychopathology, 22*, 803-818.

Perez-Edgar, K., Fox, N. A. (2005). Temperament and anxiety disorders. *Child and Adolescent Psychiatric Clinics of North America, 14*, 681-706.

Pfeifer, M., Goldsmith, H. H., Davidson, R. J., & Rickman, M. (2002). Continuity and change in inhibited and uninhibited children. *Child Development, 73*(5), 1474-1485.

Plomin, R., Coon, H., Carey, G., DeFries, J.C., & Fulker, D. (1991). Parent-offspring and sibling adoption analyses of parental ratings of temperament in infancy and childhood. *Journal of Personality, 59*(4), 705-732.

Rettew, D. C., Althoff, R. R., Dumenci, L., Ayer, L., & Hudziak, J. J. (2008). Latent profiles of temperament and their relations to psychopathology and wellness. *Journal of the American Academy of Child and Adolescent Psychiatry, 47,* 273-281.

Richards, J. E. & Rader, N. (1983). Crawling-onset age predicts visual cliff avoidance in infants. *Journal of Experimental Psychology: Human Perception and Performance, 7*(2), 382-387.

Riese, M. L. (1987). Longitudinal assessment of temperament from birth to 2 years: A comparison of full-term infants. *Infant Behavior and Development, 10,* 347-363.

Robinson, J. L., Kagan, J., Reznick, J. S., & Corley, R. (1992). The heritability of inhibited and uninhibited behavior: A twin study. *Developmental Psychology, 28*(6), 1030-1037.

Rothbart, M. K. (1981). Measurement of temperament in infancy. *Child Development, 52,* 569-578.

Rothbart, M. K., & Derryberry, D. (1981). Development of individual differences in temperament. In M. E. Lamb & A. L. Brown (Eds.), *Advances in Developmental Psychology* (Vol. 1, pp. 37-86). Hillsdale, NJ: Erlbaum.

Rothbart, M. K., & Bates, J. E. (1998). Temperament. In N. Eisenberg (Ed.), W. Damon (Series Ed.), *Handbook of child psychology: Vol. 3, Social, emotional and personality development* (5th ed., pp. 105-176). New York: Wiley.

Rothbart, M. K., Derryberry, D., & Hershey, K. (2000). Stability of temperament in childhood: Laboratory infant assessment to parent report at seven years. In V. J. Molfese & D. L. Molfese (Eds.), *Temperament and personality development across the life span* (pp. 85-119). Hillsdale, NJ: Erlbaum.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The children's behavior questionnaire. *Child Development, 72*(5), 1394-1408.

Rubin, K. H., Burgess, K. B., Dwyer, K. M., & Hastings, P. D. (2003). Predicting preschoolers' externalizing behaviors from toddler temperament, conflict, and maternal negativity. *Developmental Psychology, 39*(1), 164-176.

Saudino, K. J. (2005). Behavioral genetics and child temperament. *Journal of Developmental and Behavioral Pediatrics, 26*(3), 214-223.

Scarpa, A., Raine, A., & Venables, P. H. & Mednick, S. A.(1995). The stability of inhibited/uninhibited temperament from ages 3 to 11 years in Mauritian children. *Journal of Abnormal Child Psychology, 23,* 607-18.

Schmitz, S. (1994). Personality and temperament. In J. C. DeFries, R. Plomin, & D. W. Fulker (Eds.), *Nature and nurture during middle childhood* (pp. 120-140). Cambridge, MA: Blackwell.

Schmitz, S., Saudino, K. J., Plomin, R., Fulker, D., & DeFries, J. C. (1996). Genetic and environmental influences on temperament in middle childhood: Analyses of teacher and tester ratings. *Child Development, 67*(2), 409-422.

Schwartz, C. E., Snidman, N., & Kagan, J., (1999). Adolescent social anxiety as an outcome of inhibited temperament in childhood. *Journal of the American Academy of Child and Adolescent Psychiatry, 38,* 1008-1015.

Stifter, C. A. & Jain, A. (1996). Psychophysiological correlates of infant temperament: Stability of behavior and autonomic patterning from 5 to 18 months. *Developmental Psychobiology, 29*(4), 379-391.

Thomas, A., & Chess, S. (1977). *Temperament and development*. New York: Brunner/Mazel.

Thomas, A., & Chess, S. (1984). Genesis and evolution of behavioral disorders: From infancy to early adult life. *American Journal of Psychiatry, 141*. 1-9.

van den Akker, A. L., Dekovic, M., Prinzie, P., & Asscher, J. J. (2010). Toddlers' temperament profiles: Stability and relations to negative and positive parenting. *Journal of Abnormal Child Psychology, 38*(4), 485-495.

