Journal of Autism and Developmental Disorders (2023) 53:3770–3786
https://doi.org/10.1007/s10803-022-05659-z

ORIGINAL PAPER

Sexual Knowledge, Experiences, and Pragmatic Language in Adults With and Without Autism: Implications for Sex Education

Brooke H. Kohn[1,6] · **Paige Vidal**[1,7] · **Rachael Chiao**[1,2] · **David W. Pantalone**[3,4] · **Susan Faja**[1,5]

Accepted: 17 June 2022 / Published online: 3 August 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

Autistic adults have similar levels of desire for sexual and romantic relationships as their non-autistic peers. However, autistic adults are less likely to be in relationships and have less dating experience. We compared sexual knowledge, experiences, and pragmatic language ability in a community sample of young adults with ($n = 27$, mean age = 22.11) and without autism ($n = 122$, mean age = 19.47). Receipt of sex education and sexual knowledge did not differ between groups. However, autistic adults had significantly fewer partnered experiences and impaired pragmatic language. Within both groups, pragmatic skill predicted accurate sexual knowledge above and beyond general communication abilities. Findings suggest that sex education for autistic adults must address the social communication component of healthy romantic and sexual relationships.

Keywords Autism spectrum disorder · Sexual health · Sex education · Pragmatic language

Autistic individuals are met with unique challenges as they become interested in romantic and sexual relationships. Prior literature has shown that autistic adults report sexual desire and satisfaction at a level that does not differ from non-autistic peers, although some differences have emerged by gender, sexual orientation, and for dyadic versus solitary sexual desire (Bush, 2018; Turner et al., 2019). Autistic individuals may engage in comparable rates of sexual behaviors (Fourie et al., 2017; Gilmour et al., 2012); 96% expressed an interest in sexuality (Hellemans et al., 2007), and 47% reported living with a spouse or romantic partner (Gotham et al., 2015a). Although autistic adults may desire sexual and romantic relationships, several studies have found that autistic adults are less likely to be in a relationship (Bush, 2018; Dewinter et al., 2017; Hellemans et al., 2010; Mogavero & Hsu, 2020a), have fewer opportunities to date (Hancock et al., 2020), and have less dating experience (Mogavero & Hsu, 2020a) than their non-autistic peers. The source of the gap between the desires of autistic adults and reported experiences has been the topic of nascent literature regarding adult sexuality over the past decade. The present study aims to investigate this discrepancy by exploring how the knowledge of autistic adults relates with challenges in pragmatic language—skills that may underlie the ability of autistic adults to connect and communicate with potential romantic partners.

Across surveys, autistic adults universally rated sexual health education as a gap in their healthcare (Burke et al., 2019), despite literature suggesting that autistic adults may be receiving the same formal sex education in school settings as their non-autistic peers (Hellmans et al., 2010). Findings suggest that autistic adults have comparable knowledge to their peers regarding basic biology (Gilmour et al., 2012) but lower overall knowledge of sexual behaviors, intimate relationships, sexual identity (Dekker et al., 2017; Konstantareas & Lunsky, 1997; Mogavero & Hsu, 2020b), perceived sexual health knowledge (Brown-Lavoie et al., 2014), and awareness of one's sexuality and its impact on others (Bush, 2018; Hannah & Stagg, 2016). Collectively, these findings suggest that existing sex education for autistic individuals may provide some benefit but is insufficient for teaching more

✉ Susan Faja
susan.faja@childrens.harvard.edu

1 Boston Children's Hospital, Boston, MA, USA

2 Boston University, Boston, MA, USA

3 University of Massachusetts, Boston, MA, USA

4 The Fenway Institute, Fenway Health, Boston, MA, USA

5 Harvard Medical School, Boston, MA, USA

6 Present Address: New York University Langone Health, New York, NY, USA

7 Present Address: Boston College, Boston, MA, USA

complex topics, such as the sociocultural norms involved in interacting with a romantic partner, including how to communicate interest through flirting or what expectations may be on a date.

Navigating romantic relationships requires a high level of complex communication skills. Being able to convey ones' intentions to another and understand their intentions in turn, is paramount to building a safe, healthy romantic connection. Given the high social demands of pursuing romantic relationships, it is not surprising that navigating these experiences may be particularly difficult for autistic adults who have documented difficulties reading and responding to the social world with expected emotion recognition, pragmatic language, and perspective-taking. Being able to express interests effectively and at the right moment requires a high level of social understanding in addition to specific pragmatic language skills.

Pragmatic language refers to the use of language for social communication. Specifically, it is *how* someone chooses to say something. Difficulties with pragmatic language are a well-documented feature of autism (de Marchena & Eigsti, 2016; Eigsti et al., 2011). Autistic people have difficulties providing pragmatic responses that are context-appropriate (Nadig et al., 2009), efficient (Volden, 2004), and organized (Capps et al., 2000; Liles et al., 1995; Norbury & Bishop, 2003). Further, deficits in pragmatic language appear to be enduring, e.g., for children who once had an autism diagnosis but no longer meet criteria for the disorder (Kelley et al., 2006; Tager-Flusberg et al., 2005) and persisting into adulthood for autistic individuals (Lewis et al., 2008), particularly when the pragmatic context requires understanding of another person's perspective (Deliens et al., 2018).

