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Temperament, Character, and Personality Disorders in Adults with Autism Spectrum Disorder: a Systematic Literature Review and Meta-analysis

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Abstract

This article offers a systematic review of studies of personality and the dimensions of temperament and character, personality pathology, and personality disorders (PDs) in adults with autism spectrum disorder (ASD). Fifteen studies met the inclusion criteria for the review, from which seven studies were meta-analyzed. Results indicate that ASD is significantly and systematically associated with an introvert, rigid, passive-dependent temperament with low novelty seeking, high harm avoidance, low reward dependence and high persistence, and with an immature and poorly developed character with low self-directedness, low cooperativeness, and high self-transcendence. The review further finds a positive correlation between ASD (severity) and neuroticism and a negative correlation between ASD (severity) and extraversion, openness to experience, agreeableness, and conscientiousness. It also finds a positive correlation with paranoid, schizoid, schizotypal, avoidant, and obsessive-compulsive PDs. However, the far from perfect associations indicate there is considerable variation between people with ASD in their personality and personality pathology. In order to obtain a comprehensive picture of an individual with ASD and to implement the most effective intervention plans for and therapeutic relationship with adults with ASD, temperament, character, and comorbid personality pathology and PDs should be considered.

Keywords Autism spectrum disorder · Asperger's disorder · Personality disorder · Temperament · Character

Introduction

There is a developing but still small amount of literature on personality and its dimensions of temperament and character and on personality pathology and personality disorders (PDs) in adults with autism spectrum disorder (ASD). Many researchers have independently studied these concepts in adults with ASD,

but no systematic reviews on this research have been carried out. The purpose of this systematic review is to summarize the existing research on personality and personality pathology in adults with ASD and to conduct a meta-analysis of temperament, character, and PDs in adults with ASD. Implications for future research and clinical practice are discussed.

We first define ASD, personality, temperament, character, and PDs. Personality and its dimensions of temperament and character are present in all people, including those with ASD. This might account for and could advance our understanding of the considerable heterogeneity within the ASS-phenotype resulting from multiple possible etiological factors and various clinical presentations in severity, cognitive style, and concurrent comorbid conditions (De Pauw et al. 2011; Lai and Baron-Cohen 2015; Landry and Chouinard 2016; Schriber et al. 2014; Schwartzman et al. 2016). The study of personality, temperament, character, and PDs could significantly improve our understanding of adults with ASD. A greater understanding of these concepts within this population may contribute to a comprehensive picture of people with ASD and of the potential for effective interaction, intervention, and therapeutic relationship.

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Autism Spectrum Disorder

Based on the most recent update of the Diagnostic and Statistical Manual (DSM-5; American Psychological Association 2013), with its onset in childhood (but sometimes not becoming fully manifest until social demands exceed limited capacities, or being masked by learned strategies in later life), ASD is an impairing neurodevelopmental disorder with social problems as a key symptom. Persons with ASD show persistent deficits in social communication and social interaction and restricted, repetitive patterns of behavior, interests and activities (APA 2013). The participants with ASD in the studies reviewed here were all diagnosed with the former DSM-IV pervasive developmental disorders, individually classified as autistic disorder (AD), Asperger's disorder (AS), and pervasive developmental disorder not otherwise specified (PDD-NOS) (APA 2000). All three have now been incorporated into and replaced by DSM-5 autism spectrum disorder.

Apart from the behavioral level, ASD is associated with cognitive limitations and deficits in social cognition and social perception (theory of mind), executive functions, and bottom-up and top-down (local vs. global) information processing (central coherence) (see Hutchins et al. 2016; Lai and Baron-Cohen 2015). ASD affects approximately 0.6 to 1% of the general population (Brugha et al. 2011; Elsabbagh et al. 2012; Fombonne 2005) and can be seen as a lifelong disorder causing significant lifetime disabilities (Shattuck et al. 2007). Both clinical practice and epidemiological research show that more than 70% of individuals with ASD have concurrent medical, developmental, or psychiatric conditions (like PDs) (Buck et al. 2014; Croen et al. 2015; Hofvander et al. 2009; Lai and Baron-Cohen 2015; Lugnegård et al. 2011; Mannion and Leader 2013; Supekar et al. 2017; Tebartz Van Elst et al. 2013). Above all, ASD is still associated with a poorly detectable pathophysiology and an unclear etiology, course, prognosis, and treatment (Verhoeff 2015; Waterhouse et al. 2016).

Personality

There are several ways to define personality. Millon (1981, p. 8) defines personality as a complex pattern of deeply embedded psychological characteristics that are largely unconscious, cannot be eradicated easily, and express themselves automatically in almost every facet of functioning. Intrinsic and pervasive, these traits emerge from a complicated matrix of biological dispositions and experiential learnings and now comprise the individual's distinctive pattern of perceiving, feeling, thinking, and coping. Costa and McCrae (1990, p. 23) define personality traits as dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings, and actions. Their five-factor-model of personality consists of

neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness (Costa and McCrae 1990). Cloninger developed a psychobiological model of the structure and development of personality, conceptualized as the combination of and interaction between temperament and character (Cloninger et al. 1993) as the two major domains of personality, whereby temperament is close to biological substrates and character is influenced by social-cultural factors (Strelau 2001). Any of the combinations may be found in well-functioning as well as in personality disordered individuals (Svarkic et al. 1993). When there is a problematic innate temperament and/or a problematic development of character, this may develop into a PD.

Temperament

Temperament refers to those aspects of an individual's personality that are often regarded as the result of biological evolution, initially constitutionally based rather than learned (Strelau 1983). Temperament can be described as a combination of a certain level of activity, a tolerance for feelings, a certain degree of vitality, and a certain degree of extraversion/introversion, based on biological processes. The individual has a temperament from the moment he is born. The baby shapes his social environment with his temperament, and this temperament is conversely influenced by the environment. Research indicates that it is a misunderstanding to assume that temperament is insensitive to changes over time; it has been found to be as changeable as personality traits (Roberts and DelVecchio 2000; Roberts et al. 2007). Many classification schemes for temperament have been developed, but there is still no general consensus. In this review, we will define temperament on the basis of the *Temperament and Character Inventory* (TCI; Cloninger et al. 1994), which is based on Cloninger's "psychobiological theory" of personality (Cloninger et al. 1993). The temperament scales of the TCI include the following: novelty seeking (exploratory excitability, impulsiveness, extravagance, disorderliness), harm avoidance (anticipatory worry, fear of uncertainty, shyness, fatigability, asthenia), reward dependence (sentimentality, attachment, dependence), and persistence. The complex interaction between temperament and social environment influences the formation of what is called "character." Certain temperament profiles can complicate a healthy character development, contributing to the development of PDs in adulthood (Anckarsäter et al. 2006).

Character

There are also several ways to define character. In contrast to temperament, character is theorized as less heritable, later developing, influenced by processes of maturation, and

representing individual differences in self-object relationships (Cloninger et al. 1998). Allport (1937, p. 52) stated that “character is personality evaluated.” A healthy character is described by Cloninger et al. (1993) and Svarkic et al. (1993) as a maturity of personality in relation to self (self-directedness), to others (cooperativeness), and to a unique wholeness (self-transcendence). Character on the basis of the TCI (Cloninger et al. 1994) includes the following: self-directedness (responsibility, purposefulness, resourcefulness, self-acceptance, congruent second nature), cooperativeness (social acceptance, empathy, helpfulness, compassion, pure-hearted), and self-transcendence (self-forgetful, transpersonal identification, spiritual acceptance).

Personality Disorder

Personality disorders are associated with ways of thinking and feeling about oneself and others, interpersonal functioning, and controlling impulses that significantly and adversely affect how a person functions in many aspects of life. A PD is an enduring, pervasive, inflexible, and time-stable pattern of inner experience and behavior that deviates markedly from the expectations of the individual’s culture, resulting in distress and/or impairment (APA 2013).

Current Review

The purpose of the current review and meta-analysis is to provide a literature overview of how personality and its dimensions of temperament and character, as well as personality pathology and PDs have been studied in adults with ASD, and to conduct meta-analyses of temperament, character, and PDs in adults with ASD. We first examine participant characteristics like age, gender, diagnosis, IQ, and settings (e.g., psychiatric clinics). We then examine types of measures used to assess temperament, character, and PDs in adults with ASD (i.e., self-report, questionnaires) and the types of statistical methods and results concerning statistical significance in the included studies. We conduct a detailed review of the outcomes and key findings of the included studies. We report the results of meta-analyses linking temperament and character dimensions and PDs to adults with ASD. Two West-European studies investigating PD prevalence rates for the general population are included as well: these two studies were selected because PDs in adults with ASD have only been examined in Europe so far. Meta-analyses were performed on each of the TCI dimensions and on each of the ten DSM-IV PDs individually using fixed-effect models due to the small number of included studies (Borenstein et al. 2009, p. 84). In our discussion, we evaluate the outcomes, identify limitations, and suggest future directions for research and clinical practice.

Method

Search Strategy

This review is based on a systematic search of articles between February 1996 and February 2016. Searches were conducted in two electronic databases: Ovid MEDLINE 1996 to present, and Embase 1996 to present, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Moher et al. 2009). In these databases, the search was limited to articles written in English and published in peer-reviewed journals. The keyword fields in these databases were searched using various forms and combinations of the terms autism*, autism spectrum disorder*, Asperger syndrome*, pervasive developmental disorder*, personality*, personality disorders*, temperament*, and character*. The asterisk after a term means that all terms that begin with that root were included in the search. After the search, the titles, abstracts, and keywords of the identified articles were screened for possible inclusion. Next, the reference lists of the studies that met inclusion criteria were reviewed to identify additional studies for inclusion. Finally, additional studies were identified by searching the reference list of the studies that met inclusion criteria and which were already known to the first author. Two West-European studies investigating PD prevalence rates for the general population (Barnow et al. 2010; Coid et al. 2006) were identified in Torgersen (2012).

