J Autism Dev Disord (2011) 41:196–212
DOI 10.1007/s10803-010-1043-6

ORIGINAL PAPER

How Temperament and Personality Contribute to the Maladjustment of Children With Autism

Sarah S. W. De Pauw · Ivan Mervielde · Karla G. Van Leeuwen · Barbara J. De Clercq

Published online: 5 June 2010

Abstract To test the spectrum hypothesis—postulating that clinical and non-clinical samples are primarily differentiated by mean-level differences—, this study evaluates differences in parent-rated temperament, personality and maladjustment among a low-symptom ($N = 81$), a high-symptom ($N = 94$) ASD-group, and a comparison group ($N = 500$). These classic spectrum hypothesis tests are extended by adding tests for similarity in variances, reliabilities and patterns of covariation between relevant variables. Children with ASD exhibit more extreme means, except for dominance. The low- and high-symptom ASD-groups are primarily differentiated by mean sociability and internal distress. Striking similarities in reliability and pattern of covariation of variables suggest that comparable processes link traits to maladaptation in low- and high-symptom children with ASD and in children with and without autism.

Keywords Autism · Temperament · Personality · Problem behavior · Maladjustment · Spectrum hypothesis

Introduction

Recent research increasingly suggests that the study of temperament and personality traits could significantly advance our understanding of the large heterogeneity within the autism phenotype (Eaves et al. 1994; Garon et al. 2009; Hepburn and Stone 2006; Ozonoff et al. 2005; Schwartz et al. 2009; Wing 1997). Temperament and personality measures, frequently used in developmental and clinical practice, assess multiple normally distributed dimensions of behavioral individuality within the general population. These individual differences are defined as constitutionally based tendencies in thoughts, behaviors, and emotions that surface early in life, are relatively stable and follow intrinsic paths of development basically independent of environmental influences (Caspi and Shiner 2006; McCrae et al. 2000; Rothbart et al. 2000).

Given their early appearance (Rothbart and Bates 2006) and long-term stability (Caspi et al. 2005; Roberts and DelVecchio 2000), it is not surprising that there is growing interest to describe, measure and assess the scope and impact of traits in autism. In recent years, we have witnessed a steady increase in the search for distinct trait profiles associated with autism spectrum disorders. Identifying such profiles may eventually provide 'red flag' indicators on standard assessment tools and alert general practitioners and clinicians for autism-related deficits. Trait profiles gain importance for early diagnosis of autism in infancy and early childhood (e.g., Garon et al. 2009; Zwaigenbaum et al. 2005), lifetime assessment of older age groups, particularly in higher functioning individuals (e.g., Anckarsater et al. 2006; Hepburn and Stone 2006; Konstantareas and Stewart 2006; Ozonoff et al. 2005; Schwartz et al. 2009), and for distinguishing autism from other developmental conditions (e.g., Bailey et al. 2000; Ratekin 1993).

Many theorists suggest that individual differences in temperament and personality could also help to explain why only part of the children with ASD develop emotional

S. S. W. De Pauw (✉) · I. Mervielde · B. J. De Clercq
Department of Developmental, Personality and Social Psychology, Ghent University, Henri Dunantlaan 2, 9000 Ghent, Belgium
e-mail: Sarah.DePauw@UGent.be

K. G. Van Leeuwen
Centre for Parenting, Child Welfare and Disabilities, Catholic University Leuven, Andreas Vesaliusstraat 2, 3000 Louvain, Belgium

or behavioral problems (Eaves et al. 1994; Hepburn 2003; Leyfer et al. 2006; Wing 1997). This wide range of maladaptive behaviors continues to be an important part of the heterogeneity of the autism phenotype for which the underlying mechanisms remain insufficiently understood (Bryson and Smith 1998). However, compared to the growing literature on all sorts of mean-level differences, surprisingly little research has addressed the role of temperament and personality traits in the maladjustment of children with ASD.

Two fundamental issues limit the expansion of research on the role of traits in the development of problem behaviors of children with ASD. First, researchers wonder whether temperament and personality, as viable concepts for the study of typical development, can be applied to the study of clinical syndromes such as autism. Although—to our knowledge—this concern has not yet been explicitly raised for autism, it has been debated in the research literature on clinical groups, both for adults and youngsters (O'Connor 2002; Shiner and Caspi 2003; Van Leeuwen et al. 2007).

A second major issue is the co-existence of multiple, only partially overlapping multi-trait taxonomies designed for the assessment of individual differences in childhood. This conceptual diversity is exacerbated by the controversy on whether traits are best viewed as *temperament* or *personality*. Historically, temperament and personality have been conceived as quite distinct domains, with temperament referring to more constitutionally based behavioral styles in young children, and personality to more complex psychosocially shaped behavioral and cognitive preferences in adults (Nigg 2006). More recently, this classic bifurcation has been challenged by both empirical and conceptual research, indicating that both temperament and personality concepts validly describe 'endogenous basic tendencies of thoughts, emotions, and behavior' from at least the preschool age onwards (Caspi et al. 2005; De Pauw et al. 2009).

Yet, the exact nature of the convergence among temperament and personality remains essentially unknown because of the lack of empirical studies comparing these multi-trait models. As a result, the integration of research findings across trait models is identified as one of the biggest challenges for modern trait research (Rettew and McKee 2005; Tackett 2006). Moreover, this applies to research on traits in autism as well since this emergent research also assesses a wide range of traits with a variety of instruments based on a diverse set of trait models. To go beyond model-specific inferences, scholars now recommend the simultaneous administration of multiple trait instruments, particularly when studying the associations between traits and problem behavior (De Pauw et al. 2009; Tackett 2006).

The present study systematically addresses these two core issues. First, the generalizability of a trait approach to autism is examined by implementing a recently developed approach to evaluate differences in means, psychometric properties, and the nomological network of variables between clinical and non-clinical groups (Van Leeuwen et al. 2007). Second, traits are comprehensively assessed based on the age-appropriate measures of the Rothbart temperament model (Rothbart and Bates 2006) and a Five-Factor based personality model for children (Mervielde and De Fruyt 2002). Both models can be considered as among the most influential frameworks in contemporary trait research. In what follows, we first introduce the rationale for this new approach and present the limited research focusing on Rothbart's temperament and Five-Factor personality in autism within this new perspective.

An Extended Empirical Test of Differences Between Clinical and Non-Clinical Samples

In children without autism, temperament and personality factors are substantially and differentially linked to problem behaviors (e.g., De Pauw and Mervielde 2010; Mervielde et al. 2005, 2006; Muris and Ollendick 2005; Nigg 2006; Rettew and McKee 2005; Tackett 2006). Moreover, similar trait-maladjustment associations have been highlighted in both clinical and non-clinical samples. Notably, the pattern of these relationships appears to be comparable across both types of samples, even though the strength of the associations tends to be stronger in the clinical samples (e.g., Mervielde et al. 2005, 2006). One remaining and intriguing research question is whether the differences between typical and clinical samples should be conceived as qualitative or quantitative. In recent years, the *spectrum hypothesis* (Shiner and Caspi 2003) rapidly gained recognition as a perspective capturing the complex interplay between normal personality and psychopathological variation in clinical as well as in non-clinical samples (O'Connor 2002; Van Leeuwen et al. 2007). It postulates that the differences between individuals from non-clinical and clinical samples are mainly *quantitative* and hence that both types can be located on the same set of continuous variables with partially overlapping distributions and a different mean. In other words, this implies that both types of samples are primarily differentiated by *mean-level differences*.

Recently, Van Leeuwen et al. (2007) extended the classic version of this spectrum hypothesis by proposing a series of tests that to go beyond the simple test for mean-level differences. They introduced a hierarchical system of levels to test for differences between clinical and non-clinical samples. At Level 1, they compare groups by calculating *means and variances* for relevant variables.

Because similarity of psychometric properties is a prerequisite for a valid interpretation of any mean-level differences, Level 2 comparisons target *psychometric properties* of measures such as reliability and factorial structure. Although most studies comparing groups only rely on Level 1 and some on Level 2 type analyses, a comprehensive test of the spectrum hypothesis should also assess similarities and differences of the *nomological network* (i.e., the pattern of relationships among variables) in clinical and non-clinical samples. This is achieved by Level 3 analyses comparing the *covariation* between relevant variables in both samples.

If tests at each level reveal significant differences, the groups are definitely *qualitatively* different and in effect incomparable, because differences in structure, reliability and the nomological network indicate that the same instrument behaves differently and has a distinct meaning in clinical versus non-clinical samples. If all tests, except those for mean-level effects, fail to show significant differences, we have a pure case for *quantitative* differences and hence the most convincing evidence for the spectrum hypothesis. Of course, most comparisons of groups will reveal a pattern of results that is located in between the opposite poles of this 'qualitative versus quantitative' continuum. In this regard, the successive levels can be seen as more stringent tests of the spectrum hypothesis. For instance, compliance with Level 2 or 3 tests presents a stronger case for spectrum-type differences between groups than the common exclusive focus on Level 1 mean differences.