While few studies explore pragmatic language specifically in autistic adults, deficits in pragmatic language skills across disabilities are adversely related to psychosocial functioning. Studies have shown that pragmatic language difficulties are correlated with lower social adaptation that persists into adulthood (Clegg et al., 2005; Eales, 1993; Whitehouse et al., 2009). Longitudinal work by Clegg et al. (2005) found that, at age 30, more than half of participants with reduced pragmatic language abilities had a limited range of friendships, and less than one-third had ever been married. Evidence indicates that this association is bidirectional; children with behavioral challenges or limited social groups are also more likely to have language impairments (Cohen et al., 1998; Gallagher, 1999; Hartas, 2012; Helland et al., 2014; Lord, 1996). Little is known about the relationship between pragmatic language and social outcomes in samples of only autistic adults. However, we hypothesize that the correlation between reduced pragmatic language abilities and poorer social outcomes can be extrapolated to autistic adults with lower pragmatic language abilities. Taken together, these studies suggest that enduring pragmatic language deficits may affect social and romantic functioning for autistic adults and, relatedly, sociobehavioral deficits may further perpetuate these difficulties.

The social use of language represents a bridge between knowledge and beliefs and the ability to communicate this information with others within a situational context. As such, studying the pragmatic language skills of autistic adults in terms of sexual health may offer tangible insight into what autistic adults actually know about sexual health, what they think they know, how they communicate what they know, and how their knowledge relates to their experiences. In the present study, we examined these variables through the lens of perceived knowledge, accuracy of knowledge, pragmatic skill, and romantic experiences. We compared autistic adults to a group without autism and predicted autistic adults would have lower perceived knowledge, similar accuracy, reduced pragmatic skill, and fewer romantic experiences based on previous findings. Additionally, we examined the relationship between language and these various aspects of functioning separately within both groups.

Methods

Recruitment

Recruitment for autistic adults occurred via a recruitment registry at Boston Children's Hospital and community sources (events, clinicians, the study website, presentations, and email groups/websites) via fliers and electronic postings on social media webpages. Recruitment for adults without autism occurred via the University of Massachusetts, Boston's online research participation platform. Procedures for this study were approved by the Institutional Review Boards at both study sites.

Participants

Autistic Adults

Autistic participants included 27 young adults between the ages of 19–26 years ($M = 22.19$, $SD = 2.11$), with a previous diagnosis of autism spectrum disorder, autistic disorder, Asperger's syndrome, or pervasive developmental disorder not otherwise specified (PDD-NOS) and an IQ > 70. Diagnosis was confirmed by record review and/or collateral report of current symptoms on the Social Responsiveness Scale, Second Edition (Constantino et al., 2012). The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012), was also completed for most participants ($n = 20$, 74.01%), and all met criteria for autism spectrum disorder. The ADOS-2 could not be completed for all participants ($n = 7$, 25.93%) due to restrictions during the

coronavirus pandemic. Cognitive ability was estimated using the two subtest version of the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011) ($M = 107.22$, $SD = 18.02$, 75–148). Cognitive and diagnostic assessments and record review were conducted by a licensed psychologist. Participation occurred at an academic medical center in the Northeastern United States.

See Table 1 for full participant demographics.

Prospective participants responded to the recruitment materials and then participated in a phone screening conducted by a trained research assistant to assess their ability to provide informed consent. Autistic adults who were unable to provide legally valid consent were asked to submit documentation of their legal guardianship agreement prior to scheduling the first appointment. During the first appointment, informed consent was obtained from the participant or, if applicable, their legal guardian. Written consent materials were supplemented by visual schematics and visual schedules in the form of checklists and study flowcharts to aid understanding of study procedures, risks associated with participation, and alternatives for responding.

Following consent, participants completed the WASI-II to estimate cognitive ability and an online questionnaire of self-report measures. Surveys were completed either at home in a private room ($n = 7$) or in a private room in the lab ($n = 20$). Participants responded to questions that assessed their knowledge and experiences related to sexual health as well as a background questionnaire to elicit demographic information. Research staff checked in with participants while responding to ensure understanding of the questionnaires.

Table 1 Descriptive information for final sample

	Autistic adults ($n = 27$)	Non-autistic adults ($n = 122$)
Age in years, Mean (SD)	22.19 (2.11)	19.47 (1.40)
Sex assigned at birth	9 Female, 18 Male, 0 Intersex	95 Female, 25 Male, 0 Intersex, 2 No response
Gender identity, % (n)		
Cisgender male	51.9 (14)	16.4 (20)
Transgender male	3.7 (1)	2.5 (3)
Cisgender female	22.2 (6)	60.7 (74)
Transgender female	3.7 (1)	0 (0)
Nonbinary	3.7 (1)	0 (0)
Genderqueer	0 (0)	.8 (1)
Not sure of gender identity	11.1 (3)	5.7 (7)
Gender identity: Other	3.7 (1)	6.6 (8)
Gender identity: prefer not to answer	0 (0)	7.4 (9)
Sexual orientation, % (n)		
Heterosexual	51.9 (14)	78.7 (96)
Homosexual	11.1 (3)	.8 (1)
Bisexual	18.5 (5)	11.5 (14)
Asexual	11.1 (3)	.8 (1)
Queer	3.7 (1)	4.1 (5)
Sexual orientation: Other	0 (0)	1.6 (2)
Sexual orientation: Prefer not to answer	3.7 (1)	2.5 (3)
Race and ethnicity, % (n)		
Asian	14.8 (4)	24.6 (30)
Black	3.7 (1)	12.3 (15)
White	81.5 (22)	41.0 (50)
Race: other	0 (0)	19.7 (24)
Race: prefer not to answer	0 (0)	.8 (1)
Hispanic or Latinx	7.4 (2)	23.0 (28)
Education and housing, % (n)		
Living with at least one parent	59.3 (16)	83.6 (102)
Completed at least some college	74.1 (20)	100 (122)

Non-Autistic Adults

Comparison participants included 122 undergraduates between the ages of 18–25 years ($M = 19.47$, $SD = 1.40$) recruited from a university in the Northeastern United States. To be eligible, participants needed to be fluent in English and of legal age in the state from which they were completing the questionnaire. Participants were excluded during screening if they had a previous diagnosis of autism spectrum disorder, autistic disorder, Asperger's syndrome, or PDD-NOS.

