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ORIGINAL PAPER

Psychometric Properties of Psychosexual Functioning Survey Among Autistic and Non-autistic Adults: Adapting the Self-Report Teen Transition Inventory to the U.S. Context

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Abstract

Psychosexual functioning is an important aspect of human development and relationships. A previous study investigated psychosexual functioning of autistic adolescents using the Teen Transition Inventory (TTI), but there is a lack of comprehensive measurement of psychosexual functioning among autistic and non-autistic (NA) adults. To address this gap, the current study adapted the self-report TTI to the Psychosexual Functioning Survey (PSFS) and presented it to 131 autistic ($n=59$) and NA adults ($n=72$) in the U.S. Comparisons of psychometric properties between the original TTI and the PSFS are shared; the developmental relevancy among some items was changed, and the alphas indicated a difference in the content of certain scales. Differences emerged between autistic and NA adults in both the intra- and interpersonal domains of psychosexual functioning, but not in sexual and intimate behaviors. The findings suggest the persistence of differences from adolescence to adulthood between autistic and NA people and highlight the importance of understanding the unique experiences of adults in psychosexual functioning relative to diagnostic status.

Keywords Psychosexual functioning · Psychometric properties · Autism spectrum disorder · Adults · Typically-developing

Understanding psychosexual functioning can be essential to learn about the sexual health of sexually-active adults and potentially support those who want support in the area of sexuality (Lief & Reed, 1972; Pereira, 2017; World Health Organization, 2021). Psychosexual functioning refers to individuals' abilities to engage in social and sexual activities. It encompasses three domains: Psychosexual Socialization, describing individuals' abilities to form interconnected social and sexual relationships; Psychosexual Selfhood, focusing on individuals' development of self-esteem and knowledge; and Sexual/Intimate Behaviors, considering individuals' participation of all types of sexual and intimate behaviors (Dekker et al., 2015; Dewinter et al., 2017). Despite the important role of psychosexual functioning in the lives of adults, the measurement of psychosexual functioning is limited by a lack of comprehensive tools.

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Current Psychosexual Functioning Measures

Most measures of psychosexual functioning are delivered in the form of self-report questionnaires. Existing questionnaires often focus on specific parts of psychosexual functioning instead of psychosexual functioning more broadly. For example, some focus on particular developmental milestones, such as the Course of Life Questionnaire, which measures at what age respondents develop autonomy and sexual relations (Stam et al., 2005). Others focus on specific aspects related to sexual behaviors and functioning, such as the Sexual Functioning Questionnaire (SFQ; Syrjala et al., 2000), or certain populations, such as Women Sexual Health Questionnaire (Ford et al., 2014). The questionnaires include aspects related to sexual behaviors and experiences pathways like key events or physical conditions and mental transitions in sexual relationships, measuring only subdomains of psychosexual functioning. A comprehensive picture of adults' psychosexual functioning is missing, especially regarding Psychosexual Selfhood.

Due to the limitations of the current measures, the concept of psychosexual functioning is often conflated with "sexual health," "sexual experiences," and "sexual behaviors" in studies that investigate psychosexuality in a broad way. Many of the studies among adults focus more on the dysfunction aspect of sexual health and its relationship with elements such as age, gender, and sexual orientation when investigating psychosexuality (Easton et al., 2011; Sinković & Towler, 2019). This approach limits understanding of positive psychosexual functioning, and therefore a more comprehensive, positively-framed approach is much needed (Rocha et al., 2023). Other studies emphasize the changes in individuals' sexual behaviors or satisfaction in relation to their social and physical conditions, such as cerebral palsy, traumatic experiences, or spinal cord injury (Cho et al., 2004; Kriofske Mainella & Smedema, 2022; Romeo et al., 1993). Most of the studies considered only some aspects of psychosexuality, despite the interrelatedness (i.e., Brown-Lavoie et al., 2014; Dekker et al., 2017). The lack of comprehensive measurement of psychosexual functioning among adults makes identifying universal benchmarks to compare across the lifespan or across different populations or groups difficult.

Measuring Psychosexual Functioning Among Autistic Population

Few studies on psychosexual functioning have considered individuals with neurodevelopmental disabilities. In particular, the sexuality and wellbeing of autistic adults needs more representation and discussion. Current studies of autistic adults' psychosexuality too often centered on their engagement in sexual misconduct behaviors and experiences with a lack of understanding in their self-perception and intrapersonal performances (Graham Holmes et al., 2020; Hancock et al., 2017; Hartmann et al., 2019). Some assessment questionnaires, such as the Sexual Behavior Scale (Hancock et al., 2017), Female Sexual Functioning Index (FSFI; Rosen et al., 2000), Sexual Desire Inventory (SDI-2; Mark et al., 2014), and Sexual Satisfaction Scale (Spector et al., 1996) have been used among individuals with developmental disabilities, but none of the questionnaires and measures were designed particularly for autistic adults. There are important and unique factors to consider when designing a survey for autistic individuals. For instance, interpretation of language can be more literal (American Psychiatric Association, 2013). Also, studies show that autistic individuals exhibit uncertainty when engaging in communication about sexuality and have higher risk of low sexual knowledge (Graham Holmes et al., 2020; Sala et al., 2020). The generalizability of the previous questionnaires to autistic participants remains unclear. Measurements of psychosexual functioning need to be accessible for both autistic and nonautistic (NA) individuals to carefully study psychosexual functioning in both groups. A standardized and comprehensive assessment tool would allow us to better measure and thus understand psychosexual functioning in both autistic and NA adults.

Teen Transition Inventory

The Teen Transition Inventory (TTI) was the first measure developed to investigate psychosexual functioning among autistic adolescents using both self- and parent- report questionnaires (Dekker et al., 2017). The inventory includes "a total of 81 items in the parent-report TTI and 123 items in the self-report TTI" to learn about three domains of psychosexual functioning: Psychosexual Socialization, Psychosexual Selfhood, and Sexual/Intimate Behaviors (Dekker et al., 2017, p. 1720). The TTI was originally designed to assess the psychosexual functioning of adolescents between 12 and 21 years old and has been applied to both autistic and NA adolescents without intellectual disabilities. A Dutch study with both parent- and self-report TTI showed that the scales used to measure psychosexual functioning had mostly good internal consistency (Dekker et al., 2017). Statistically significant differences were found between autistic and their NA peers in Psychosexual Socialization and Psychosexual Selfhood based on self-report TTI, where autistic adolescents on average had less positive psychosexual functioning compared with their NA peers. These differences are important to acknowledge so that adaptations to programming can meet the learning needs and supported desired outcomes for autistic individuals.

