Structure of observed temperament in middle childhood

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Abstract

Although much is known about the structure of adult temperament and personality, significantly less is known about the structure of child temperament. We examined the structure of child temperament in 205 seven-year-olds using observational measures. Exploratory factor analysis identified factors representing positive emotionality/sociability, disinhibition/anger, fear/behavioral inhibition, and sadness. The predictive validity of these dimensions was evaluated by examining their associations with children's internalizing and externalizing symptoms: positive emotionality/sociability showed positive associations with ADHD symptoms, disinhibition/anger showed positive associations with externalizing symptoms, fear/behavioral inhibition showed negative associations with ADHD and CD symptoms, and sadness showed positive associations with both internalizing and externalizing problems. These associations were consistent with extant literature on temperament and psychopathology, supporting the validity of the structure obtained.

Keywords

Middle childhood; Temperament; Developmental psychopathology; Exploratory factor analysis

1. Introduction

A vast body of research has accrued on both the nature and structure of adult personality and temperament.[1] In the 20th century, taxonomies were developed using factor analysis, producing an array of models that differed in terms of the number of core traits identified (e.g., McCrae & Costa, 1997; Tellegen, 1985; Watson & Clark, 1993). However, there is general consensus that these models are not mutually exclusive and that they can be arranged hierarchically (Markon, Krueger, & Watson, 2005). At the broadest level, Markon et al. (2005) and others (e.g., Digman, 1997; Zuckerman, Kuhlman, & Camac, 1988) have

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[1]While temperament and personality were historically considered distinct albeit related constructs, many experts agree that emotional predispositions are central to both domains (Digman, 1994; Watson & Clark, 1993), and that distinctions between the two constructs are less pronounced than previously thought. For example, although heritability estimates tend to differ from sample to sample, estimates ranging from .20 to .60 are generally reported for personality and temperament traits (e.g., Jang, McCrae, Angleitner, Riemann, & Livesley, 1998; Saudino, 2005). Similarly, stability across lifespan and multidimensionality are characteristic of both of these domains (De Pauw & Mervielde, 2010). Hence, we will consider relevant research on both and use the terms interchangeably throughout the current paper.

reduced adult temperament to two superfactors, alpha and beta, with alpha comprised of negative emotionality (NE; with fear, anger, and sadness as the lower-order facets) and disinhibition (versus constraint), and beta comprised of positive emotionality (PE). These are broadly consistent with three-factor temperament models (e.g., Eysenck, 1967; Tellegen, 1985; Watson & Clark, 1993) that identify dimensions capturing individual differences in PE, NE, and disinhibition (i.e., impulsivity). Furthermore, disinhibition can be parsed into the relatively narrow traits of disagreeableness and low conscientiousness, which align with agreeableness and conscientiousness from the Five Factor Model (FFM; Digman, 1990; McCrae & Costa, 1997). Additionally, PE can be separated into two relatively narrow facets that represent extraversion and openness to experience, thus yielding a full FFM (Markon et al., 2005). Numerous studies analyzing an array of measures of adult temperament have yielded findings consistent with this hierarchical structure (DeYoung, 2006; Digman, 1997; McCrae et al., 2008; Zuckerman et al., 1988).

In contrast, much less is known about the structure of child temperament, since structural models of youth temperament have a much shorter history. Contemporary research on child temperament focuses largely on the model of Rothbart (2007), which conceptualizes child temperament as individual differences in emotional reactivity and self-regulation (i.e., the ability to modulate reactive processes). This model is based on factor-analytic studies that derived three broad dimensions of child temperament: extraversion/surgency, negative affectivity and effortful control (EC; Ahadi, Rothbart, & Ye, 1993; Rothbart, Ahadi, Hersey, & Fisher, 2001). Extraversion and negative affectivity reflect the aforementioned reactive dimensions of temperament, whereas EC reflects the regulatory dimension. This model maps well onto various three-factor models of personality based on adult samples (Eysenck, 1967; Tellegen, 1985; Watson & Clark, 1993).

There is also evidence for models of early temperament/personality that map well onto the FFM found in adult samples; for example, (Caspi and Shiner, 2006; Shiner and Caspi, 2012) proposed a hierarchical model encompassing traits from the preschool years into adulthood containing five higher-order dimensions, using FFM labels for temperament and personality. Several researchers have provided evidence for the five-factor structure from parent-report measures in older children and adolescents (e.g., Barbaranelli, Caprara, Rabasca, & Pastorelli, 2003; John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994), teacher-reports (e.g., Barbaranelli et al., 2003; Digman & Shmelyov, 1996; Goldberg, 2001; Graziano &Ward, 1992; Mervielde, Buyst, & De Fruyt, 1995), and self-reports (e.g., Barbaranelli et al., 2003; De Fruyt, Mervielde, Hoekstra, & Rolland, 2000; Markey, Markey, Tinsley, & Ericksen, 2002). Despite several attempts at recovering the same structure in younger samples (e.g., Abe, 2005; Abe & Izard, 1999; Halverson et al., 2003; Tackett, Krueger, Iacono, & McGue, 2008; Tackett, Slobodskaya, et al., 2012), the evidence for a five-factor model is unclear (e.g., De Pauw & Mervielde, 2010; De Pauw, Mervielde, & Van Leeuwen, 2009; Measelle, John, Ablow, Cowan, & Cowan, 2005; Mervielde et al., 1995). Hence, while there is general support for the conceptual similarity of the three- and five-factor adult personality models and traits and those found in younger samples, the extent of this support varies somewhat across child age.