See Table 1 for full participant demographics.

Prospective participants found the online study through their research participation portal. Following the online screener to determine eligibility, participants provided informed consent, and then completed an online survey assessing their sexual health knowledge and sexual behaviors. Participants also completed the Autism Quotient (AQ; Baron-Cohen et al., 2001) to assess for autism symptoms and a demographic questionnaire. We followed best online practices to maximize valid responses (e.g., Teitcher et al., 2015).

Measures

Psychometric properties of the knowledge- and experience-based tasks have not been reported for autism, although all have been used in previously published studies with this population.

Demographics

We collected demographic data from both groups. The questionnaire developed for use in this study elicited information about age, race, gender identity, and sexual and romantic orientations. Other questions focused on current relationship status, timing and type of sex education experience, access to the internet, and medical and behavioral histories.

Autism Quotient (Baron-Cohen et al., 2001)

The Autism Quotient (AQ) is one of the most widely used scales assessing autistic traits in the general population. It has shown good sensitivity and specificity in detecting autism among adults (Booth et al., 2014), as well as acceptable internal consistency and retest reliability (Stevenson & Hart, 2017). It consists of 50 self-report items that assess subclinical traits of autism spectrum disorder. The AQ was administered to the non-autistic group only. It consists of 10 items in each of five domains: Social Skill, Attention to Detail, Communication, Imagination, and Attention Switching. Responses are given on a 4-point Likert scale (*strongly agree* to *strongly disagree*). Some items are reverse coded. Following scoring methods used by Austin (2005), responses were summed to yield scores ranging from 50 to 200 for the total score and 0–40 for each subscale, with higher scores indicating more autism features. The AQ was used to characterize the non-autistic sample. The Communication domain was used in analyses.

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011)

The WASI-II is an abbreviated measure of verbal and nonverbal intelligence designed for individuals 6–90 years old. The FSIQ-2, composed of the matrix reasoning and vocabulary section, was used in the current study. The FSIQ-2 yields standardized scores ($M = 100$, $SD = 15$). The FSIQ-2 has been found to have a split-half reliability coefficient of 0.89 and test–retest reliability of 0.90 (McCrimmon & Smith, 2013). In this study, we used the Vocabulary subtest *t*-score in analyses.

Sexual Experiences Questionnaire

We adapted The Sexual Experiences Questionnaire from a prior measure by Trotter and Alderson (2007). It is a 14-item multiple choice survey that elicits information about various sexual experiences. Responders rated the frequency with which they have engaged in each activity (i.e., never, once, often). For current analyses, we dichotomized variables to create two groups: those who ever had a given experience vs. those who never had the experience. We computed an overall partnered experience total score by summing the items related to partnered experiences. Information about solo sexual experiences was derived from responses regarding whether participants reported having ever masturbated.

Perceived Knowledge of Sexual Health

The Perceived Knowledge of Sexual Health Questionnaire (Brown-Lavoie et al., 2014) is a 5-item true/false self-evaluation of sexual knowledge (e.g., I know how to put a condom on correctly). Participants received one point for each item they indicated as "true." Total scores were computed by summing the five items.

Knowledge of Sexual Health Questionnaire

The Knowledge of Sexual Health Questionnaire (Walsh & Ward, 2010) is a 44-item survey measuring actual sexual health knowledge, knowledge sources, and self-efficacy in relationships. Topics cover sexually transmitted infections, contraception, and reproductive health. Answers are true/false and have shown good internal consistency in previous samples of the general, young adult population (Walsh

& Ward, 2010) and have been correlated with other sexual knowledge measures (Diclemente et al., 1989). Participants received one point for each correct response. In this study, we administered a subset of 15 items to participants. Total scores were computed by summing final scores. Scores from this measure are referred to as *recognition accuracy*, to reflect ability to recognize the correct response.

Sexual Vocabulary Test

We created a Sexual Vocabulary Test from previous measures of sexual knowledge in autistic adults or with intellectual disability (Ousley & Mesibov, 1991; Penny & Chataway, 1982). Consistent with Ousley and Mesibov (1991), the measure included 18 terms related to basic knowledge of sexual health and anatomy. Example items include: "Provide examples of birth control," "Define Masturbation," and "Define Sexual Intercourse." In this study, we asked participants to "define the following terms to the best of [their] ability" and record their responses in writing. No verbal or written prompting was given.

Vocabulary Accuracy Consistent with past studies, items on the Sexual Vocabulary Test were scored on a 3-point scale for accuracy: 2 for a detailed correct answer, 1 for a generally correct answer, and 0 for a response of "don't know" or an incorrect answer (Ousley & Mesibov, 1991; Penny & Chataway, 1982). For the present study, we expanded upon the original scoring scheme to create a detailed manual with guidelines for scoring each specific item. In developing this manual, we used definitions for each term from the Merriam-Webster (n.d.) online dictionary as a guide. We chose this source, as opposed to an anatomy textbook, due to its ubiquitous availability and accessibility to lay audiences. To establish the manual, coders scored each item independently and met to compare scores and establish criteria through iterative coding discussions.

