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ORIGINAL PAPER

First Psychometric Properties of the Dutch Interview for Diagnostic Assessment of Autism Spectrum Disorder in Adult Males Without Intellectual Disability

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Abstract

Abstract For autism spectrum disorder (ASD) in adults there are several diagnostic instruments available with a need for consideration of the psychometric properties. This study aimed to conduct a first psychometric evaluation of a new diagnostic ASD instrument, the NIDA (Dutch Interview for Diagnostic assessment of ASD in adults) in 90 adult males without intellectual disability (age 18–65 years) in the Netherlands: 30 with ASD, 30 with a Personality Disorder and 30 nonpatient controls. The interrater agreement ranged from 0.79 to 1.00, the convergent validity including sensitivity and specificity ranged from 0.76 to 1.00, and we observed an adequate concurrent criterion-related validity. These promising findings can serve as foundation for future psychometric NIDA studies in a more diverse population.

Trial registration The Netherlands National Trial Register NTR6391. Registered 04 May 2017.

Keywords Autism spectrum disorder (ASD) · NIDA · Personality disorder (PD) · Interrater agreement · Validity

Autism spectrum disorder (ASD) is typically considered as a neurodevelopmental condition with an early childhood onset and life time persistency of specific behavioural aspects. In the DSM-IV (American Psychiatric Association 2000), the core symptoms emphasize qualitative challenges in social interaction and in communication, and restricted repetitive and stereotyped patterns of behavior, classified as autistic disorder (AD), Asperger's disorder (AS) and pervasive developmental disorder not otherwise specified (PDD-NOS). These three are all considered to be 'autism spectrum disorders'. However, the DSM-5 (American Psychiatric Association, 2013) definition of ASD changed considerably. The core symptoms are still persistent challenges in social communication and social interaction across multiple contexts and a tendency for repetitive patterns of behavior, interests, or activities. However, the classification is now autism spectrum disorder (ASD) with three severity levels. This change in criteria has an impact on the ASD assessment toolbox, raising the question which instruments can be used to assess DSM-5 ASD. Until now, not a single autism-specific diagnostic instrument follows the complete DSM-5 decision-making rules for diagnostic classification (Evers et al., 2021). Thereby assessment tools for adult ASD are limited and, to the best of our knowledge, not a single

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in-person diagnostic DSM-5 interview for adult ASD is available.

The social condition associated with ASD is multifaceted with challenges in social-emotional reciprocity, social non-verbal communication, and developing, understanding and maintaining relationships. Symptoms must be present in the early developmental period, but may not become fully manifested until social demands exceed limited capacities, or may be masked by learned strategies later in life (American Psychiatric Association 2013, p. 50). ASD starts when children are infants or toddlers, continues into adulthood and thus can be seen as a lifelong condition, with an estimated prevalence rate of 2.2% for adults in the United States (Dietz et al., 2020). Although no single one of the symptoms indicates that a person meets criteria for ASD, a person who shows a number of these symptoms is a likely candidate for an ASD diagnosis and should be screened and assessed appropriately. ASD is usually diagnosed early in life, but ASD is being increasingly recognized and first-time diagnosed in adults who have not been diagnosed in childhood. Four independent studies showed that the mean age of these adulthood diagnoses is between 30 and 45 years (Geurts and Jansen 2012; Happé et al., 2016; Jones et al., 2014; Lehnhardt et al., 2012). Diagnosing adults with ASD is not just a lengthy process (Rutherford et al., 2016), but is also a complex and challenging task. It becomes especially complex when issues of comorbidity and differential diagnosis arise, a high intelligence compensates for challenges, a structured support system is available, parental and partner informants are not available, and the social disability is camouflaged (Bastiaansen et al., 2011; Huang et al., 2020; Lai & Baron-Cohen, 2015). Moreover, many non-specialist healthcare professionals lack knowledge and clinical assessment skills in adult ASD (Brugha et al., 2011). Expertise in a variety of disciplines, like psychology and psychiatry, and clinicians specialized in ASD are needed to avoid misdiagnosing in ASD, as illustrated in a case series by Van Schalkwyk et al. (2015). The combination of clinical assessment skills, expertise with standardized testing, and awareness of ASD in adults is required for a valid ASD diagnosis (Wigham et al., 2019).

There is insufficient evidence for any specific formal assessment tool for ASD in adults. The best predictor of valid and reliable ASD diagnoses in children is the clinical judgment by experienced clinicians accompanied by standardized diagnostic instruments (Lord et al., 2006; Wiggins et al., 2015). For valid and reliable ASD diagnoses in adults we expect this diagnostic process to be the same. In a survey of 116 practitioners from child and adult services, 75% reported standardised instruments to be very or quite helpful for the assessment of ASD (Rogers et al., 2015). The NICE guideline on recognition, referral, diagnosis and management of adults on the autism spectrum (NCCMH 2012) recommends the combined use of the autism diagnostic interview—revised (ADI-R; Lord et al., 1997) as a semi-structured assessment of developmental history and the autism diagnostic observation schedule—generic (ADOS-G; Lord et al., 2000) as a standardised observational measure, as best practice in the diagnosis of ASD in adults. The Dutch guideline on diagnosis and treatment of adults on the autism spectrum (Kan et al., 2013) does not recommend a specific instrument, concluding for instance ADOS-G being inadequate for those who are intelligent and, for example, are able to camouflage the social difficulties in specific circumstances (Bastiaansen et al., 2011; Lai et al., 2011; Langmann et al., 2017; Lord et al., 2000), and ADI-R being not practical due to, among others, time consuming administering. The Dutch Guideline (Kan et al., 2013) advises after identification of the need for ASD assessment in-person interviews, interaction with the adult, and an interview with the adult's childhood caregiver or someone who knew the adult very well in childhood when available. Thereby, a clinical ASD diagnosis is defined by describing core characteristics in terms of DSM (or equivalent) criteria. Thus a (semi-)structured DSM-5 interview for ASD might be helpful for quantifying ASD characteristics and the level of severity. The *Dutch Interview for Diagnostic assessment of ASD in adults* (NIDA; *Nederlands Interview ten behoeve van Diagnostiek Autismespectrumstoornis bij volwassenen*) (Vuijk, 2016) might be such an instrument. The development of the NIDA might fill a gap in the availability of autism-specific diagnostic instruments following the complete DSM-5 decision-making rules for diagnostic classification.