However, an unresolved but potentially important issue in the work on the structure of childrens' individual differences concerns the methods used to gather information on children's temperament. While self-report is the predominant method used in research on adult personality (although see Borkenau, Riemann, Angleitner, and Spinath (2001) and Durbin, Schalet, Hayden, Simpson, and Jordan (2009) for important examples of observational work on adult personality), a diverse array of methods has been used in child temperament research. That being said, the vast majority of research on the structure of child temperament has relied on parent report methods, which yield a number of important

advantages. For example, such methods capitalize on parents' extensive exposure to their children's behavior across diverse settings, and parent reports are affordable, efficient to administer and have reasonable predictive validity for temperament later in childhood (Pauli-Pott, Mertesacker, Bade, Haverkock, & Beckmann, 2003; Rothbart et al., 2001; Rothbart & Bates, 2006). However, parent reports may be subject to mood state and/or availability biases (Durbin, Hayden, Klein, & Olino, 2007; Durbin & Wilson, 2012; Hayden, Durbin, Klein, & Olino, 2010; Rothbart & Bates, 2006), and they have typically shown low convergent validity with teacher reports and observational and laboratory measures (Durbin et al., 2007). Several authors have shown that parents' reports of child behavior are influenced by parents' symptoms and personality traits (De Los Reyes & Kazdin, 2005; Durbin & Wilson, 2012; Youngstrom, Izard, & Ackerman, 1999). Despite being expensive and time-consuming to administer, laboratory measures of child temperament (e.g., Gagne, Van Hulle, Aksan, Essex, & Goldsmith, 2011; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995) have several advantages, such as reducing rater bias through standardized coding procedures, and the use of standardized stimuli facilitating observation of child behaviors that may be present at a lower frequency rates in naturalistic settings (Durbin et al., 2007).

Given the low convergence found between laboratory and parent-report measures of child temperament, it may be the case that the two methods will lead to different conclusions regarding the nature of the structure of child temperament. However, we know of only one study, that of Dyson, Olino, Durbin, Goldsmith, and Klein (2011), that has investigated the structure of observational measures of child temperament. These researchers used a combination of exploratory and confirmatory factor analytic techniques to derive a five-factor model of observed child temperament in 559 preschoolers. The final model showed some overlap with that proposed by Rothbart (2007), in that factors reflecting positive affect/interest, dysphoria, and impulsivity/constraint were extracted, which bear similarity to the extraversion/surgency, negative affectivity, and EC factors from Rothbart's model. However, a fourth factor, sociability, was also derived, which was subsumed within the extraversion/surgency factor in Rothbart's model. Dyson et al. (2011) concluded that some traits such as sociability and positive affect/interest, as well as dysphoria and fear/inhibition, do not coalesce into their respective higher-order factors (extraversion and neuroticism) until later in life.

With these issues in mind, the present study had several goals. First, we aimed to extend the extremely limited extant literature on the nature and structure of observed child temperament. As noted, other than Dyson et al. (2011), we know of no other published research using standardized observations to characterize the structure of child temperament. Dyson and colleagues' findings suggest both similarities and differences in the structure of temperament in young children relative to adult temperament. We extended this work by examining children in middle childhood, thus potentially providing further clues about possible developmental transitions in the structure of temperament. In addition, since there is no consensus on the nature and number of primary temperament traits in childhood, we wanted to make a contribution to identifying these traits based on a method (i.e., observational measures) that may confer some advantages over informant reports.

We did not make specific predictions regarding the number of temperament dimensions we expected to find in our older sample of children for several reasons. While a clear three-factor structure consisting of extraversion/surgency, negative affectivity, and EC has been found in multiple samples of preschoolers based on parent report (Rothbart et al., 2001), the paucity of research using observed methods, and the general lack of research on the nature of temperament in middle childhood, makes formulating a priori hypotheses difficult. Having said that, a small, distinct literature focused on developmental changes in children's

NE (Camras et al., 1998; Izard et al., 1995) led us to tentatively propose that we might find further differentiation of NE in our older sample than Dyson et al. (2011) did in their preschool-aged sample.