Wachs, T. D., Pollitt, E., Cueto, S., & Jacoby, E. (2004). Structure and cross-contextual stability of neonatal temperament. *Infant Behavior and Development, 27*(3), 382-396.

Woodward, S. A., Lenzenweger, M. F., & Kagan, J. (2000). Taxonic structure of infant reactivity: Evidence from a taxometric perspective. *Psychological Science, 11*(4), 296-301.

APPENDIX A: TABLES

Table 1.

Demographics for Birth Mothers and Adoptive Parents

Variable	Birth Mother	Adoptive Mother	Adoptive Father
Mean age	24.2 (7.3)	38 (7.3)	38.7 (5.9)
Race (%)			
Caucasian	77	93	92
African-American	11	4	5
Hispanic/Latino	4	1	1
Multi-ethnic	5	2	2
Other	2	1	1
Median annual household income ($)	14,000	100,000	
Mean education level	5	9	9

Note: Numbers within parentheses are standard deviations. Education scores: 1 = <8th grade, 2 = completed 8th grade, 3 = completed 12th grade, 4 = some trade school, 5 = completed trade school, 6 = some junior college, 7 = completed junior college, 8 = some college, 9 = completed college, 10 = some graduate/professsional school, 11 = completed graduate/profesional school.

Table 2.
Temperament Descriptives at 9, 18, and 27 Months

Dimension - Time of Assessment	Min.	Max.	Mean	Std. Dev.	Skewness
Activity Level - 9 Mo.	2.00	6.36	4.04	.76	.12
Activity Level - 18 Mo.	2.42	6.21	4.17	.63	-.01
Activity Level - 27 Mo.	2.17	6.15	4.24	.67	-.08
Distress to Novelty - 9 Mo.	1.00	4.64	2.41	.63	.55
Fear - 18 Mo.	1.18	6.06	3.76	.93	.03
Fear - 27 Mo.	1.68	5.79	3.73	.88	.10
Distress to Limitations - 9 Mo.	1.13	5.50	3.12	.75	.31
Anger - 18 Mo.	1.63	5.77	3.43	.70	.16
Anger - 27 Mo.	1.88	5.96	3.62	.70	.46
Duration of Orienting - 9 Mo.	1.13	6.13	3.28	.99	.23
Interest - 18 Mo.	1.47	6.42	3.72	.81	-.13
Interest - 27 Mo.	1.71	6.23	4.17	.78	-.31
Smiling and Laughing - 9 Mo.	3.00	6.93	5.14	.78	-.21
Soothability - 9 Mo.	2.50	7.00	5.16	.83	.02
Pleasure - 18 Mo.	2.87	6.95	5.13	.75	-.29
Pleasure - 27 Mo.	3.44	7.00	5.37	.68	-.39

Note. Min. = Minimum, Max. = Maximum, Std. Dev. = Standard Deviation, Mo. = Months

Table 3.

Correlations Between Temperament Dimensions at 9, 18, and 27 Months

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	.15	.16
1. Activity Level	[]															
2. Distress to Limitations	**.39**	[]														
3. Distress to Novelty	**.25**	**.32**	[]													
4. Duration of Orienting	-.07	**-.23**	.03	[]												
5. Smiling and Laughing	.00	**-.14**	-.09	.26	[]											
6. Soothability -	-.04	-.04	.04	.17	**.32**	[]										
7. Activity Level - 18 mo.	**.35**	**.33**	**.20**	-.12	.06	-.07	[]									
8. Pleasure - 18 Mo.	.08	-.01	-.01	.16	**.63**	**.27**	**.15**	[]								
9. Fear - 18 Mo.	.10	**.15**	**.45**	-.02	**-.14**	-.04	.06	**-.25**	[]							
10. Interest - 18 Mo.	**-.12**	**-.12**	-.06	**.42**	**.20**	**.20**	**-.25**	**.29**	-.08	[]						
11. Anger - 18 Mo.	**.24**	**.44**	**.28**	-.03	**-.12**	-.08	**.42**	-.05	**.28**	-.06	[]					
12. Activity Level - 27 Mo.	**.38**	**.35**	**.20**	-.02	.10	.00	**.66**	**.15**	**.12**	**-.12**	**.33**	[]				
13. Pleasure - 27 Mo.	.05	-.08	.00	.12	**.55**	**.28**	.06	**.67**	**-.17**	**.13**	-.07	**.15**	[]			
14. Fear - 27 Mo.	.08	**.12**	**.39**	.02	-.11	-.06	.11	**-.18**	**.62**	-.10	**.21**	**.14**	**-.33**	[]		
15. Interest - 27 Mo.	**-.12**	-.10	.01	.36	**.21**	**.21**	**-.24**	**.24**	-.01	**.70**	-.02	**-.13**	**.19**	-.06	[]	
16. Anger - 27 Mo.	**.24**	**.42**	**.19**	-.07	-.09	.01	**.43**	.03	**.17**	-.09	**.61**	**.48**	.06	**.22**	**-.13**	[]

Note: ***p < .05.***

Table 4.