Although the TTI has great utility in assessing psychosexual functioning of Dutch autistic adolescents, its applicability to the lives of autistic adults is unknown. Compared with adolescents, adults are more mature in their physical, cognitive, and social development. They have also spent more time exploring their sexuality. Therefore, adults usually have more opportunities to establish sexual relationship and their perceptions of sexuality and sexual behaviors can also be different from adolescents (Foulkes et al., 2009; Peter & Valkenburg, 2011). Further, the original TTI was developed in the Netherlands and its relevancy in a U.S. context has not been explored. Conceptualization of sexuality differs across cultural groups, and the U.S. and Dutch population have diverse understanding and ways of communication about sexuality (Szlachta, 2020). For example, sex education is mandatory and starts earlier in the Netherlands than in the U.S., which is thought to be related to a lower rate of risky sexual behaviors in the Netherlands. Although some aspects of sexuality are broadly similar across the two cultures, it is important to pay attention to the different contexts when adapting this measure. To build on the success and unique tool designed specifically for an autistic audience, we sought to make the TTI applicable to the U.S. adult population.

The current study aimed to test the internal consistency of the adapted English version of the self-report TTI for use among adults in the U.S, i.e., the Psychosexual Functioning Survey (PSFS) for adults. We conducted exploratory analyses to compare scales and items within three domains of psychosexual functioning (Psychosexual Socialization, Psychosexual Selfhood, and Sexual/Intimate Behaviors) between autistic and NA adults. Based on the self-report results from the adolescent TTI, we hypothesized similar patterns between the diagnostic groups in an adult sample. Specifically, compared with NA adults, autistic adults would rate themselves lower on scales of friendship skills, social acceptance, perceived social competence and self-esteem, and similar to NA adults on levels of appropriate and inappropriate sexual/intimate behaviors (Dekker et al., 2017).

Method

Participants & Procedures

Participants were recruited through social media platforms like Instagram, Twitter, and Facebook. Emails with flyers were sent to institutions like autism community centers, organizations, and schools that provide special education in the U.S. Participants had to be at least 18 years old, and they were asked directly about whether they were able to consent for the study independently. Those who answered "yes" continued to the informed consent forms. The online questionnaires were then sent through REDCap, a secure and confidential website for online questionnaire data collection. Each participant received a $20 Amazon gift card for compensation. All procedures of the study were approved by the Social, Behavioral & Educational Research Institutional Review Board (SBER IRB) of Tufts University.

The research team also took steps to reduce the impact of bots. First, the team reviewed the "scam" rating of IP addresses and only included those with a "low risk" rating. Fifteen attention check items (i.e., please select "not at all true" for this question) were added to the questionnaires and only participants who answered more than 70% correct were included. Mean survey completion time was calculated and only participants who finished the survey within two standard deviations below the mean were included. We examined consistency across similar items within participants and open-ended questions between participants. All identical/multiple responses and suspected bots were removed.

Overall, 155 participants were confirmed and completed the study (60 ASD; 95 NA). One participant was removed due to the inability to consent independently. Autistic or NA was determined by (1) self-report and (2) score on the Autism Quotient-10 (AQ-10). The question "Have you ever been diagnosed with autism spectrum disorder (ASD), Asperger's, or Autistic disorder?" was asked and participants who answered "yes" were assigned to the autistic group. To make group comparisons most meaningful, participants who did not report to be autistic and had AQ-10 scores in the elevated range (see Measures for cut-off value) were not included in the NA group or the autistic group. With the above criteria, another 23 participants were excluded from the dataset and 131 participants were included in these analyses.

Measures

After the consent process, ten demographic questions were asked to provide descriptive statistics of our participants, including gender, sex, race, age, puberty start age, and current relationship status. Two separate questions asked about their previous sex education and training experiences in friendship/intimacy. The final two questions confirmed participants' eligibility by asking about their autism diagnosis and birth year.

The Psychosexual Functioning Survey (PSFS)

The PSFS is a minimally adapted version of the TTI self-report used to assess psychosexual functioning of adults (Dekker et al., 2017). Modifications were made so that the inventory is relevant to adults' psychosexual condition

(see Table 1). In total, ten items were worded differently. "Peers" and "teenagers" were changed to "people (of my age)," (i.e., the scale "Social acceptance by peers' was changed to 'Social acceptance') and "boy/girl" changed to "man/woman" to accommodate for the daily experiences of adults. Seven items related to school life and specific traits during puberty, like "I do not like the physical changes my body has gone through which are part of puberty," were deleted. One item considered as inappropriate sexualized behavior: "I discuss my feelings and/or questions about intimacy/sexuality with strangers" was also deleted given the increased amount of online life for adults compared with adolescents (Stephure et al., 2009). In addition, given the changes since the development of the TTI, a different approach was taken to better reflect the diversity of sexual interest/orientation and to avoid discrimination and overgeneralization (Moleiro & Pinto, 2015). Instead of recoding the answer (i.e., gay/lesbian, homo/heterosexual), the current study used questions like "have you been in love with man/woman" to investigate adults' romantic attraction and previous dating experiences so that they were more likely to answer the questions and come up with less binary answers (Drill et al., 2019; Matsick et al., 2022).

A total of 13 items were added to the inventory. Two new scales (i.e., 'Previous friendship skills' and 'Recent amount of sexual desires') were added. Under the Psychosexual Socialization domain, four new items form the new scale: 'Previous friendship skills.' These items were added to replace the deleted high school friendship skills questions in TTI self-report as there might be changes in adults' friendship skills since adolescence. Two items about bullying experiences were also included in 'Social acceptance' as social isolation and negative experiences in social communication may increase in adulthood (Einarsen et al., 2009). For Psychosexual Selfhood domain, "I think I am good looking (beautiful/attractive)" was added under the scale of 'Body image.' As adults have relatively stable body shape compared with adolescents, they may have a different understanding of their bodies. This question was added to replace the deleted questions about physical changes during puberty under the same scale. "I find it pleasant to be physically intimate with another person (for example French Kissing, cuddling or sex)" was added to 'Perceived social competence.' Because adults are more likely to engage in sexual activities compared with adolescents, they may have more chances of getting physically intimate with other person and variation in their answers to this question. Within the Sexual/Intimate Behaviors domain, five items were added to measure 'Recent amount of sexual behaviors' as a new scale. Because adults tend to be more mature in their sexuality compared with adolescents, they are likely to engage in more frequent sexual activities. The scales intended to learn about participants' most recent sexual behaviors.