Our next goal was to assess the predictive validity of the derived temperament dimensions in our sample. As a key goal of personality research is to predict important behavior and outcomes, models that lack the capacity to do so are limited in value. In light of the large literature relating adult temperament to psychopathology (e.g., Clark, 2005; Fowles & Dindo, 2009; Ready & Clark, 2002), we examined the associations between observational temperament dimensions and internalizing (i.e., depressive and anxious) and externalizing child symptoms (i.e., symptoms of Attention Deficit/Hyperactivity Disorder; ADHD, oppositional defiant disorder; ODD, and conduct disorder; CD). Based on the previous work implicating NE as a broad risk factor for psychopathology (e.g., Clark, 2005), we expected to find significant associations between child temperament dimensions related to NE that factor analysis might reveal and both internalizing and externalizing child symptoms. Specifically, we expected an association with any anger-related dimensions that might emerge and externalizing problems (e.g., Kim, Walden, Harris, Karrass, & Catron, 2007; Morris, Silk, Steinberg, Terranova, & Kithakye, 2010; Tackett, Martel, & Kushner, 2012) and sadness and fear-related dimensions and internalizing problems (e.g., Eisenberg et al., 2009; Kagan, 1998). Finally, as per the tripartite model (e.g., Clark, 2005), we expected to see an association between lower levels of any PE-related dimensions that might emerge and child symptoms of depression.

2. Method

2.1. Participants

A community sample of 205 seven-year-old children (46% male, M_{age} = 7.41 years, SD = .30) and their parents (M_{age} mothers = 37.48 years, SD = 8.96; M_{age} fathers = 40.43 years, SD = 11.50) were recruited through a psychology department database, and advertisements placed in local newspapers and online bulletin boards. Child participants were Caucasian (87.80%), Asian (1.95%) or other ethnicity (7.80%); 2.45% of the sample was missing ethnicity data. Approximately half (50.24%) of the families participating reported a family income ranging from $40,000 to $100,000; 26.83% of families reported a family income greater than $100,000, and 15.12% of families reported a family income of less than $40,000; 7.81% of the sample was missing family income data. Our sample characteristics are comparable to data pertaining to race and income reported for the 2006 census for the London, Ontario area from which families were recruited (Statistics Canada, 2008).

2.2. Child temperament assessment

Child temperament was assessed using an hour-long battery of laboratory tasks based on the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith et al., 1995), adapted to be age-appropriate for older children based on pilot testing (e.g., stimuli thought to be more engaging to children in middle childhood were used; tasks designed to be challenging to older children were substituted as appropriate). In support of the validity of these tasks, Durbin et al. (2007) found that temperament ratings based on a similar battery of tasks used with 6-year-olds showed meaningful associations with ratings from the original Lab-TAB at age 3. Tasks were designed to elicit individual differences in PE and NE including sadness, fear, and anger/frustration. Furthermore, tasks simulated naturalistic events likely to be experienced by children in their everyday lives (e.g., being allowed to play with a novel toy, interacting briefly with a stranger, or attempting to complete a frustrating puzzle), and were sequenced such that no episodes presumed to evoke a similar affective response occurred consecutively to minimize carry-over effects. Children were also provided with a short break

between tasks in order to return to a neutral state. Tasks were video-recorded for coding and are described below in the order that they were administered along with the traits they were designed to elicit.

2.2.1. Exploring new objects (fear, PE)—The child was left alone to play freely in room containing several ambiguous or mildly "scary" objects: a cloth tunnel and tent, a remote-controlled spider, a plastic skull covered with a red cloth, a Halloween mask, and a box containing a plastic beating heart and fake spider webs. After 4 min, the experimenter returned and asked the child to approach and touch each object.

2.2.2. Disappointing toy (anger, sadness, PE)—The child was given photographs of an exciting/desirable toy (a remote-controlled race car) and of a relatively boring toy (a small plastic doll with unmoving parts) and was told to choose which s/he wanted to play with. Next, the child was told that the requested toy was lost and was given the non-preferred toy to play with. Following a short delay, the desirable toy was given to the child.

2.2.3. Stranger approach (fear)—The child was left alone in the main experimental area to play with a toy golf set. Following a short delay, a friendly male research assistant entered the room. The stranger attempted to engage the child following a scripted set of prompts and gradually approached the child. The experimenter then returned and introduced the stranger as her friend.

2.2.4. Frustrating puzzle (anger, sadness)—The child was left alone to complete a puzzle that the experimenter said was easy but actually contained pieces that would not fit together. After 3 min, the experimenter returned and explained that she had made a mistake and had given the child the wrong pieces. The child was then given the correct pieces and allowed to complete the puzzle.

2.2.5. Practical joke (PE)—The experimenter showed the child how to use a remote-controlled whoopee cushion, and the child was invited to surprise his/her parent with the toy when they sat in a chair in the experimental room.

2.2.6. Object fear (fear, behavioral inhibition; BI)—The child was shown a pet carrier and told that it contained "something scary." The child was instructed to look inside and subsequently left alone in the room. If the child did not look inside the carrier after 1 min, the experimenter returned and showed him/her that the carrier actually contained a stuffed toy animal.

2.2.7. Toy parade (PE)—The child was given a bell and told that each time they rang it, a research assistant would bring them a new toy, but that they would have to trade in the toy they had for the new toy. Toys were intended to be fun and included Mr. Potato Head, a Fun Hop, a Gearation Toy, a floor piano and guitar, and legos.