Inclusion and Exclusion Criteria

Studies were included if they met three inclusion criteria. First, original surveys on adults diagnosed with an ASD based on any DSM (III, III-R, IV, IV-TR, or 5), aged 16 and over (within a study population of at least adult mean age/18 years), and with a Full Scale IQ or Verbal IQ of 70 and above (without intellectual impairment). In studies in which IQ data were not reported, the participant had to be diagnosed with Asperger syndrome or high-functioning autism (HFA). Second, the study had to examine participants’ possible personality (i.e., temperament and character) and/or PD. Finally, the study had to contain systematic data-collection procedures (e.g., structured questionnaires and tests).

Studies were excluded for four reasons: first, studies with adult participants not diagnosed with ASD (Austin 2005; Bejerot et al. 2001; Butler et al. 2015; Eryigit-Madzwamuse et al. 2014; Hurst et al. 2007; Kadak et al. 2015; Kunihiro et al. 2006; Mealy et al. 2014; Picardi et al. 2015; Pisula et al. 2015; Wakabayashi et al. 2006); second, studies that examined autistic traits in participants with PDs not diagnosed with ASD (Rydén et al. 2008); third, studies that targeted temperament and character aspects in children and adolescents with ASD (Barger et al. 2014; Barneveld et al. 2011; De Pauw et al. 2011; Kerekes et al. 2013; Schwartz et al. 2009); and finally,

a study with adults with ASD already included in an earlier study by the same author (Sizoo et al. 2015) was excluded as it did not yield additional data.

In the end, 15 studies, including one Dutch study with an English abstract by the first author, were selected for inclusion in this review: Anckarsäter et al. (2006), Hesselmark et al. (2015), Hofvander et al. (2009), Kanai et al. (2011a, b), Ketelaars et al. (2008), Lugnegård et al. (2012), Ozonoff et al. (2005), Rydén and Bejerot (2008), Schriber et al. (2014), Schwartzman et al. (2016), Sizoo et al. (2009), Soderstrom et al. (2002), Strunz et al. (2015), and Vuijk et al. (2012). Meta-analyses were performed on each of the TCI dimensions across four studies by Anckarsäter et al. (2006), Sizoo et al. (2009), Soderstrom et al. (2002), and Vuijk et al. (2012) and on each of the ten DSM-IV PDs individually across four studies by Anckarsäter et al. (2006), Hofvander et al. (2009), Ketelaars et al. (2008), and Lugnegård et al. (2012).

Data Extraction

The following features of the included studies were extracted: (1) authors, (2) aims of the study, (3) characteristics of participants with ASD (total number of participants, age, sex, setting, country), as well as type of comparison group(s), (4) personality measures used, (5) statistical methods used and results concerning significance, and (6) outcomes. Some studies had several aims, research questions, and outcomes (e.g., Anckarsäter et al. 2006; Hofvander et al. 2009; Kanai et al. 2011b; Ozonoff et al. 2005; Rydén and Bejerot 2008; Schriber et al. 2014; Hesselmark et al. 2015; Schwartzman et al. 2016): we decided to describe only the aims, research questions, and outcomes relevant to the topic of this review.

The initial literature search in the two databases resulted in a total of 805 records. Excluding duplicates of the 805 records led to a total of 742 unique records. Seven additional records were identified through other sources: 3 by searching the reference list of the studies that met inclusion criteria (Kanai et al. 2011a, b; Wakabayashi et al. 2006) and 4 which were already known to the first author (Austin 2005, Barger et al. 2014; Ozonoff et al. 2005; Picardi et al. 2015). This led to a total of 749 records. Using the inclusion and exclusion criteria, a total of 33 studies of 749 were further screened for possible inclusion on the basis of title, keywords, and abstracts. After this initial screening, 15 studies were identified for possible inclusion. The first and second authors applied the inclusion criteria to the list of 15 potential studies. Agreement was obtained on 15 of the 15 studies. See Fig. 1 for the flow diagram of the search strategy.

After the list of included studies was agreed upon, the first author extracted information to summarize the studies. The accuracy of these initial summaries was independently verified by the second author using a checklist including the summary of the study and four questions on the accuracy of the

summary, specifically: (1) is this an accurate description for the topic of our review? (2) Is this an accurate description of included participants? (3) Is this an accurate summary of the results? (4) Is this an accurate summary of the statistical methods used and classification of significance? There were 60 items on which there could be initial agreement (i.e., 15 studies with 4 questions per study). Initial agreement was obtained on all items.

Results

Participants

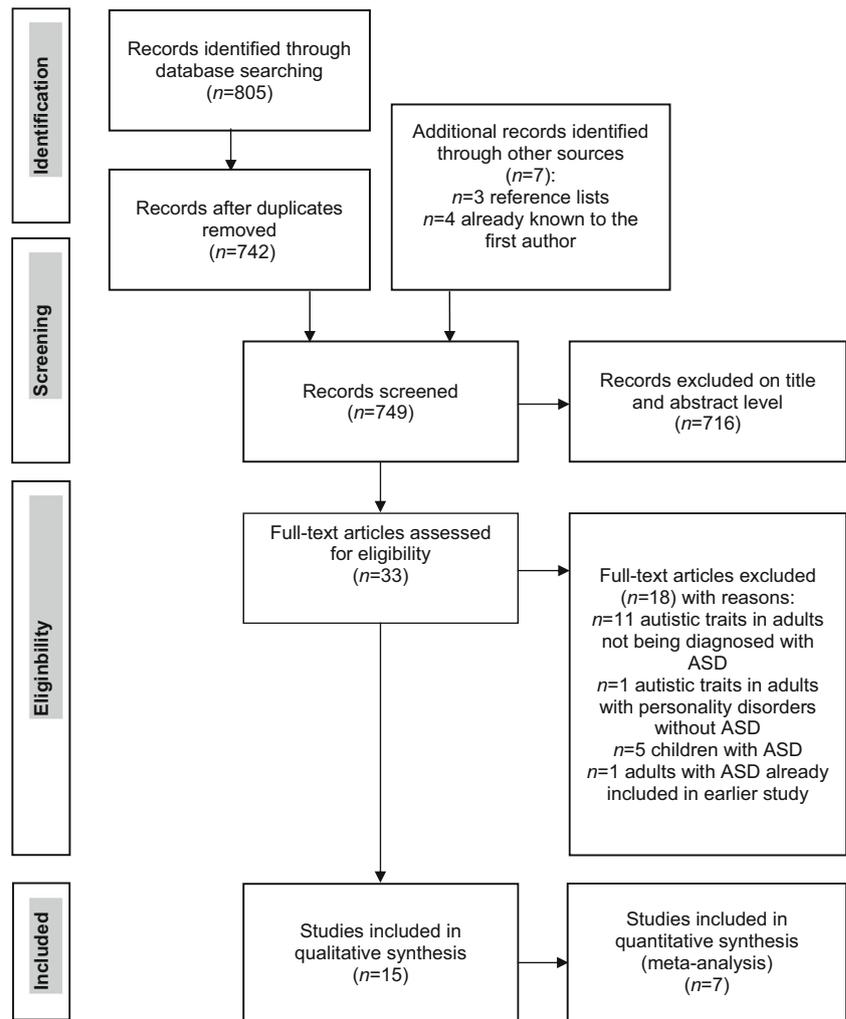
A total number of 992 persons with ASD participated in the studies and 991 of them (99.9%) met the inclusion criteria for participants. The sample size of the studies ranged from 15 to 152. Among the 992 included participants, gender was specified for 707 (71.8%): 481 were male (68%), 226 were female (32%). In two studies (Anckarsäter et al. 2006; Ozonoff et al. 2005), gender was not specified for 133 of the participants with ASD. In one study (Schwartzman et al. 2016), gender was only specified for ASD ($n = 152$) and non-ASD ($n = 676$) participants together ($n = 828$; 73% were female, 24% were male, and 3% choose other). The participants ranged in age from 16 to 87 years old. In one study (Vuijk et al. 2012), participants' ages ranged from 15 to 72 years, but this study was nevertheless included because the mean age ($M = 38$ years) met our inclusion criteria: only one participant (15 years) was under the age of 16. Thirty-one participants were diagnosed with autistic disorder (3.1%), 463 with Asperger's disorder (46.7%), 181 with PDD-NOS or atypical autism (18.2%), and 317 with high-functioning autism (HFA) or were diagnosed with having ASD, classified as autistic disorder, Asperger syndrome, or PDD-NOS, but without specified numbers of participants (32%): see Table 1. All of the included participants had a Full Scale IQ or Verbal IQ of 70 or above, based on IQ test or level of education.

A total number of controls cannot be given. Four studies used norm groups (Anckarsäter et al. 2006; Sizoo et al. 2009; Soderstrom et al. 2002; Vuijk et al. 2012). Eight studies used non-ASD participants as controls (Hesselmark et al. 2015; Kanai et al. 2011a, b; Ketelaars et al. 2008; Ozonoff et al. 2005; Rydén and Bejerot 2008; Schriber et al. 2014; Strunz et al. 2015). Three studies had no non-ASD control group (Hofvander et al. 2009; Lugnegård et al. 2012; Schwartzman et al. 2016). All controls were age-, sex-, and IQ-/education-matched to the participants with ASD (the experimental group).