Evaluating Differences Between Individuals With and Without ASD

The question whether individuals with autism are *quantitatively* or *qualitatively* different from individuals without autism has not yet been formally investigated. The present study adopts the framework proposed by Van Leeuwen et al. (2007) to probe the nature of differences among children with and without autism in terms of temperament, personality and their associations with problem behavior. Moreover, this methodology also provides a tool to further specify the nature of the 'autistic spectrum'. Notably, the term '*spectrum hypothesis*' (Shiner and Caspi 2003), as discussed above, explicitly refers to the comparison of clinical and non-clinical samples as it is described in general psychopathology literature. This type of research developed independently from the '*autistic spectrum hypothesis*' which refers to a continuum reflecting the degree of autistic symptoms (Baron-Cohen 1995; Wing 1997). Analogous to the 'general' spectrum idea, the 'autistic spectrum hypothesis' suggests that individuals exhibiting more autistic symptoms are mainly *quantitatively* but not *qualitatively* different from those with fewer autistic symptoms. Hence, the proposed extended tests of the spectrum hypothesis can also be applied to formally address the '*autistic spectrum*'.

Testing the Spectrum Hypothesis for Traits in Autism: A Review of Prior Research

Level 1: Differences in Means and Variances Between Autism and Non-Autism Groups

Temperament Differences Rothbart's model (Rothbart and Bates 2006) delineates temperamental traits as constitutionally based individual differences in reactivity and self-regulation. Her framework postulates three overarching temperament dimensions—Negative Affect (NA), Surgency (SU), and Effortful Control (EC)—expressed by different behaviors throughout development and therefore measured by age-specific instruments (see Table 1).

Up till now, five studies analyzed differences between youngsters with and without autism on these trait dimensions. Three studies (Janes 2001; Konstantareas and Stewart 2006; Landry 2000) have focused on children 3–10 years of age, administering the Child Behavior Questionnaire (Rothbart et al. 2001) to *parents*. These studies compared 23, 19, and 15 children with autism (mean chronological age 6–7) with 24, 23, and 13 typically developing children respectively, matched for mental age to the ASD group (mean mental age 4–5). All three studies report that, at the domain level, only lower Effortful Control differentiated children with autism from the comparison group, yielding particularly large effect sizes indicating lower attention and inhibitory control. Yet, no significant differences were retrieved for Negative Affect and Surgency. At the NA-facet level, anger (Landry 2000), discomfort (Konstantareas and Stewart 2006), and unsoothability (Janes 2001; Konstantareas and Stewart 2006) tended to be significantly higher for the ASD group. Landry (2000) also reported higher activity (assigned to Surgency) for children with autism.

Two studies evaluated the Rothbart model in older children and adolescents, using the Early Adolescent Temperament Questionnaire-Revised (EATQ-R; Ellis and Rothbart 2001). Descriptive data on *parent reports* were presented in Myles et al. (2007) about 156 adolescents with Asperger syndrome (mean age 15) without comparable data for a reference group. When we compare these data to the US standardization sample for the EATQ-R ($N = 165$; Ellis 2002), major differences on all three variables are evident, revealing that this ASD group scores about one standard deviation lower on Effortful Control and Surgency and higher on Negative Affect. More recently, Schwartz et al. (2009) compared temperament *self-reports* of 44 high-functioning children with autism (mean age 13) to 38

Table 1 Definitions of the Rothbart temperament and five-factor personality dimensions

Trait model	Definition
Temperament	
Negative affect	The tendency to be fearful, easily frustrated, and irritable (as opposed to being laid back and adaptable)
Surgency	The tendency to actively and energetically approach people in an emotionally positive way (rather than to be shy, inhibited and withdrawn)
Effortful control	The ability to sustain attention, control one's behavior, and regulate one's emotions (as opposed to an inability to regulate one's arousal and to remain calm and focused)
Personality	
Emotional stability	The tendency to be self-confident and well-balanced (as opposed to experience the world as distressing and threatening)
Extraversion	The frequency and intensity of engagement with the social world (rather than avoidance of intense social experiences)
Conscientiousness	The ability to control impulses and to efficiently carry out plans and tasks (as opposed to the inability to persevere until goals are reached or to delay gratification)
Benevolence	The tendency to empathize with people's needs and emotions and to experience positive interpersonal relationships (rather than to react antagonistically and irritable, hindering congenial relationships with others)
Imagination	The interest and willingness to explore new activities, ideas, and beliefs (rather than lack of creativity, curiosity, and intellect)

typically developing controls. Notably, these two groups did not differ on self-reported Effortful Control but moderate effect sizes were found for higher Negative Affect and lower Surgency (but not on the facet shyness) in the ASD group.

Personality Differences There is a growing consensus among personality psychologists that the Five-Factor Model (FFM) provides a valid framework not only to describe individual differences among adults (McCrae and Costa 1987) but also among children and adolescents, at least from preschool age onwards (Caspi and Shiner 2006; De Pauw et al. 2009). This FFM-framework postulates five bipolar dimensions, commonly referred to as Neuroticism, Extraversion, Openness-to-experience, Conscientiousness, and Agreeableness (see Table 1). No study to date relied on this framework to examine trait profiles of individuals clinically diagnosed with autism. Yet, two studies administered self-report FFM-instruments to characterize the personality profile of the 'broader autism phenotype' as assessed by self-reports on the Autism Spectrum Quotient (AQ; Baron-Cohen et al. 2001). Using a short FFM-measure for a sample of 206 UK students, Austin (2005) found that having more autistic symptoms was related to lower Extraversion and Agreeableness and to higher Neuroticism. Wakabayashi et al. (2006) administered the NEO-PI-R (McCrae and Costa 1987) and the AQ in 320 Japanese students and replicated that autistic symptoms correlated with lower Extraversion and higher Neuroticism. Unexpectedly, a negative correlation was found with Conscientiousness instead of with Agreeableness.

Variance Differences Although there is a growing interest in mean-level differences, very few studies addressed differences in *trait variance* across groups. Only Janes (2001) examined differences in variances and reported four times *less* variance in Surgency-ratings made by mothers of children with ASD than by mothers of the typically developing children, whereas variances on Effortful Control and Negative Affect were more comparable. This difference between variances is noteworthy, as it may corroborate the implicit assumption that individuals within a diagnostic category such as ASD share notable similarities in their trait profiles and hence will exhibit *less* trait variation. As such, lower variance in Surgency could be consistent with the restriction of affect often associated with pervasive developmental disorders. At the mean-level, however, Janes (2001) did not retrieve any differences in Surgency between children with and without ASD. Hence, more research with larger sample sizes is required to further address the scope and impact of variance differences between children with and without autism.

Level 2: Differences in Psychometric Properties Between Autism and Non-Autism Groups

Because every studied sample yields a unique set of scores for a particular instrument, equal or similar internal consistency or reliability coefficients of measures across samples cannot be assumed (Fan and Thompson 2001). Moreover, it should not be assumed that reliabilities can be generalized from normal to specific clinical groups such as children with autism (Hepburn and Stone 2006). Unfortunately, most researchers do not report reliabilities for their samples, precluding comparisons of internal consistency across samples or studies. Only Janes (2001) reported reliability estimates for the temperament data from the samples of children with and without ASD. In absolute

sense, Cronbach's alphas were lower for the ASD group, although all coefficients were above .70 and hence deemed to be satisfactory.

Level 3: Differences in Covariation Between Autism and Non-Autism Groups

Temperament-Personality Covariation To date, both temperament and personality researchers acknowledge the conceptual similarities between Negative Affect, Surgency, and Effortful Control on the one hand and the FFM-dimensions of Neuroticism, Extraversion, and Conscientiousness on the other (Caspi et al. 2005; Rothbart and Bates 2006). So far, however, empirical convergence was only assessed in non-clinical adult samples (Evans and Rothbart 2007; Rothbart et al. 2000). This research supports the expected associative pattern but points towards additional, moderate correlations between Agreeableness and Negative Affect, Openness-to-experience and Surgency, and between Neuroticism and Effortful Control.

Trait-Maladjustment Covariation Although temperament and personality play a critical role in typical children's development, both types of traits are seldom assessed in the same sample. Rothbart (2007) recently summarized the differential relationships in children and adolescents and concluded that all three *temperament* dimensions explain a significant part of the variance of both Internalizing and Externalizing problems. Higher levels of Negative Affect are strongly associated with both types of problem behavior while higher Surgency is moderately related to more Externalizing and fewer Internalizing problems. Low Effortful Control correlates strongly with Externalizing and modestly with Internalizing problems.

Analogously, Mervielde et al. (2005, 2006) reviewed the expanding literature on five-factor-based *personality* and maladjustment. Compared to Rothbart's review, these authors postulate more complex links between traits and problem behaviors: high Neuroticism and low Extraversion are the typical correlates of Internalizing problems; low Agreeableness and Conscientiousness are mainly associated with Externalizing behavior; while Openness-to-experience is not related to problem behavior. Moreover, they suggested that this covariation pattern appears to be stronger in clinical than in non-clinical samples.

To allow a more rigorous analysis of the differences between clinical and non-clinical samples, Van Leeuwen et al. (2007) developed the extended tests for the spectrum hypothesis and adopted this framework to compare a heterogeneous sample of children referred for psychological counseling and therapy ($N = 205$) to a large non-referred community sample ($N = 596$). Their study generally supported the spectrum hypothesis, revealing mainly mean-level differences and few Level 2 and 3 differences. Although Level 3-analyses revealed similar patterns of covariation between traits and problem behavior, some covariations turned out to be stronger in the referred/clinical sample. Unfortunately, the referred sample included few children diagnosed with autism spectrum disorders and therefore, these results cannot be generalized to children with and without ASD.