The goal of the present study was to examine the reliability and validity of the in-person current functioning part of the NIDA by measuring its interrater agreement, and convergent, and concurrent criterion-related validity in a Dutch sample. In this first study, we examined whether the NIDA is a psychometrically sound instrument for assessing ASD in adult males without intellectual disability only. By focusing on this specific subgroup of the autism spectrum we intended to establish whether the NIDA is promising enough to be tested more extensively in future studies. Our research questions are: (1) Does the in-person current functioning part of the NIDA have a good interrater agreement? (2) Does the in-person current functioning part of the NIDA have a good convergent validity? (3) Does the in-person current functioning part of the NIDA have a good concurrent criterion-related validity? Most of the ASD studies focusing on the psychometric properties of assessment tools only include general population comparison groups (COM). We compared our ASD group not only with a COM group, but also with a clinical group. In this way we examined the suitability of the NIDA for clinical use and especially differentiation to

conditions for which the differential diagnosis is considered to be clinical challenging. We, therefore, chose to compare the ASD group with a group of males with a clinical diagnosis of a personality disorder (PD), because several studies reporting ASD significantly associating and overlapping with some of the major PDs (Anckarsäter et al., 2006; Hofvander et al., 2009; Lai & Baron-Cohen, 2015; Lugnegård et al., 2012; Vuijk et al., 2018).

Methods

Setting

Sarr Autism Rotterdam, Parnassia Psychiatric Institute, the Netherlands, is specialized in psychodiagnostic assessments and interventions for children, adolescents and adults with ASD. Parnassia Psychiatric Institute is a multisite mental health institute specialized in psychodiagnostic assessments and interventions for children, adolescents, and adults with a broad range of psychiatric disorders including PD.

Participants

Participants have been sampled from three sources: (1) male (ex-)clients with ASD from the Sarr Autism Rotterdam; (2) male clients with PD without ASD from the Parnassia Rotterdam site, and (3) male individuals recruited from the general population by advertisements and flyers.

Inclusion criteria for the ASD group were a primary clinical diagnosis of DSM-IV Autistic Disorder or Asperger's Disorder, and/or DSM-5 ASD, with or without a comorbid DSM-IV/5 PD, male sex, age ≥ 18 years, and no intellectual disability, at least a completed primary school and secondary education, and being able to state and/or recognize own (psychological and problematic) functioning. We have solely included males to limit heterogeneity affected by sex differences in phenotypic presentation between men and women with ASD (Loomes et al., 2017; Wilson et al., 2016). The diagnosis ASD (including AD and AS) was verified by studying the diagnostic report including the diagnosis ASD based on clinical evaluation of autism-specific behaviors by direct observation of the patient and report of developmental and behavioral history and current functioning obtained by partner, parent or mentor. The ASD had to be diagnosed in a multidisciplinary team consisting of at least a registered psychologist or psychiatrist. The multidisciplinary ASD diagnosis was blinded from the NIDA and ADOS results throughout the process. We used the SCID-5-SPQ (First et al., 2016; Dutch version: Arntz et al., 2017), a self-report screening tool, as a check for PD, which was not an inclusion criterion when scoring positive nor an exclusion criterion when scoring negative. We used the SCID-5-SPQ information to accurately map possible PDs with the SCID-5-PD in the ASD participants. All ASD participants were included in the analyses independent whether or not they had a comorbid PD.

Inclusion criteria for the PD group were a primary diagnosis of DSM-IV and/or DSM-5 PD, assessed with the Dutch version of the SCID-II (First et al., 1997; Dutch version: Weertman et al., 2000), SCID-5-PD (First et al., 2016; Dutch version: Arntz et al., 2017), or psychological-psychiatric assessment, no past or current suspicion by health care professionals of and no diagnosis of DSM-IV/DSM-5 ASD, male sex, age ≥ 18 years, no intellectual disability, at least a completed primary school and secondary education, and being able to state and/or recognize own (psychological and problematic) functioning. We used the SCID-5-SPQ (First et al., 2016; Dutch version: Arntz et al., 2017), a self-report screening tool, as a check for PD. When having five or more positive scores on this screening tool, the participant was included in this study, implicating that PD otherwise specified was included.

Inclusion criteria for the general population comparison group (COM) were no ASD and no PD diagnosis, no suspicion of ASD and PD, male sex, age ≥ 18 years, no intellectual disability, at least a completed primary school and secondary education, having a reasonable degree of insight into and recognition of their (psychological) functioning. We used the SCID-5-SPQ (First et al., 2016; Dutch version: Arntz et al., 2017), a self-report screening tool, as a check for PD. The participant was excluded from this study when having five or more positive scores on this screening tool.

Exclusion criteria for all participants were intellectual disability (IQ < 80), female sex, and presence of current suicidal ideation, and those who have received an ASD diagnosis in the past for which the NIDA was used.

Participants with ASD, participants with PD without ASD, and COM participants have been matched for age within a 5-years range and education on group level.

Sample Size Estimation

For the interrater agreement, we used Krippendorff's alpha (Hayes & Krippendorff, 2007), a conservative agreement estimate for judgments made by any number of raters, and adaptable to any level of measurement (Van Krugten et al., 2019, p. 4; see also Lombard et al., 2002). In addition to Krippendorff's alpha values we also used Cohen's kappa (Cohen, 1960) to allow comparison of interrater agreement across studies in future studies/meta-analyses. For Cohen's kappa the sample size calculation was identical to the calculation of convergent validity (see next), because the same

statistic was calculated. Guidelines by Fleiss (1981) characterize kappa over 0.75 as excellent, 0.40 to 0.75 as fair to good, and below 0.40 as poor.