Settings

The setting was specified in all studies. The most often reported settings were outpatient (neuro)psychiatric clinics

Fig. 1 PRISMA flow diagram of selected studies



(Hofvander et al. 2009; Hesselmark et al. 2015; Kanai et al. 2011a, b; Soderstrom et al. 2002; Rydén and Bejerot 2008; Lugnegård et al. 2012; Strunz et al. 2015; Vuijk et al. 2012) including child and adolescent neuropsychiatric clinics where patients participated in an adult project and where previous patients were recruited (Anckarsäter et al. 2006; Lugnegård et al. 2012; Ozonoff et al. 2005). Outpatient centers of expertise (Ketelaars et al. 2008; Sizoo et al. 2009; Vuijk et al. 2012) were also present. Three studies recruited participants from local physicians, psychologists, speech and language pathologists, occupational therapists, advocating groups, regional centers, ASD support groups, ASD websites, or electronic and paper-based flyers (Hesselmark et al. 2015; Schriber et al. 2014; Schwartzman et al. 2016).

Types of Personality Measures Used in the Included Studies

A total of 15 personality measures were used across the 15 studies; 67% ($n = 10$) of the studies included one personality

measure, 33% ($n = 5$) of the studies included two personality measures. As shown in Table 2, all measures were used by only one study except for three: (1) the *NEO Personality Inventory-Revised* (NEO-PI-R) was used in two studies (Hesselmark et al. 2015; Strunz et al. 2015); (2) the *Structured Clinical Interview for DSM-IV Personality Disorders* (SCID-II) was used in three studies (Anckarsäter et al. 2006; Hofvander et al. 2009; Lugnegård et al. 2012); and (3) the *Temperament and Character Inventory* (TCI) was used in three studies (Anckarsäter et al. 2006; Soderstrom et al. 2002; Vuijk et al. 2012). Eighty-seven per cent ($n = 13$) of the personality measures were self-report questionnaires, and 13% ($n = 2$) were a structured interview. Table 2 shows the 15 personality measures used in the included studies.

Statistical Methods Used and Classification of Significance

A total of seven statistical methods were used across the 15 studies. Four studies used a one-sample t test with a cross-

Table 1 Number of ASD diagnosis of the participants and number of controls in the included studies

	Autistic disorder	Asperger's disorder	PDD-NOS atypical autism	ASD HFA	Total ASD participants	Total controls
Soderstrom et al. (2002)		31			31	Not indicated (norm group)
Ozonoff et al. (2005)				20	20	24
Anckarsäter et al. (2006)	6	46	61		113	Not indicated (norm group)
Ketelaars et al. (2008)		4	10	1	15	21
Rydén and Bejerot (2008)	5	51	28		84	46
Hofvander et al. (2009)	5	62	50		117	None
Sizoo et al. (2009)				75	75	657 (norm group)
Kanai et al. (2011a)		55			55	57
Kanai et al. (2011b)		64			64	65
Lugnegård et al. (2012)		54			54	None
Vuijk et al. (2012)	15	26	27		68	447 (norm group)
Schriber et al. (2014)		21	5	11	37	42
Hesselmark et al. (2015)				48	48	53
Strunz et al. (2015)		49		10	59	248
Schwartzman et al. (2016)				152	152	None
Total	31 3.1%	463 46.7%	181 18.2%	317 32%	992	–

PDD-NOS pervasive developmental disorder not otherwise specified, *ASD* autism spectrum disorder, *HFA* is high-functioning autism, i.e., characterized by cognitively “higher functioning” (with an IQ of 70 or above) than other people with ASD

sectional design (Anckarsäter et al. 2006; Sizoo et al. 2009; Soderstrom et al. 2002; Vuijk et al. 2012). Four studies used an independent samples *t* test (Hesselmark et al. 2015; Ozonoff et al. 2005; Schriber et al. 2014; Schwartzman et al. 2016). Three studies used a chi-square test (Hofvander et al. 2009; Ketelaars et al. 2008; Lugnegård et al. 2012). One study used a Kruskal-Wallis test (Rydén and Bejerot 2008), one used a Spearman's rank correlation coefficient (Kanai et al. 2011a), one a Mann-Whitney *U* test (Kanai et al. 2011b), and one a MANOVA (Strunz et al. 2015).

Eleven studies (73.3%) reported significant results (Anckarsäter et al. 2006; Hofvander et al. 2009; Kanai et al. 2011a, b; Rydén and Bejerot 2008; Schriber et al. 2014; Sizoo et al. 2009; Soderstrom et al. 2002; Strunz et al. 2015; Schwartzman et al. 2016; Vuijk et al. 2012). Three studies (20%) reported effect sizes and exploratory and descriptive

results, because of small sample sizes (Ketelaars et al. 2008; Lugnegård et al. 2012; Ozonoff et al. 2005). One study (6.7%) that tested validity and reliability using the NEO-PI-R reported satisfactory results supporting the use of self-reported measures when assessing adults with ASD (Hesselmark et al. 2015).

Outcomes and Summary of Key Findings

Table 3 provides a summary of aims of study, characteristics of participants with ASD, characteristics of comparison group, personality measures used, statistical methods used and results concerning significance, and the outcomes relevant for the topic of this review, for each of the 15 included studies.

Table 2 Personality measures used in the included studies

Personality measure	Method	Studies that used measure
BFI (Big Five Inventory; John et al. 2008)	Self-report questionnaire	Schriber et al. (2014)
DAPP-BQ (Dimensional ASSESSment of Personality Pathology-Basic Questionnaire; Livesley and Jackson 2009)	Self-report questionnaire	Strunz et al. (2015)
DSM-IV-based clinical interview (not specified, unknown author)	Structured interview	Hofvander et al. (2009)
EPQ (Eysenck Personality Questionnaire; Eysenck and Eysenck 1975)	Self-report questionnaire	Kanai et al. (2011a)
IPDE (International Personality Disorder Examination; Loranger et al. 1994)	Self-report questionnaire	Ketelaars et al. (2008)
IPIP-NEO-120 (International Personality Item Pool Representation of the NEO-PI-R; Johnson 2014)	Self-report questionnaire	Schwartzman et al. (2016)
MMPI-2 (Minnesota Multiphasic Personality Inventory – Second edition; Butcher et al. 2001)	Self-report questionnaire	Ozonoff et al. (2005)
NEO-FFI (NEO Five-Factor Inventory; Costa and McCrae 1992)	Self-report questionnaire	Kanai et al. (2011b)
NEO-PI-R (NEO Personality Inventory-Revised; Costa and McCrae 1992)	Self-report questionnaire	Hesselmark et al. (2015) Strunz et al. (2015)
SCID-II screen (Structured Screening for DSM-IV Personality Disorders; First et al. 2004)	Self-report questionnaire	Rydén and Bejerot (2008)
SCID-II (Structured Clinical Interview for DSM-IV Personality Disorders; First et al. 2004)	Structured interview	Anckarsäter et al. (2006) Hofvander et al. (2009) Lugnegård et al. (2012)
SPQ (Schizotypal Personality Questionnaire; Raine 1991)	Self-report questionnaire	Kanai et al. (2011a)
SSP (Swedish Universities Scales of Personality; Gustavsson et al. 2000)	Self-report questionnaire	Rydén and Bejerot (2008)
TCI (Temperament and Character Inventory; Cloninger et al. 1994)	Self-report questionnaire	Soderstrom et al. (2002) Anckarsäter et al. (2006) Vuijk et al. (2012)
VTCI (Short version of Temperament and Character Inventory; Cloninger et al. 1994)	Self-report questionnaire	Sizoo et al. (2009)

Personality Pathology and Personality Disorders

Rydén and Bejerot (2008) compared personality traits in patients with ASD to a psychiatric control group and compared differences of personality traits between females and males in the ASD group. This study showed that patients with ASD had significantly more schizotypal and avoidant personality traits, higher rates on Stress-susceptibility, Embitterment, Detachment, Trait irritability, and Lack of assertiveness than controls. Females with ASD scored significantly higher than

males on borderline and passive-aggressive traits and on Embitterment and Trait irritability, showing that patients with ASD have a gender-specific personality profile.

Schriber et al. (2014) examined whether ASD and typically developing (TD) individuals showed different personality trait levels. Individuals with ASD, both men and women, were significantly more neurotic and less extraverted, agreeable, conscientious and open to experience. Kanai et al. (2011a) also found significantly higher scores on Neuroticism and lower scores on Extraversion of the EPQ in adults with