After developing the manual, coders scored responses independently and met to compare scores. When discrepancies were identified, they were discussed until a mutually acceptable decision was made. Raters met regularly to ensure consistency. Total accuracy was computed by summing all scores for each participant. Scoring agreement by two independent raters before consensus discussions was computed across all items; kappa was 0.854. See Table 2 for definitions and in-depth scoring criteria.

Pragmatics The authors developed a scale specifically for this study to measure pragmatic skills related to the descriptions provided on the Sexual Vocabulary Test. The codes were developed based on a review of the literature and theoretical constructs of interest: Sociocultural Competence, Vulgarity, Mechanical, Relevancy, Strategic Competence, and Discourse Competence.

- Sociocultural Competence refers to the ability to express oneself within the overall social and cultural contextual norms for communication (Celce-Murcia et al., 1995; Nadig et al., 2009).
- Vulgarity was coded as a separate construct as it represents a more severe transgression of sociocultural norms and may have more serious social implications.
- Mechanical Language refers to the use of objectifying language in descriptions of human body parts or the utilization of words that are commonly only used to describe machines.
- Relevancy refers to the ability to self-edit in order to provide information that is sufficient without being redundant (Volden, 2004).
- Strategic competence refers to the ability to overcome breakdowns and problem solve in communication—i.e., the flexible use of language, such as the addition of emphasis and the creative application of language in order to bridge a gap in communication (Capps et al., 2000; Celce-Murcia et al., 1995; Liles et al., 1995; Norbury & Bishop, 2003).
- Discourse competence refers to the selection and arrangement of words (Capps et al., 2000; Celce-Murcia et al., 1995; Liles et al., 1995; Norbury & Bishop, 2003).

To develop the coding system, we preliminarily defined the constructs, and coders scored each response independently before meeting to compare scores for each item. Using an iterative process, the authors collaborated to create a shared rubric of the scoring criteria for each item. Each subscale, with the exception of Vulgarity, was scored on a scale of 0–2 with 0 representing the highest level of pragmatic skill and 2 represented the lowest. Vulgarity was measured on a 2-point scale (1 present or 0 not present).

After the manual was developed, coders then scored responses independently and met to compare scores. When discrepancies were identified, they were discussed until a mutual decision was made by each pair of coders. Raters met regularly to ensure consistency. Scoring agreement by two independent raters before consensus discussions was computed across all items; kappa was 0.778. A total pragmatics score was compiled by summing subscale scores. See Table 3 for definitions of constructs and Pragmatics scoring criteria.

Table 2 Vocabulary accuracy

Term	Guiding definition	Scoring Criteria			
		0	1	2	3
Testicles	Male organs which produce sperm. Located behind the penis	Do not know or blank	Incorrect or irrelevant commentary	Only location or only function	References males or location. Must reference sperm production or storage
Penis	External male sex organ; Used for intercourse, urination, sperm	Do not know or blank	Incorrect or irrelevant commentary. Only stating "reproductive organ" or "sex organ"	Only one of the criteria sufficient to score a 3	Must reference male anatomy and must include at least one of the following: used for intercourse, urination, releasing sperm
Sperm	Male reproductive cell; released from the penis during ejaculation. Fertilizes an egg	Do not know or blank	Incorrect or irrelevant commentary. "Semen" is incorrect	Only one of the criteria sufficient to score a 3	Must indicate produced by males or male cell and (a) references reproduction/fertilizing an egg OR (b) references ejaculation
Breasts	Located on chest, secondary sex characteristic, can produce milk	Do not know or blank	Incorrect or irrelevant commentary	Only denotes location or function. Or states that it is part of the female anatomy without indicating location	Must indicate association with female anatomy. Must reference the ability to produce milk
Vagina	Part of the female anatomy. Functions in sexual intercourse, childbirth, menstruation	Do not know or blank	Incorrect or irrelevant commentary. Used for urination	Only one of the criteria sufficient to score a 3	Must reference female anatomy. Must include at least one of the following: sexual intercourse, childbirth, menstruation
Uterus	Female reproductive organ. Holds fertilized egg/fetus during pregnancy	Do not know or blank	Incorrect or irrelevant commentary. "reproductive organ" without further description	Only one of the criteria sufficient to score a 3	Must denote female reproductive organ and must say that it is where a fetus develops
Ovary	Female reproductive organ. Produces eggs/ovum	Do not know or blank	Incorrect or irrelevant commentary	Only one of the criteria sufficient to score a 3	Must denote female reproductive organ and must say that it produces or carries eggs/ovum
Egg/Ovum	Female reproductive cell produced by the ovaries	Do not know or blank	Incorrect or irrelevant commentary	Only one of the criteria sufficient to score a 3	Must indicate that it is produced by females or female cells AND must (a) reference reproduction OR ovulation or (b) when fertilized by sperm can develop into a fetus
Clitoris	Located near the vaginal opening. Related to pleasure	Do not know or blank	Incorrect or irrelevant commentary	Only denotes general location or only states that it is part of the female anatomy or only mentions pleasure	Must include all of the following: Associated with the female anatomy, reference to pleasure, location
Masturbation	Act of touching your own genitals for sexual stimulation/pleasure	Do not know or blank	Incorrect or irrelevant commentary	Does not mention genitals or orgasm	Must reference the act of touching one's own genitals and sexual pleasure or orgasm
Sexual intercourse	Sex between individuals. Inserting a penis into a vagina	Do not know or blank	Incorrect or irrelevant commentary	Only references genitals. Only writes "sex" without further elaboration	Must include (a) contact, insertion, or penetration, and (b) must reference contact with genitals