Summary of Fit Statistics for Latent Profile Analysis of Child Temperament

No. Profiles	BIC	Entropy
9 Month Temperament		
One Profile	4154.7	N/A
Two Profiles	4093.5	0.72
Three Profiles	4076.8	0.68
Four Profiles	4070.2	0.74
Five Profiles	4081.9	0.69
18 Month Temperament		
One Profile	3204.5	N/A
Two Profiles	3150.2	0.54
Three Profiles	3114.3	0.64
Four Profiles	3122.4	0.65
27 Month Temperament		
One Profile	2916.6	N/A
Two Profiles	2872.2	0.59
Three Profiles	2833.2	0.67
Four Profiles	2839.4	0.73

Note. BIC = Bayesian Information Criterion.

Table 5.

Crosstabulations of Temperament Profile Transitions

	18 Month Profiles		
9 Month Profiles	Fearful	Positive Reactive	Negative Reactive
Positive Reactive	8[a]	43[b]	7[a]
High Reactive	3[a]	12[a]	9[a]
Low Reactive	48[a]	85[a]	73[a]
Negative Reactive	6[a]	2[b]	27[c]

	27 Month Profiles		
9 Month Profiles	Fearful	Positive Reactive	Negative Reactive
Positive Reactive	6[a,b]	36[b]	9[a]
High Reactive	2[a]	11[a]	8[a]
Low Reactive	40[b]	99[a,b]	59[a]
Negative Reactive	5[c]	4[b]	24[a]

	27 Month Profiles		
18 Month Profiles	Fearful	Positive Reactive	Negative Reactive
Fearful	32[b]	18[a]	13[a]
Positive Reactive	11[a]	104[b]	17[a]
Negative Reactive	12[b]	27[b]	67[a]

Note: Superscripts denote Chi-square differences at p<.05 across rows

Table 6.

Adoptive Mother's Temperament Predicting Temperament Profile Membership at 9 Months

Profile at 9 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	95% Conf. for Exp(B) Lower	Upper
Positive Reactive	Intercept	-1.38	.16	<.01			
	Novelty Seeking	-.44	.16	.01	.64	.47	.89
	Harm Avoidance	-.55	.17	<.01	.58	.41	.8
	Reward Dependence	.36	.17	.03	1.43	1.03	1.99
High Reactive	Intercept	-2.19	.23	<.01			
	Novelty Seeking	-.11	.22	.61	.9	.59	1.37
	Harm Avoidance	-.71	.24	<.01	.49	.31	.8
	Reward Dependence	-.08	.2	.7	.92	.62	1.37
Negative Reactive	Intercept	-1.94	.21	<.01			
	Novelty seeking	-.03	.19	.87	.97	.66	1.41
	Harm Avoidance	.42	.19	.03	1.52	1.04	2.21
	Reward Dependence	-.26	.18	.15	.77	.54	1.1

Note: [a] Low Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

Table 7.

Adoptive Mother's Temperament Predicting Temperament Profile Membership at 18 Months

						95% Conf. for Exp(B)	
Profile at 18 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	Lower	Upper
Inhibited	Intercept	-.81	.16	<.01			
	Novelty Seeking	-.12	.16	.48	.89	.65	1.23
	Harm Avoidance	.5	.16	<.01	1.65	1.19	2.27
	Reward Dependence	-.03	.16	.85	.97	.72	1.31
Negative Reactive	Intercept	-.23	.13	.08			
	Novelty Seeking	.25	.13	.06	1.29	.99	1.67
	Harm Avoidance	.5	.14	<.01	1.65	1.25	2.17
	Reward Dependence	.19	.14	.18	1.21	.92	1.59

Note: [a] Positive Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

Table 8.

Adoptive Father's Temperament Predicting Temperament Profile Membership at 27 Months

Profile at 27 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	95% Conf. for Exp(B) Lower	Upper
Inhibited	Intercept	-.41	.13	<.01			
	Novelty Seeking	.03	.14	.83	1.03	.79	1.35
	Harm Avoidance	.44	.14	<.01	1.55	1.18	2.04
	Reward Dependence	.03	.13	.83	1.03	.79	1.34
Negative Reactive	Intercept	-1.05	.17	<.01			
	Novelty Seeking	-.28	.18	.12	.76	.53	1.08
	Harm Avoidance	.3	.17	.07	1.36	.98	1.88
	Reward Dependence	-.06	.16	.72	.95	.69	1.3

Note: [a] Positive Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

Table 9.