Table 3 Summary and analysis of included studies

Study	Aims of study	Participants with ASD (n, ASD diagnosis, age, sex, IQ, setting, country)	Comparison group (n, age, sex, setting)	Personality measures	Statistical methods and results concerning significance	Outcomes relevant to the topic of this review
Soderstrom et al. (2002)	To study the personality characteristics of adults with Asperger’s disorder and to investigate the value of self-rating personality inventories	n = 31 (Asperger: 31) Age range: 17–55 years (mean 23) Sex: 28 male, 3 female IQ ≥ 85 Setting: outpatient child neuropsychiatric clinic Country: Sweden	Age- and sex-matched norm groups not further specified	Temperament and Character Inventory (TCI)	One-sample <i>t</i> test Significant results	Adults with Asperger’s disorder scored significantly higher on Harm avoidance and Self-transcendence and lower on Novelty seeking, Reward dependence, Self-directedness, and Cooperativeness compared to the norm group
Ozonoff et al. (2005)	To explore personality and psychopathology in patients with ASD compared to age-, intelligence-, and gender-matched college students	n = 20 (autism spectrum disorder/high-functioning autism: 20) Age range: 18–40 years (mean 23) Sex: 85% male, 15% female IQ range: 73–129 Setting: university child and adolescent specialties clinic Country: USA	n = 24 Age range: 18–29 years (mean 20) Sex: 75% male, 25% female IQ range: 82–127 Setting: introductory psychology class at University of Utah	Minnesota Multiphasic Personality Inventory–Second edition (MMPI-2)	Independent samples <i>t</i> test No significant results	Patients with ASD scored higher on Depression and Social introversion, Social discomfort, Repression and Personality Psychopathology Five (PSY-5) scale Introversion compared to control group
Anckarsäter et al. (2006)	To describe personality development and disorders in relation to symptoms of attention deficit hyperactivity disorders (ADHD) and autism spectrum disorders (ASD)	n = 113 (Autistic disorder: 6; Asperger: 46; Atypical autism: 61) (ASD only: 66; ASD-ADHD: 47) Age range: 19–60 years (mean 31) Sex: not specified IQ: not indicated Setting: child neuropsychiatric clinic Country: Sweden	Age- and sex-matched norm groups not further specified	Temperament and Character Inventory (TCI); Structured Clinical Interview for DSM-IV Personality Disorders (SCID-II)	One-sample <i>t</i> test; significant	Patients with ASD reported lower Novelty seeking, lower Reward dependence, higher Harm avoidance and lower Self-directedness, lower Cooperativeness compared to the norm group. Cluster A and C PDs were common in patients with ASD
Ketelaars et al. (2008)	To investigate whether patients diagnosed with mild ASD and patients who were not diagnosed with ASD differed in terms of AQ-scores and Axis I and II disorders	n = 15 (Asperger: 4; PDD-NOS: 10; high-functioning autism: 1) Age range: 18–24.5 years (mean 22) Sex: 12 male, 3 female IQ: mean 104 Setting: outpatient center of expertise for autism Country: Netherlands	n = 21 Age range: 18–55.9 years (mean 27) Sex: 18 male, 3 female IQ: mean 105 Setting: Outpatient Center of Expertise for Autism	International Personality Disorder Examination (IPDE)	Chi-square test No significant results	ASD and non-ASD patients did not differ on individual Axis II personality disorders
Rydén and Bejerot (2008)	To compare demographical factors, psychiatric comorbidity, and personality traits in patients with ASD to a psychiatric control group and to compare differences of personality traits between females and	n = 84 (autistic disorder: 5; Asperger: 51; PDD-NOS: 28) Age range: not specified (mean 30) Sex: 45 male, 39 female IQ ≥ 70 Setting: neuropsychiatry unit at a hospital Country: Sweden	n = 46 Age range: not specified (mean 34) Sex: 21 male, 25 female IQ ≥ 70 Setting: neuropsychiatry unit at a hospital	SCID-II screen; Swedish Universities Scales of Personality (SSP)	Kruskal-Wallis test Significant results	Patients with ASD had significantly more schizotypal and avoidant personality traits, higher rates on Stress-susceptibility, Embitterment, Detachment, Trait irritability and Lack of assertiveness than controls. Females with ASD scored

Table 3 (continued)

Study	Aims of study	Participants with ASD (<i>n</i> , ASD diagnosis, age, sex, IQ, setting, country)	Comparison group (<i>n</i> , age, sex, setting)	Personality measures	Statistical methods and results concerning significance	Outcomes relevant to the topic of this review
	males in the ASD group					significantly higher than males on borderline and passive-aggressive traits and on Emberitterment and Trait irritability
Hofvander et al. (2009)	To assess autistic symptomatology according to the DSM-IV-criteria and the Gillberg and Gillberg research criteria, patterns of comorbid psychopathology, and psychosocial outcome in adults with normal intelligence ASD	<i>n</i> = 117 (autistic disorder: 5; Asperger: 62; PDD-NOS: 50) Age range: 16–60 years (mean 29) Sex: 77 male, 40 female IQ: normal intelligence Settings: Expert diagnostic centers focused on neuropsychiatric assessments of childhood disorders in adults Country: Sweden and France	Within comparison group (autistic disorder, Asperger's disorder and PDD-NOS)	Structured Clinical Interview for DSM-IV Personality Disorders (SCID-II); DSM-IV based clinical interview (not specified, unknown author)	Chi-square test Significant results	Obsessive-compulsive PD was significantly more common in the Asperger group, and antisocial PD in the PDD-NOS group. Frequency of personality disorders did not differ between men and women, with the exception of schizoid, which was significantly more common among the female subjects.
Sizoo et al. (2009)	To examine the temperament and character profiles of adults with ASD or ADHD with and without substance use disorder	<i>n</i> = 75 (autism spectrum disorder: 75 whose: 53 with no history of substance use disorder/SUD-, 8 with former substance use disorder/SUD ⁺ , 14 with current substance use disorder/SUD+) Age range: not specified (mean: 33 for SUD-, 34 for SUD ⁺ , 36 for SUD+) Sex: 60 male, 15 female IQ mean: 105 for SUD-, 98 for SUD ⁺ , 89 for SUD+ Settings: Two ASD- specialized Diagnostic Centers Country: Netherlands	<i>n</i> = 657 Age range: 16–90 years (mean 43.7) Sex: 43% men IQ: not indicated Setting: Well-defined external control group for the VTCI assessment	Dutch short version of Temperament and Character Inventory (VTCI)	One-sample <i>t</i> test Significant results	Adults with ASD had significantly higher scores for Harm avoidance, and Self-transcendence and lower scores for Reward dependence, Self-directedness, and Cooperativeness. Novelty seeking and Reward dependence were only significantly lower for adults with ASD and no history of substance use disorder. Self-transcendence was significantly higher in adults with ASD and current substance use disorder
Kanai et al. (2011a)	To examine the clinical characteristics of adults with Asperger's Disorder	<i>n</i> = 55 (Asperger: 55) Age range: 18–49 years (mean 27) Sex: 36 male, 19 female IQ: mean 109.4 Setting: diagnostic outpatient clinic at a university hospital Country: Japan	<i>n</i> = 57 Age range: 20–52 years (mean 28) Sex: 35 male, 22 female IQ: not indicated Settings: diagnostic outpatient clinic at a university hospital, several drug companies and a women's college	Japanese version of Schizotypal Personality Questionnaire (SPQ); Eysenck Personality Questionnaire (EPQ)	Spearman's rank correlation coefficient Significant results	Scores on SPQ and the Neuroticism and Psychoticism scores of the EPQ were significantly higher in adults with Asperger's Disorder than in controls. The Extraversion and Lie scores of the EPQ were significantly lower in adults with Asperger's disorder than in controls. The total score of the Autism Spectrum Quotient was

Table 3 (continued)

Study	Aims of study	Participants with ASD (<i>n</i> , ASD diagnosis, age, sex, IQ, setting, country)	Comparison group (<i>n</i> , age, sex, setting)	Personality measures	Statistical methods and results concerning significance	Outcomes relevant to the topic of this review
						correlated with 3 subscale scores (Unusual perceptual experiences, Odd or eccentric behavior, and Suspiciousness) of the SPQ in the Asperger’s disorder group, but not in the control group
Kanai et al. (2011b)	To examine the clinical characteristics of Asperger’s disorder in adults	<i>n</i> = 64 (Asperger: 64) Age range: 19–50 years (mean 32) Sex: 50 male, 14 female IQ range: 92–134 (mean 110) Setting: diagnostic outpatient clinic at a university hospital Country: Japan	<i>n</i> = 65 Age range: 19–57 years (mean 32) Sex: 52 male, 13 female IQ: not indicated Setting: diagnostic outpatient clinic at a university hospital	NEO Five-Factor Inventory (NEO-FFI)	Mann-Whitney <i>U</i> test Significant results	Neuroticism scores of the NEO-FFI were significantly higher in adults with Asperger’s disorder than in controls. The Extraversion, Agreeableness, and Conscientiousness scores of the NEO-FFI were significantly lower in adults with Asperger’s Disorder than in controls. Total score of the Autism Spectrum Quotient correlated with the Extraversion, Openness, and Conscientiousness subscale scores of the NEO-FFI in adults with Asperger’s disorder, but not in controls
Lugnegård et al. (2012)	To investigate the presence of possible PDs in young adults with Asperger’s disorder	<i>n</i> = 54 (Asperger: 54) Age range: not specified (mean 27) Sex: 26 male, 28 female IQ range: 73–143 (mean 102) Settings: outpatient clinic for adults with ASD and outpatient neuropsychiatric clinic for children and adolescents Country: Sweden	Within comparison group (male-female, and ASD with and without PD)	Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II)	Chi-square test No significant results	48% fulfilled criteria for a PD, all belonging to clusters A or C. Men with Asperger’s disorder met PD criteria much more often than women with Asperger’s disorder (65 vs 32%). Participants fulfilling criteria for a PD showed more marked autistic features according to the Autism Spectrum Quotient
Vuijk et al. (2012)	To map personality traits of persons with ASD	<i>n</i> = 68 (Autistic disorder: 15; Asperger: 26; PDD-NOS: 27) Age range: 15–72 years (mean 38) Sex: 68 male, 0 female IQ: at least normal intelligence	<i>n</i> = 447 Age range: 18–87 years (mean 44.2) Sex: 447 male, 0 female IQ: not indicated	Dutch version of Temperament and Character Inventory (TCI)	One-sample <i>t</i> test Significant results	Compared to the control group, men with ASD scored higher on Harm Avoidance, but lower on Novelty Seeking, Reward Dependence,

Table 3 (continued)