Table 2 (continued)

Term	Guiding definition	Scoring Criteria			
		0	1	2	3
Orgasm	Peak or climax of sexual pleasure during sexual activity	Do not know or blank	Incorrect or irrelevant commentary	Only references ejaculation	Must reference peak of sexual pleasure
Menstruation	Occurs in females. Involves the shedding or blood and tissue from the uterus approximately once a month	Do not know or blank	Incorrect or irrelevant commentary	Only one of the criteria sufficient to score a 3	Must include 2 of 4: (a) associated with females, (b) absence of pregnancy, (c) a mention of the regular reoccurrence of the event, (d) shedding of blood or tissue
Erection	When a penis or clitoris fills with blood during arousal	Do not know or blank	Incorrect or irrelevant commentary	Only one of the criteria sufficient to score a 3	Must indicate its associated with the penis or clitoris and must reference sexual arousal
Ejaculation	Release of semen from the male reproductive tract through the penis	Do not know or blank	Incorrect or irrelevant commentary	Only mentions semen or a slang alternative. Only mentions sexual arousal	Must include 2 of 3: (a) mentions semen or slang alternative, (b) makes a reference to sexual arousal or orgasm, (c) specifies that it is related to the male reproductive system
STD/STI	Infection passed from one to another through some form of sexual contact	Do not know or blank	Incorrect or irrelevant commentary	No mention of sexual transmission or mentions that it is the result of sex without an indication of illness or infection	Must indicate that it is an infection passed from one to another through some form of sexual contact OR could write out Sexually Transmitted Disease/Infection
AIDS	Chronic illness transmitted through shared bodily fluids. Can be fatal	Do not know or blank	Incorrect or irrelevant commentary. "autoimmune deficiency"	Only writes "infection or illness." Does not mention transmission	Must indicate that it is an STD or infection passed from one to another through exchange of bodily fluids AND one of the following: (a) Caused by HIV (b) affects immune system (c) can be life-threatening. OR can write out "acquired immunodeficiency syndrome"
Gay	Sexually or romantically attracted to people of the same sex	Do not know or blank	Incorrect or irrelevant commentary	Must indicate romantic or sexual attraction. Must indicate that attraction is directed towards members of the same sex	

Table 2 (continued)

Term	Guiding definition	Scoring Criteria			
		0	1	2	3
Pregnancy	State of a female carrying a developing fetus in the uterus for 9 months	Do not know or blank	Incorrect or irrelevant commentary	Only two of the criteria sufficient to score a 3	Must include all of the following: (a) occurs in females, (b) references the gestation period, (c) mention of a baby or creation of life or mentions sperm fertilizing an egg
Explain how to get pregnant	A male's sperm fertilizes a females egg	Do not know or blank	Incorrect or irrelevant commentary	Only references unprotected sex or sex with a failed contraceptive	Must reference a sperm fertilizing an egg
Give examples of birth control	(a) The pill (b) IUD (c) Condom (d) Abstinence (e) Diaphragm (f) Contraceptive patches (g) Pulling out (h) Rhythm method (i) Sterilization	Do not know or blank	Incorrect or irrelevant commentary	Mentions 1 or 2 types of birth control	Mentions 3 or more types of birth control. Does not need to be an effective or recommended form

Detailed scoring criteria for Vocabulary Accuracy are listed. Definitions were scored on a 3-point scale: 2, "detailed correct answer," 1, "general correct answer," 0, "don't know" or "incorrect answer." Guiding definitions of terms are listed

Results

Between-Groups Comparisons: Autistic vs. Non-autistic

Demographics

An independent samples *t*-test showed that age differed significantly by group, $t(31.25) = 6.37$, $p < 0.001$, with individuals in the non-autistic group being younger (19.47 ± 1.40 years) on average than the autistic group (22.19 ± 2.11 years). A Pearson's chi-square test indicated a significant difference in sex distribution between samples [χ^2 (1, $N = 147$) = 22.37, $p < 0.001$] with the non-autistic group having a greater number of female participants. The two samples did not meet expected "assigned at birth" sex ratios for the general population (1:1) or the autism population (1:4) and are overall skewed female. Further analyses revealed greater diversity in sexual orientation [$\chi^2(5, N = 145) = 21.08$, $p = 0.001$] and gender identity [$\chi^2(7, N = 140) = 27.42$, $p < 0.001$] in the autistic group compared to the non-autistic group (see Table 1).

Pearson's chi-square tests showed both groups received sex education at similar rates [$\chi^2(1, N = 146) = 0.011$, $p = 0.92$] and sex education type (abstinence until marriage vs. comprehensive) [$\chi^2(2, N = 120) = 1.42$, $p = 0.49$]. Both groups reported similar solo-sexual experiences [$\chi^2(1, N = 131) = 0.19$, $p = 0.66$]; however, autistic participants reported significantly fewer partnered sexual experiences [$t(132) = -3.37$, $p = 0.001$].

In the following models, outcomes from the battery were entered as dependent variables. Group (autistic or non-autistic) was entered as the independent variable. Given significant group differences in sex and age, these variables were covaried in all preliminary analyses; however, where age and/or sex were not significant, these covariates were removed in reported models.

Diagnostic Group Comparisons of Knowledge, Perceived Knowledge, and Pragmatic Skill

Perceived Knowledge An initial analysis of covariance (ANCOVA) examining group differences in perceived knowledge revealed a significant effect of sex [$F(1, 141) = 5.72$, $p = 0.02$]; however, age was not significant. A subsequent ANCOVA covarying only sex found a significant effect of sex [$F(1, 143) = 6.01$, $p = 0.02$] but no significant diagnostic group differences in perceived knowledge [$F(1, 143) = 1.24$, $p = 0.27$]. Women had higher perceived knowledge scores (4.37 ± 0.88) than men (3.76 ± 1.38).