The study by Schwartz et al. (2009) is—to our knowledge—the only study that investigated traits and maladjustment in individuals with autism. They related self-reported EATQ-R temperament of 44 young adolescents with high-functioning autism and scores on 38 controls to parent's reports of psychopathology. Correlation analyses corroborated the links with maladjustment proposed by Rothbart, but did not replicate the link between Surgency and externalizing problems. Notably, regression analyses indicated that the effect of traits was severely attenuated when diagnostic group was included in the regression model. Yet, after accounting for group membership, higher levels of Surgency and Effortful Control were still predictive of lower levels of respectively Internalizing and Externalizing behavior. Moreover, since no group-by-trait interactions emerged in this study, these findings appear to generalize across the different samples, supporting the hypothesis that similar processes link traits to maladjustment in children with and without autism.

The Present Study

The present study implements the extended tests of the spectrum hypothesis to achieve a more comprehensive account of the contribution of temperament and personality to maladjustment in childhood autism. More specifically, we compare a low and a high score autism group with a large sample of children without autism at three distinct levels: means and variances (Level 1), psychometric properties (Level 2), and the covariation between trait measures and between traits and maladjustment problems (Level 3).

This study extends previous work through (a) providing a systematic framework to evaluate differences in temperament, personality and their associations with maladjustment across clinical and non-clinical groups, (b) including a relatively large sample of children with autism from an understudied age range, (c) evaluating differences between a high versus low symptom autism group, relative to a large and adequate comparison sample, (d) incorporating age-appropriate, well-developed measures to assess relationships from both a temperament and personality

perspective, and (e) focusing on the most commonly used informant in research on traits and maladjustment, namely the parent.

Method

Participants and Procedure

The ASD-referred sample includes 175 children (mean age 10.28; SD = 2.4 years), identified through the registries of four of the largest autism-services centers in Flanders, Belgium, subsidized by the Flemish government to provide support-at-home and counseling to parents and family members of persons with autism. These ambulant services are exclusively accessible for individuals who previously received a formal, psychiatric diagnosis of Autistic or Asperger's Disorder or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), relying on DSM-IV(-TR) or ICD-10-criteria.

The four governmental autism centers required that investigators were blind to patient information. Three centers mailed our set of questionnaires (with detailed written instructions and informed consent) to all mothers who had a registered child between 6 and 14 years with ASD, *without* severe cognitive, sensory, motor, or medical conditions. One hundred thirty-seven mothers (78% of the sample) returned the questionnaires by mail, which is 53% of the originally addressed mothers. The fourth center posted an advertisement in its newsletter, to which 38 mothers responded (22% of the sample), subsequently receiving our set of questionnaires by mail. Mothers completed the questionnaires and a demographic form with extra information about the disorder. The ASD-sample was predominantly male (sex ratio 6:1, 26 girls) and only 17 children (13 boys) were reported to have significant cognitive impairment. Based on the information provided by the mothers, 88 children received the diagnosis Autistic Disorder, 50 were diagnosed as children with Asperger Syndrome, while 19 children were classified as PDD-NOS. For 18 children, the diagnostic characterization was unknown. All diagnoses were made by a child psychiatrist. According to the mothers, 54% of the children were diagnosed at or before 5 years of age, while 46% were diagnosed after age 5. The ASD-diagnosis was established for an average of 4.6 years (SD = 2.4 years).

The non-clinical sample was drawn from a large scale study on the relations between multiple temperament models, a five-factor personality model and children's problem behavior. Children and parents were recruited by undergraduate psychology students who individually contacted two families within their social environment (no first degree family members) with a child between 6 and 14 years. These families were visited at home and independently completed the questionnaires in the presence of the student. From this general community sample, 500 children (75 girls; mean age 10.51, SD = 2.6 years) were randomly selected to serve as comparison group. Chronological age and gender closely correspond to the distribution within the autism-referred sample. Each mother rated the child's problem behavior whereas temperament and personality questionnaires were randomly assigned to mothers and fathers in this sample.[1] All participants provided written informed consent.

All families were Caucasian and there were no significant differences between the ASD-referred sample and the non-clinical sample in parental age and years of maternal education. In both samples, mothers' average age was 39.7 years (SD = 4.9 years) while fathers were on average 41.9 years (SD = 5.6 years). All mothers had an average of 13.6 years of education (SD = 2.2 years). Fathers from the comparison group ($M = 13.5 \pm 2.3$ years) received on average about one more year education than fathers of the ASD-sample ($M = 12.6 \pm 2.5$ years). The professional status of mothers and fathers was also different. In the comparison sample, 88% of the mothers and 96% of the fathers were employed whereas in the ASD-sample, only 72% of the mothers and 89% of the fathers were employed.

Instruments

Current Autistic Symptoms

Parents from the ASD-sample completed the Current version of the Social Communication Questionnaire in Dutch (SCQ; Rutter et al. 2003; Warreyn et al. 2004). This parent-report questionnaire requires 40 yes-or-no answers probing for symptoms in communication and social functioning over the most recent 3-month period. Importantly, this SCQ-version assesses the *current* severity of autistic symptoms and should not be confused with the SCQ-Lifetime version which consists of identical questions but instructs parents to consider the child's entire developmental history. The present study finds adequate reliability ($\alpha = .85$) for the SCQ-total score (range 1–31, $M_{SCQ} = 15.7$, SD = 7.0).

[1] Based on random distribution methodology, the Rothbart and Five-Factor measure in the comparison group were separately filled in by two different caregivers in 50% of the cases ($N = 250$). For the other 50% of the data, a single informant rated both the Rothbart and Five-Factor measure (25% mothers, 25% fathers). Analyses of variance revealed no significant mean differences ($p < .05$) between mothers and fathers in HiPIC-personality and CBQ-temperament. For EATQ-R ratings, one significant difference was found: fathers rated their child higher on Negative Affect than mothers (F (1, 340) = 26.86, $p < .001$).

In order to compare differences across a lower and a higher region of the autistic spectrum, we adopted 15 as the criterion score to divide the sample in a low SCQ-symptom group ($N = 81$, $M_{SCQ} = 9.5$, SD = 3.3) versus a high SCQ-symptom group ($N = 94$, $M_{SCQ} = 21.0$, SD = 4.4). This criterion corresponds to the median SCQ-total score in this sample but also to the cut-off, proposed in the SCQ-Lifetime version, to determine whether or not a child needs referral for ASD-evaluation (Rutter et al. 2003). Given that there is no formal way to divide the autistic spectrum, we consider children currently exhibiting less than 15 symptoms (*low* SCQ-symptom group) as positioned in the *lower* region of the autistic spectrum, whereas children with 15 or more symptoms (*high* SCQ-symptom group) are considered to belong to a *higher* region of the autistic spectrum. Importantly, chi-square analyses revealed no significant differences in child (gender, ethnicity, cognitive impairment, educational placement) and family characteristics (parental education, parental professional status) between the low and high SCQ-symptom group.

Temperament

In both the ASD and the comparison sample, two different temperament instruments were administered to parents of children below and above age 8. Below age 8, parents completed the Dutch version (Majdandzic and van den Boom 2007) of the Child Behavior Questionnaire—very short form (CBQ; Putnam and Rothbart 2006). This 36-item questionnaire measures the three dimensions Negative Affect, Surgency, and Effortful Control. Above age 8, parents completed the Dutch translation (Hartman 2000) of the Early Adolescent Temperament Questionnaire-Revised (Ellis and Rothbart 2001). This 62-item measure comprises two behavioral scales (not considered in this study) and eight temperament scales, reflecting the broad dimensions of Negative Affect (combining the subscales Fear, Frustration), Surgency (High-Intensity Pleasure, Shyness), and Effortful Control (Activation Control, Attention, Inhibitory Control). In addition, the EATQ-R measures Affiliation independent of Surgency, tapping the desire for warmth and closeness with others. The three CBQ- and EATQ-R domains of Negative Affect, Surgency, and Effortful Control are highly consistent (Rothbart 2007) and are considered comparable in both age-specific instruments. To permit aggregation, the 7-point Likert CBQ ratings were rescaled to 5-point scales as used for the EATQ-R.

Personality

All parents completed the Hierarchical Personality Inventory for Children (HiPIC; Mervielde and De Fruyt 2002). The HiPIC includes 144 items that are rated on 5-point Likert scales, assessing 18 facets, empirically derived lower-order scales, that are hierarchically organized under five higher-order dimensions: Emotional stability (comprising the facets Anxiety and Self-confidence), Extraversion (Shyness, Optimism, Expressiveness, and Energy), Conscientiousness (Achievement Motivation, Concentration, Perseverance, and Orderliness), Benevolence (Egocentrism, Irritability, Compliance, Dominance, and Altruism), and Imagination (including the subscales Creativity, Curiosity, and Intellect). The Emotional Stability, Benevolence and Imagination labels differ from their adult counterparts but are empirically and conceptually clearly related to the FFM-domains Neuroticism, Agreeableness and Openness-to-experience.