2.3. Coding procedures

Undergraduate, post-baccalaureate, and graduate student raters blind to other study data coded all laboratory episodes for affect and behavior. As part of the training process, raters coded individual episodes with a trained " master" coder. Trainees then coded sets of 10–15 episodes independently until they were able to code episodes with a minimum ICC = .80. Ongoing reliability checks were done to maintain minimum inter-rater reliability (all ICCs exceeded .80) for all episodes.

Each instance of facial, bodily, and vocal positive affect, fear, sadness, and anger exhibited by children in each episode was rated on a three-point scale as low, moderate, or high. The number of instances of moderate and high behaviors were weighted to account for their greater intensity (e.g., *N* of moderate intensity smiles * 2; *N* of high intensity vocal sadness * 3). After weighting, the total numbers of low, moderate, and high intensity behaviors were summed separately within each channel (facial, bodily, vocal) across the seven episodes. Temperament scale internal consistencies, indexed by Cronbach's , were generally moderate, although some were poor: facial positive affect (PA) = .73, vocal PA = .82, bodily PA = .67, facial anger = .58, vocal anger = .71, bodily anger = .48, facial fear = .47, vocal fear = .44, bodily fear = .46, facial sadness = .53, vocal sadness = .53, and bodily sadness = .34. As indicated in the description of the episodes provided above, not all of them were equally likely to elicit the display of each type of affect equally, thus, contributing to some of the lower reliability statistics. At the same time, since temperament reflects individual differences across a variety of contexts, we decided against reducing the episodes to solely the highly potent ones. Finally, these internal consistency statistics are similar to those reported in other studies using laboratory measures of temperament (e.g., Dougherty et al., 2011; Durbin, Klein, Hayden, Buckley, & Moerk, 2005; Durbin et al., 2007).

In addition to affective codes, a single rating on a three-point scale (low, moderate, and high) was made for each of the following behavioral variables per episode: activity level/ vigor, compliance, sociability, and impulsivity. These global ratings were then added across episodes to derive scores for each of the behavioral variables. Activity level/vigor (= .81) was based on the quantity and quality of movement and the level of vigor exhibited in manipulating stimuli in each episode. Compliance (= .58) was based on the amount of "rule-breaking" behaviors, the persistence of the noncompliance, and the degree to which these behaviors were judged to reflect an intentional unwillingness to comply with the experimenter's suggestions or requests. Sociability (= .87) was based on the quality and quantity of the child's interactions with experimenter and/or parent. Impulsivity (= .77) was based on the child's tendency to respond and/or act without reflection.

The object fear episode was designed specifically for the purposes of eliciting child behavior relevant to BI. While BI shows conceptual overlap with fear, previous work indicates that the two are only moderately correlated (i.e., values ranging from .20 to .50; Durbin et al., 2005; Dyson, Klein, Olino, Dougherty, & Durbin, 2011) and can hence likely be viewed as related but distinct constructs. Facial, vocal, and bodily fear codes from this episode were not used in order to eliminate overlap between children's BI and fear scores, and the episode was coded for BI as described below.

To assess behavioral components of BI, latencies to approach, touch, and look at lab stimuli were coded, as well as withdrawal attempts (attempts to leave the room or withdraw from lab stimuli). Tentativeness in interacting with novel stimuli was rated on a 4-point scale (0–3). Reverse coding of variables was used as needed (e.g. longer latencies to touch objects were coded to reflect greater BI). As with the affect coding, post-baccalaureate, and graduate student raters blind to other study data coded all videos, and ongoing reliability checks were done to maintain minimum interrater reliability (minimum ICC = .80) for all episodes. Since variables comprising the BI composite were measured on different scales, they were transformed into *z*-scores before creating an aggregate. The internal consistency of the BI scale was high (= .95).

Log (base 10) transformations were applied to the PA (vocal and bodily), fear (facial, vocal, and bodily), sadness (facial, vocal, and bodily), anger (facial, vocal, and bodily), and impulsivity scales to reduce skewness and kurtosis.

2.4. Children's internalizing and externalizing symptoms

Following the laboratory assessment, a home visit took place with each family an average of 40.02 days (SD = 29.65) later. During the home visit, mothers and fathers completed a measure of children's symptoms of psychopathology, the Child Behavior Checklist/4–18, (CBCL, Achenbach, 1991).