Table 3 Pragmatic language

Construct	Guiding definition	Scoring criteria			
		0	1	2	7
Sociocultural competence	Sociocultural Competence refers to the ability to express oneself appropriately within the overall social and cultural context of communication (Celce-Murcia et al., 1995)	Provides a definition that matches the context of research using appropriate terminology and sociocultural context of situation (can utilize word "balls")	1–2 clear examples of utilizing slang to define anatomy in an inappropriate way. Juvenile definitions (Pregnancy: "makes baby"). OR exceptionally clinical that a lay person would find difficult to understand (e.g., sperm: "male gamete," zygote)	3 or more clear examples of a response constituting a 1	Experimenter cannot judge
Vulgarity	Explicit and offensive reference to sex or bodily functions; coarse and rude	Vulgarity is not present		Any use of vulgarity	Experimenter cannot judge
Mechanical terminology	The objectification of body parts or those who own them. Describing bodies with words that are not typically used to refer to a person	Defines anatomy and body parts in an expected manner with perspective	Utilizes language that is not typically used to refer to a person. Use of inanimate descriptions Includes mention of man/woman/person	Defines terms as objects or tools. Use of inanimate descriptions, frequent occurrences of a 1 or omits perspective. (e.g., "Where the eggs are held.")	Experimenter cannot judge
Relevancy	Relevancy refers to the ability for one to edit themselves in order to provide information that is sufficient without being redundant. According to Grice's maximum of quantity, speakers should provide content that is informative while excluding details that are irrelevant, distracting, or otherwise detract from the discourse (Grice, 1975)	Provides appropriate details, defines any jargon or acronyms utilized, and omits personal narratives	Provides one detail that is unnecessary or irrelevant	Utilizes multiple minute details that are unnecessary or irrelevant. Utilizes personal examples or includes commentary that does not contribute to defining the term	Experimenter cannot judge
Strategic competence	Strategic competence refers to the ability to overcome breakdowns in communication—in other words, the flexible use of language (Celce-Murcia et al., 1995)	Provides appropriate details and defines any jargon or acronyms utilized. Uses emphasis only if appropriate	Omits critical details or omits the definitions of acronyms or slag terms (e.g., Ovary: "eggs. Female"), talks around or attempts to provide the definition with some indication that they are circling the correct mark	Omits major details in the majority of responses, suggests that understanding may not be fully demonstrated (e.g., STD: "a thing you can get"; "know what it is, don't know how to describe")	Experimenter cannot judge

Table 3 (continued)

Construct	Guiding definition	Scoring criteria			
		0	1	2	7
Discourse competence	Discourse competence refers to the selection, sequencing, and arrangement of words and sentences into a unified text (Celce-Murcia et al., 1995)	Presents a clear definition in an organized fashion. Words seem interrelated rather than unrelated. Top-down organization of words	Defines only with synonyms (e.g., Testicles: "Sword, penis"). Lists terms or attributes, rather than writing a cohesive definition. Unusual sentence structure (i.e., word association. E.g., Breasts: "cherry, mound. They can be fake or real. Breast implants"). Bottom up organization of words (e.g., "touching genitals. For pleasure")	Frequent occurrences of 1 responses	Experimenter cannot judge

Detailed scoring criteria for Pragmatic Language are listed. Constructs are defined. All constructs were scored on a 3-point scale, 0–2, with the exception of Vulgarity which was scored on a 2 point scale

Accurate Sexual Vocabulary An analysis of variance (ANOVA) was run to compare group differences in Vocabulary Accuracy after first determining that age and sex were not related to accurate sexual knowledge. The main effect of group for accuracy was not significant [$F(1, 143) = 0.31$, $p = 0.59$].

Recognition of Sexual Knowledge An ANCOVA was also used to examine group differences in Recognition Accuracy. It revealed significant effects of sex [$F(1, 132) = 5.21$, $p = 0.02$] and age [$F(1, 132) = 3.98$, $p = 0.048$] on total recognition scores but not a significant effect of diagnostic group [$F(1, 132) = 2.07$, $p = 0.15$]. Women demonstrated better recognition knowledge (6.41 ± 2.55) than men (5.25 ± 2.82) and older participants performed better than younger participants.

Pragmatic Language Ability A MANOVA examining group differences in pragmatic language, revealed a significant main effect of group for pragmatic language [$F(6, 137) = 2.52$, $p = 0.02$]. Post-hoc, Bonferroni-corrected comparisons of group differences indicated that the group difference was due to scores in the Relevancy domain [$F(1, 142) = 10.17$, $p = 0.002$]. Non-autistic participant scores (0.16 ± 0.45) reflected better pragmatic abilities in this domain when compared to autistic participant scores (0.54 ± 0.86). Group differences in all other pragmatic domains were non-significant; however, mean scores were lower for the non-autistic group across all domains, reflecting better general performance of pragmatic skills.

Within-Group Comparisons

Autistic Group

To examine the relations between variables of interest and overall Verbal IQ, we computed Pearson correlations between WASI-II Vocabulary *t*-scores, Perceived Knowledge scores, Vocabulary Accuracy scores, Recognition Accuracy scores, Total Pragmatic Language scores, and Total Partnered Experience scores (see Table 4, top). Vocabulary Accuracy was significantly related to WASI-II Vocabulary, $r(24) = 0.48$, $p = 0.01$, and to Pragmatic Total scores, $r(24) = -0.59$, $p = 0.002$. All other correlations were non-significant.