Maladjustment

In both samples, mothers completed the Child Behavior Checklist (CBCL; Achenbach 1991; Verhulst et al. 1996) to rate the frequency—over the past 6-month period—of 120 maladaptive behaviors on a 3-point Likert scale. Two broadband factors can be derived from the CBCL scale scores: Internalizing problems, with items referring to anxiety/depression, social withdrawal, and somatic complaints, and Externalizing problems, including items on disruptive, aggressive and delinquent behavior.

Results[2]

Level 1: Group Differences in Means and Variances

Univariate ANOVA's were conducted to examine group differences in problem behavior, temperament, and personality. As anticipated, significant mean-level differences were observed for each variable. At the domain level (see Table 2), post hoc tests reveal that the frequency of internalizing and externalizing problems is higher for children with ASD than for comparison group children. Children with ASD differed on each temperament domain and were rated as higher on Negative Affect, lower on Effortful Control and Surgency, yielding comparable effect sizes with η^2 ranging from .18 to .21. Children with ASD also scored lower than controls on the five personality domains, but yielding different effect sizes ranging from very large for Extraversion ($\eta^2 = .36$) and Imagination ($\eta^2 = .30$), over moderate for Benevolence ($\eta^2 = .23$) and Emotional Stability ($\eta^2 = .23$), to modest for Conscientiousness ($\eta^2 = .12$). The high SCQ-symptom group scored more maladaptive than the low SCQ-symptom group but the

[2] In the light of the number of comparisons made in this study, a conservative significance level of $p \leq .01$ is adopted for all analyses.

Table 2 Level 1 analyses for differences in means and variances on trait and maladjustment variables

	High SCQ-symptom group $n = 94$		Low SCQ-symptom group $n = 81$		Comparison group $n = 500$		Test means		Test variance	Cohen's d		
	M	SD	*M*	SD	*M*	SD	*F*	η^2	*Levene*	HI-CO	LO-CO	HI-LO
Temperament												
Negative affect	3.32[a]	0.66	3.07[b]	0.73	2.50[c]	0.59	88.75**	0.21	2.53	1.36	0.93	0.36
Effortful control	2.56[a]	0.69	2.68[a]	0.59	3.32[b]	0.61	82.92**	0.20	0.94	−1.22	−1.05	−0.19
Surgency	2.64[a]	0.79	2.95[b]	0.77	3.47[c]	0.62	73.99**	0.18	4.82*	−1.28	−0.81	−0.40
Personality												
Extraversion	2.59[a]	0.66	2.88[b]	0.60	3.63[c]	0.52	184.94**	0.36	6.29*	−1.91	−1.41	−0.46
Imagination	2.81[a]	0.79	2.94[a]	0.61	3.76[b]	0.56	144.59**	0.30	10.02**	−1.58	−1.45	−0.18
Benevolence	2.75[a]	0.62	2.91[a]	0.65	3.51[b]	0.52	102.88**	0.23	8.68**	−1.42	−1.11	−0.25
Emotional stability	2.64[a]	0.74	2.73[a]	0.70	3.47[b]	0.60	99.67**	0.23	4.86*	−1.33	−1.2	−0.12
Conscientiousness	2.65[a]	0.67	2.70[a]	0.57	3.21[b]	0.64	46.72**	0.12	0.53	−0.87	−0.81	−0.08
Maladjustment												
CBCL internalizing	18.16[a]	9.54	14.62[b]	8.14	5.79[c]	6.17	158.78**	0.32	25.67**	1.82	1.36	0.40
CBCL externalizing	19.64[a]	9.43	17.58[a]	9.98	8.19[b]	7.60	107.83**	0.24	6.47*	1.45	1.18	0.21

HI high SCQ-symptom group, *LO* low SCQ-symptom group, *CO* comparison group. * $p \leq .01$; ** $p \leq .001$

Scales are ordered by decreasing magnitude of effect size η^2

Different superscripts refer to statistical differences (post hoc test, Games-Howell's modification of Tukey's HSD because homogeneity of variances assumption is sometimes violated, $p < .01$)

differences were only significant for four trait domains. Compared to children with fewer ASD symptoms, high scorers on the SCQ presented with more internalizing problems, higher temperamental Negative Affect, lower Surgency and Extraversion.

This pattern of mean-level differences also surfaces at a more fine-grained trait level, as children with ASD were rated as significantly more maladaptive than controls on the 8 temperament[3] scales and on 17 of the 18 personality facets. For temperament, effect sizes (η^2) range from .10 (Fear) to .33 (Affiliation) whereas significant effects for personality facets range from .05 (Orderliness) to .47 (Altruism). Facet-level analyses also identified fewer temperament and personality facets differentiating the high from the low SCQ-symptom group. For temperament, the high SCQ-symptom group scored lower on Affiliation (not assigned to a higher domain) and High Intensity Pleasure and higher on Shyness (the two latter scales constitute the Surgency domain). For personality, the high-scoring group presents with lower Altruism (Benevolence domain) as well as lower Optimism, Expressiveness and higher Shyness (Extraversion domain). Importantly, no differences were found for the Benevolence-facet Dominance ($F(2, 672) = 1.26$, *ns*). This means that parents of children with and without autism provide similar ratings on items such as 'my child manipulates others, acts the boss, imposes his/her will, or puts him/herself to the fore'.

Levene's tests of homogeneity of variances showed that children with ASD did not differ from controls on the temperament dimensions Effortful Control and Negative Affect and on the personality domain Conscientiousness. However, variances significantly differed for all other trait domains, revealing consistently greater variance within the ASD-groups. Variability is extensive ($p < .001$), in particular for Internalizing problems and the personality domains Imagination and Benevolence. More modest differences were found ($p < .01$) for Externalizing problems, the personality domains Extraversion and Emotional Stability, and temperamental Surgency. The magnitude of the variance differences did not infringe ANOVA assumptions but required Games-Howell post hoc tests for evaluating mean-level differences.

Level 2: Group Differences in Psychometric Properties

Table 3 presents the reliability estimates together with their 95% confidence intervals (Fan and Thompson 2001) in the three groups. In each group, Cronbach's coefficient alpha for the temperament, personality, and maladjustment variables is acceptable to high, ranging from .66 (CBQ-Negative Affect, high SCQ-symptom group) to .95 (HiPIC-Conscientiousness, comparison group). Inspection of the confidence intervals indicates overall similarity in reliability because, for 12 of the 13 domains, confidence

[3] Temperament facet level data were only available for EATQ-data. Reports on these facet analyses are available upon request from the first author.

Table 3 Level 2 analyses for differences in internal consistencies of traits and maladjustment

	# Items	Autism group		Comparison group
		High SCQ α (95% CI)	Low SCQ α (95% CI)	α (95% CI)
Temperament				
CBQ		$n = 17$	$n = 18$	$n = 158$
Surgency	12	0.86 (.73,.94)[a]	0.72 (.46,.89)[a]	0.67 (.58,.74)[a]
Negative affect	12	0.66 (.37,.86)[a]	0.7 (.42,.88)[a]	0.76 (.69,.81)[a]
Effortful control	12	0.67 (.36,.86)[a]	0.77 (.54,.91)[a]	0.78 (.71,.83)[a]
EATQ-R		$n = 77$	$n = 66$	$n = 342$
Surgency	14	0.79 (.71,.85)[a]	0.84 (.78,.90)[a]	0.81 (.78,.84)[a]
Negative affect	12	0.7 (.59,.80)[a]	0.82 (.75,.88)[a]	0.78 (.74,.82)[a]
Effortful control	18	0.79 (.72,.85)[a]	0.78 (.69,.85)[a]	0.89 (.87,.90)[b]
Personality		$n = 94$	$n = 81$	$n = 500$
Emotional stability	16	0.85 (.80,.89)[a]	0.87 (.82,.91)[a]	0.88 (.86,.89)[a]
Extraversion	32	0.9 (.86,.93)[a]	0.88 (.84,.92)[a]	0.91 (.90,.93)[a]
Imagination	24	0.9 (.87,.93)[a]	0.86 (.82,.91)[a]	0.91 (.90,.93)[a]
Benevolence	40	0.91 (.88,.93)[a]	0.93 (.91,.95)[a]	0.94 (.93,.95)[a]
Conscientiousness	32	0.9 (.87,.93)[a]	0.87 (.83,.91)[a]	0.95 (.94,.96)[a]
Maladjustment		$n = 94$	$n = 81$	$n = 500$
Internalizing	31	0.87 (.83,.91)[a]	0.86 (.81,.90)[a]	0.89 (.87,.90)[a]
Externalizing	31	0.89 (.84,.91)[a]	0.9 (.87,.93)[a]	0.91 (.89,.92)[a]

High SCQ high SCQ-symptom group, *Low SCQ* low SCQ-symptom group. * $p \leq .01$; ** $p \leq .001$. Different superscripts refer to statistical differences (confidence intervals overlap)

boundaries for one group overlap with those of the other groups. For EATQ-R Effortful Control, reliability is significantly higher in the comparison group ($CI_{comparison} = .87–.90$), because the confidence interval fails to overlap with that for both ASD-groups ($CI_{low\ SCQ} = .69–.85$; $CI_{high\ SCQ} = .72–.85$).

Level 3: Group Differences in the Nomological Network

The relations between temperament and personality dimensions on the one hand and between these dimensions and problem behaviors on the other hand, are explored in Table 4 with bivariate correlations *within* each group. Correlations differing *across* groups are indexed with different superscripts based on pairwise comparisons (after Fisher *r* to *z* transformation) of the magnitude of the correlations.