Study	Aims of study	Participants with ASD (<i>n</i> , ASD diagnosis, age, sex, IQ, setting, country)	Comparison group (<i>n</i> , age, sex, setting)	Personality measures	Statistical methods and results concerning significance	Outcomes relevant to the topic of this review
		Settings: Expertise Centre for Autism, and Department of Psychiatry at a University Hospital Country: Netherlands Age range: 18–40 years (mean 22) Sex: 22% female IQ range: 79–140 (mean 108) Settings: local physicians, psychologists, speech and language pathologists, occupational therapists, advocating groups, regional centers and ASD support groups Country: USA	Setting: well-defined external control group for the TCI assessment			Self-directedness, and Cooperativeness
Schriber et al. (2014)	To compare self-reports of Big Five personality traits in adults with ASD to those of typically developing adults	<i>n</i> = 37 (Asperger: 21; PDD-NOS: 5; high-functioning autism: 11)	<i>n</i> = 42 Age range: 18–34 years (mean 23.2) Sex: 20% female IQ range: 87–136 (mean 116) Settings: local physicians, psychologists, speech and language pathologists, occupational therapists, advocating groups, regional centers and ASD support groups	Big Five Inventory (BFI)	Independent samples <i>t</i> test Significant results	Compared to typically developing adults, ASD adults tended to be significantly more Neurotic and less Extraverted, Agreeable, Conscientious, and Open to Experience
Hesselmark et al. (2015)	To test the validity and reliability of self-reported data using the NEO-PI-R in an ASD group	<i>n</i> = 48 (Autism spectrum disorder: 48) Age range: 20–47 years (mean 29.8) Sex: 26 male, 22 female IQ range: within the average range Settings: outpatient tertiary psychiatric unit for diagnosing ASD, a community-based facility for ASD and a Swedish ASD website Country: Sweden	<i>n</i> = 53 Age range: age matched, not specified Sex: 28 male, 25 female IQ range: within the average range Settings: Nonprofit keep-fit organization, local university, student accommodation center, private companies, dentists and vaccination centers, employment agencies, recommendations from friends	NEO Personality Inventory-revised (NEO-PI-R)	Independent samples <i>t</i> test Significant results	Satisfactory internal consistency of the NEO-PI-R, a satisfactory factor structure, predicted correlations with clinician ratings in the ASD group, and predicted differences in personality between the ASD groups and controls
Strunz et al. (2015)	To identify personality traits and personality pathology specific to adults with ASD	<i>n</i> = 59 (Asperger: 49; high-functioning autism: 10)	<i>n</i> = 80 (borderline personality disorder patients), <i>n</i> = 62 (narcissistic)	NEO Personality Inventory-revised (NEO-PI-R); Dimensional	MANOVA	ASD individuals scored significantly lower on the NEO-PI-R scales Extraversion

Table 3 (continued)

Study	Aims of study	Participants with ASD (n, ASD diagnosis, age, sex, IQ, setting, country)	Comparison group (n, age, sex, setting)	Personality measures	Statistical methods and results concerning significance	Outcomes relevant to the topic of this review
	without intellectual impairments	Age range: not specified (mean 32.7) Sex: 27 male, 32 female IQ range: without accompanying intellectual impairment Setting: outpatient’s clinic of Department of Psychiatry at a University Hospital Country: Germany	personality disorder patients), n = 106 (nonclinical controls) Age range: not specified (BPD mean 29.7; NPD mean 36; NCC mean 30.8) Sex: BPD 29 male, 51 female; NPD 45 male, 17 female; NCC 56 male, 50 female) IQ range: without accompanying intellectual impairment Settings: BPD and NPD were outpatient and recruited as part of a multicenter study by Department of Psychiatry at a University Hospital; NCC via advertisements in local papers	ASSEssment of Personality Pathology-Basic Questionnaire (DAPP-BQ)	Significant results	and Openness to experience and significantly higher on DAPP-BQ scales Inhibitedness and Compulsivity relative to all other groups
Schwartzman et al. (2016)	To determine the extent to which the five-factor model of personality (FFM) accounts for variability in ASD symptomatology in adults, examine differences in average FFM personality traits of adults with and without ASD, and identify distinct behavioral phenotypes within ASD	N = 828 (with and without self-identified ASD; formerly diagnosed with autism spectrum disorder: 152) Age range: 18–87 years (mean 36) Sex: 24% male, 73% female, 3% “other” IQ range: not specified, education ranged from “less than high school” to “professional degree” Settings: recruited via flyers (electronic and paper-based), listserv emails, postings on blogs, forums, online classified pages, social network sites (autism-related) Country: USA	Within comparison group	International Personality Item Pool Representation of the NEO-PI-R (IPIP-NEO-120)	Independent samples t test Significant results	Five-factor model (FFM) facets accounted for 70% of variance in autism traits scores. Neuroticism positively correlated with autism symptom severity, while Extraversion, Openness to experience, Agreeableness, and Conscientiousness negatively correlated with autism symptom severity. Four FFM subtypes emerged within adults with ASD, with three subtypes characterized by high Neuroticism and none characterized by lower-than-average Neuroticism

Asperger’s disorder (AS) than in controls, corresponding with significantly higher Neuroticism scores of the NEO-FFI, and significant lower Extraversion, Agreeableness, and Conscientiousness scores of the NEO-FFI in adults with AS

than in controls in a study by Kanai et al. (2011b). Total score of the AQ correlated with the Extraversion, Openness, and Conscientiousness subscale scores of the NEO-FFI in adults with Asperger’s Disorder, but not in controls, and is consistent

with the clinical picture of Asperger's Disorder (Kanai et al. 2011b). Consistent with Kanai et al. (2011a, b) and Schriber et al. (2014), in a study testing the validity and reliability of self-reported data using the NEO-PI-R, Hesselmark et al. (2015) and, in a study with IPIP-NEO-120, Schwartzman et al. (2016) found higher scores on Neuroticism and lower scores on Extraversion, Agreeableness, Conscientiousness, and Openness in the ASD group compared with controls. Strunz et al. (2015) found significantly lower scores on the NEO-PI-R scales of Extraversion and Openness to experience and significantly higher scores on the DAPP-BQ scales of Inhibitedness and Compulsivity in ASD individuals, compared to adults with borderline and narcissistic PDs and controls.

Ozonoff et al. (2005) administered the MMPI-2 to 20 adults with ASD compared to a group of matched college students. They found large group differences for Introversion, indicating higher scores on scale 0 (Social introversion) and on Personality Psychopathology Five (PSY-5) scale Introversion for patients with ASD.

Lugnegård et al. (2012) investigated the presence of possible PDs in 54 young adults with AS and found approximately half of the study group (48%) met criteria for a personality disorder, all belonging to cluster A or C, the same as Anckarsäter et al. (2006) found to be common in their study. Hofvander et al. (2009) found that 62% of 117 adults with ASD met criteria for at least one PD, with obsessive-compulsive PD significantly more common in adults with AS, and antisocial PD in adults with PDD-NOS. Men with Asperger's disorder met PD criteria much more often than women with Asperger's disorder (65 vs 32%) (Lugnegård et al. 2012), and schizoid PD was significantly more common in women than in men with ASD (Hofvander et al. 2009). Participants who met criteria for a personality disorder showed more outspoken autistic features according to the Autism Spectrum Quotient (AQ). Lugnegård et al. (2012) conclude that there is a considerable overlap in symptoms between Asperger's disorder and schizoid, avoidant, and obsessive-compulsive PDs. In a pilot study, Ketelaars et al. (2008) found that self-reporting did not differentiate mild ASD patients from non-ASD patients, whereby PDs seem equally prevalent (47 vs 48%) among these two groups. An important limitation in this latter research was the small number of patients diagnosed with ASD ($n = 15$), plus that they belonged to the less-severe side of the spectrum.

Results of Personality Disorders Meta-analysis

Meta-analyses across four European studies (Anckarsäter et al. 2006; Hofvander et al. 2009; Ketelaars et al. 2008; Lugnegård et al. 2012) using SCID-II or IPDE for DSM-IV personality disorders show adults with ASD meeting criteria for a DSM PD classification. For comparison, DSM-IV PD prevalence rates for the general European population (Barnow et al. 2010; Coid et al. 2006) are shown as well. Notable are the paranoid (20%), schizoid (24%), schizotypal (14%),

avoidant (23%), and obsessive-compulsive (31%) PDs in adults with ASD, both in prevalence percentage as well as compared to the general population ranging from 0% for schizotypal to 5% for obsessive-compulsive PDs. Forest plots can be found in Figs. 2, 3, and 4.

Results of Temperament Meta-analysis

Four studies (Anckarsäter et al. 2006; Sizoo et al. 2009; Soderstrom et al. 2002; Vuijk et al. 2012) investigated temperament in adults with ASD by administering them the (short version of) Temperament and Character Inventory (VTCI/TCI). Meta-analyses (see Fig. 5) over all the four studies using VTCI/TCI show significant deviances from norm groups ($T = 50$) on the different temperament dimensions for participants with ASD: lower scores on novelty seeking ($M = 47.90$; $SD = 10.26$; $d = 0.20$) and reward dependence ($M = 42.91$; $SD = 8.5$; $d = 0.83$) and higher scores on harm avoidance ($M = 63.39$; $SD = 10.75$; $d = 1.24$) and persistence ($M = 51.88$; $SD = 10.98$; $d = 0.17$) compared to the norm group. Note that for persistence, none of the studies individually reported a significant deviance from their norm group. However, when combined in the meta-analysis, the overall 95% confidence interval does not include $T = 50$, denoting the mean of the general population.