Among the 123 items the original self-report TTI used to measure psychosexual functioning, a total of 115 items were included into the PSFS. All items, including the added 13 items, were rated on a 3-point scale with "0" indicating "Not at all true," "1" for "Somewhat or sometimes true," and "2" for "Definitely or Often true." Some items used opposite wording and were therefore reversely coded so that higher points indicate better psychosexual functioning. The majority of the scales had good internal consistency (Cronbach's $\alpha \geq 0.7$) among autistic adolescents in TTI, and all scales and items were therefore included into the PSFS. The PSFS consists of 75 items that cluster onto 13 scales. All scale scores were calculated using the mean score of items. The rest of the questions were "separate items" (Dekker et al., 2017, p. 1720). The separate items that could not be analyzed within scales were reduced to the same scoring as the TTI (binary: behaviors/experiences have/have not occurred) and assessed separately. Table 2 presents a detailed comparison between TTI self-report and the PSFS in items and scales.

Autism Quotient-10 (AQ-10)

The AQ-10 (Allison et al., 2012; Baron-Cohen et al., 2001) is a self-administered questionnaire with ten questions to measure individuals' autistic traits (Cronbach's $\alpha = 0.85$). The AQ-10 was used as an additional screener of autistic traits, given the self-report method of data collection. Those scoring higher than six are considered to have a profile consistent with an autism diagnosis; for this study, participants who identified as NA with an AQ-10 score greater than 6 were removed from the analysis (Allison et al., 2012). The brief and self-report aspect of the AQ-10 make it a useful tool for online surveys. Of note, since these data were collected, some studies suggest that the AQ-10 may not be the best psychometric tool to assess autistic traits in the general population (Taylor et al., 2020).

Data Analysis Plan

The results of priori sample size calculation indicated that the study was adequately powered ($1-\beta = 0.8$) to detect moderate effect size group differences using t-test comparisons (Faul et al., 2007). Age, gender, race, AQ-10 score, and puberty start age of all participants are each summarized in Table 3. Independent sample t-tests were conducted to measure the mean differences between autistic and NA groups in the descriptive characteristics. Frequencies of participants' gender, sex, race, sexual preferences, current relationship status, and previous education or training experiences

Table 1 Comparisons of Changes Made for TTI Self-report for adolescents and PSFS (Dekker et al., 2017)

Domains	Scales	TTI Self-report for adolescents (original TTI)	PSFS
Psychosexual Socialization	Friendship skills	I am popular amongst my peers.	I am popular amongst other people.
	Previous friendship skills	I quickly made new friends in high school (social acceptance by peers)	I was part of a group of friends in high school I was considered popular amongst my peers in high school I had the need for a best friend in high school I had at least one best friend in high school.
	Social acceptance by peers (replaced with Social acceptance)	N/A	I get bullied by other people. I bully other people.
		I am accepted by my peers.	I am accepted by other people.
	Personal openness about intimacy	I discuss my feelings and/or questions about intimacy/sexuality with my brother or sister.	I discuss my feelings and/or questions about intimacy/sexuality with my siblings
Psychosexual Selfhood	Sexual preference/Types of intimate or sexual behavior and experiences	I have been in love with a boy/man.	I have been in love with a man.
		I have been in love with a girl/woman.	I have been in love with a woman.
		I have (once) dated a boy/man	I have (once) dated a man
		I have (once) dated a girl/woman	I have (once) dated a woman
	Body image	I do not like the physical changes my body has gone through which are part of puberty.	Replaced with: I think I am good looking (beautiful/attractive).
		How skinny or fat do you consider yourself? I think I am…	
		What do you think about your height? I think I am…	
		Please indicate how satisfied you are with the shape of your body (for example muscle growth, breasts, but, belly, legs, etc.). I am…	
		I have had to get used to the physical changes my body has gone through, which are part of puberty.	
	Perceived social competence	I feel uncomfortable when I am around a group of teenagers.	I feel uncomfortable when I am around a group of people my age.
		I feel confident when I am hanging out with my peers.	I feel confident when I am hanging out with other people.
		N/A	I find it pleasant to be physically intimate with another person (for example French Kissing, cuddling or sex).
		I get along well with my peers.	I get along well with other people.
Sexual/ Intimate Behaviors	Type of intimate or sexual behaviors and experiences	I have been in love with a peer.	Deleted
	Amount of inappropriate sexualized behavior	I discuss my feelings and/or questions about intimacy/sexuality with strangers.	Deleted
	Recent amount of sexual desires		Have you ever masturbated in six month?
			Have you ever French kissed in six months?
			Have you ever touched or caressed it in six month?
			Have you ever fingered by or of someone/gave or received a hand-job in six month?
			Have you ever had intercourse (making love, sex) in six month?