Temperament-Personality Covariation Across Children With and Without Autism

Panel 1 of Table 4 reports the correlations between the Rothbart temperament and Five-Factor personality dimensions across the three groups. Within each group, the analyses corroborate the assumed conceptual similarities, showing substantial correlations between Surgency and Extraversion, Negative Affect and Emotional Stability, and Effortful Control and Conscientiousness. In accordance with adult research (e.g., Evans and Rothbart 2007), we obtained a positive correlation between Surgency and Emotional Stability and between Effortful Control and Benevolence and replicated a significant negative correlation between Negative Affect and Benevolence in the comparison ($r = -.44$, $p < .001$) and the low SCQ-symptom group ($r = -.41$, $p < .001$), but not in the high SCQ-symptom group ($r = -.14$, *ns*).

The consistent pattern of correlations across the three groups is remarkable, as only five out of the 45 bivariate relationships turned out to be different. Nevertheless, these few differences reveal some differential relations between temperament and personality in children with and without autism. Imagination emerges as a substantial correlate of Effortful Control in the comparison sample ($r = .34$) but not in both ASD-groups. Moreover, three out of five personality correlates for Negative Affect differ between the high SCQ-symptom group and the comparison group. In the high SCQ-symptom group, the negative Benevolence-Negative Affect correlation is lower than in the comparison group. In this group of children scoring high on the SCQ, additional positive correlations are reported between NA and Imagination and Conscientiousness but these relationships are near zero (Imagination) or negative

Table 4 Level 3 analyses for differences in covariation between traits and maladjustment

	High SCQ-symptom group ($n = 94$)	Low SCQ-symptom group ($n = 81$)	Comparison group ($n = 500$)
Panel 1: Personality—Temperament			
Correlations with surgency			
Emotional stability	.36[a]**	.34[a]*	.39[a]**
Extraversion	.59[a]**	.55[a]**	.53[a]**
Imagination	.26[a]	.11[a]	.25[a]**
Benevolence	−.18[a]	−.23[a]	−.07[a]
Conscientiousness	−.11[a]	−.30[a]*	−.01[a]
Correlations with negative affect			
Emotional stability	−.48[a]**	−.59[a]**	−.45[a]**
Extraversion	.12[a]	.09[a]	−.12[a]**
Imagination	.40[a]**	.07[ab]	−.05[b]
Benevolence	−.14[a]	−.41[ab]**	−.44[b]**
Conscientiousness	.24[a]	−.14[ab]	−.20[b]**
Correlations with effortful control			
Emotional stability	.07[a]	.19[a]	.22[a]**
Extraversion	−.02[a]	−.13[a]	.04[a]
Imagination	.03[a]	.02[a]	.34[b]**
Benevolence	.30[a]*	.36[a]**	.40[a]**
Conscientiousness	.50[a]**	.57[a]**	.64[a]**
Panel 2: Traits—Maladjustment			
Correlations with internalizing problems			
Surgency	−.27[a]*	−.22[a]	−.27[a]**
Negative affect	.42[a]**	.49[a]**	.38[a]**
Effortful control	−.08[a]	−.36[a]**	−.22[a]**
Emotional stability	−.71[a]**	−.63[ab]**	−.48[b]**
Extraversion	−.22[a]	−.23[a]	−.36[a]**
Imagination	.08[a]	.01[a]	−.16[a]**
Benevolence	−.19[a]	−.41[a]**	−.27[a]**
Conscientiousness	.12[a]	−.10[a]	−.13[a]*
Correlations with externalizing problems			
Surgency	.26[a]	.36[a]**	.09[a]
Negative affect	.23[a]	.45[a]**	.35[a]**
Effortful control	−.26[a]	−.42[a]**	−.37[a]**
Emotional stability	−.16[a]	−.24[a]	−.17[a]**
Extraversion	.31[ab]*	.37[a]**	.05[b]
Imagination	.24[a]	.06[ab]	−.07[b]
Benevolence	−.74[ab]**	−.80[a]**	−.61[b]**
Conscientiousness	−.21[a]	−.36[a]**	−.31[a]**

Note * $p \leq .01$, ** $p \leq .001$. Different *superscripts* refer to statistical differences ($p < .01$)

(Conscientiousness) in the low SCQ-symptom and the comparison group.

Trait-Maladjustment Covariation across Children With and Without Autism

Panel 2 of Table 4 shows how temperament and personality correlate with internalizing and externalizing problems in each diagnostic group. Again, striking similarities across groups are documented as only 4 out of the 48 bivariate relationships—all pertaining to personality traits—are different. Hierarchical multiple regression (HMR) analyses estimate the independent contribution of group, temperament and personality to internalizing and externalizing behavior and explore whether these trait-adjustment relationships differ across the three groups.

These HMR-analyses were conducted with temperament and personality as independents, and internalizing versus externalizing as dependents. Gender and age were always entered in Step 1 as control variables. In Step 2, main effects for group and traits were calculated by entering two dummy-coded group variables 'low' and 'high' (representing the low SCQ- and the high SCQ-symptom group, contrasted with the comparison group), and one of the three Rothbart domains or FFM-dimensions. In Step 3, temperament-by-group or personality-by-group interactions were entered. All variables were standardized following the guidelines proposed by Aiken and West (1991, p. 44). Given the lack of convincing theoretical justifications for trait-by-group interactions, a step-down procedure (Aiken and West 1991, p. 105) dropping non-significant Step 3-interactions was implemented and in these cases the estimated Step 2-effects were reported.

Table 5 reports the main effects on internalizing and externalizing problems of diagnostic groups, the three Rothbart dimensions (top panel) and the five broad personality domains (bottom panel). As expected, all analyses reveal major effects of group membership indicating that children from autism groups show more internalizing and externalizing behavior than comparison children. Moreover, coefficients for the high SCQ-symptom group uniformly exceed those for the low SCQ-symptom group, suggesting more maladjustment in children exhibiting more ASD-symptoms.

The present study corroborates the review by Rothbart (2007) and, given the lack of group-by-temperament interactions, suggests that this pattern is equally valid for children with and without autism. Across all participants, higher levels of Surgency predict lower levels of internalizing and elevated levels of externalizing behavior, whereas higher

Table 5 Level 3 analyses for differences in trait-maladjustment covariation accounting for group

	Internalizing problems			Externalizing problems		
	ΔF	B	ΔR^2	ΔF	B	ΔR^2
Panel 1: Temperament						
Sex, age	2.50	.20, .02	.01	3.90	−.03, −.04*	.01
Low, high, SU	130.67**	.91**, 1.24**, −.24**	.37	80.57**	1.13**, 1.42**, .17**	.26
Low × SU, high × SU	.27		.00	3.68		.01
Sex, age	2.50	.12, .04*	.01	3.90	−.17, −.02	.01
Low, high, NA	169.71**	.77**, 1.07**, .38**	.43	111.82**	.74**, .83**, .35**	.33
Low × NA, high × NA	2.01		.00	1.80		.00
Sex, age	2.50	.26*, .02	.01	3.90	−.03, −.03	.01
Low, high, EC	118.70**	.93**, 1.34**, −.17**	.35	114.32**	.72**, .88**, −.35**	.34
Low × EC, high × EC	2.72		.01	2.69		.01
Panel 2: Personality						
Sex, age	2.50	.10, .01	.01	3.90	−.10, −.04*	.01
Low, high, EMS	250.52**	.48**, .69**,− .43**	.53	81.62**	.83**, 1.02**, −.19**	.27
Low × EMS, high × EMS	11.50**	.20, .37**	.02	.53		.00
Sex, age	2.50	.23*, −.01	.01	3.90	−.02, −.03	.01
Low, high, EXT	140.63**	.71**, 1.01**, −.32**	.38	76.49**	1.38**, 1.63**, .03	.25
Low × EXT, high × EXT	.86		.00	7.70**	.42**, .28*	.02
Sex, age	2.50	.23, .01	.01	3.90	−.05, −.04*	.01
Low, high, IMA	108.61**	1.00**, 1.42**, −.06	.33	71.19**	1.03**, 1.44**, −.11	.24
Low × IMA, high × IMA	3.65		.01	6.21*	.17, .34**	.01
Sex, age	2.50	.24*, .02	.01	3.90	−.05, −.02	.01
Low, high, BEN	135.96**	.81**, 1.18**, −.27**	.38	306.81**	.28*, .35**, −.60**	.57
Low × BEN, high × BEN	.97		.00	5.00*	−.22*, −.15	.01
Sex, age	2.50	.25*, .01	.01	3.90	−.02, −.05**	.01
Low, high, CON	109.45**	1.02**, 1.45**, −.07	.33	102.57**	.79**, .99**, −.30**	.31
Low × CON, high × CON	3.05		.01	1.40		.00

* $p \leq .01$; ** $p \leq .001$. *Low* low SCQ-symptom group, *high* high SCQ-symptom group, *BE* benevolence, *CO* conscientiousness, *EC* effortful control, *ES* emotional stability, *EX* extraversion, *IM* imagination, *NA* negative affect, *SU* surgency. Coefficient *B* refers to the unstandardized regression coefficient calculated by the Friedrich's procedure (Aiken and West 1991, p. 44). This represents the appropriate standardized solution for use with multiplicative terms

levels of Negative Affect and lower levels of Effortful Control predict higher levels of both internalizing and externalizing problems. In combination with group membership, these models explain up to 34% (Effortful Control) of the variance of externalizing and 43% (Negative Affect) of the variance of internalizing problems.