Birth Mother's Discomfort Predicting Temperament Profile Membership at 9 Months

Profile at 9 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	95% Conf. for Exp(B) Lower	Upper
Positive Reactive	Intercept	-1.23	.16	<.01			
	Discomfort	-.02	.16	.88	.98	.71	1.34
High Reactive	Intercept	-2.21	.26	<.01			
	Discomfort	.66	.24	<.01	1.94	1.21	3.1
Negative Reactive	Intercept	-1.91	.21	<.01			
	Discomfort	.01	.21	.99	1.03	.66	1.52

Note: [a] Low Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

Table 10.

Birth Mother's Reward Dependence Predicting Temperament Profile Membership at 18 Months

Profile at 18 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	95% Conf. for Exp(B) Lower	Upper
Inhibited	Intercept	-.82	.16	<.01			
	Reward Dependence	-.37	.15	.02	.69	.51	.93
Negative Reactive	Intercept	-.2	.13	.11			
	Reward Dependence	-.07	.13	.58	.93	.72	1.2

Note: [a] Positive Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

Table 11.

Birth Mother's Positive Affect Predicting Temperament Profile Membership at 27 Months

						95% Conf. for Exp(B)	
Profile at 27 Months[a]		*B*	Std. Error	Sig.	Exp(*B*)	Lower	Upper
Inhibited	Intercept	-.48	.14	<.01			
	Positive Affect	-.19	.14	.19	.83	.63	1.1
Negative Reactive	Intercept	-1.12	.18	<.01			
	Positive Affect	-.44	.17	.01	.64	.46	.91

Note: [a] Positive Reactive is the reference profile. *B,* Beta. Std. Error, Standard Error. Sig., Significance. Conf., Confidence Interval