We created a three-stage hierarchical multiple linear regression model to better understand how the variables related to Vocabulary Accuracy. Vocabulary Accuracy was the dependent variable, WASI-II Vocabulary was entered in the first step (to control for general verbal ability), Recognition Accuracy was added at step two, and Pragmatic Total score was added at step three. In the first

Table 4 Pearson correlations within group

Variable	*n*	Mean (SD)	1	2	3	4	5
Autistic group							
1. WASI-II Vocabulary	27	57.9 (13.9)	–				
2. Pragmatics Total	26	4.3 (3.0)	− .27	–			
3. Vocabulary Accuracy	26	39.6 (15.1)	.49*	− .59**	–		
4. Perceived Knowledge	27	3.8 (1.1)	− .12	− .14	.21	–	
5. Recognition Accuracy	25	5.4 (2.4)	.29	− .27	.31	.28	–
6. Partnered Experience	27	11.2 (5.3)	.19	− .01	− .04	.03	.02
Non-autistic group							
1. AQ Communication	106	19.4 (4.1)	–				
2. Pragmatics Total	118	3.2 (2.2)	0.08	–			
3. Vocabulary Accuracy	119	38.1 (12.2)	− 0.21*	− .51**	–		
4. Perceived Knowledge	121	4.3 (1.0)	− .03	.05	.01	–	
5. Recognition Accuracy	112	6.2 (2.7)	− .29**	− .23*	.40**	.14	–
6. Partnered Experience	107	14.6 (4.5)	− .03	.04	.07	− .07	.18

SD standard deviation, *WASI-II* Wechsler Abbreviated Scale of Intelligence, Second Edition; *AQ* Autism Quotient

*$p < .05$, **$p < .01$

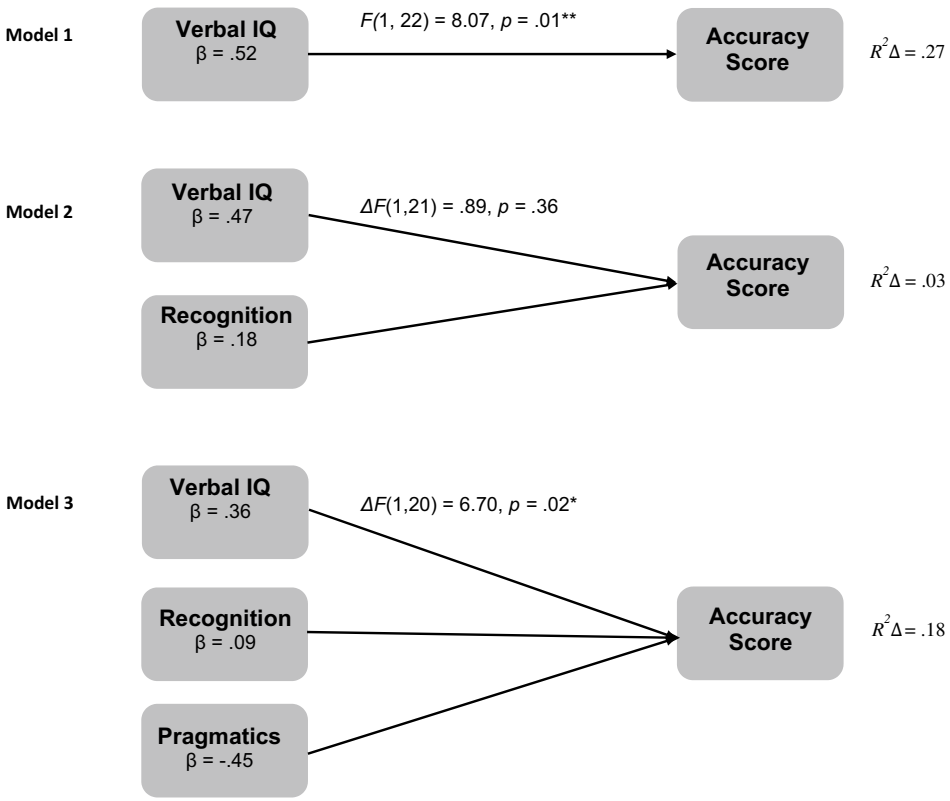


Fig. 1 Hierarchical linear regression model for autistic participants. Model 1: Verbal IQ predicts Accuracy scores. Model 2: Recognition scores do not improve prediction of Accuracy scores. Model 3: Pragmatics improves prediction of Vocabulary Accuracy scores beyond Verbal IQ and Recognition scores

step, WASI-II Vocabulary significantly contributed to the model, $F(1, 22) = 8.07$, $p = 0.01$, and accounted for 26.8% of the variation in Vocabulary Accuracy scores. Recognition Accuracy explained an additional 3% of variance in vVcabulary Accuracy scores; however, this change in R^2 was non-significant, $\Delta F(1, 21) = 0.89$, $p = 0.36$. Finally, adding Pragmatic Total scores to the regression model explained an additional 17.6% of variance in Vocabulary Accuracy scores and this change in R^2 was significant, $\Delta F(1, 20) = 6.70$, $p = 0.02$. When all three variables were included in step three, WASI-II Vocabulary and Pragmatics were both significant and independent predictors of

Vocabulary Accuracy. Together, the model with three independent variables accounted for 47.4% of variance in Vocabulary Accuracy scores (See Fig. 1).