The present results support the suggestion by Mervielde et al. (2005, 2006) that Internalizing and Externalizing are more clearly differentiated by the HiPIC-personality framework. Low levels of Emotional Stability and Extraversion are primarily associated with internalizing problems whereas low levels of Benevolence and Conscientiousness are the most powerful predictors of externalizing problems, whereas Imagination is again unrelated to childhood problem behavior. Consistent with previous research (e.g., De Pauw et al. 2009; Mervielde et al. 2005), this basic HiPIC-pattern is not exclusive because Emotional Stability and Benevolence are also moderately related to Externalizing and Internalizing. Group membership combined with Emotional stability explains up to 53% of internalizing variance and combined with Benevolence, it explains 57% of the variance in externalizing problems.

The outcome of Step 3-analyses shows that 15 of the 20 personality-by-group interactions are non-significant, implying essential consistency of the personality effects across children with and without autism. One group by Emotional Stability interaction predicts internalizing problems, and three group-by-personality interactions predict externalizing behavior: Group by Extraversion, Imagination, and Benevolence. Not surprisingly, these effects match the four statistically different correlations in Table 4.

The Emotional Stability-by-group and Benevolence-by-group interactions are plotted in Fig. 1. Strikingly, they replicate two interaction effects reported by Van Leeuwen et al. (2007) comparing referred and non-referred children. The slopes of the comparison group (Emotional Stability, $t = -11.54$; Benevolence, $t = -17.08$), low SCQ- (Emotional Stability, $t = -7.86$; Benevolence, $t = -11.81$), and high SCQ-symptom group (Emotional Stability, $t = -11.35$; Benevolence, $t = -11.02$) are all significant at $p < .001$, confirming the highly similar shape of the regression lines. This confirms that, across all participants, children scoring low on Benevolence display more externalizing problems and that those low on Emotional Stability exhibit more internalizing behavior. The slopes reveal that these effects are stronger in the autism groups, and that, for Emotional Stability, the covariation is more pronounced in the high SCQ- than in the low SCQ-symptom group.

The Extraversion-by-group and Imagination-by-group interactions (presented in Fig. 2), are not documented by

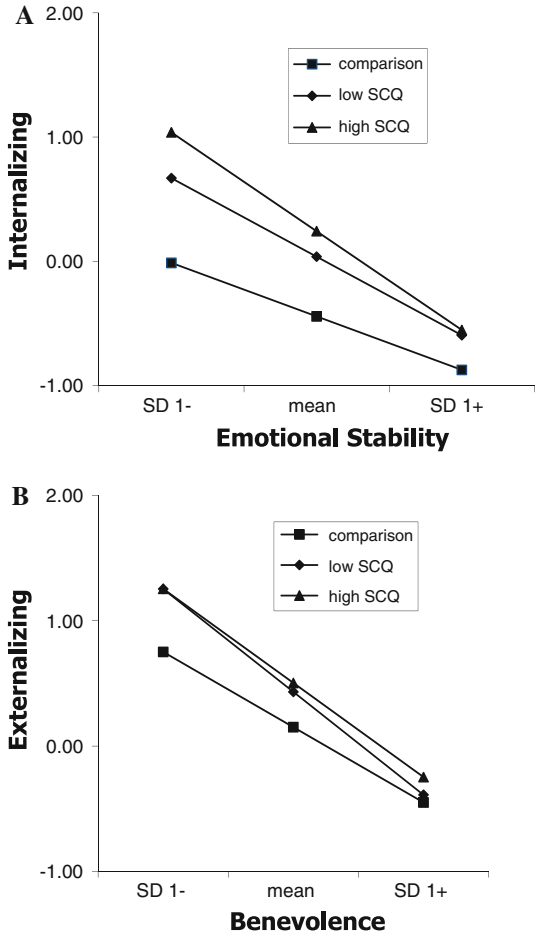

Fig. 1 **a** Interaction between emotional stability and group predicting internalizing. **b** Interaction between benevolence and group predicting externalizing. *Note Comparison* comparison group, *low SCQ* low SCQ-symptom group, *high SCQ* high SCQ-symptom group

Van Leeuwen et al. (2007), perhaps suggesting two *autism-specific* mechanisms. The first interaction presents Extraversion as a predictor of externalizing problems in both the low SCQ- ($t = 4.05$, $p < .001$) and the high SCQ-symptom group ($t = 3.34$, $p < .001$) but not in the comparison group ($t = 0.61$, *ns*). It shows that children with ASD exhibiting higher levels of Extraversion (more energy, expressiveness, optimism, and less shyness) present significantly more externalizing problems. The interaction with Imagination points towards a similar pattern, uniquely affecting the high SCQ-symptom group. Higher levels of Imagination (more curiosity, creativity, and intellect) predict more externalizing problems ($t = 2.75$, $p = .006$) in the high SCQ- but not in the low SCQ-symptom group ($t = 0.49$, *ns*). A reversed, marginally significant effect surfaces in the comparison group ($t = -2.16$, $p = .031$).

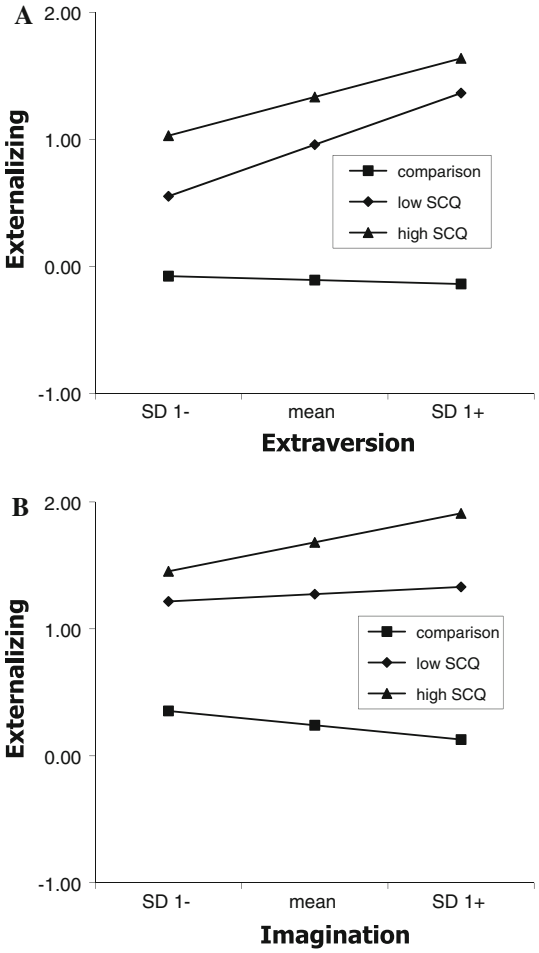

Fig. 2 **a** Interaction between extraversion and group predicting externalizing. **b** Interaction between imagination and group predicting externalizing. *Note Comparison* comparison group, *low SCQ* low SCQ-symptom group, *high SCQ* high SCQ-symptom group

Discussion

The assumption that the psychological processes operating in autism are *qualitatively* different is implicit in much of the psychopathology literature. Indicators of this trend are the exclusion of children with ASD from trait-maladjustment studies in clinical groups (e.g., Van Leeuwen et al. 2007), the omission of autism in prominent reviews on the role of traits in developmental psychopathology (e.g., Muris and Ollendick 2005; Nigg 2006; Rettew and McKee 2005), and the sparse research on the role of traits in autism compared to other types of childhood psychopathology. The present study explicitly addressed differences in temperament, personality and their associations with maladjustment in high and low symptom frequency children with ASD, as well as in a control group without an autism diagnosis. To this end, we implemented the extended spectrum hypothesis tests (Van Leeuwen et al. 2007), assessing group differences at three distinct levels: means and variances (Level 1), psychometric properties (Level 2), and the nomological network of variables (Level 3).

Extended Tests for the Spectrum Hypothesis

Comparing children with and without ASD, we found important Level 1 mean differences on nearly all variables, hardly any differences in Level 2 psychometric properties and limited differences for the Level 3 comparisons regarding the nomological network. This lack of major differences at Level 2 and 3 is remarkable and suggests that children with ASD differ *quantitatively* from children without ASD. Notably, these results are very similar to the Van Leeuwen et al. (2007) comparison of personality-adjustment relationships in referred (including very few children with ASD) and non-referred children. This implies that the spectrum hypothesis (Shiner and Caspi 2003) also applies to trait-maladjustment relationships in autism, and hence that samples with and without ASD can be located on a common set of continuous variables as partially overlapping distributions with a different mean. In a similar way, the current study supports the 'autistic spectrum hypothesis' since Level 2 and 3 analyses revealed no differences between the low and high symptom group. Yet, Level 1 differences between the low and high ASD-group only emerged for a limited set of variables, highlighting that a majority of traits does not differentiate between the two ASD-groups.

Analyses at the successive levels further demonstrate the value and relevance of traits to fully capture the broad variability within the autism phenotype. The large heterogeneity is evidenced in the present sample by the large range of autistic symptoms probed by the SCQ and by substantial variance in internalizing and externalizing problems.