APPENDIX B: FIGURES

Figure 1.
Characteristics of Temperament Profiles At 9 Months

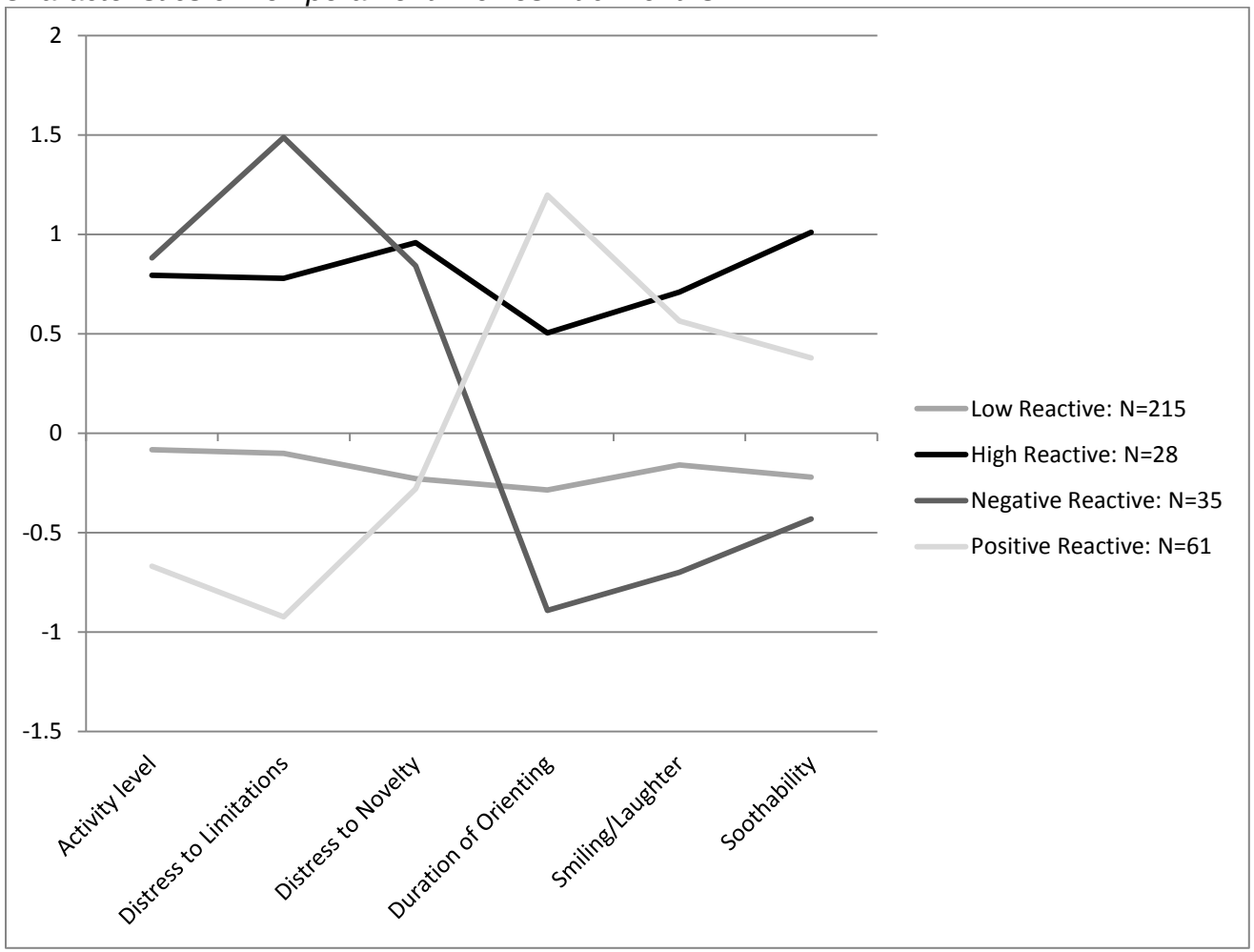


Figure 2.
Characteristics of Temperament Profiles at 18 Months