For the sample size calculation of convergent validity Sim and Wright (2005) indicate that with the null-hypothesis value of kappa of 0.40 (the lowest value of kappa representing clinically acceptable agreement according to Landis & Koch, 1977), with 80% power and a positive value rate around 0.30, the sample size should be around 85 participants to detect kappa of 0.70.

Sample size calculations for concurrent criterion-related validity were performed using G*Power 3.0.10 (Faul et al., 2007). For comparisons on the total score of the NIDA of the ASD group with both the PD without ASD group and the COM group using one-way multivariate analysis of variance (MANOVA) with a power of 0.80, an alpha level of 0.05 and an expected large effect size (=0.80), the sample size for each of the three groups needed to be minimally 24 participants.

To prevent the interrater agreement, convergent and concurrent criterion-related validity from being underpowered, we included 30 participants in each of the three groups, thus leading to a total of 90 participants.

Measures

Demographic characteristics like age, marital status and education were extracted from a questionnaire for demographic characteristics. To assess and differentiate psychological symptoms and mental disorders most commonly seen in clinical practice, like depressive disorder and social anxiety disorder, the Standardized assessment for mental disorders—a semi-structured Dutch interview (SAM; Hoogduin, 1999) was administered. The SAM consists of 18 main questions and several subquestions per question. The SAM generally takes 15–60 min to administer. To date, psychometric properties of this interview have not been studied.

Primary Measure

The NIDA (Vuijk, 2016) is a semi-structured interview for adults and their informants (e.g. partners, family members/parents, and mentors) when ASD is a possible diagnosis for the adult individual. The primary purpose of the NIDA is to provide the DSM-5 ASD classification. The NIDA is based on DSM-5 diagnostic criteria for ASD, and follows DSM-5 decision making rules for scoring and diagnostic classification. The original Dutch NIDA as well the English version under construction are presented in Online Resources 1 and 2. The NIDA includes eight questions for past and current functioning with DSM-5 based and practice-based examples that operationalize four of the five DSM-5 ASD criteria (persistent impairments in social communication and social interaction; restricted, repetitive patterns of behavior, interests, or activities; symptoms must be present in the early developmental period and current functioning; symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning) (American Psychiatric Association 2013, p. 50). For an overview of the questions see Table 2. The questions and the scoring system are presented in Online Resource 3. An example is: do you feel impaired in making contact with others and in sharing thoughts and feelings? Two examples of possible answers are (1) unable to start, respond to or keep social interactions going, and (2) only responding from one's own point of view or experience. This question is related to the social communication domain of the dyad of ASD domains as formulated in the DSM-5. For each interviewee each question is scored as yes (the question is confirmed), questionable (the given answer is dubious) or no (the question is not confirmed) for both past and current functioning. In case several informants are interviewed about one person, the interviewer considers the scores of all interviewees per question in order to determine an overall summarized scoring (yes, questionable, or no) per question. When there is only one interviewee, the interviewer only considers the information of this interviewee for an overall summarized score per question. For this study's purposes we rated "no" with zero, "questionable" with one and "yes" with two points. In order to obtain a DSM-5 ASD diagnosis, one has to score three times yes (in our study three times two points) on questions one to three (DSM-5 ASD criterion A) and two or more scores of yes (in our study two or more scores of two points) on questions four to seven (DSM-5 ASD criterion B) for past or current functioning, and a yes score (in our study two points) on question eight (DSM-5 ASD criterion D) for current functioning following DSM-5 ASD criteria. The NIDA generally takes 30–45 min to administer per person. For this study we use the overall summarized scores of the eight questions for current functioning and do not use the past scores as past functioning was not assessed in this first study, comparing NIDA with ADOS-2 (Lord et al., 2012), the latter exclusively focusing on current functioning and in-person assessment.

Secondary Measures

The autism diagnostic observation schedule—second edition (ADOS-2; Lord et al., 2012; Dutch version: De Bildt et al. 2016), the updated version of ADOS-G (Lord et al., 2000) is a standardised observational measure for assessing ASD. The ADOS-2 generally takes 30 to 60 min to administer. During this time the examiner provides a series of opportunities for the participant to show social and communication behaviors relevant to the diagnosis of autism. The ADOS-2 module 4 consisting of 32 items is the only instrument for

assessing ASD in adults that has been validated with good predictive value for ASD. The ADOS-2 shows fair interrater agreement in naturalistic clinical settings (Zander et al., 2016). A sum score of eight or more points (for clinical practice) and 10 or more points (for more specificity in academic research) on 15 items is indicative for ASD (De Bildt et al., 2016; Hus & Lord, 2014). For this study we use the revised algorithm by Hus and Lord (2014).

The Structured Clinical Interview for DSM-5 Personality Disorders (SCID-5-PD; First et al., 2016), the updated version of the former Structured Clinical Interview for Axis II Personality Disorders (SCID-II; First et al., 1997), is a semi-structured clinical interview for assessing the ten DSM-5 PDs in 106 questions. The SCID generally takes 60–120 min to administer. The SCID-5-PD incorporates the SCID-5-SPQ, a brief 20-min self-report screening tool with 106 questions corresponding directly to each first question in the full SCID-5-PD. The Italian translation of SCID-5-PD shows adequate interrater agreement (Somma et al., 2017). To date, further psychometric properties of SCID-5-PD are unknown. For this study we use the scores on the 106 SCID-5-PD questions after first being screened on PD with the SCID-5-SPQ.