Table 2 TTI Self-report for adolescents and PSFS domains, scales, and items

Domains	Scales	TTI Self-report for adolescents	PSFS
Psychosexual Socialization	Friendship skills	Scale of 5 items, e.g. I am good at making friends.	Same as TTI
	Previous Friendship skills	N/A	Scale of 4 items, e.g. I was part of a group of friends in high school.
	Social acceptance by peers	Scale of 6 items, e.g. I am part of a group of friends.	Scale of 7 items, e.g. I get bullied by other people.
	Perceived romantic competence	Scale of 3 items, e.g. When I'm in love with someone, I do not know what to do.	Same as TTI
	Personal openness about intimacy	Scale of 3 items, e.g. I discuss my feelings and/or questions about intimacy/sexuality with my parents.	Same as TTI
Psychosexual Selfhood	Sexual preference	Separate 2 items, e.g. I have been in love with a man/woman; I have dated a man/woman. Recoded to heterosexual/homosexual love interest; heterosexual/homosexual dating experience.	Separate 2 items same as TTI. Use as demographic information to learn about romantic attraction and dating experiences.
	Body image	Scale of 7 items, e.g. I am satisfied with the way I look	Scale of 3 items, e.g. I think I am good looking (beautiful/attractive).
	Perceived social competence	Scale of 12 items, e.g. Around other people I lose my confidence.	Scale of 13 items, e.g. I find it pleasant to be physically intimate with another person (for example French Kissing, cuddling or sex).
	Social desires	Separate 10 items, e.g. I think it is important my best friend is funny	Same as TTI
	Romantic desires	Separate 9 items, e.g. I think it is important a (future) partner has the same interests as I do.	Same as TTI
	Amount of sexual desires	Scale of 6 items, e.g. I want to French kiss; I want to have intercourse; I fantasize sometimes about being physically intimate with someone.	Same as TTI
	Self-esteem	Scale of 12 items, e.g. I am happy with myself as a person	Same as TTI
Sexual/Intimate Behaviors	Amount of sexual behaviors	Scale of 5 items, e.g. I have had intercourse	Same as TTI
	Recent amount of sexual behaviors	N/A	Scale of 5 items, e.g. I have had intercourse in six months
	Types of intimate or sexual behavior and experiences	Separate 26 items, e.g. I have been in love with a peer.	Separate 25 items, e.g. I have been in love with a fictional character, Do you have a specific physical limitation or at the moment have any physical problems (for example infections or injuries on the genitals) that make having intimate relations or sexuality more difficult? (Recoded into yes and no)
	Amount of inappropriate sexualized behaviour	Scale of 3 items, e.g. I discuss my feelings and/or questions about intimacy/sexuality with strangers.	Scale of 2 items, e.g. I keep contacting someone even though that person has indicated he/she does not want any contact with me; I touch people in places where the other does not want to be touched
	Online sexual activity	Scale of 7 items, e.g. I have set a date with someone I met on the Internet.	Same as TTI
	Age of onset	Separate 5 items, e.g. how old were you the first time you had intercourse	Same as TTI

related to sexuality/intimacy/friendship were also computed for each group. A chi-square test was conducted to measure the differences in sex across two groups. Because there were large numbers of subcategories (>5) under participants' gender, race, current relationship status, and previous education and training experiences, not all categories included participants from both groups. No comparisons were made across groups in these characteristics.

To investigate the internal consistency of the PSFS, we used Cronbach's α, which was calculated separately for each scale and by each group. An item was removed from the scale if the deletion of it led to an improvement of Cronbach's α for at least 0.1 (similar to Dekker et al., 2017). The item-rest correlation was also checked to be at least 0.3 and items were retained or removed from the scale based on their conformity with the scales' construct (Field, 2013).

Table 3 Demographic statistics of ASD and NA group

Self-report Diagnosis	ASD ($n=59$, 45%)		Range	NA ($n=72$, 55%)		Range	*P*
	M	*SD*		*M*	*SD*		
Age	26.31	6.45	18–58	25.06	5.46	18–48	0.23
AQ-10	6.3	2.56	1–10	3.32	1.34	0–5	
Puberty Start Age	13.6	2.77	9–24	13.07	1.97	9–18	0.24
	n	%		*n*	%		
Gender							
Woman	26	44.1%		39	54.2%		
Man	23	39%		17	23.6%		
Non-binary	5	8.5%		4	5.6%		
Agender	1	1.7%		0	0%		
Transgender	1	1.7%		0	0%		
Prefer not to tell	3	5.1%		12	16.7%		
Sex							0.14
Female	30	50.8%		42	58.3%		
Male	25	42.4%		20	27.8%		
Prefer not to tell	4	6.8%		10	13.9%		
Race							
Hispanic or Latino	8	13.6%		0	0%		
Asian	4	6.8%		5	6.9%		
White	30	50.8%		52	72.2%		
Black	7	11.9%		2	2.8%		
Multiracial	5	8.5%		2	2.8%		
Chose not to identify/other	5	6.8%		11	15.3%		
Current Relationship Status							
Single	18	30.5%		19	26.4%		
Casual Dating	12	20.3%		12	16.7		
Committed monogamous relationship (not married)	11	18.6%		28	38.9%		
Committed open relationship (not married)	5	8.5%		6	8.3%		
Committed open relationship (married)	2	3.4%		1	1.4%		
Civil Union	9	15.3%		2	2.8%		
Married	2	3.4%		3	4.2%		
Prefer not to tell	0	0%		1	1.4%		
Previous education or training experiences in sexuality/friendship/intimacy							
By parents/caregivers	21	35.6%		18	25%		
By teachers at school	35	59.3%		47	65.3%		
By friends/peers	27	37.5%		27	37.5%		
By media/Internet	33	56%		29	40.3%		
By training programs	2	3.4%		7	9.7%		
Never had	8	13.6%		14	19.4%		
Prefer not to tell	1	1.7%		7	9.7%		

After the removal of the items, correlation tests were conducted to find the relationship between scales within each group. Scales that were significantly and highly correlated ($\geq \pm 0.9$) with each other indicated that they were measuring the same construct and might be excluded from the survey after evaluating their contents.

Lastly, independent sample t-tests were conducted between the autistic and NA groups for every scale separately within the three domains. Separate items were compared individually across two groups. To control for Type I error, we used Bonferroni correction as we were conducting multiple comparisons. Overall, 62 (13 on scales and 49 on separate items) independent t-test were conducted. Therefore, the p-value after correction was 0.0008 (0.05/62).

Results

Demographics

Table 3 shows the demographic information of the ASD and NA groups. 55 participants from the ASD group and 59 from NA group answered the question about their puberty start age. The two groups had no significant differences

Table 4 Sexual Preferences by Group

ASD ($n=55$)					NA ($n=72$)			
Gender Identity	Attracted to Male	Attracted to Female	Dated Male	Dated Female	Attracted to Male	Attracted to Female	Dated Male	Dated Female
Cis-Female	22(40%)	15(27%)	21(38.2%)	15(27.3%)	27(37.5%)	9(1.25%)	33(18.1%)	12(16.7%)
Cis-Male	8(14.6%)	4(7.3%)	4(7.3%)	16(29.1%)	6(8.3%)	13(18.1%)	9(1.25%)	15(20.8%)
Non-binary	2(3.7%)	4(7.3%)	2(3.7%)	4(7.3%)	0(0%)	2(2.8%)	3(4.2%)	2(2.8%)
Agender	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
Transgender	1(1.8%)	1(1.8%)	1(1.8%)	1(1.8%)	0(0%)	0(0%)	0(0%)	0(0%)
Prefer not to tell	2(3.6%)	3(5.5%)	3(5.5%)	2(3.6%)	8(11.1%)	10(13.9%)	10(13.9%)	10(13.9%)
Total	35(63.6%)	27(49.1%)	31(56.4%)	38(69.1%)	41(56.9%)	34(47.2%)	55(76.4%)	39(54.2%)