The Child Behavior Checklist (CBCL 4/18; Achenbach, 1991) is a widely used measure designed to identify social, emotional, and behavioral problems in children, and was used as a measure of child psychopathology. Traditional scoring of the CBCL yields standard scores for eight empirically derived problem areas as well as three composite scores assessing overall Internalizing, Externalizing, and Total Problems (Achenbach, 1991). Although such scales differentiate between clinical and nonclinical samples (e.g., Achenbach, 1991; Rishel, Greeno, Marcus, Shear, & Anderson, 2005), they are less useful for differentiating between specific subtypes of dimensions of internalizing and externalizing problems (Lengua, Sadowski, Friedrich, & Fisher, 2001). Therefore, alternative scale scores derived to be consistent with DSM-IV diagnostic criteria for anxiety and depressive disorders, ADHD, ODD, and CD were used (Lengua et al., 2001). The internal consistencies of the Lengua anxiety ($_{mother}$ = .69; $_{father}$ = .52), depression ($_{mother}$ = .64; $_{father}$ = .59), ADHD scale ($_{mother}$ = .81; $_{father}$ = .77), ODD ($_{mother}$ = .67; $_{father}$ = .67), and CD ($_{mother}$ = .78; $_{father}$ = .76) were moderate. The internal consistency statistics for the internalizing scales were slightly lower than the ones initially reported by Lengua et al. (2001). Average scores for anxiety, depression, ADHD, ODD, and CD were low (see Table 3) and consistent with published means reported for a community sample (Lengua et al., 2001). Correlations between mother and father CBCL symptom reports were as follows: r = .34, (depression), r = .34 (anxiety), r = .61 (ADHD), r = .57 (ODD), and r = .59 (CD), all of which were significant at p < .001. The magnitude of these is consistent with those the extant literature (e.g., Grigorenko, Geiser, Slobodskaya, & Francis, 2010; Schroeder, Hood, & Hughes, 2010).

2.5. Data analytic plan

Since our sample size was smaller, we were unable to use the same procedures as Dyson et al. (2011), who used half their sample for exploratory factor analysis (EFA) and the other half for confirmatory factor analysis (CFA). Therefore, we instead performed an EFA with a Varimax rotation[2] and maximum-likelihood estimation procedure using Mplus6 statistical software package (Muthen & Muthen, 1998–2013). In evaluating models, we applied a number of considerations. First, we considered variables meaningful when their factor loadings exceeded .30 (Floyd & Wildman, 1995). Also, the acceptability of the EFA factor solution was evaluated against the following criteria for factor retention: (a) eigenvalue >1.00 rule (Kaiser–Guttman criterion); (b) screen test (Gorsuch, 1983); (c) the configuration accounted for at least 50% of the total variance (Streiner, 1994); (d) at least three variables per factor (Anderson & Rubin, 1956; Comrey, 1988); (e) the root-mean-square error (RMSEA; Steiger & Lind, 1980). More conventional goodness-of-fit criteria suggest that values between .06 and .08 for the RMSEA indicate a good model fit (e.g., Hu & Bentler, 1999). However, it has been noted that traditional goodness-of-fit indices are not absolute cutoffs to be used as "golden rules" irrespective of research area, but rather, these should be regarded as rough guidelines, applied cautiously and thoughtfully in combination with other features of the data (Marsh, Hau, & Wen, 2004; Marsh et al., 2010).

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[2]Based on Fabrigar, Wegener, MacCallum, and Strahan (1999) as well as Russell (2002), we provide an additional set of results using an oblique (oblimin) rotation in tables available as an Online supplement (Tables 2A–2C). The results of this rotation are virtually identical to those reported in the present manuscript, derived from an orthogonal rotation.

3. Results

3.1. Bivariate correlations

Two participants were excluded due to missing data on all observation variables, resulting in a sample of 203 participants with complete data. Table 1 displays bivariate correlations between the observed variables. Significant correlations were found between facial, vocal, and bodily affective expressions within each affective category (i.e., PA, anger, sadness, and fear). In addition, sociability, activity and impulsivity showed significant positive correlations with both PA and anger facets, while compliance was strongly negatively associated with anger facets, activity, impulsivity, and sociability. BI showed significant associations with all fear modalities. In general, this pattern of associations between emotion expression and behavior showed both similarities and differences to that reported by Gagne et al. (2011). They observed similar positive associations between positive expression and anger, as well as sadness and fear; similar to our sociability and activity scales, their approach and active engagement scales showed positive associations with anger and positive expression. However, unlike the positive association between fear and BI found in our sample, shyness was unrelated to fear in Gagne and colleagues' sample.

3.2. Exploratory factor analyses

A four-factor solution presented in Table 2 and consisting of PE/sociability (PE/Soc), disinhibition/anger (Dis/Anger), fear/BI, and low sadness (the loadings for the sadness facets were negative) was deemed to be the most appropriate for our data. Despite the fact that the five-factor solution appeared as a potential fit to our data (five factors had eigenvalues >1; percentage of variance accounted for = 48%; RMSEA = .07), this structure was inadmissible due to the negative estimated error variance for laboratory activity; some of the factor loadings were also difficult to interpret (e.g., factor having a single observed indicator with a loading >.30). The four-factor solution consisting of PE/Soc (eigenvalue = 4.63), Dis/Anger (eigenvalue = 2.06), fear/BI (eigenvalue = 1.69), sadness (eigenvalue = 1.34) accounted for 43% of the variance and had a RMSEA of 0.08. All factor loadings, except for facial anger on Dis/Anger, exceeded .30. Fear/BI and sadness had variables that loaded only onto these factors, while PE/Soc and Dis/Anger had three laboratory variables (activity, impulsivity, and sociability) cross load at >.30 on both of these factors. These cross loadings are consistent with some models of temperament that include activity level as part of an Extraversion/Surgency/PA factor (e.g., Caspi & Shiner, 2006; Kochanska, Aksan, Penney, & Doobay, 2007; Rothbart et al., 2001) and other models suggesting that activity level is closely linked to high impulsivity or disinhibition (Abe, 2005; Buss, Block & Block, 1980; Digman, 1990; Prior, 1992; Whiteside & Lynam, 2001).