Procedure

To decide if a person could participate in one of the three groups, and for general information, the SCID-5-SPQ and a questionnaire for general information about primary diagnosis, age, education, marital status etc. were administered. When eligible for one of the three groups according to this first assessment, each participant was once interviewed by a psychologist and once interviewed and observed by two other psychologists. The NIDA, ADOS-2, SCID-5-PD interview and SAM were administered to all participants ($n = 90$). All interviewers and observers were well trained and educated in ASD in adults, and in each of the aforementioned assessment tools. The interviewers and observers were blind for diagnostic group and were not permitted to obtain other sources of information to ensure that the final DSM-classification ASD for current functioning was based only on the results of the NIDA.

To establish the interrater agreement of the NIDA, we studied the outcomes on the items of the NIDA between the interviewer and the observer, independently judging the item scores for current functioning on this instrument. Two psychologists jointly assessed 90 participants (30 with ASD, and 30 with PD without ASD, and 30 COM). Both present during the assessment one performed the interview, the second observed, and both have independently evaluated the participant according to this instrument.

Convergent validity (sensitivity and specificity) was established in two ways. First, the 'yes' or 'no' current ASD scores on the NIDA and the ADOS-2 clinical cut off and scientific cut off scores were compared for the three groups. Second, we compared the 'yes' or 'no' current ASD scores on the NIDA to the clinically assessed DSM-IV or DSM-5 ASD diagnosis ('yes' for current ASD). Third, we compared the 'yes' or 'no' current ASD scores on the NIDA or the ADOS-2 as well as on the NIDA and the ADOS-2, both compared to the clinically assessed DSM-IV or DSM-5 ASD diagnosis ('yes' for current ASD). The order of the NIDA and ADOS-2 was counterbalanced across participants. The NIDA and ADOS-2 were administered by the same psychologists' duo: one interviewed and the second observed or vice versa.

To establish concurrent criterion-related validity we compared the scores on the NIDA between three groups of participants, expecting the ASD group to score higher than the other two groups. The psychologist assessing DSM-5 disorders with the SAM assessed PDs with the SCID-5-PD interview in all three groups.

Statistical Analysis

Statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 25 (IBM SPSS Version 25, IBM, New York, NY, USA). Demographic characteristics were examined using descriptive statistics (means, SD, ranges, percentages).

To examine interrater agreement Krippendorff's alpha values (Hayes & Krippendorff, 2007) and Cohen's kappa values were calculated for each of the eight items for current functioning of the NIDA (i.e. DSM-5 ASD criteria A, B and D), as well as for the diagnostic conclusion ('yes' or 'no' current ASD) based on the NIDA, comparing the two raters. For each of the estimated Krippendorff's alpha values, 95% confidence intervals (CIs) were computed based on 10.000 bootstrap replications, with a minimum recommended agreement level of 0.667 (Krippendorff, 2012). We regarded a Cohen's kappa of 0.70 as an indication of a good interrater agreement.

To examine convergent validity of ASD assessment we calculated Cohen's kappa in two ways: (1) NIDA and ADOS-2 converged if they both resulted in 'yes' or 'no' current ASD, (2) NIDA converged with a clinical diagnosis of ASD if NIDA resulted in 'yes' current ASD, and (3) we compared the NIDA or the ADOS-2 as well as the NIDA and the ADOS-2, both compared to the clinically assessed DSM-IV or DSM-5 ASD diagnosis ('yes' for current ASD). We regarded a Cohen's kappa of 0.70 as an indication of a good convergent validity.

To examine concurrent criterion-related validity, one-way MANOVA followed up by Bonferroni corrected pairwise comparisons between groups was used to determine whether

there were statistically significant differences in NIDA and ADOS-2 item scores.

Results

Demographic Characteristics

A total of 90 male participants were included (30 per group). Mean age was comparable for the three groups (ASD, PD, and COM). After the SCID-5-PD assessment seven formerly diagnosed PD participants no longer met the criteria for a (specified) PD. Based on the detailed information provided in their patient charts, we decided to still include these participants in the PD group given their general and long-term patterns of personality pathology. Table 1 gives an overview of the demographic characteristics of all participants.

Research question 1: interrater agreement

The interrater agreement of the in-person current functioning part of the NIDA items ranged from 0.80 to 0.95 (Krippendorff's alpha values). See Table 2 for details for the findings regarding each question of the NIDA. For the agreement on the diagnostic conclusion ('yes' or 'no' current ASD) based on the in-person current functioning of the NIDA Krippendorff's alpha value was 1.00. There was 100% agreement as both raters agreed on the ASD diagnosis for 25 out of the 30 ASD participants, on no ASD diagnosis for 5 out of 30 ASD participants, and on no ASD diagnosis for all PD and COM participants.

In addition to Krippendorff's alpha values we also reported Cohen's kappa values to allow comparison of interrater agreement across studies in future studies/meta-analyses presented in the supplementary material (Online Resource 3).

Research question 2: convergent validity

The convergent validity of the in-person current functioning part of the NIDA with both ADOS-2 cut offs and with the clinical diagnosis ranged from 0.80 to 0.95 (Cohen's kappa). The sensitivity of the NIDA items ranged from 0.76 to 0.96 and the specificity from 0.93 to 1.00. See Table 3 for details for the findings regarding each of the different measures as well for the comparison of our ADOS-2 sensitivity and specificity with the findings reported in previous studies evaluating ADOS-2 module 4.

Research question 3: concurrent criterion-related validity

The MANOVA on the items of the in-person current functioning part of the NIDA revealed a statistically significant effect of group, $F(18, 158) = 47.73$, $p < 0.001$; Wilk's $\Lambda = 0.024$, $\eta_p^2 = 0.85$. The MANOVA on the items of the ADOS-2 Module 4 revealed a statistically significant effect of group, $F(30, 146) = 9.39$, $p < 0.001$; Wilk's $\Lambda = 0.116$, $\eta_p^2 = 0.66$. Bonferroni corrected pairwise comparisons (presented in Table 4) revealed that the differences between the ASD and the PD as well the ASD and COM group were significant. The difference between the PD and COM group was non-significant. The multivariate effect size of the NIDA ($\eta_p^2 = 0.85$) was larger than that of the ADOS-2 ($\eta_p^2 = 0.66$). Distribution of scores on all NIDA items and ADOS-2 Module 4 algorithm items for all participants are presented in the supplementary material (Online Resource 4).