Results of Character Meta-analysis

Four studies (Anckarsäter et al. 2006; Sizoo et al. 2009; Soderstrom et al. 2002; Vuijk et al. 2012) investigated character in adults with ASD by administering them the VTCI/TCI. Meta-analyses (see Fig. 6) over all the four studies using VTCI/TCI show significant deviances from norm groups ($T = 50$) on the different character dimensions for participants with ASD: lower scores on self-directedness ($M = 37.67$; $SD = 12.76$; $d = 0.96$) and cooperativeness ($M = 41.47$; $SD = 13.96$; $d = 0.61$) and a higher score on self-transcendence ($M = 52.06$; $SD = 12.24$; $d = 0.16$) compared to the norm group.

Discussion

To our knowledge, this literature review of 15 studies is the first to systematically examine temperament, character, personality pathology and PDs in adults with ASD. Our systematic review summarized 15 studies involving temperament, character, personality pathology, and PDs in normal intelligent adults with ASD.

The systematic review and meta-analysis indicated that ASD is linked (1) to an introvert, rigid, passive-dependent temperament with low novelty seeking, high harm avoidance, low reward dependence, and high persistence; (2) to an immature and poorly developed character with low self-

directedness and low cooperativeness, indicating possible personality pathology, and high self-transcendence; (3) to a positive correlation between ASD (severity) and neuroticism, and a negative correlation between ASD (severity) and extraversion, openness to experience, agreeableness and conscientiousness; and finally (4) to PDs, particularly paranoid, schizoid, schizotypal, avoidant, and obsessive-compulsive PDs. Anckarsäter et al. (2006) confirmed with their study that childhood-onset neuropsychiatric disorders like ASD are reflected as difficult temperaments, deficits in character maturation, and PDs, whereby the high harm avoidance and low reward dependence is described as a typical autism temperament, named as a methodical and obsessive temperament. The pervasive developmental problems in psychosocial functioning in ASD seem to inhibit the maturation of character and personality relevant for interaction with self and others and are thus reflected by low TCI scores for self-directedness and cooperativeness. Temperament and character may interact with symptoms of ASD leading to individual differences and a variety of both internalizing and externalizing problems among individuals with ASD, like Burrows et al. (2016) also found in their study of children and adolescents with high-functioning autism. When ADHD is comorbid in patients with ASD, they had more ADHD-like temperament with higher novelty seeking and harm avoidance and lower reward dependence than patients with ASD only (Anckarsäter et al. 2006). In our meta-analysis, we found a significantly high score on self-transcendence, like Sizoo et al. (2009) and Soderstrom et al. (2002) also found. The high self-transcendence scores in combination with low self-directedness and low cooperativeness are an indication for naivety and problems with reality-testing (Cloninger et al. 1993).

The studies in our review yield empirical support for personality variation and diversity in possible comorbid PDs within the ASD group. Different effect sizes (no, weak, medium, and large effect sizes) on temperament and character dimensions ranging from 0.16 (self-transcendence) to 1.24 (harm avoidance) in the ASD group were found. The far from perfect association between ASD and temperament and character are echoed by the PD comorbidity findings: although clear associations were found, they were far from perfect (highest PD prevalences in the 25–30% range), across multiple PDs and even in different clusters (A and C). It can therefore be concluded that there is considerable variation in personality and personality pathology in people with ASD. Previous studies have reported similar findings. Schwartzman et al. (2016) found four different personality profiles with different patterns, with three subtypes characterized by high Neuroticism and none characterized by lower-than-average Neuroticism. Schwartzman et al. (2016) views ASD as a set of personality traits on the one hand paralleling the diagnostic or associated characteristics of ASD (e.g., low social reward sensitivity and rigidity), but in other ways a set

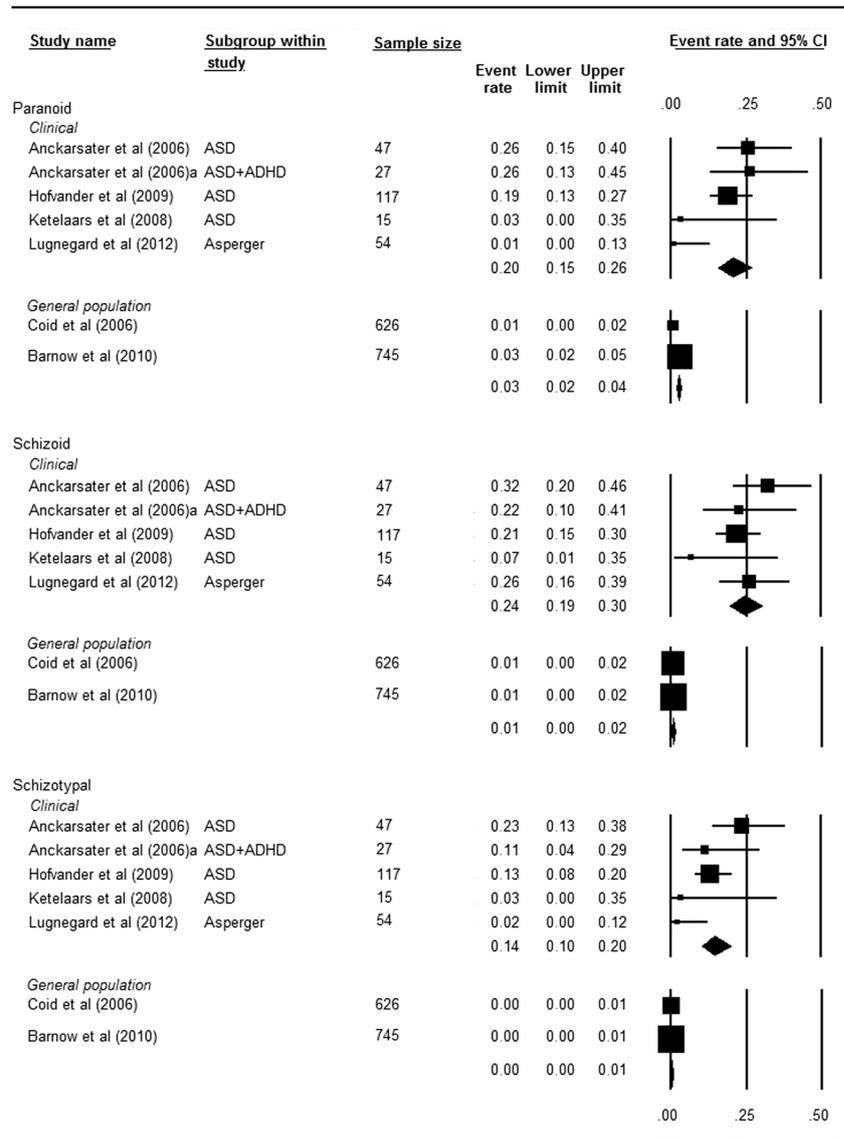
of non-ASD related personality traits (e.g., anxiety). A first study (Strunz et al. 2015) aimed at differentiating ASD from PDs identified an ASD-specific personality profile with differences in introversion, openness, conscientiousness and dis-social behavior between people with ASD and with narcissistic and borderline PD. Note however that cluster A and cluster C PD comparisons groups were missing in the Strunz et al. study (2015), while these are the most relevant, given the present findings.

Our meta-analytic results show no (near) 100% prevalence of any specific PD in adults with ASD. Specifically, it is remarkable that DSM-IV and DSM-5 instruct to not diagnose schizoid and schizotypal PDs in patients with ASD. It is suggested that this is because of an overlap in diagnostic criteria, but then these criteria are not made explicit. Our meta-analysis finds pooled prevalence rates of only 24% for schizoid PD and 14% for schizotypal PD, versus 20% for paranoid PD, 23% for avoidant PD, and 31% for obsessive-compulsive PD. For these latter three PDs, ASD is remarkably not indicated by DSM as an exclusion criterion, while their prevalence is at least as high in adults with ASD. In our view, the “relatively” low prevalence rates of schizotypal and schizoid PDs in adults with ASD, and the comparable or higher prevalences of three other PDs do not support the DSM-IV and DSM-5 exclusion criterion. It would probably be better to assess all PDs in patients with ASD when a better understanding of personality pathology is needed in these patients.

The studies in our review provide empirical support for a co-occurrence of autistic traits, temperament, character, personality pathology, and PDs. ASD and personality pathology may present the same clinical picture with lifelong impairments and pervasive problems in interpersonal social behavior and affective areas. The findings in the reviewed studies demonstrate both a similarity and a variation in clinical phenotypes, also found in studies with a non-ASD population exploring overlaps and correlations between autistic traits and personality (Austin 2005; Barneveld et al. 2011; Hurst et al. 2007; Kunihira et al. 2006; Picardi et al. 2015; Pisula et al. 2015; Wakabayashi et al. 2006). On the basis of significantly found phenotypic correlations with the above TCI temperament and character dimensions in a non-autistic population, Picardi et al. (2015) suggest that autistic traits and these personality dimensions share common genetic and environmental etiological factors. However, a correlation of phenotypal variables is not a proof of this.

On the basis of the definition of ASD, temperament, character, personality, and PDs as described in the introduction, we must first conclude they are differently defined concepts. Secondly, according to the studies in our review, they both resemble and differ from each other in terms of clinical phenotype. For now, there is simply very little empirical research into these issues and it might be too early to conclude that neither ASD and personality dimensions share genetic and

Fig. 2 Forest plot of the meta-analyses for SCID-II and IPDE personality disorders DSM cluster A in patients with autism spectrum disorder (ASD) and in general European population



environmental etiology nor that ASD, temperament, character, personality pathology, and PDs should be conceptually and diagnostically mutually exclusive (see also De Clerq and De Fruyt 2007; Verhoeff 2015). For clinical practice, we suggest that temperament and character of adults with ASD can be described, and all PD comorbidity (even the co-occurrence of both schizoid and schizotypal PDs) can be classified as well.