3.3. Predictive validity of observed temperament factor scores

Temperament factor scores were calculated as aggregates of observed indicators identified in the model (see Table 2). To equilibrate the means and variances in the observed indicators, the observed variables were standardized (*z*-transformed) and weighted aggregates of these indicators were calculated within each factor based on the EFA solution provided in Table 2. We also reverse coded the sadness factor in order to increase the interpretability of its associations with symptoms. Correlations between these newly derived temperament scores and mother- and father-reported child symptoms as measured by the CBCL (Lengua scales for depression, anxiety, ADHD, ODD, and CD) are presented in Table 3.[3]

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[3]Table 3A in the Online supplement provides correlations between the factor scores from the solution with an oblique (oblimin) rotation and child symptoms; the results are virtually identical to the ones reported here.

The pattern of results was similar across both mother and father reports of child symptoms; however, minor differences emerged as well. Temperamental sadness showed significant positive associations with symptoms of mother- and father-reported child depression and ADHD, and only father-reported symptoms of anxiety, ODD, and CD. Fear/BI also showed significant negative associations with maternal reports of ADHD and CD symptoms. Dis/Anger showed significant, positive associations with mother and father-reported child ADHD, ODD, and CD symptoms. PE/Soc was significantly, positively associated with mother and father-reported child symptoms of ADHD, which is likely due to the significant loading of laboratory-assessed activity on the PE/Soc factor.

4. Discussion

We extended the very limited work on the structure of observed child temperament by examining the structure of observational measures of child temperament in middle childhood. Findings suggested a four-factor structure of observed temperament in this age group, comprised of PE/Soc, Dis/Anger, fear/BI, and sadness, while the latter two factors showed a clear structure, several variables loaded on both PE/Soc and Dis/Anger. Overall, both our model and that of Dyson et al. (2011) show some resemblance to the hierarchy of adult models of temperament described by Markon et al. (2005). All these models are characterized by presence of a PE/extraversion-related factor, a disinhibition factor, and a NE factor, which appears as a combination of fear and sadness or sadness/anger factors. Thus, the small literature examining the structure of observational measures of temperament provides some support for the developmental continuity of temperament/personality over time.

However, our findings yielded both similarities and differences to the model derived for preschoolers by Dyson et al. (2011). Some of these differences may have to do with developmental changes in child temperament, while others may have occurred due to differences in samples and assessment strategies. Both Dyson and colleagues' model and ours have a factor that reflects PE, consistent with virtually all major models of child and adult temperament (e.g., Buss & Plomin, 1984; Clark & Watson, 1999; McCrae & Costa, 1997). It is also worth noting that our model is consistent with factor analyses of informant-reports indicating that activity and impulsivity correlate with positive affect in children in early to middle childhood (e.g., Rothbart et al., 2001; Simonds & Rothbart, 2004). Similar to Dyson and colleagues' model, our PE/Soc factor showed an overlap with the Dis/Anger factor, driven by the cross loadings of activity, impulsivity, and sociability on both of these factors in both models. This is consistent with the literature that considers anger, impulsivity and sensation seeking to be significantly related to PE and extraversion (e.g., Depue & Collins, 1999; Eysenck & Eysenck, 1985; Putnam, 2012; Zuckerman, 1994). For example, Putnam (2012) suggests that despite the differences in valence, PE/extraversion and anger frequently show positive associations due to both being approach behaviors. Overall, there are a number of similarities between our structure and the one reported by Dyson et al. (2011) in the sample of preschoolers.

However, there were also differences between our model and that of Dyson et al. (2011). In particular, Dyson and colleagues extracted another factor, sociability, which is frequently associated with extraversion. In their study, this factor included initiative, sociability, and dominance ratings, some of which were codes not available in the present study. Thus, the use of multiple sociability indicators may have led to the emergence of a separate sociability factor in the Dyson et al. study. We found that sociability ratings loaded together with PE in our model, consistent with models positing that extraversion leads to higher levels of PE through increased social contact (Eysenck & Eysenck, 1985; Lucas, Le, & Dyrenforth, 2008; Pavot, Diener, & Fujita, 1990). We also failed to extract a clear factor related to EC,

although our Dis/Anger factor subsumed some of the EC-related traits, such as compliance (reversed) and impulsivity. However, the lack of emergence of a clear EC factor is likely due to the fact that our battery did not incorporate specific tasks that were designed to elicit this trait. For example, with younger children, tasks which entail children waiting to take his/her turn in a game or to receive a piece of candy are frequently used (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). We did not include such episodes in the present study as observational tasks of this nature have not been developed that are developmentally appropriate for older children (i.e., well-validated tasks designed to tap EC have been designed for use with children ages 6 and younger; Kochanska, Murray, & Coy, 1997; Kochanska et al., 1996).