Discussion

In the present cross-sectional study we aimed to explore the utility of a new ASD assessment instrument for adults, the NIDA, by determining the interrater agreement and validity of the in-person current functioning part of the interview among adult males without intellectual disability. The in-person current functioning part of the NIDA seems psychometrically sound when used in males as: (a) the interrater agreement; (b) the convergent validity with the ADOS-2 and the clinical diagnosis of ASD; (c) the sensitivity and the specificity; and (d) the concurrent criterion-related validity can all considered to be very good. The NIDA and ADOS-2 were comparable with respect to how well they discriminate between males with ASD, males with PD, and males without either ASD or PD. Using the NIDA and ADOS-2 simultaneously resulted in similar sensitivity and specificity scores as when using either one of both. The NIDA and the ADOS-2 are different instruments, an interview and an observation respectively: based on our study it seems that both instruments can be recommended for use in clinical practice.

Having demonstrated these first promising NIDA psychometric properties, we next explored whether our ADOS-2 findings are in line with previous ADOS-2 findings. We compared our ADOS-2 results with the results reported in previous studies evaluating ADOS-2 Module 4 (see Table 3). In these studies ADOS-2 sensitivity estimates ranged from 53 to 92% and ADOS-2 specificity estimates ranged from 65 to 100% (De Bildt et al., 2016; Fusar-Poli et al., 2017; Hus & Lord, 2014; Langmann et al., 2017; Pugliese et al., 2015). Our ADOS-2 specificity estimates were higher for most previous studies and comparable for the study of De Bildt et al. (2016). Moreover, our ADOS-2 sensitivity estimates were

Table 1 Demographic characteristics of participants ($N=90$)

	ASD	PD		COM
N	30	30		30
Age, years				
Mean	43.23	44.13		44.37
SD	11.00	12.64		14.85
Range	18–62	19–63		18–65
Marital status				
Unmarried	23 (77%)	19 (63%)		18 (60%)
Married	7 (23%)	4 (13%)		9 (30%)
Divorced	0	6 (20%)		0
Other	0	1 (3%)		3 (10%)
Education				
University	7 (23%)	3 (10%)		10 (33%)
Higher vocational education	8 (27%)	10 (33%)		13 (43%)
Secondary school	8 (27%)	8 (27%)		6 (20%)
Lower vocational education	5 (17%)	6 (20%)		0
Elementary school	1 (3%)	2 (7%)		0
Unknown/other	1 (3%)	1 (3%)		1 (3%)
ASD diagnosis[†]	30	0		0
Autistic disorder	6 (20%)			
Asperger's disorder	10 (33%)			
Autism spectrum disorder	14 (47%)			
PD diagnosis[‡]	$N=18$	$N=30$[§]	$N=23$	$N=0$
Avoidant PD	1 (3%)	3 (10%)	7 (23%)	
Dependent PD	0	1 (3%)	1 (3%)	
Obsessive–compulsive PD	5 (18%)	0	4 (13%)	
Paranoid PD	0	0	0	
Schizotypal PD	0	0	0	
Schizoid PD	3 (10%)	0	0	
Histrionic PD	0	0	0	
Narcissistic PD	0	3 (10%)	2 (7%)	
Borderline PD	0	7 (23%)	5 (17%)	
Antisocial PD	1 (3%)	1 (3%)	3 (10%)	
Other specified PD (≥ 5 traits)	12 (40%)	19 (63%)	15 (50%)	
Psychological symptoms and disorders				
Alcohol, drugs and medication problems	2 (7%)		4 (13%)	
Psychotic symptoms	1 (3%)		0 (0%)	
Depressive disorder	5 (17%)		11 (37%)	
Panic disorder	2 (7%)		2 (7%)	
PTSD	3 (10%)		4 (13%)	
Specific phobia	1 (3%)		1 (3%)	
Social anxiety disorder	1 (3%)		6 (20%)	
Generalized anxiety disorder	1 (3%)		3 (10%)	
Obsessive–compulsive disorder	2 (7%)		2 (7%)	
Somatic symptom disorder and related disorders	0 (0%)		2 (7%)	
Eating disorders	0 (0%)		1 (3%)	
Adjustment disorder	2 (7%)		1 (3%)	
Relational problems	1 (3%)		2 (7%)	
Bereavement disorder	1 (3%)		1 (3%)	

Table 1 (continued)

Psychological symptoms and disorders		
Problems with agression	1 (3%)	2 (7%)
Other complaints	3 (10%)	2 (7%)

ASD autism spectrum disorder, *COM* general population comparison group, *PTSD* posttraumatic stress disorder, *PD* personality disorder

[†]ASD diagnosis was a clinically assessed diagnosis without using NIDA. Psychological symptoms and disorders were assessed with a semi-structured interview for mental disorders in this study

[‡]The number of participants assessed with PD diagnosis is lower than the total number of specific PDs. The explanation for this difference is that some participants have been assessed with more than one specific PD. PDs assessed with SCID-5-PD in current NIDA study

[§]PDs assessed in the past with the Dutch version of the SCID-II, SCID-5-PD, or psychological-psychiatric assessment