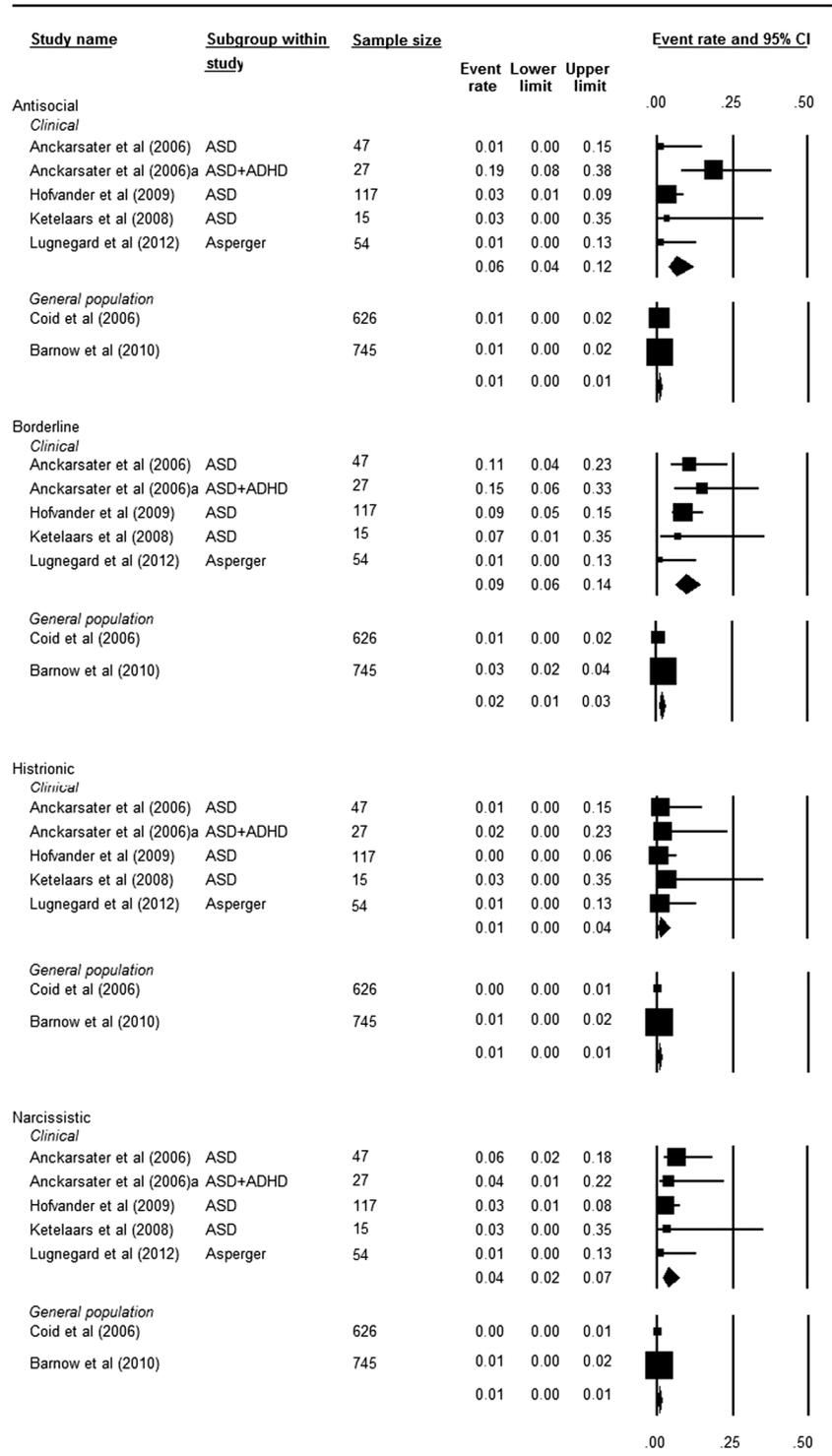
Limitations

There are a number of limitations to the reviewed studies that need to be considered when interpreting the results of our review and meta-analyses. The information obtained from the questionnaires in these studies is subject to limitations inherent in self-report. The current review does not assess

whether the personality measures are valid or reliable in measuring temperament, character, personality pathology, and PDs in adults with ASD. The results of these types of measures should be interpreted with caution in this population, given that adults with ASD can show a lack of self-reflection and self-understanding (Jackson et al. 2012). On the other hand, there is a growing number of studies supporting the valid and reliable use of self-reports in adults with ASD with intelligence within the average range (Berthoz and Hill 2005; Hesselmark et al. 2015; Schriber et al. 2014; Shipman et al. 2011).

The majority of participants with ASD in the included studies were recruited in psychiatric and health care clinics. The samples could be biased by these participants not representing people with ASD in the general population. The high prevalence of PDs in ASD participants can be an artifact of sampling in psychiatric and health care clinics.

Fig. 3 Forest plot of the meta-analyses for SCID-II and IPDE personality disorders DSM cluster B in patients with autism spectrum disorder (ASD) and in general European population

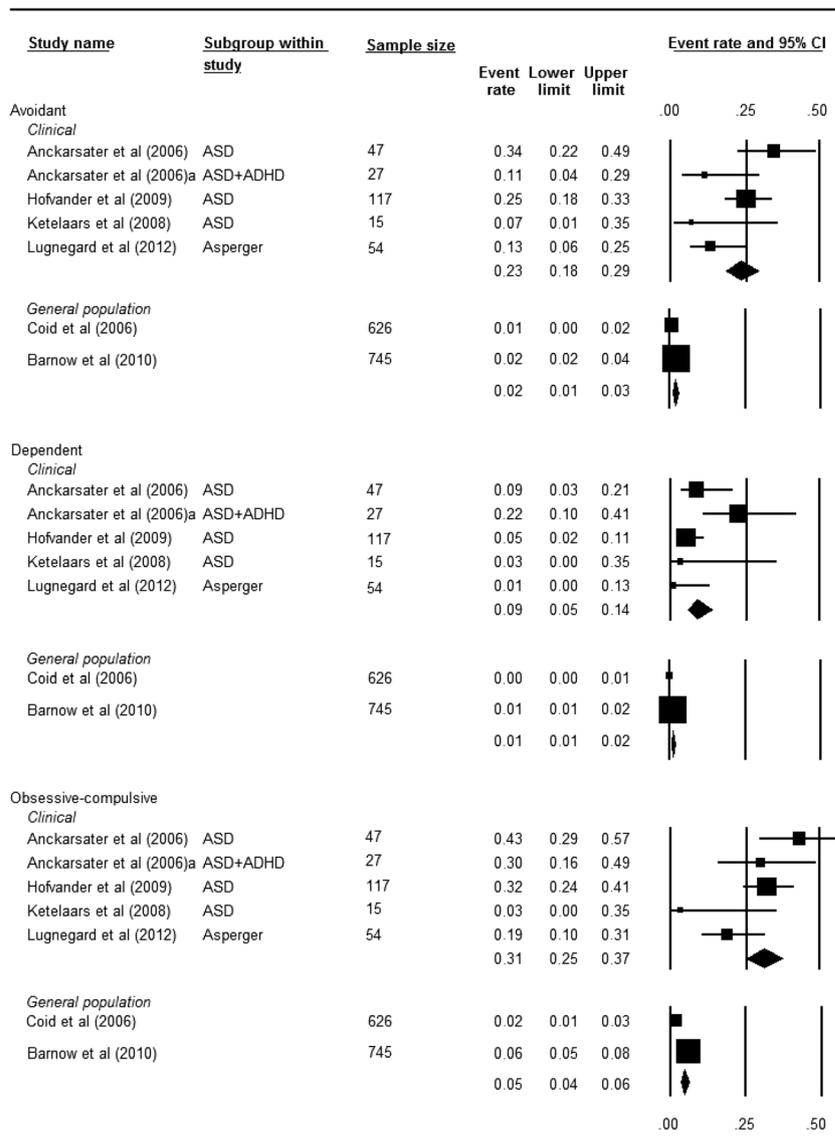


All studies in this review consisted of adult participants with normal intelligence. Therefore, the results may not be generalizable to the larger population of individuals with ASD including children and adolescents, and individuals with an IQ below 70 (intellectual disability). Nevertheless, more or less similar TCI scores for harm avoidance, reward

dependence, self-directedness, and cooperativeness have been found in 9- to 12-year-old children (Kerekes et al. 2013).

From the 15 studies, three studies reported effect sizes and exploratory and descriptive results, because of small sample sizes. Replication of our findings in other and larger study groups, including both adults and children and equal numbers

Fig. 4 Forest plot of the meta-analyses for SCID-II and IPDE personality disorders DSM cluster C in patients with autism spectrum disorder (ASD) and in general European population “50” denotes the mean of the general population



of females and males, and a comparison of our findings to children and adolescents are required to examine comorbidity and differences between ASD and personality (pathology) and to better understand the developmental pathways of personality (pathology) in ASD across the lifespan and genders (see also Supekar et al. 2017). Adults with ASD are historically an understudied group, and on this specific topic, more research is needed on how to best view, assess, and treat problems with temperament, character, and PD in people with ASD (e.g., Damiano et al. 2014).