Finally, Dyson et al. (2011) found that their model had the best fit when anger and sadness were combined into one factor, which they labeled dysphoria, while in our study, anger and sadness separated into two factors. Dyson et al. (2011) hypothesized that as children get older, anger, sadness, and fear would coalesce into a factor resembling NE in adults. However, in our study we found evidence of further bifurcation of NE into three separate factors which was consistent with our predictions based on studies showing increased differentiation of NE across development (Camras et al., 1998; Izard et al., 1995). More research is required on the nature of processes associated with emotion expression that take place in the time period from early to middle childhood. Overall, the structure of individual differences from ages 3 to 8 may vary due to rapid and wide-ranging developmental changes (Caspi, Roberts, & Shiner, 2005). To our knowledge, no study has investigated the underlying structure of observational measures of adult temperament; thus, it is possible that such observational studies might reveal more differentiation among facets of NE in adulthood.

We further attempted to validate our model results by examining associations between our derived temperament scores and child symptoms reported by parents. Overall, our findings were fairly consistent with the extant literature based on parent reports of temperament. Consistent with the notion that facets of NE are linked to both internalizing and externalizing symptoms (Clark, 2005), we found that sadness was related to both of these dimensions. We found that lower levels of fear/BI were associated with higher levels of maternal reports of child ADHD and CD symptoms, which is consistent with the suggestion that children lower in fear/BI exhibit consistently fearless, sociable, and uninhibited profile (Kagan, 2012; Putnam, 2012), as well as with models suggesting that disruptive children tend to exhibit low fear of punishment and physiological underactivity (e.g., Cloninger, 1987, 1994; van Goozen & Fairchild, 2006). We also found that our Dis/Anger factor was positively related to parental reports of children's ADHD, ODD, and CD symptoms, consistent with the literature suggesting that anger is an especially important temperamental characteristic with respect to externalizing problems (e.g., Kim et al., 2007; Morris et al., 2010; Tackett et al., 2012). Finally, we also found a positive association between PE and ADHD symptoms, likely because laboratory measures of activity and impulsivity loaded together with various aspects of PE. This finding is consistent with a number of accounts of the role of emotion and activity in childhood; for example, both Putnam (2012) and Tackett et al. (2012) discuss the positive associations between PE and higher levels of activity, and Martel (2009) recently suggested that emotion dysregulation lies at the core of ADHD symptoms. Surprisingly, we did not observe an association between observed PE and depression as would be expected based on the tripartite model (Clark & Watson, 1999). While examining interactions between PE and other temperament traits was beyond the scope of the present study, low PE may be related to risk for depression depending on the level of other temperamental factors (e.g., Olino, Klein, Dyson, Rose, & Durbin, 2010).

Our study has a number of strengths. For example, to our knowledge, this is the first study to examine the structure of observed temperament in middle childhood. We assessed a fairly large community sample of youth using observational measures of child temperament, which may have important advantages over informant-reports, including the use of standardized stimuli, standardized coding procedures that minimize rater bias, and observation of child behaviors that may be present at a lower rate in naturalistic settings (Durbin et al., 2007). We found associations between our newly derived observed temperament factor scores and child symptoms that were generally consistent with those reported to date in the literature, which are largely based on parent-report methods. This latter contribution is a key strength of our paper, as structural investigations of temperament and personality do not always seek to tie their findings to important outcomes that should be linked to individual difference factors. However, our study also had some limitations. The smaller sample size in our study did not allow a combination of exploratory and confirmatory factor analytic techniques in identifying the underlying factor structure. Finally, despite the significant advantages offered by the observational measures of temperament, some concerns have also been raised with regards to eliciting a representative sample of children's affective states (PE in particular; Gartstein, Bridgett, & Low, 2012; Goldsmith & Gagne, 2012). Also, some of the internal consistency estimates of the observed temperament indicators used in our CFA were rather low.

To conclude, we examined a structure of observed temperament in large sample of school-aged children, finding a four-factor solution consisting of PE/Soc, Dis/Anger, sadness (reversed), and fear/BI factors. We further related these factors to parental reports of child symptoms which yielded a pattern of correlations that is consistent with extant theory (e.g., Clark, 2005) and prior research (Eisenberg et al., 2009; Gomez & Corr, 2010; Rothbart & Bates, 2006; Tackett et al., 2012).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Bivariate correlations between observed temperament scales.