Table 5 Cronbach's alphas of PSFS Scales

Themes	Scales	ASD	NA
Psychosexual Socialization	Friendship Skills	0.49	0.59
	Previous Friendship Skills	0.37* (0.64)	0.31* (0.45)
	Social Acceptance by Peers	0.52* (0.66)	0.63
	Perceived Romantic Competence	0.77	0.82
	Personal Openness about Intimacy	0.52* (0.72)	0.27* (0.41)
Psychosexual Selfhood	Body Image	0.30* (0.56)	0.32* (0.44)
	Perceived Social Competence	0.71	0.72
	Amount of Sexual Desires	0.83	0.75
	Self-esteem	0.62	0.67
Sexual/Intimate Behaviors	Amount of Sexual Behaviors	0.84	0.83
	Recent Amount of Sexual Behaviors	0.84	0.82
	Amount Inappropriate Sexual Behaviors	0.64	0.77
	Sexual Behavior Online	0.85	0.85

*Removal of one item from the scale improved average Cronbach's alpha for at least 0.1 (alpha after removal of one item in both groups)

in their age ($p=0.23$), puberty start age ($p=0.24$), and sex ($p=0.14$). The sexual preferences of participants are included in Table 4.

Internal Consistency

The internal consistency of PSFS was shown by scale based on the Cronbach's α calculated within each group (see Table 5). Six scales showed good internal consistency in both groups ($\alpha \geq 0.7$). (i.e., 'Perceived romantic competence,' 'Perceived social competence,' 'Amount of sexual desire,' 'Amount of sexual behaviors,' 'Recent amount of sexual behaviors,' and 'Sexual Behavior Online'). One scale ('Self-esteem') had moderate internal consistency in both group ($\alpha > 0.55$). Two had low internal consistency in both groups ($\alpha < 0.5$; Field, 2013). (i.e., 'Previous friendship skills' and 'Body image'). Moreover, for the autistic group in particular, the internal consistency of 'Amount inappropriate sexual behaviors' was moderate, and 'Friendship skills' was low. For the NA group, two scales ('Friendship skills' and 'Social acceptance by peers') showed moderate consistency, and 'Personal openness about intimacy' showed low internal consistency.

Four scales warranted an investigation of removing items, namely, 'Previous friendship skills,' 'Personal openness about intimacy,' 'Body image,' and 'Social acceptance by peers.' As indicated in Table 5, removing of one item in each of these scales could improve the average Cronbach's α for at least 0.1 within the scales (i.e., "I had the need for a best friend in high school;" "I discuss my feelings and/or questions about intimacy/sexuality with my friends;" "I wish my body looked different;" "I bully other people"). Due to their content value, the four items were further analyzed as separate items, and none showed significant difference between groups. After the removal of the items, there were nine items in NA group and 17 items in autistic group showed item-rest correlation below 0.3. We retained all other items as removing them would either decrease or only slightly improve the Cronbach's α value (i.e., < 0.1).

Correlation Between Scales

The correlation between scales was calculated individually for two groups (Table 6). There were more significant correlations in the autistic group (63%) than the NA group (45%). The majority of the significant correlations were small (ASD = 4, 8%; NA = 9, 26%) to moderate (ASD = 33, 67%; NA = 20, 57%). There were 12 strong correlations for autistic group and 6 for NA group (($\geq \pm 0.5$), but none of the correlations were strong enough to meet the reduction criteria ($\geq \pm 0.9$). The majority of the correlations were within the expected direction and degree. For example, 'Friendship

Table 6 Correlation between scales for ASD and NA group

ASD / NA	ASD ($n=59$); NA ($n=72$)												
	F.S	P.F.S	S.A	P.R	P.O	B.I	S.C	S.D	S.E	S.B	R.S.B	I.S.B	S.O
F.S		0.43**	0.63**	0.40**	0.32*	0.40**	0.71**	0.48**	0.31*	0.31*	0.58**	-0.39**	-0.50**
P.F.S	0.48**		0.45**	0.17	0.09	0.31*	0.46**	0.23	0.14	0.11	0.16	-0.28*	-0.24
S.A	0.66**	0.45**		0.27*	-0.04	0.57**	0.63**	0.36**	0.46**	0.12	0.41**	-0.17	-0.38**
P.R	0.22	0.25*	0.26*		-0.19	0.12	0.23	0.06	0.07	0.32*	0.34*	0.04	0.72
P.O	-0.21	-0.07	-0.16	-0.14		-0.03	0.25	0.42**	-0.07	0.27*	0.24	-0.48**	-0.31*
B.I	0.15	0.13	0.12	0.05	0.26*		0.44**	0.36**	0.60**	-0.08	0.39**	0.14	-0.42**
S.C	0.52**	0.27*	0.56**	0.37**	-0.02	0.20		0.49**	0.38**	0.29*	0.54**	-0.37**	-0.48**
S.D	0.09	0.04	0.07	-0.46**	0.24*	0.17	0.001		0.09	0.39**	0.45**	-0.53**	-0.54**
S.E	0.47**	0.16	0.54**	0.16	0.01	0.45**	0.60**	0.10		-0.10	0.25	0.11	-0.25
S.B	0.03	0.06	0.07	0.27*	0.33**	0.25*	0.40**	0.12	0.07		0.62**	-0.29*	-0.48**
R.S.B	0.05	0.25*	0.17	0.40**	0.04	0.13	0.31**	0.01	0.07	0.57**		-0.16	-0.58**
I.S.B	0.36**	0.20	0.25*	0.42**	-0.4**	-0.21	0.18	-0.32**	0.26*	0.27*	0.21		0.45**
S.O	0.03	0.05	0.02	0.28*	-0.22	-0.08	-0.06	-0.44**	0.15	-0.37**	-0.16	0.43**	

*$p<0.05$, **$p<0.01$

FS friendship skills; PFS previous friendship skills; SA social acceptance; PR perceived romantic competence; PO personal openness; BI body image; SC perceived social competence; SD amount of sexual desire; SE self-esteem; SB amount of sexual behavior; RSB recent amount of sexual behavior; ISB amount inappropriate sexualized behavior; OS sexual intimate behaviors online