Table 2 Interrater reliability of the NIDA

	Krippendorff's alpha	CI
NIDA items		
1. Do you think that you are impaired in making contact with others and in sharing thoughts and feelings?	0.95	0.88–1.00
2. Do you think that you are impaired in your non spoken way of communicating?	0.93	0.83–1.00
3. Do you think that you are impaired in starting, maintaining and understanding relationships?	0.91	0.81–0.98
4. Do you have a typical or repetitive way of moving, of using objects or of speaking?	0.83	0.65–0.9
5. Are you insistent on sameness, do you have rigid inflexible routines or ritualised patterns in your manner of speaking or behaving?	0.80	0.66–0.91
6. Do you have highly restricted, fixated interests which are extreme in intensity or focus?	0.84	0.71–0.95
7. Are you hyper- or hypo reactive to sensory input or do you have an unusual interest in sensory aspects of the environment?	0.87	0.75–0.97
8. In which areas do you experience distress or do you think you are impaired in your ability to function due to the aforementioned symptoms?	0.95	0.88–1.00
NIDA diagnostic conclusion ('yes' or 'no' current ASD)	1.00	1.00–1.00

Krippendorff's alpha values of the NIDA (N = 90, 95% CIs generated by two raters)

NIDA Dutch Interview for Diagnostic assessment of Autism spectrum disorder in adults, *CI* confidence interval

Please note that as the NIDA follows the DSM-5 criteria closely only the often considered negative aspects of ASD have been included

higher compared to most previous studies and comparable to one study (Hus & Lord, 2014; a clinical subsample of adolescents and adults [VIQ 85-115]). The largest difference in ADOS-2 sensitivity between our and another study is with the study of De Bildt et al. (2016). This study included participants with a diagnosis of PDD-NOS who might be presenting less ASD characteristics and/or less obvious ASD characteristics. These ADOS-2 findings suggest our study having clearly defined groups of participants. Hence, focusing on males without an intellectual disability seemed to have successfully reduced heterogeneity of the ASD sample as we anticipated in our study design.

Interestingly, we observed a rather clear distinction between the ASD group and the PD group on the NIDA as well as with respect to the ADOS-2 scores. This finding is in contrast with the dominant view in the literature. For example (see also Table 4) we observed a clear distinction regarding the means of the total scores on the NIDA between the ASD group and the PD group. While this seems unexpected, there is a clear explanation for this difference between the literature so far and our study. We explicitly only included men with overt ASD presentations and who do not seem to be camouflaging their social disability. Moreover, the included men with PD had absolutely no past or current suspicion on ASD. Hence this increased the likelihood of observing such a difference. Whether in a sample of participants who might all be suspected having an ASD this will be as clear as in the current study is debatable. Our selection procedure also implies that while this first study into the psychometric properties of a part of the NIDA is promising, the NIDA does need to be put further to the test with less obvious ASD samples. The low comorbidity with co-occurring conditions observed in the present samples also indicates that future studies should use samples with (at least initially) less clear diagnostic characteristics. As the men we selected for the ASD and

Table 3 Sensitivity and specificity of NIDA and ADOS-2

	Sen	Spec	Cohen's kappa	CI	SE
Current study					
NIDA based on ADOS-2 cut-off 8	0.76	1.00	0.80	0.67–0.93	0.07
NIDA based on ADOS-2 cut-off 10	0.89	0.98	0.89	0.79–1.00	0.05
NIDA based on clinical diagnosis ASD	0.83	1.00	0.87	0.76–0.98	0.06
ADOS-2 cut-off 8 based on clinical diagnosis ASD	0.96	0.93	0.88	0.77–0.98	0.05
ADOS-2 cut-off 10 based on clinical diagnosis ASD	0.90	1.00	0.92	0.84–1.00	0.04
NIDA or ADOS-2 cut-off 8 based on clinical diagnosis ASD	0.96	0.93	0.88	0.77–0.98	0.05
NIDA or ADOS-2 cut-off 10 based on clinical diagnosis ASD	0.93	1.00	0.95	0.88–1.00	1.00
NIDA and ADOS-2 cut-off 8 based on clinical diagnosis ASD	0.83	1.00	0.87	0.76–0.98	0.06
NIDA and ADOS-2 cut-off 10 based on clinical diagnosis ASD	0.90	1.00	0.92	0.84–1.00	0.04
Previous study findings					
ADOS-2 cut-off 8 (Hus & Lord, 2014)	0.92	0.77			
ADOS-2 cut-off 8 (Pugliese et al., 2015)	0.83	0.65			
ADOS-2 cut-off 8 (De Bildt et al., 2016)	0.61	1.00			
ADOS-2 cut-off 10 (De Bildt et al., 2016)	0.53	1.00			
ADOS-2 cut-off 8 (Fusar-Poli et al., 2017)	0.87	0.74			
ADOS-2 cut-off 7 (Langmann et al., 2017)	0.82	0.83			
ADOS-2 cut-off 10 (Langmann et al., 2017)	0.57	0.92			

ADOS-2 autism diagnostic observation schedule, *ASD* autism spectrum disorder, *CI* confidence interval, *NIDA* Dutch Interview for Diagnostic assessment of Autism spectrum disorder in adults, *SE* standard error, *Sen* sensitivity, *Spec* specificity

PD group were recruited in a psychiatric institute, at the end of their treatment or already dismissed from treatment, this could well have resulted in the observed lower prevalence of co-occuring mental health conditions compared to what is to be expected from clients with ASD and/or PD when referred for diagnosis and treatment.

Next to the aforementioned limitation regarding representativeness of the overall ASD and PD population, other limitations are: the exclusive inclusion of males, the exclusion of men with an intellectual disability, the small sample sizes, the lack of more than one clinical comparison group, and the fact that PD diagnoses of the PD participants were not all based on a 'gold standard' DSM-interview like the SCID, leading to a few formerly diagnosed PD participants who did not or no longer met the criteria for a specified DSM-5 PD. Moreover, in this first study we did not yet examine test–retest reliability, and we focused solely on the in-person current functioning part of the NIDA while for an ASD diagnosis following the DSM-5 the past functioning part of the NIDA is also of relevance.