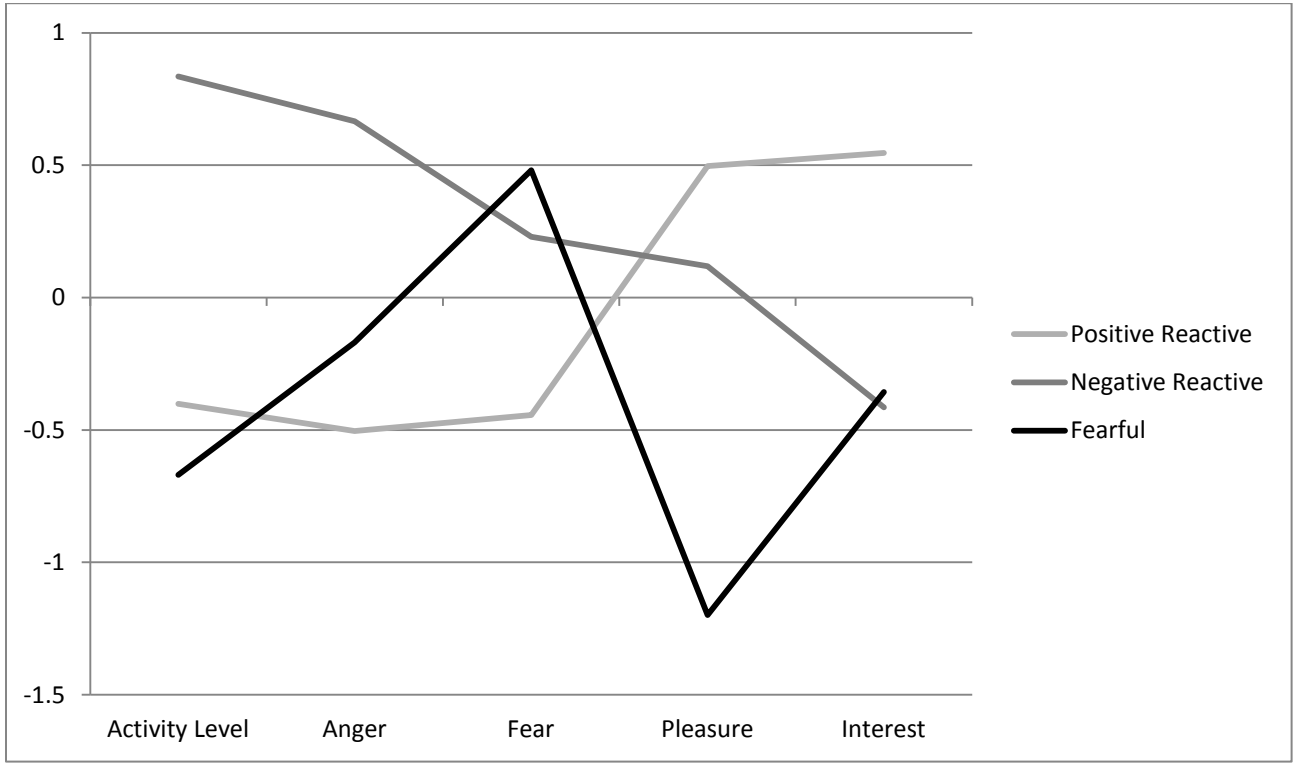


Figure 3.
Characteristics of Temperament Profiles at 27 Months

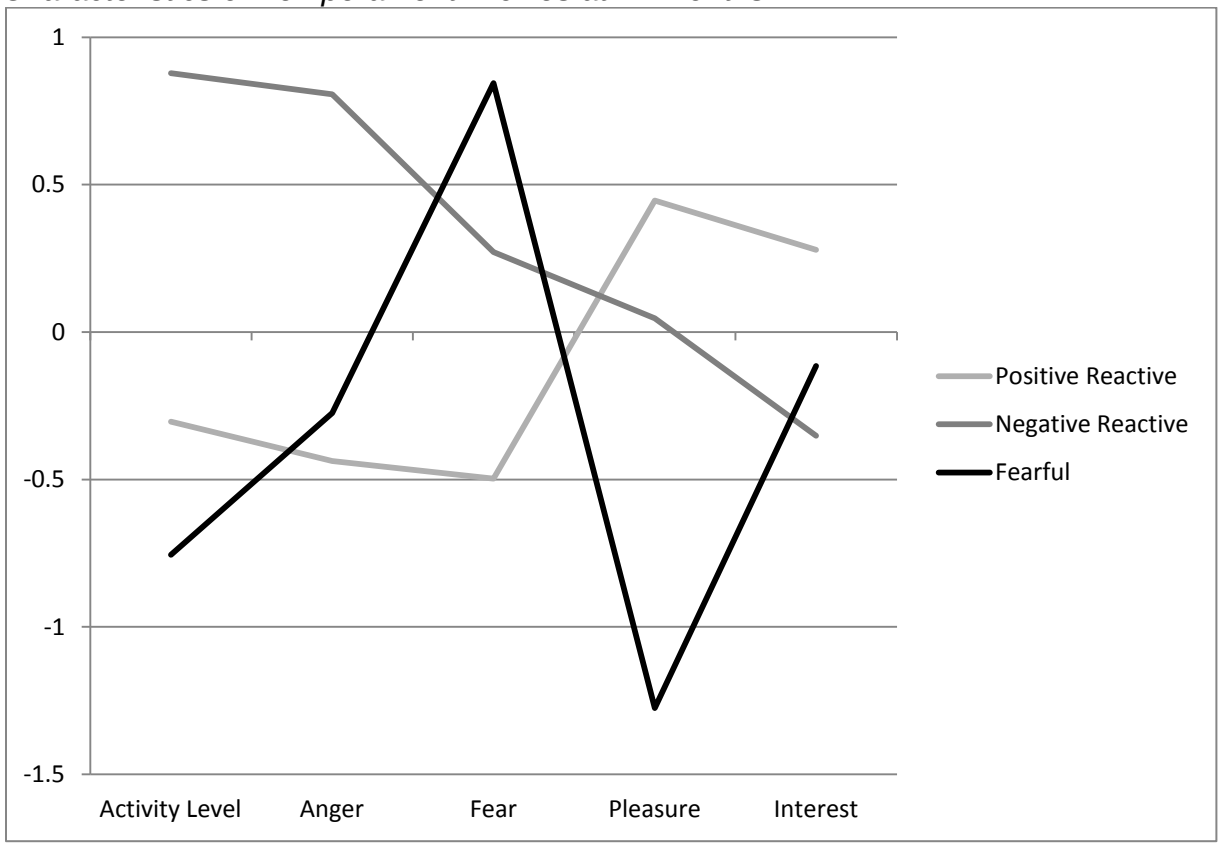
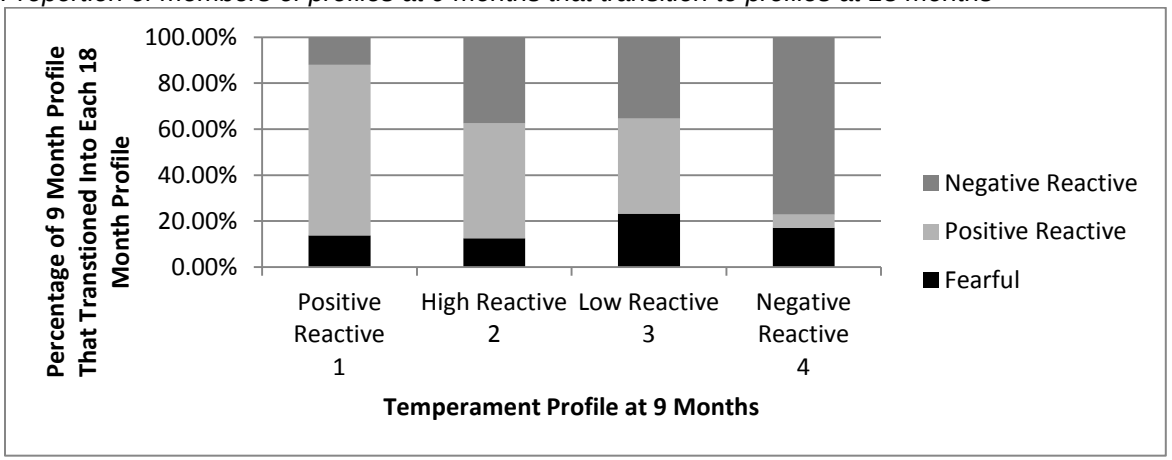