Table 7 Group comparisons of scales between ASD and NA group ($n=131$)

Themes	Scales	ASD ($n=59$)		NA ($n=72$)		*df*	t-value	*p*
		M	*SD*	*M*	*SD*			
Psychosexual Socialization	Friendship skills scale	1.06	0.44	1.39	0.37	129	-4.77*	< 0.001
	Previous friendship skills scale	0.87	0.49	1.25	0.46	129	-4.54*	< 0.001
	Social acceptance by peers scale	0.99	0.39	1.34	0.35	129	-5.46*	< 0.001
	Perceived romantic competence scale	0.887	0.56	1.20	0.60	124	-3.21	0.002
	Personal openness about intimacy scale	0.69	0.58	0.56	0.44	129	1.36	0.18
Psychosexual Selfhood	Body image scale	1.06	0.57	1.16	0.40	129	-1.21	0.23
	Perceived social competence scale	1.02	0.33	1.27	0.27	129	-4.78*	< 0.001
	Amount of sexual desires scale	1.28	0.58	1.44	0.49	127	-1.75	0.083
	Self-esteem scale	1.17	0.29	1.29	0.28	129	-2.35	0.02
Sexual/intimate behaviors	Amount of sexual behaviors scale	0.88	0.25	0.92	0.21	129	-0.90	0.37
	Recent amount of sexual behaviors scale	2.00	0.56	2.23	0.49	128	-2.51	0.014
	Amount of inappropriate sexual behaviors scale	1.22	0.66	1.54	0.59	129	-2.95	0.004
	Sexual intimate behaviors online scale	1.11	0.54	1.16	0.50	129	-0.47	0.64

*$p<0.0008$ (significant after Bonferroni correction)

skills,' 'Previous friendship skills,' 'Social acceptance by peers,' and 'Perceived social competence' were expected to be strongly and positively correlated with each other in both groups. The 'Amount of sexual behaviors' and 'Recent amount of sexual behaviors' were also expected and found to be highly correlated. The only surprising scale was the 'Friendship skills,' which was significantly correlated with all other scales for only the autistic group, but not the NA group. In particular, it was positively correlated with 'Recent amount of sexual behaviors,' and negatively correlated with 'Sexual intimate behaviors online.' Both correlations were strong and present only for the autistic group.

Comparisons Between Autistic and NA Groups on the PSFS

Comparisons made between the autistic and NA groups on all the scales were shown in Table 7. Within the Psychosexual Socialization domain, there were statistically significant differences between the autistic and NA groups on three scales (i.e., 'Friendship skills,' 'Previous friendship skills,' and 'Social acceptance by peers'). Autistic adults scored lower on all these scales compared with NA adults. The effect sizes were all moderate ($0.3<$ Cohen's $d<0.5$). The other two scales had no significant differences across the two groups while utilizing the Bonferroni correction, with 'Perceived romantic competence' approaching significance ($p=0.002$). In Psychosexual Selfhood domain,

autistic adults scored significantly lower on the scale 'Perceived social competence' compared with NA adults. The effect size was moderate (Cohen's $d = 0.3$). No significant differences were identified between autistic and NA adults in the other three scales ('Body image,' 'Amount of sexual desires,' and 'Self-esteem') and all separate items (10 in 'Social desires' and nine in 'Romantic desires'). In Sexual/Intimate Behaviors domain, the two groups had no statistically significant differences on any scales or separate items, indicating that autistic and NA adults had the similar performance in sexual and intimate behaviors. Because there were no significant results on separate items, they were not reflected in tables.

Discussion

Although research into psychosexuality is steadily increasing, a comprehensive measure for adults, specifically autistic adults, is currently lacking. To work toward a comprehensive measure of psychosexual functioning that would be accessible for both autistic and NA adults in the U.S., the current study tested the internal consistency of the PSFS, a questionnaire adapted from the self-report TTI (Dekker et al., 2017). We recruited a diverse sample group in terms of race, gender, relationship status, and sexual preferences to explore the psychometrics of the PSFS in comparison to the original adolescent-focused TTI, and to explore psychosexual functioning of autistic and NA adults in the U.S.

Development of the PSFS and Differences with the TTI

In comparison to the TTI, modifications have been made to better suit an adult population, both in terms of item phrasing as well as in terms of content within the scales. First, several items were excluded as they were not appropriate for the age group of adults. Second, item phrasing was altered to better reflect the different developmental state, for example, replacing the scale "Friendship skills" with "Previous friendship skills" to assess social interactions during adolescence. Third, items that performed poorly within the scales, were investigated leading to the removal of some, and the retainment of others.

Other than the improvement of statistics, reasons behind the removal of items in scales with low internal consistency can be attributed to their content. There were multiple ways of understanding particular retrospective questions across participants, making some items vulnerable to interpretation bias (Tourangeau et al., 2000). For example, the item "I had the need for a best friend in high school" on the scale 'Previous friendship skills' could be interpreted in different ways. Those who indicated they had no need for a best friend might have not needed friends because of their "low" friendship making skills or because they already had many best friends. Similar situation can also be applied to the item "I wish my body looked different" on the 'Body image' scale. Therefore, the two items were removed. In addition, within the scale, adults' responses were affected by social desirability bias to different items (Podsakoff et al., 2003; Tourangeau et al., 2000). For instance, on the scale 'Social acceptance by peers,' compared with other items like "I am accepted by other people," individuals are less likely to admit that they have bullied other people (Rigby, 2022). Therefore, we decided to remove this item and the item "I discuss my feelings and/or questions about intimacy/sexuality with my friends" in 'Personal openness about intimacy' scale based on statistics and the literature.