The key strengths of this study are the broad age range of the sample, the recruitment of all participants with ASD directly from a clinical setting specialized in psychodiagnostic assessments and psychotherapeutic treatment for adults with ASD, and the comparison of three different groups including a PD group which make the results more relevant for clinical practice. Further, to our knowledge, this is the first study in which an interview based on DSM-5 ASD criteria administered to adults with ASD is validated for men.

Future research is needed to critically review and to further establish the current psychometric properties of the NIDA. This instrument should be tested in a larger study in more detail and in a more diverse population (e.g., also including women). The inclusion of adults with less overt autism features and inclusion of other clinical groups with comparable social challenges like social anxiety disorder and obsessive–compulsive PD (Vuijk et al., 2018) or a mixed neuropsychiatric sample (ASD with comorbid ADHD) should test the NIDA's current concurrent criterion-related validity. Moreover, the NIDA focuses solely on the negative characteristics of ASD as this is in line with the formulation of the DSM-5 criteria. However, it could well be that the concurrent criterion-related validity and construct validity improves when positive characteristics of ASD are included as well. Please note that while the NIDA is currently only available in Dutch an English version is under construction (and presented in Online Resource 2).

In conclusion, this first attempt to validate the NIDA suggests that an important part of the instrument shows preliminary indications of its psychometric usefulness in adult males without intellectual disability. Both the NIDA and the ADOS-2 show good psychometric properties, considering them to be alternatives in the set of ASD psychodiagnostic instruments. The NIDA is available free of charge, with a low-threshold training and provides a

Table 4 Pairwise comparisons of NIDA and ADOS-2 item and total scores

	N	Mean	SD	SE	Comparison	Mean difference	SE	CI	df	p
NIDA										
Item 1										
ASD	30	2.0	0	0.04	ASD-PD	1.93	0.05	1.80–2.07	2	< 0.001
PD	30	0.07	0.37	0.04	ASD-COM	2.00	0.05	1.87–2.13	2	< 0.001
COM	30	0	0	0.04	PD-COM	0.07	0.05	− 0.07–0.20	2	0.672
Item 2										
ASD	30	1.93	0.37	0.06	ASD-PD	1.83	0.08	1.74–2.03	2	< 0.001
PD	30	0.10	0.40	0.06	ASD-COM	1.93	0.08	1.74–2.13	2	< 0.001
COM	30	0	0	0.06	PD-COM	0.10	0.08	− 0.10–0.30	2	0.661
Item 3										
ASD	30	1.83	0.53	0.07	ASD-PD	1.73	0.10	1.49–1.98	2	< 0.001
PD	30	0.10	0.40	0.07	ASD-COM	1.83	0.10	1.59–2.08	2	< 0.001
COM	30	0	0	0.07	PD-COM	0.10	0.10	− 0.14–0.34	2	0.950
Item 4										
ASD	30	1.17	0.99	0.11	ASD-PD	1.13	0.15	0.77–1.50	2	< 0.001
PD	30	0.03	0.18	0.11	ASD-COM	1.17	0.15	0.80–1.53	2	< 0.001
COM	30	0	0	0.11	PD-COM	0.03	0.15	− 0.33–0.40	2	1.000
Item 5										
ASD	30	1.67	0.71	0.10	ASD-PD	1.40	0.14	1.05–1.75	2	< 0.001
PD	30	0.27	0.64	0.10	ASD-COM	1.67	0.14	1.32–2.01	2	< 0.001
COM	30	0	0	0.10	PD-COM	0.27	0.14	− 0.08–0.61	2	0.194
Item 6										
ASD	30	1.60	0.81	0.11	ASD-PD	1.37	0.15	0.99–1.74	2	< 0.001
PD	30	0.23	0.63	0.11	ASD-COM	1.60	0.15	1.23–1.97	2	< 0.001
COM	30	0	0	0.11	PD-COM	0.23	0.15	− 0.14–0.61	2	0.393
Item 7										
ASD	30	1.40	0.89	0.12	ASD-PD	1.07	0.18	0.64–1.49	2	< 0.001
PD	30	0.33	0.76	0.12	ASD-COM	1.40	0.18	0.97–1.83	2	< 0.001
COM	30	0	0	0.12	PD-COM	0.33	0.18	− 0.09–0.76	2	0.179
Item 8										
ASD	30	2	0	0.64	ASD-PD	1.80	0.09	1.58–2.02	2	< 0.001
COM	30	0	0	0.64	PD-COM	0.20	0.09	− 0.02–0.42	2	0.092
ADOS-2										
Item A2										
ASD	30	1.17	0.65	0.09	ASD-PD	0.93	0.13	0.61–1.25	2	< 0.001
PD	30	0.23	0.50	0.09	ASD-COM	1.07	0.13	0.75–1.39	2	< 0.001
COM	30	0.10	0.31	0.09	PD-COM	0.13	0.13	− 0.19–0.45	2	0.930
Item A4										
ASD	30	0.63	0.62	0.83	ASD-PD	0.37	0.12	0.08–0.65	2	0.007
PD	30	0.27	0.45	0.83	ASD-COM	0.60	0.12	0.31–0.89	2	< 0.001
COM	30	0.03	0.18	0.83	PD-COM	0.23	0.12	− 0.05–0.52	2	0.147
Item A8										
ASD	30	0.80	0.76	0.10	ASD-PD	0.60	0.13	0.27–0.93	2	< 0.001
PD	30	0.20	0.41	0.10	ASD-COM	0.73	0.13	0.41–1.06	2	< 0.001
COM	30	0.07	0.25	0.10	PD-COM	0.13	0.13	− 0.19–0.46	2	0.969
Item A10										
ASD	30	1.13	0.78	0.11	ASD-PD	0.90	0.16	0.51–1.29	2	< 0.001
PD	30	0.23	0.63	0.11	ASD-COM	1.03	0.16	0.64–1.42	2	< 0.001
COM	30	0.10	0.40	0.11	PD-COM	0.13	0.16	− 0.26–0.52	2	1.000
Item B1										
ASD	30	1.67	0.76	0.10	ASD-PD	1.53	0.14	1.20–1.87	2	< 0.001
PD	30	0.13	0.51	0.10	ASD-COM	1.67	0.14	1.33–2.00	2	< 0.001
COM	30	0	0	0.10	PD-COM	0.13	0.14	− 0.20–0.47	2	0.989