A Distinct Trait Profile for Children With Autism Spectrum Disorders

Level 1 mean-level analyses not only showed that children with ASD presented more problems but also clearly distinct trait profiles compared to those for controls. Children with ASD deviated, on both temperament and personality, more than one standard deviation from the comparison group. Previous findings on temperament in young children with ASD (Janes 2001; Konstantareas and Stewart 2006; Landry 2000) were corroborated since we retrieved lower levels of Effortful Control in both ASD-groups. Consistent with research on adolescents with Asperger syndrome (Myles et al. 2007; Ellis 2002), the ASD-groups also exhibited more Negative Affect and lower Surgency.

This study is also the first to examine the Five-Factor based personality profile of children with and without

autism. In accordance with analogue studies in university students (Austin 2005; Wakabayashi et al. 2006), we found that children with ASD presented lower levels of Extraversion and Emotional Stability, but also that they scored lower than controls on Benevolence, Imagination, and Conscientiousness. Compared to the more uniform profile for temperament traits, the personality dimensions pointed towards a more differentiated profile. Extraversion and Imagination produced the largest differences with controls whereas Benevolence, Emotional Stability and Conscientiousness marked less pronounced differences.

Large differences between children with and without ASD also emerged for the more fine-grained temperament and personality facets, except for the Benevolence-facet dominance. Importantly, children with ASD were not rated as more or less dominant, manipulating, forceful or bossy than children from the general community.

Interestingly, the temperament and personality trait profiles highlight that more extreme scores on these non-clinical assessment instruments indicate higher risk for ASD. Further diagnostic research is needed to refine this ASD-trait profile and to differentiate it from temperament and personality profiles typical for other prevalent clinical conditions, such as ADHD, OCD, depression, and anxiety disorders.

The limited differences between the low and the high ASD-group suggest similar but less extreme trait expression for children with lower SCQ-scores. Differences in means between both groups were documented for shyness, expressiveness, high-intensity pleasure, altruism and need for affiliation, reflecting lower Extraversion and Surgency at the domain level. These traits point towards core ASD-features, targeted by the Social Communication Questionnaire, such as impaired social interaction and communication. Moreover, the high ASD-group exhibits more Negative Affect and lower optimism, revealing internal distress and vulnerability as additional features of the high ASD-group.

Level 1 analyses also showed limited variance differences for a subset of variables. Overall, variability of traits was consistently greater for children with ASD than for controls. These findings clearly contradict the often expected restricted trait expression in ASD (e.g., for Surgency; Janes 2001) and show that children with ASD constitute a rather heterogeneous group in terms of temperament and personality. This pattern of results supports and encourages parents and professionals who appreciate the uniqueness of each child diagnosed with autism and thwarts stereotyping based on mean-level profiles. Individual trait profiles describe particular strengths and vulnerabilities of each child and hence are useful to tailor interventions and treatments to the specific needs of the individual. Moreover, these results suggest that a systematic inquiry of trait variability could generate valuable insights into behavioral variability within the autism spectrum. Future research might take into account this trait variation to search for and define different subtypes of autism or to detect moderators of the wide variability of adaptive behaviors or comorbidity with other disorders.

Temperament and Personality are Valid Trait Languages

Level 2-analyses show acceptable to high reliabilities for each instrument in each group, supporting the viability of a trait approach to autism. In addition, Level 2-analyses support the mounting evidence (e.g., Caspi and Shiner 2006; De Pauw et al. 2009; Tackett 2006) that both Rothbart temperament and Five-Factor based personality are valid tools to describe trait characteristics in middle childhood. Moreover, Level 3-analyses point towards both similarities and differences in how temperament and personality are associated with adjustment problems. They confirm that temperament and personality are complementary languages capturing childhood traits and that research reviews should incorporate both common and model-specific patterns.

Similarity of the Nomological Network

Finally, Level 3 analyses demonstrated that the nomological network of trait-adjustment relationships is highly similar across the three groups. Regression analyses revealed major group effects indicating that, compared to controls, children of both ASD-groups have a greater risk for internalizing as well as externalizing problems. Moreover, temperament as well as personality traits independently contribute to the prediction of problem behavior.

For temperament, the lack of trait-by-group interactions confirmed Schwartz et al. (2009)'s suggestion about similar links between Rothbart's dimensions and maladjustment for children with and without ASD. Moreover, parent reports—instead of self-reports—confirmed, for both children with and without autism, the complete pattern proposed by Rothbart (2007) instead of the two main effects for Surgency and Effortful Control retrieved by Schwartz et al. (2009). Regardless of diagnostic group, internalizing problems are related to higher levels of Negative Affect and lower levels of Surgency and Effortful Control whereas externalizing problems are associated with lower levels of Effortful Control, higher levels of Negative Affect and to a lesser extent higher Surgency.

Personality also predicts adjustment problems in both children with and without ASD and explains more variance than temperament. Our results further indicate a less uniform or more differentiated pattern of associations for personality (Mervielde et al. 2005, 2006; Van Leeuwen et al. 2007). Lower levels of Emotional Stability and

Extraversion (and to a lesser extent, Benevolence) predict Internalizing problems, whereas lower Benevolence and Conscientiousness (and to a lesser degree Emotional Stability) are linked to Externalizing.

Only 5 out of the 32 tested trait-by-group interactions were significant, indicating minor disconfirmations of the extended spectrum hypothesis. Moreover, the shape of the Emotional Stability-by-group interaction (for Internalizing) and the Benevolence-by-group interaction (for Externalizing) designates a quantitative difference in the strength of the relationship because of the similarity of the shape of the regression line in the three groups. Both interaction effects point towards stronger covariation in the ASD-groups than in the control group and hence indicate quantitative rather than qualitative differences between the groups. Similar interactions were also documented by Van Leeuwen et al. (2007), and are therefore presumably related to the 'clinical' nature of the ASD-groups.

By contrast, the Extraversion- and Imagination-by-group interactions are ASD-specific as both personality domains are positively related to Externalizing in children with ASD but not in the comparison group. When these associations are examined at the item level, some correlations stand out. For Extraversion, particularly high correlations were found with items from the Expressiveness scale 'does not mince words' and 'talks the whole day long', in addition to the Energy scale items 'has an excess of energy' and 'is constantly on the move'. For Imagination, moderate associations only emerged in the high ASD-group, particularly for the Curiosity scale items 'wants to know the nitty-gritty of things' and 'asks many 'why' questions'. The higher energy and talkativeness is perhaps due to the co-morbidity between ASD and ADHD (Leyfer et al. 2006), which might partly explain the increased risk for externalizing behavior. Notably, these items also reflect 'active-but-odd' social impairment (Wing 1997). Active-but-odd children repetitively talk about a favorite theme and constantly ask the same questions regardless of the social context. In line with their egocentrism and resistance to doing anything else than their preferred activities, this active-but-odd subgroup also exhibits higher levels of externalizing problems (e.g., Eaves et al. 1994; Wing 1997). These personality-by-group interactions might tap into these ASD-specific processes, but future research is needed to further document the role of comorbidity with ADHD. The potential role of the active-but-odd subtype moreover suggests that fine-grained trait information is useful to detect and describe different clusters of children with autism.

The documented trait-adjustment relations provide additional tools for identifying children with ASD at risk for developing emotional or behavioral problems. The substantial evidence for the extended spectrum hypothesis, supports the application of trait-based interventions to ASD children. Hence, programs developed to increase Effortful Control (e.g., Rothbart 2007) or trait-focused parent training (e.g., Sheeber and Johnson 1994) in children without autism could also be promising in reducing problem behavior in children with autism.

Limitations and Future Directions

The generalizability of the present findings is limited by the specific choice of temperament, personality and maladjustment instruments, and by relying on mothers as the primary source of information. Future research could benefit from including alternative measures and assessment methods (e.g., observational measures) and multiple informants. The presented trait-adjustment links are also derived from concurrent assessments and should be confirmed by multi-wave longitudinal research to further probe the causal status of traits as antecedents of child maladjustment. Moreover, this study had to rely on clinical judgment for ASD diagnosis, and on limited information about social and cognitive development.

Future research might pursue the role of traits as distinctive features characterizing subtypes of ASD and examine more fine-grained observations of autistic symptoms and behaviors. Research on traits that distinguish autism from commonly co-occurring conditions in ASD such as ADHD or mental retardation is also an important part of the research agenda. Finally, we acknowledge that childhood traits are only one of the many factors and transactional processes that contribute to the development of adjustment problems. Future research should explicitly test the relative contribution of trait variables compared to other variables such as parenting behavior (e.g., Van Leeuwen et al. 2007).

In conclusion, the present study offers comprehensive and empirical evidence for the role of traits in large samples of children with and without ASD. The analysis of between-group differences indicates the expected large mean-level differences. In addition, the extended tests corroborate the spectrum hypothesis because the observed similarities across groups and in particular the similarity of the nomological network suggest comparable links between traits and maladjustment in low and high ASD children and in children with and without autism. These findings underscore the viability of a trait approach to autism, suggesting that both temperament and personality assessment are promising additional tools for screening and identification of children with autism at risk for developing adjustment problems.

Acknowledgments This research was supported by a Ph.D. research grant from the National Fund of Scientific Research-Flanders awarded to the first author (Grant nr: 1.1.212.08.N.01). The authors wish to thank Marcia Verhulst for her assistance in the data collection, the autism services centers and all the families that contributed their time to this research.