Compared with the original self-report TTI, many of the scales in PSFS had a similar level of internal consistency in both autistic and NA population (Dekker et al., 2017). After the removal of the items, the majority of the scales (nine out of 13) in PSFS had moderate to good internal consistency among autistic (92%) and NA (77%) adults. For those with low internal consistency, Cronbach's alpha might have underestimated the connection between items within the scales. For example, there were scales (i.e., 'Personal openness about intimacy,' and 'Body image') that included elements covering different aspects of the same concept (Dekker et al., 2017). The development of the scales focused more on the combination of items in illustrating the concept (i.e., thinking oneself as good-looking and satisfaction of appearance together show 'Body image'). Also, the variance for particular items on the scales might differ within each group. For instance, most of the NA participants had at least one best friend in high school, making their answers to the item clustered to one score, which lowered the Cronbach's value for only the NA group. This can also account for the low internal consistency of 'Friendship skills' scale among the autistic adults, who mostly reported no best friend in high school. The phenomenon shows that certain questions might be more appropriate to ask to one group than the other. However, because all scales had moderate to good internal consistency within at least one group, they reflected relevant aspects of the psychosexual functioning and should remain in the survey. Future work utilizing methods such as focus groups and cognitive interviewing would help strengthen the development of new items (Cheng & Clark, 2017; Creswell, 2007).

The significant correlation between scales shows the interrelatedness of different aspects of psychosexual functioning for both autistic and NA groups, especially between the domains of Psychosexual Socialization and Psychosexual Selfhood. This is consistent with the findings from previous

TTI (Dekker et al., 2017). In the Psychosexual Socialization domain, the correlation between scales within the domains was similar across two groups, but autistic adults showed more interrelated relationships with other domains in interpersonal skills (i.e., 'Friendship skills'). In the Psychosexual Selfhood domain, both groups shared similar strengths and significant levels of correlation between scales within and across domains. In the Sexual/Intimate Behaviors domain, stronger interconnected relationships were found in autistic than NA adults (i.e., Sexual intimate behaviors online). The results showed the potential impact of autistic traits over the correlation between scales in the survey and indicated the need to improve the accessibility of particular items even further in the future.

We also found stronger and more significant correlations between scales on the PSFS than from the TTI, which might indicate that as individuals enter into adulthood, they tend to be more integrated and coherent in various aspects of psychosexual functioning. Their abilities to organize and connect experiences, beliefs, and behaviors also become more complex and mature (Tolman & McClelland, 2011). However, with the diversity of elements like sample size and cultural backgrounds between the two studies, further confirmation will be needed to make the comparison between adults and adolescents across domains of psychosexual functioning (Dekker et al., 2017). The results also indicate the importance of considering all three domains when analyzing the psychosexual functioning of adults in the U.S. Further research is still in need to better interpret the nature of the interrelated relationships especially across domains and how such relationship differs between NA and autistic adults.

Group Comparisons

Group comparison revealed important differences between the two groups. Compared with NA adults, autistic adults showed significantly lower current and previous friendship skills, levels of social acceptance, and perceived social competence while similar appropriate and inappropriate sexual/intimate behaviors. The findings were mainly consistent with differences on the TTI, indicating the consistency of psychosexual functioning across age among autistic and NA population (Dekker et al., 2017).

Psychosexual Socialization

In the domain of Psychosexual Socialization, autistic adults had lower friendship skills, similar to the adolescent TTI findings (Dekker et al., 2017). Studies indicate that although there are developmental changes within the friendship in quality and nature, the ability to form friendships begins developing in childhood (Furman & Rose, 2015; Laursen & Bukowski, 1997). Therefore, it is expected that autistic adults continue to have low friendship skills and low acceptance among peer groups, as measured here. Adults' low friendship skills are related to feelings of loneliness, which can further lead to high depression and anxiety levels as well as low self-esteem and life satisfaction (Mazurek, 2014). However, other studies also showed that autistic adults had the same desire for social relationship but often had challenges maintaining friendship especially when they were expected to follow NA's social norms (Bennett et al., 2018; Monahan et al., 2023). Autistic adults could feel uncomfortable and even experience mental health symptoms if forced to maintain friendships in ways that conform to non-autistic expectations (Sosnowy et al., 2019). Therefore, the differences in friendship skills among the two groups underlines the importance of providing lifespan support to satisfy autistic adults' particular needs.

The current study showed no significant differences in personal openness to intimacy, which is consistent with the adolescent study. However, studies indicate that adults differ in their openness about sexuality with parents, siblings, and friends, and such openness also diverged across age (Grafsky et al., 2018; Morgan et al., 2010; Yen, 2020). Given the low internal consistency of this scale, the results need to be interpreted with caution. More detailed division in the target openness may be needed when investigating adults. Overall, autistic adults showed lower levels of Psychosexual Socialization abilities compared with NA adults, which is consistent with previous research with autistic people.

Psychosexual Selfhood

Lower perceived social competence was found in autistic adults in the Psychosexual Selfhood domain. This result is consistent with previous research among adolescents using the TTI and other studies among autistic individuals over their self-concept (i.e., Huang et al., 2017; Vickerstaff et al., 2007). Adults with low perceived social competence often have low self-confidence when meeting potential partners and engaging in romantic relationships (Cheak-Zamora et al., 2019). Low self-perceived social confidence in social interaction can also lead to social isolation, withdrawal, increasing the likelihood of anxiety and depression (Nguyen et al., 2020; Whitton et al., 2008). However, the current study used self-reported questionnaires and lacked qualitative assessments, which limits our understanding of adults' self-perceived social competence (Nguyen et al., 2020).

Our results are consistent with prior studies that autistic adults exhibit a similar amount of sexual desire as NA adults (Dekker et al., 2017; Graham Holmes et al., 2020; Joyal et al., 2021). Contrary to the results from the TTI, no

significant differences were found in body image and self-esteem between the two groups. In adulthood, most individuals have a more stable body shape in comparison to the period of rapid physical development during adolescence (Tiggemann, 2004). This stability might lead to more self-reconciliation of body image in both groups. The similarity in body image might also account for the similar self-esteem findings across the two groups. As their body shape stabilizes, adults will not likely attach self-esteem with changes in physical bodies. Consequently, they have relatively stable self-esteem compared with adolescents, and their level of self-esteem tends to persist over time (Trzesniewski et al., 2003). As autistic adults participate in the neurodivergent community and they explore their autistic identity even more during emerging adulthood, autistic individuals are more likely to embrace their identity and have less self-doubt (Riccio, 2020; Robertson, 2009). The self-esteem of the autistic individuals could also improve as they received more support from their community, which narrowed the gap between the two groups. Adults in the current study also had lower levels of self-esteem compared with the adolescents in Dekker et al.'s study (2017). Nevertheless, other studies showed that adults had relatively higher self-esteem compared with adolescents (Orth & Robins, 2014; Robins et al., 2002). The divergent results might be accounted for by the cultural differences in the U.S. and Dutch populations (Rentzsch & Schröder-Abé, 2018).