Figure 4.

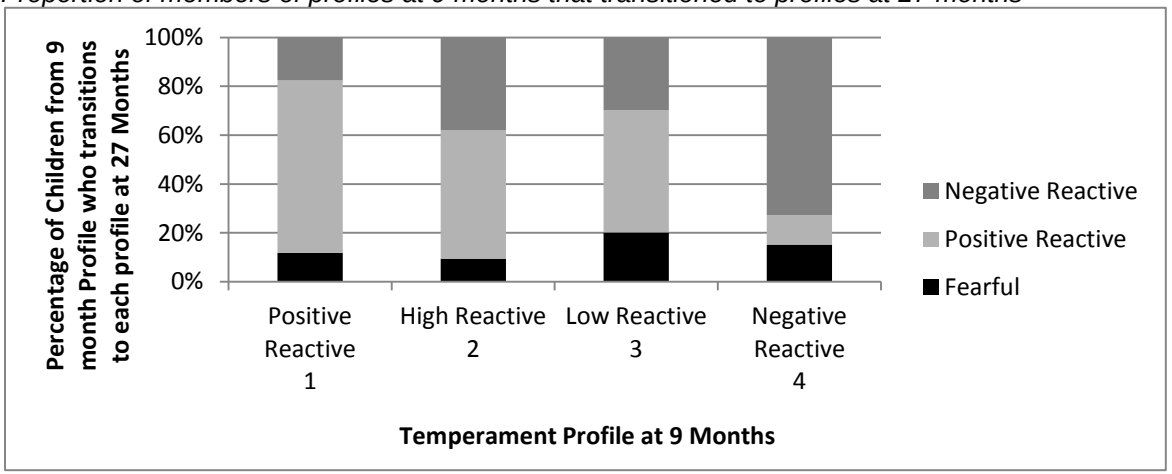
Panel A.

Proportion of members of profiles at 9 months that transition to profiles at 18 months



Panel B.

Proportion of members of profiles at 9 months that transitioned to profiles at 27 months



Panel C.
Proportion of members of profiles at 18 months that transitioned to profiles at 27 months