	FPA	VPA	BPA	FA	VA	BA	FSad	VSad	BSad	FFear	VFear	BFear	OFBI	Soc	Activ	Imp	Compl
FPA	–	.58**	.43**	-.01	.08	.04	-.12	.08	-.01	-.02	.10	-.08	-.09	.59**	.44**	.24**	-.09
VPA		–	.57**	.07	.31**	.20**	-.10	.28**	-.01	-.07	.19**	-.12	-.04	.70**	.58**	.43**	-.25**
BPA			–	.06	.14*	.19**	-.11	.14	-.06	-.05	.08	-.11	-.16*	.45**	.64**	.50**	-.17*
FA				–	.13	.22**	.13	.17*	.05	.19**	.14	.08	-.05	.14*	.19*	.05	-.07
VA					–	.50**	.02	.29**	.12	.03	.13	-.18**	-.08	.34**	.39**	.53**	-.32**
BA						–	-.03	.19**	-.02	-.02	.06	-.27**	-.18*	.24**	.47**	.57**	-.28**
FSad							–	.23**	.44**	.10	.05	.04	.15*	-.02	-.16*	-.08	.03
VSad								–	.37**	.01	.20**	-.05	-.10	.35**	.30**	.19**	-.20**
BSad									–	-.01	.17*	.14*	.08	.01	-.08	-.01	.09
FFear										–	.23**	.24**	.12	.02	.02	-.11	-.01
VFear											–	.22**	.17*	.19**	.10	.05	-.08
BFear												–	.28**	-.24**	-.38**	-.37**	.13
OFBI													–	-.05	-.27**	-.17*	.01
Soc														–	.66**	.51**	-.33**
Activ															–	.69**	-.31**
Imp																–	-.43**
M	5.85	.40	.15	.19	.05	.08	.12	.11	.15	.09	.04	.24	.00	1.87	1.75	.09	1.83
SD	2.65	.21	.13	.12	.08	.09	.09	.08	.10	.09	.06	.14	.72	.72	.57	.11	.21

Note. FPA, VPA, BPA – facial, vocal, and bodily positive affect, Soc – sociability, Activ – activity, Imp – impulsivity, FA, VA, BA – facial, vocal, and bodily anger, Compl – compliance, FSad, VSad, BSad – facial, vocal, and bodily sadness, FFear, VFear, BFear – facial, vocal, and bodily fear, OFBI – BI measured in object fear episode.

*
$p < .05$

**
$p < .01$.

Table 2

EFA results: Varimax rotated observed factor loadings.

Laboratory variable	PE/Soc	Dis/Anger	Fear/BI	Sadness
FPA	**.74**	−.04	−.02	.03
VPA	**.79**	.21	.06	−.04
BPA	**.62**	.26	−.10	.10
FFear	−.03	.06	**.44**	.03
VFear	.16	.11	**.48**	−.15
BFear	−.13	**−.31**	**.54**	−.05
FSad	−.13	−.02	.09	**−.55**
VSad	.24	.27	.08	**−.50**
BSad	−.02	−.02	.07	**−.74**
FA	.05	**.24**	.23	−.09
VA	.14	**.63**	.04	−.17
BA	.05	**.73**	−.09	−.01
Activ	**.64**	**.58**	−.16	.06
Imp	**.37**	**.73**	−.22	.01
Compl	−.18	**−.44**	−.05	−.03
OFBI	−.08	−.17	.37	−.09
Soc	.77	**.32**	.03	−.10

Note. FPA, VPA, BPA – facial, vocal, and bodily positive affect, Soc – sociability, Activ – activity, Imp – impulsivity, FA, VA, BA – facial, vocal, and bodily anger, Compl – compliance, FSad, VSad, BSad – facial, vocal, and bodily sadness, FFear, VFear, BFear – facial, vocal, and bodily fear, BI – BI measured in object fear episode; Soc/PE – sociability/PE factor, Dis/Anger – disinhibition/anger factor; Laboratory variables that had loadings >.30 on more than one factor are highlighted and underlined; loadings for the sadness facets were negative.

Table 3

Correlations between observed temperament factor scores and parent-reported child internalizing and externalizing symptoms.

	PE/Soc	Dis/Anger	Fear/BI	Sadness	M	SD
MDep	.03	.03	.05	−.13†	1.38	1.87
FDep	.02	.05	.13	.16*	1.00	1.50
Manx	−.03	.01	.10	.10	1.49	1.87
FAnx	−.09	−.02	.07	.14†	1.12	1.39
MADHD	.23**	.30**	−.12†	.14†	1.38	1.56
FADHD	.15*	.23**	−.07	.28**	1.50	1.53
MODD	.08	.13†	.02	.10	1.96	1.56
FODD	.10	.17*	−.03	.27**	1.70	1.54
MCD	.07	.18*	−.18*	.08	1.55	2.40
FCD	.07	.16*	−.07	.17*	1.37	2.10

Note. MDep and FDep – mother and father-reported child depressive symptoms measured by the CBCL Lengua scale; Manx and Fanx – mother and father-reported child anxiety symptoms measured by the CBCL Lengua scale; MADHD and FADHD – mother and father-reported child ADHD symptoms measured by the CBCL Lengua scale; MODD and FODD – mother and father-reported child ODD symptoms measured by the CBCL Lengua scale; MCD and FCD – mother and father-reported child CD symptoms measured by the CBCL Lengua scale.

Temperament factor scores were computed by *z*-score transforming the observed variables and computing their weighted aggregate based on the EFA results provided in Table. 2; sadness factor was reversed scored to improve interpretability of the correlations.

†
$p < .10$

*
$p < .05$

**
$p < .01$