References

Achenbach, T. M. (1991). *Integrative guide for the 1991 CBCL-4-18, YSR, and TRF profiles*. Burlington, VT: University of Vermont, Department of Psychiatry.

Aiken, L., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park: Sage Publications.

Anckarsater, H., Stahlberg, O., Larson, T., Hakansson, C., Jutblad, S. B., Niklasson, L., et al. (2006). The impact of ADHD and autism spectrum disorders on temperament, character, and personality development. *American Journal of Psychiatry, 163*, 1239–1244.

Austin, E. J. (2005). Personality correlates of the broader autism phenotype as assessed by the Autism Spectrum Quotient (AQ). *Personality and Individual Differences, 38*, 451–460.

Bailey, D. B., Hatton, D. D., Mesibov, G., Ament, N., & Skinner, M. (2000). Early development, temperament, and functional impairment in autism and fragile X syndrome. *Journal of Autism and Developmental Disorders, 30*, 49–59.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Boston: MIT Press/Bradford Books.

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*, 5–17.

Bryson, S. E., & Smith, I. M. (1998). Epidemiology of autism: Prevalence, associated characteristics, and implications for research and service delivery. *Mental Retardation and Developmental Disabilities Research Reviews, 4*, 97–103.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annual Review of Psychology, 56*, 453–484.

Caspi, A., & Shiner, R. L. (2006). Personality development. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 300–364). New York: Wiley.

De Pauw, S. S. W., & Mervielde, I. (2010). Temperament, personality and developmental psychopathology: A review based on the conceptual dimensions underlying childhood traits. *Child Psychiatry and Human Development, 41*, 313–329.

De Pauw, S. S. W., Mervielde, I., & Van Leeuwen, K. G. (2009). How are traits related to problem behavior in preschoolers? Similarities and contrasts between temperament and personality. *Journal of Abnormal Child Psychology, 37*, 309–325.

Eaves, L. C., Ho, H. H., & Eaves, D. M. (1994). Subtypes of autism by cluster-analysis. *Journal of Autism and Developmental Disorders, 24*, 3–22.

Ellis, L. K. (2002). Individual differences and adolescent psychosocial development. Unpublished doctoral dissertation, University of Oregon, Eugene.

Ellis, L. K., & Rothbart, M. K. (2001). *Revision of the early adolescent temperament questionnaire.* Paper presented at the 2001 biennial meeting of the Society for Research in Child Development, Minneapolis, MN.

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

Fan, X. T., & Thompson, B. (2001). Confidence intervals about score reliability coefficients, please: An EPM guidelines editorial. *Educational and Psychological Measurement, 61*, 517–531.

Garon, N., Bryson, S., Zwaigenbaum, L., Smith, I., Brian, J., Roberts, W., et al. (2009). Temperament and its relationship to autistic symptoms in a high-risk infant sib cohort. *Journal of Abnormal Child Psychology, 37*, 59–78.

Hartman, C. A. (2000). *Dutch translation of the early adolescent temperament questionnaire. Internal report*. The Netherlands: Department of Psychiatry, University of Groningen.

Hepburn, S. L. (2003). Clinical implications of temperamental characteristics in young children with developmental disabilities. *Infants and Young Children, 16*, 59–76.

Hepburn, S. L., & Stone, W. L. (2006). Using Carey temperament scales to assess behavioral style in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 36*, 637–642.

Janes, J. (2001). *Executive function, emotion regulation, and maternal report of child temperament in children with PDD*. Unpublished Master of Arts Thesis, University of Guelph, Guelph, ON, Canada.

Konstantareas, M. M., & Stewart, K. (2006). Affect regulation and temperament in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 36*, 143–154.

Landry, R. (2000). Autism: Attentional disengagement and its relationship to temperament. *Dissertation Abstracts International, Section B: The Sciences & Engineering, 60*, 4231.

Leyfer, O. T., Folstein, S. E., Bacalman, S., Davis, N. O., Dinh, E., Morgan, J., et al. (2006). Comorbid psychiatric disorders in children with autism: Interview development and rates of disorders. *Journal of Autism and Developmental Disorders, 36*, 849–861.

Majdandzic, M., & van den Boom, D. C. (2007). Multimethod longitudinal assessment of temperament in early childhood. *Journal of Personality, 75*, 121–167.

McCrae, R. R., & Costa, P. T. (1987). Validation of the 5-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52*, 81–90.

McCrae, R. R., Costa, P. T., Ostendorf, F., Angleitner, A., Hrebickova, M., Avia, M. D., et al. (2000). Nature over nurture: Temperament, personality, and life span development. *Journal of Personality and Social Psychology, 78*, 173–186.

Mervielde, I., De Clercq, B., De Fruyt, F., & Van Leeuwen, K. (2005). Temperament, personality, and developmental psychopathology as childhood antecedents of personality disorders. *Journal of Personality Disorders, 19*, 171–201.

Mervielde, I., De Clercq, B., De Fruyt, F., & Van Leeuwen, K. (2006). Temperament and personality as broad-spectrum antecedents of psychopathology in childhood and adolescence. In T. A. Widiger, E. Simonsen, P. J. Sirovatka, & D. A. Regier (Eds.), *Dimensional models of personality disorders. Refining the research agenda for DSM-V* (pp. 85–109). Washington, DC: American Psychiatric Association.

Mervielde, I., & De Fruyt, F. (2002). Assessing children's traits with the hierarchical personality inventory for children. In B. De Raad & M. Perugini (Eds.), *Big five assessment* (pp. 129–146). Seattle: Hogrefe & Huber Publishers.

Muris, P., & Ollendick, T. H. (2005). The role of temperament in the etiology of child psychopathology. *Clinical Child and Family Psychology Review, 8*, 271–289.

Myles, B. S., Lee, H. J., Smith, S. M., Tien, K. C., Chou, Y. C., Swanson, T. C., et al. (2007). A large-scale study of the characteristics of Asperger syndrome. *Education and Training in Developmental Disabilities, 42*, 448–459.

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 47*, 395–422.

O'Connor, B. P. (2002). The search for dimensional structure differences between normality and abnormality: A statistical review of published data on personality and psychopathology. *Journal of Personality and Social Psychology, 83*, 962–982.

Ozonoff, S., Garcia, N., Clark, E., & Lainhart, J. E. (2005). MMPI-2 personality profiles of high-functioning adults with autism spectrum disorders. *Assessment, 12*, 86–95.

Putnam, S. P., & Rothbart, M. K. (2006). Development of short and very short forms of the children's behavior questionnaire. *Journal of Personality Assessment, 87*, 102–112.

Ratekin, C. (1993). *Comparison of temperament ratings in children with autism, children with mental retardation, and typical children*. Paper presented at the biennial meeting of the Society for Research in Child Development.

Rettew, D. C., & McKee, L. (2005). Temperament and its role in developmental psychopathology. *Harvard Review of Psychiatry, 13*, 14–27.

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychological Bulletin, 126*, 3–25.

Rothbart, M. K. (2007). Temperament, development, and personality. *Current Directions in Psychological Science, 16*, 207–212.

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology, 78*, 122–135.

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*, 1394–1408.

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99–166). New York: Wiley.

Rutter, M., Bailey, A., Lord, C., & Berument, S. K. (2003). *Social communication questionnaire*. Los Angeles, CA: Western Psychological Services.

Schwartz, C. B., Henderson, H. A., Inge, A. P., Zahka, N. E., Coman, D. C., Kojkowski, N. M., et al. (2009). Temperament as a predictor of symptomotology and adaptive functioning in adolescents with high-functioning autism. *Journal of Autism and Developmental Disorders, 39*, 842–855.

Sheeber, L. B., & Johnson, J. H. (1994). Evaluation of a temperament-focused, parent-training program. *Journal of Clinical Child Psychology, 23*, 249–259.

Shiner, R., & Caspi, A. (2003). Personality differences in childhood and adolescence: Measurement, development, and consequences. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 44*, 2–32.

Tackett, J. L. (2006). Evaluating models of the personality-psychopathology relationship in children and adolescents. *Clinical Psychology Review, 26*, 584–599.

Van Leeuwen, K. G., Mervielde, I., De Clercq, B. J., & De Fruyt, F. (2007). Extending the spectrum idea: Child personality, parenting and psychopathology. *European Journal of Personality, 21*, 63–89.

Verhulst, F. C., Van der Ende, J., & Koot, H. M. (1996). *Handleiding voor de CBCL/4-18.* [Manual of the CBCL/4-18.] Erasmus Universiteit Rotterdam: Afdeling Kinder-en Jeugdpsychiatrie.

Wakabayashi, A., Baron-Cohen, S., & Wheelwright, S. (2006). Are autistic traits an independent personality dimension? A study of the Autism-Spectrum Quotient (AQ) and the NEO-PI-R. *Personality and Individual Differences, 41*, 873–883.

Warreyn, P., Raymakers, R., & Roeyers, H. (2004). *Vragenlijst Sociale Communicatie. [Dutch translation of the Social Communication Questionnaire]*. Destelbergen: SIG.

Wing, L. (1997). The autistic spectrum. *Lancet, 350*, 1761–1766.

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience, 23*, 143–152.