Sexual/Intimate Behaviors

Autistic and NA adults engaged in similar sexual/intimate behaviors, especially in the amount of overall and recent sexual behaviors and the appropriate intimate behaviors. The results corresponded with the previous adolescent study (Dekker et al., 2017). Adults also had more sexual behaviors in both groups compared with adolescents. Other studies using interviews also indicate that autistic adults seek physical contact and display similar kinds of sexual behaviors as their peers, such as masturbation (Hellemans et al., 2007). With more sexual behaviors, adults are also more likely to realize how they should perform in intimate relationships. However, studies indicated that autistic adults were less likely to report their sexual activity compared with their NA peers, so the results might overestimate the differences between sexual/intimate behaviors between the two groups (Weir et al., 2021). Further research using methods other than self-report is still needed.

Although sexual intimate behaviors online were similar in autistic and NA individuals from adolescence to adulthood, such behaviors in adults were found to be more than in a group of adolescents (Dekker et al., 2017). Autistic adults were also found to engage in more online sexual intimate behaviors than NA adults. In fact, there is a high prevalence and frequency of online sexual activities among autistic individuals, especially in their 20s (Byers & Nichols, 2019). At the same time, friendship skills were negatively and strongly correlated with such online behaviors in autistic group, which might suggest online sexual behaviors require different social skills compared to in-person situations for autistic adults. More studies are needed to examine this relationship and better understand underlying factors behind online sexual behaviors and relationship formation.

Limitations

The currents study has several noteworthy limitations. Although our participants were diverse in gender identity, race, and relationships status, the sample size was still too small for a confirmatory analysis, which limited our ability to conduct further analysis of the reliability of the PSFS. Furthermore, the age range of the current study was from 18 to 58 years old, which covered a wide range of adulthood. However, the average age centered on the mid-twenties for both the autistic and NA groups, making the information about elder adults' psychosexual functioning limited. Our goal in sharing these results is to continue to move forward in measure development that focuses on broad psychosexual functioning of autistic and NA adults in the U.S. Further research should be conducted to reach a larger and diverse sample from wider age range to make a thorough investigation of the reliability of PSFS.

In addition, the study also had limitations in its methodology. The division of autistic and NA groups was based in part on simple AQ-10 scores. The AQ-10 questionnaire used only 10 self-report questions to identify autism symptoms, and therefore allowed a more diverse representation of the autistic population. However, the questionnaire cannot cover a full range of autism symptoms and may miss potential autistic traits (Allison et al., 2012). The self-report response was subject to individual bias, could be inaccurate, and may underestimate traits for individuals who are masking (Tourangeau et al., 2000). Accordingly, there is a likelihood such group division might not be accurate. Additionally, participants could have other diagnoses that compromise the results. Also, the Bonferroni's correction is a conservative estimate. There is a high risk of Type-II error, similar to the previous adolescent study (Dekker et al., 2017; Field, 2013). For example, differences found between two groups that were highly significant under normal circumstances were not significant under the Bonferroni's correction (i.e., 'Perceived romantic competence' and 'Amount of inappropriate sexual behaviors'). Future research is still needed to investigate such difference as there is increased Type II error.

The study can also be improved in its adaptation of the TTI. As we removed some items due to statistics and their content, some scales had very limited numbers of items ($n < 3$). Therefore, not every aspect of the scale could be explored (i.e., 'Body image' and 'Inappropriate sexualized behaviors'). The limited items also lowered the internal consistency of the scale. New items were also not piloted before delivered to participants. Further adaptations of the survey with more items, even in the format of free response questions, pictures, or interviews, should be proceeded. Piloting of the adapted items should also be conducted before delivering to a larger sample. Moreover, because the study made comparisons between two different studies conducted at different countries in analyzing psychosexual functioning, there is an increased risk of cultural bias. No adaptation was made based on the different cultural contexts when implementing the survey. More rigorous research will be needed to carefully scrutinize the cultural relevance of the survey and compare scores between a Dutch and U.S. adult sample to learn about specific changes within each domain of psychosexual functioning overtime in different cultural contexts.

Conclusion and Future Directions

The current study intended to test the internal consistency of the PSFS adapted from self-reported TTI. The PSFS is, to our knowledge, the first survey created to capture a comprehensive understanding psychosexual functioning of adults in the U.S. The results of the study are mostly consistent with previous studies of adolescents' using TTI, indicating that differences in psychosexual functioning between autistic and NA people persist from adolescence to adulthood. Differences in psychosexual functioning were also expected from adolescence to adulthood. Therefore, the survey has the potential to be applied among individuals with diverse neurological conditions, like autistic individuals.

At the same time, more adaptations and modifications are needed to its content. To avoid confusion, concepts like "good friends/partner," can be provided with definition as autistic and NA adults might have different definitions of these concepts (Finke, 2022). Incorporating free response questions to learn about how adults conceptualize certain constructs before providing rating items would be one way to approach this in a neurodiversity affirming manner. For example, ask how adults define "bully" and "intimacy behaviors" before they start rating how often they engage in those activities. Moreover, due to the differences in understanding sexuality cross-culturally, the validity of the survey remains unclear when applied in the U.S. among diverse cultural groups. More in-depth qualitative research regarding how autistic and NA adults conceptualize sexuality and relationships is needed to further evaluate the psychometric properties of the survey. Future pilot studies should also be conducted to learn about the applicability of the survey in a larger population from diverse cultural backgrounds and neurodevelopmental conditions.

Despite the need for further adaptation and investigation, the study recognized important psychosexual characteristics and experiences of autistic adults. Such characteristics might lead to more severe consequences like victimization, depression and even suicidality (Arwert & Sizoo, 2020; Whitton et al., 2008). Current social and sexual programs for autistic individuals tend to focus on minors from early intervention stage to adolescence, while less support has been provided to adults. The study implied the possible need to expand the age group to adulthood when providing psychosexual support. Supports for autistic individuals are also more likely to follow NA's social norms, which can be problematic given the diversity between the two groups in psychosexual functioning. Therefore, it may be helpful to share the results of the study with autistic adults and learn about their personal experiences and attitudes towards the differences. From these types of data, we can better identify priority areas for support to enable people of all neurotypes to have access to positive psychosexual functioning resources and support.

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Declarations

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