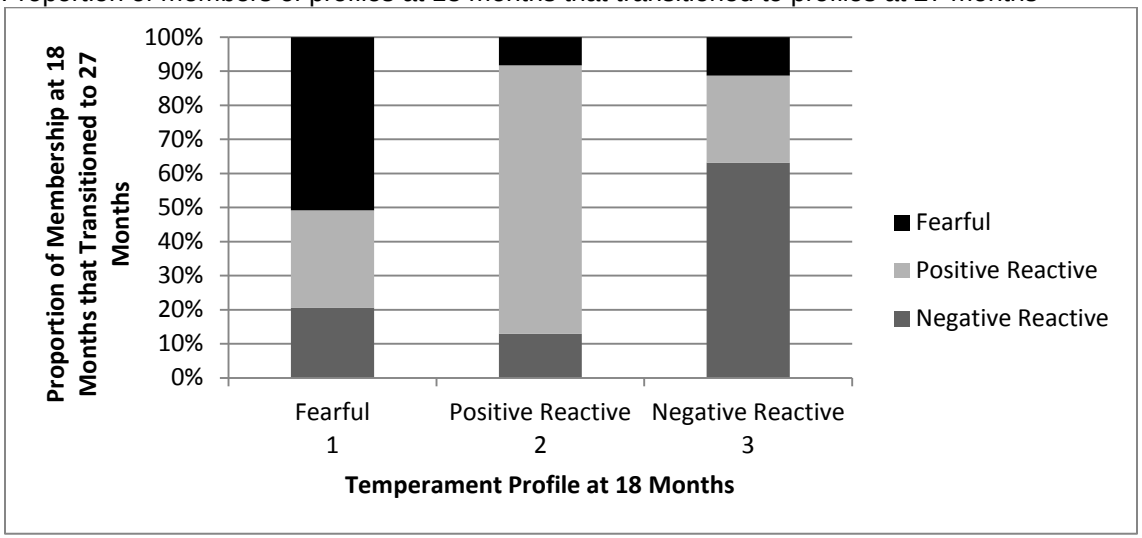
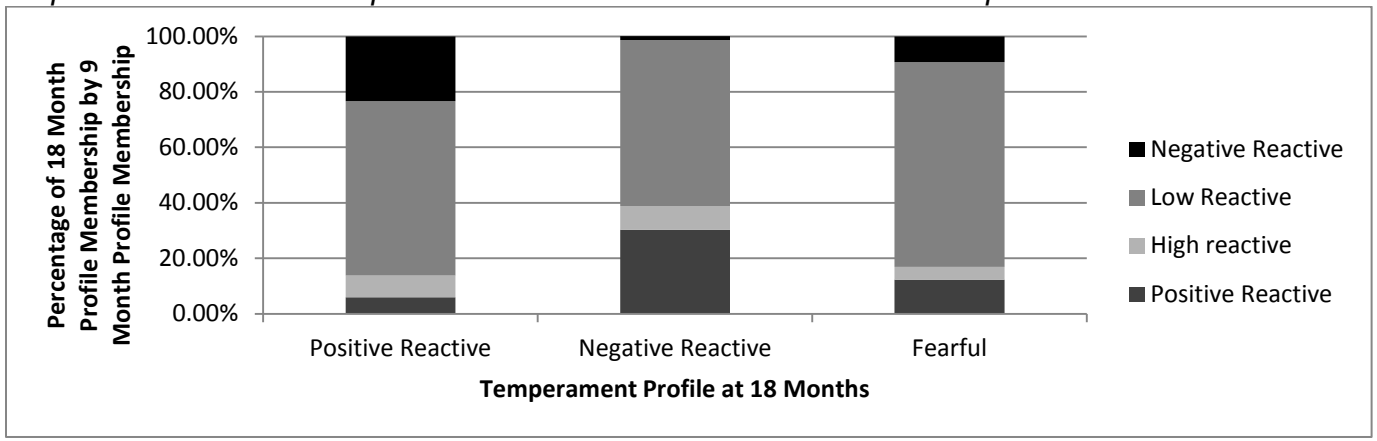


Figure 5.

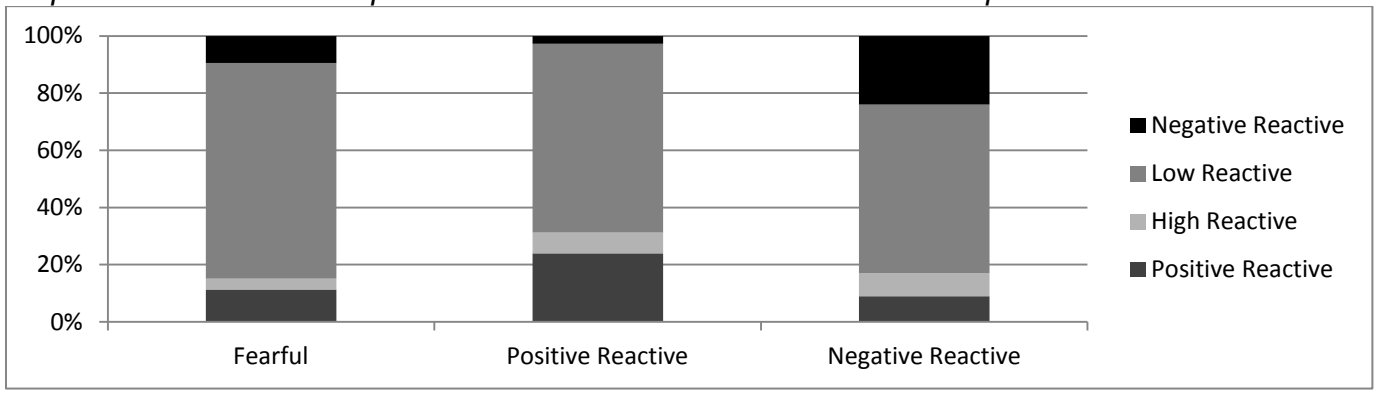
Panel A.

Proportion of members of profiles at 18 months that transitioned from profiles at 9 months



Panel B.

Proportion of members of profiles at 27 months that transitioned from profiles at 9 months



Panel C.

Proportion of members of profiles at 27 months that transitioned from profiles at 18 months