Table 4 (continued)

	N	Mean	SD	SE	Comparison	Mean difference	SE	CI	df	p
Item B2										
ASD	30	1.03	0.32	0.08	ASD-PD	0.67	0.11	0.41–0.93	2	< 0.001
PD	30	0.37	0.56	0.08	ASD-COM	0.93	0.11	0.67–1.19	2	< 0.001
COM	30	0.10	0.31	0.08	PD-COM	0.27	0.11	0.01–0.53	2	0.041
Item B5										
ASD	30	1.13	0.63	0.09	ASD-PD	0.73	0.13	0.41–1.06	2	< 0.001
PD	30	0.40	0.50	0.09	ASD-COM	0.97	0.13	0.64–1.29	2	< 0.001
COM	30	0.17	0.38	0.09	PD-COM	0.23	0.13	− 0.09–0.56	2	0.244
Item B7										
ASD	30	0.93	0.79	0.09	ASD-PD	0.77	0.13	0.44–1.09	2	< 0.001
PD	30	0.17	0.38	0.09	ASD-COM	0.90	0.13	0.58–1.22	2	< 0.001
COM	30	0.03	0.18	0.09	PD-COM	0.13	0.13	− 0.19–0.46	2	0.954
Item B9										
ASD	30	1.07	0.64	0.09	ASD-PD	0.77	0.13	(0.46–1.08)	2	< 0.001
PD	30	0.27	0.47	0.09	ASD-COM	0.97	0.13	(0.66–1.28)	2	< 0.001
COM	30	0	0.31	0.09	PD-COM	0.20	0.13	(− 0.11–0.51)	2	0.352
Item B11										
ASD	30	0.87	0.35	0.06	ASD-PD	0.60	0.09	0.39–0.81	2	< 0.001
PD	30	0.27	0.45	0.06	ASD-COM	0.87	0.09	0.66–1.07	2	< 0.001
COM	30	0	0	0.06	PD-COM	0.27	0.09	0.06–0.47	2	0.007
Item B12										
ASD	30	0.90	0.61	0.08	ASD-PD	0.73	0.11	0.46–1.00	2	< 0.001
PD	30	0.17	0.38	0.08	ASD-COM	0.87	0.11	0.60–1.14	2	< 0.001
COM	30	0.03	0.18	0.08	PD-COM	0.13	0.11	− 0.14–0.40	2	0.688
Item B13										
ASD	30	0.87	0.57	0.10	ASD-PD	0.20	0.13	− 0.13–0.53	2	0.422
PD	30	0.67	0.61	0.10	ASD-COM	0.73	0.13	0.41–1.06	2	< 0.001
COM	30	0.13	0.35	0.10	PD-COM	0.53	0.13	0.21–0.86	2	< 0.001
Item D1										
ASD	30	0.53	0.73	0.09	ASD-PD	0.47	0.13	0.14–0.79	2	0.002
PD	30	0.07	0.25	0.09	ASD-COM	0.40	0.13	0.08–0.72	2	0.010
COM	30	0.13	0.43	0.09	PD-COM	0.07	0.13	− 0.39–0.26	2	1.000
Item D2										
ASD	30	0.27	0.64	0.07	ASD-PD	0.27	0.10	0.02–0.51	2	0.026
PD	30	0	0	0.07	ASD-COM	0.23	0.10	− 0.01–0.48	2	0.063
COM	30	0.03	0.18	0.07	PD-COM	0.03	0.10	− 0.28–0.21	2	1.000
Item D4										
ASD	30	0.33	0.55	0.07	ASD-PD	0.23	0.10	0–0.47	2	0.056
PD	30	0.10	0.31	0.07	ASD-COM	0.30	0.10	0.06–0.54	2	0.08
COM	30	0.03	0.18	0.07	PD-COM	0.07	0.10	− 0.17–0.30	2	1.000
NIDA total score										
ASD	30	6.70	1.15	0.18	ASD-PD	6.13	0.25	5.54–6.72	2	< 0.001
PD	30	0.57	1.19	0.18	ASD-COM	6.70	0.25	6.11–7.29	2	< 0.001
COM	30	0	0	0.18	PD-COM	0.57	0.25	− 0.04–1.17	2	0.073
ADOS-2 total score										
ASD	30	13.33	3.31	0.61	ASD-PD	9.77	0.67	8.13–11.40	2	< 0.001
PD	30	3.56	2.71	0.50	ASD-COM	12.27	0.67	10.63–13.90	2	< 0.001
COM	30	1.07	1.36	0.25	PD-COM	2.50	0.67	0.86–4.14	2	< 0.001

ADOS-2 autism diagnostic observation schedule, *ASD* autism spectrum disorder, *CI* confidence interval (95%), *COM* comparison group of nonpatient individuals, *df* degrees of freedom, *NIDA* Dutch Interview for Diagnostic assessment of ASD in adults, *PD* personality disorder, *SD* standard deviation, *SE* standard error

relatively brief and user-friendly semi-structured interview in the clinical ASD assessment. The ADOS-2 is not available free of charge, with an extensive training, and a time-consuming administering in clinical practice. Overall, experience and competence of the clinician in the characteristics of ASD as well PD and their resemblance and difference in phenotype remains of primary importance when assessing adults suspicious for ASD.

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Declarations

Conflict of interest Vuijk, first author, developed NIDA. The NIDA is available for free. Arntz, is one of the translators of SCID-5-PD.

Ethical Approval The study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki, 2000). Approval was granted by the Ethics Committee of the University of Amsterdam (Date: 04 April 2017/No.: 2017-CP-7839).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

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