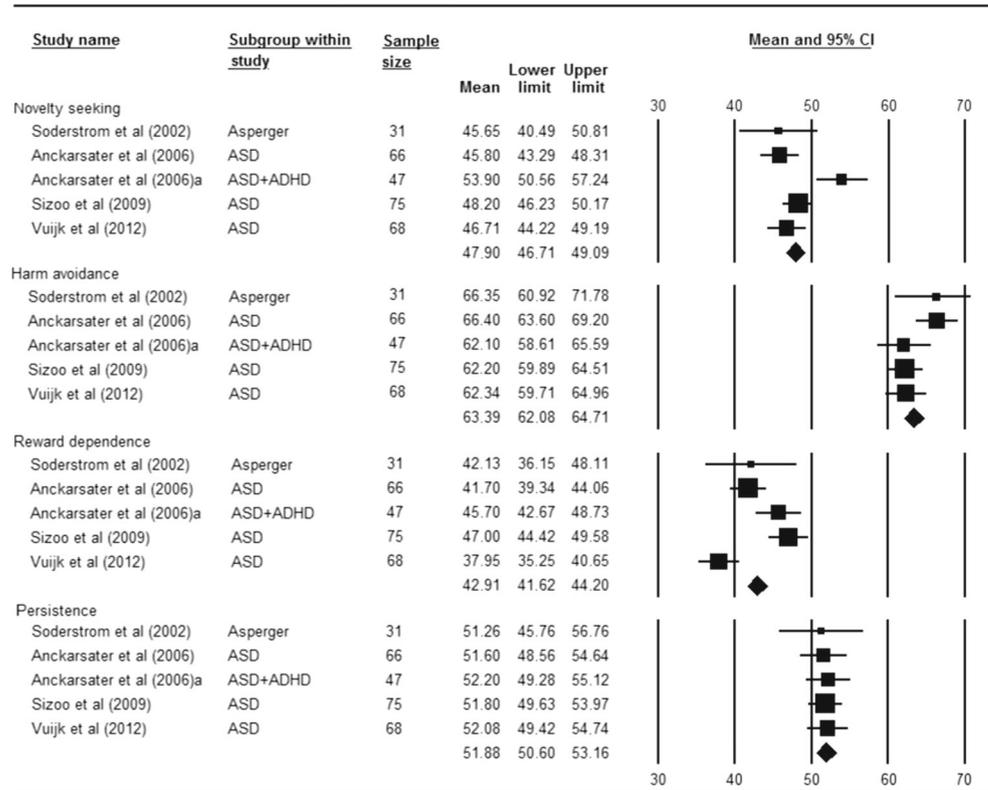
Future Directions

Overall, the findings that emerge from the included studies show similarities and differences between the concepts of

autism, temperament, character, personality pathology, and PD. The etiology of these concepts is a topic of interesting dialogs and discussions about how ASD and personality (disorders) will be found to relate in future research. To more accurately classify a patients' disturbed functioning as either ASD or PD or as both in clinical practice, further multidisciplinary longitudinal research is needed to better understand the different developmental pathways and natures of ASD, temperament, character, and PDs. Distinct personality domains have already been shown in ASD parents, suggesting specific personality features inherited as autistic phenotypes (Kadak et al. 2015).

All studies in this review were cross-sectional and the key findings and conclusions presented here do not imply causal relationships. Studies examining causal relationships between ASD, temperament, character, and personality and

Fig. 5 Forest plot of the meta-analyses for VTCI/TCI temperament dimensions in patients with autism spectrum disorder (ASD) “50” denotes the mean of the general population

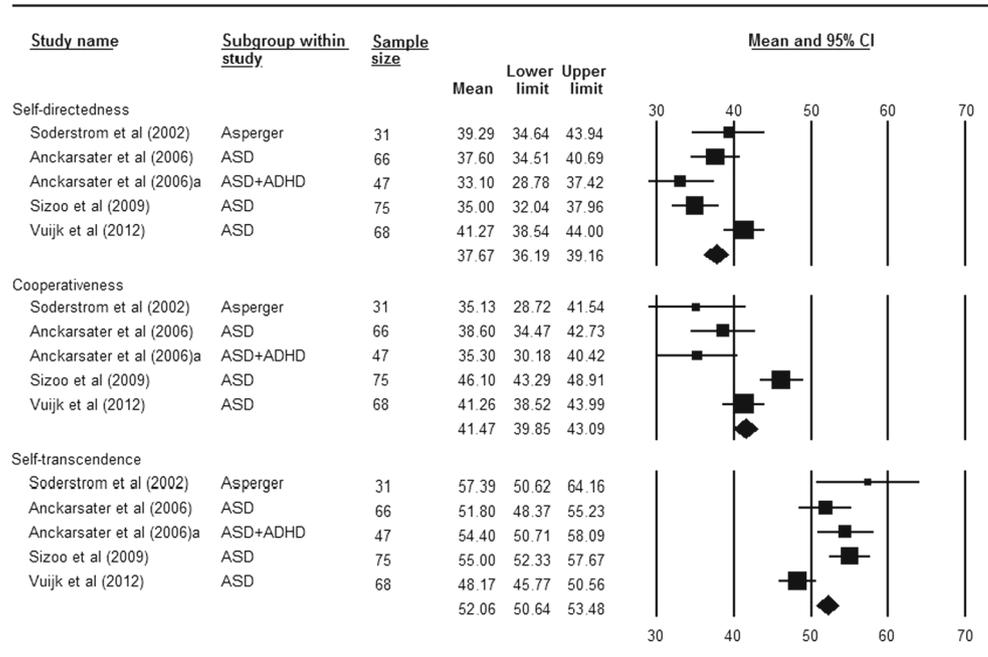


‘50’ denotes the mean of the general population

differentiating ASD from PDs, and studies examining disorder-specific endophenotypical temperament and character dimensions are needed in the future.

Despite the growing recognition and evidence that personality (pathology) is present in people with ASD, many clinicians and researchers do not consider this co-occurrence or

Fig. 6 Forest plot of the meta-analyses for VTCI/TCI character dimensions in patients with autism spectrum disorder (ASD)



‘50’ denotes the mean of the general population

comorbidity. More research into this co-occurrence or comorbidity is necessary to gain insight in optimal interaction styles, intervention benefits, and effective treatments.

Treatment for personality disordered ASD patients has, as far as we know, not been topic of any study, but should be in the near future when considering the picture of personality (pathology) in adults with ASD as provided in this review. Several treatment approaches for personality disorders in general, usually medium- to long-term, offer promising evidence. Future studies should also aim to investigate the treatment of personality (pathology) in adults with ASD (Vuijk and Arntz 2017).

Conclusion

Results from the present review and meta-analyses show that ASD is significantly associated with several temperament and character dimensions, and with major PDs, yet with such a variation that results indicate a variable instead of uniform personality profile. Taken together and in relation to Cloninger's model, the associations confirmed by our meta-analyses for ASD were for high harm avoidance, low novelty seeking, low reward dependence, high persistence, low self-directedness, low cooperativeness, and high self-transcendence. In relation to the five-factor model, our review finds a positive correlation between ASD and neuroticism and negative correlations between ASD and extraversion, openness to experience, agreeableness, and conscientiousness. These findings are indicative for an introvert, rigid, and passive-dependent temperament and an immature and poorly developed character (Soderstrom et al. 2002). In line with our meta-analytic findings, it is not surprising that studies found people with ASD meeting criteria for a PD, from the DSM clusters A (the odd and eccentric paranoid, schizoid, and schizotypal) and C (the anxious or fearful avoidant and obsessive-compulsive) and with higher prevalence rates compared to the general population. All findings are consistent with the classic and also heterogeneous clinical picture of ASD we have so far: from the autism-specific social and communication impairments, corresponding with, e.g., low reward dependence, less extraversion and agreeableness, schizoid, and avoidant PDs, to rigid and stereotypical behaviors, corresponding with, e.g., low novelty seeking, less openness to experience, and obsessive-compulsive PDs. In clinical practice this makes a diagnostic assessment of ASD complex and difficult: the correspondence of ASD, temperament, character, and PD criteria should be examined by thoroughly exploring the context and the possible developmental pathways of the complaints of an individual suspected of ASD for a well-considered final decision in classifying ASD with or without temperament and character dimensions and PD.

For now, this study provides a more detailed picture of adults with ASD by not only focusing on autism but also on aspects of

personality (pathology) and PDs. People with ASD vary, not only in the severity of their autism but also in their personality. This probably accounts for and could advance our understanding of the considerable heterogeneity within the ASS-phenotype (de Pauw et al. 2011; Lai and Baron-Cohen 2015; Landry and Chouinard 2016; Schriber et al. 2014; Schwartzman et al. 2016). In order to obtain a comprehensive picture of an individual with ASD and to implement the most effective intervention plans for and therapeutic relationship with adults with ASD, temperament, character, and comorbid personality pathology and PDs should be considered. In line with Vuijk et al. (2012), therapists may consider whether negatively interpreted temperament and character traits can be translated in a positive way in a client's life: e.g., low novelty seeking may not only mean less exploratory excitability (negative) but also less impulsiveness and less disorderliness (positive). Understanding personality can provide insight into strengths and weaknesses of the individual: it can change the perception we have of a person with ASD, by not only seeing a person with a pervasive disorder and a classification but also with a distinct personality (see also Kirchner et al. 2016; De Schipper et al. 2016; Schmidt et al. 2015; Schwartzman et al. 2016). Adults with ASD are more than just their classification of ASD, and knowing someone's personality gives color by not only classifying but also characterizing a person, which may be helpful to understanding the individual's idiosyncrasies, difficulties, and strengths.

We hope that the present review not only serves clinicians and researchers with an overview of personality and its dimensions of temperament and character, and of personality pathology and PDs in adults with ASD, but that it also inspires researchers in future research and critical reflections on the relationship between these concepts and its impact on assessment and treatment.

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*Studies included in the review, †Studies also included in the meta-analysis

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