Non-Autistic Group

Pearson correlations were computed between AQ Communication scores, Perceived Knowledge scores, Vocabulary Accuracy scores, Recognition Accuracy scores, Total Pragmatic Language scores, and Total Partnered Experience scores. The AQ Communication domain related significantly to Vocabulary Accuracy, $r(101) = -0.21$, $p = 0.04$, and Recognition Accuracy, $r(99) = -0.29$, $p = 0.003$. Vocabulary Accuracy also significantly correlated with Pragmatic Total scores, $r(115) = -0.51$, $p < 0.001$, and Recognition Accuracy, $r(107) = 0.40$, $p < 0.001$. Pragmatic scores were significantly correlated with Recognition Accuracy, $r(106) = -0.23$, $p < 0.02$. All other correlations were not statistically significant (See Table 4, bottom).

A three-step hierarchical multiple linear regression model was computed with Vocabulary Accuracy as the dependent variable. The AQ Communication domain was entered at step one, Recognition Accuracy was added at step two, and the Pragmatic Total score was added at step three. In step one, AQ Communication significantly contributed to the regression model, $F(1, 94) = 4.08$, $p = 0.05$, and accounted for 4.2% of the variation in Vocabulary Accuracy scores. The addition of Recognition Accuracy explained an additional 9.4% of variance in Vocabulary Accuracy scores, and the change in R^2 was significant, $\Delta F(1, 93) = 10.09$, $p = 0.002$. Finally, adding Pragmatics Total scores to the regression model explained an additional 13.3% of variance in Vocabulary Accuracy scores and this change in R^2 was significant, $\Delta F(1, 92) = 16.66$, $p < 0.001$. When all three variables were included in the full model, all variables were significant predictors of Vocabulary Accuracy scores. Together, the three independent variables accounted for 26.8% of variance in Vocabulary Accuracy scores (See Fig. 2).

Discussion

The current study aimed to compare sexual knowledge and behavior profiles between young adults with and without autism. Further, we aimed to contribute to the understanding of the associations between pragmatic language and knowledge of sexual health terms while controlling for general verbal ability and recognition knowledge.

Consistent with prior literature, autistic adults reported fewer partnered sexual experiences but similar solo sexual experiences and sex education opportunities (Dewinter et al., 2016; Hellemans et al., 2010). Further, autistic adults did not differ in accuracy, either for the recognition or vocabulary tasks. Contrary to our hypothesis and the results of other

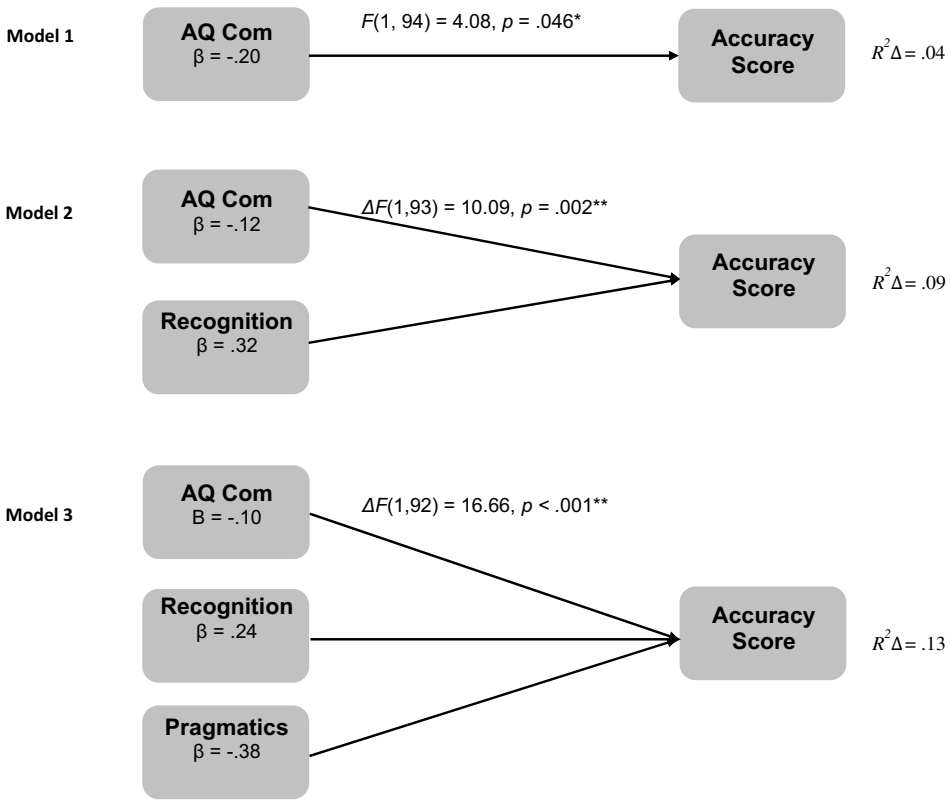


Fig. 2 Hierarchical linear regression model for non-autistic participants. Model 1: AQ Communication score predicts Vocabulary Accuracy scores. Model 2: Recognition scores improve prediction of Vocabulary Accuracy scores beyond AQ Communication scores. Model 3: Pragmatics improves prediction of Vocabulary Accuracy scores beyond AQ Communication and Recognition scores. *AQ Com* Autism Quotient Communication

studies (e.g., Brown-Lavoie et al., 2014), autistic adults did not differ from their non-autistic counterparts in their perceived knowledge of sexual health.

As predicted, although both groups demonstrated comparable accuracy, autistic adults showed significantly lower pragmatic skill relative to non-autistic adults when defining sexual anatomy and sexual health terms. The differences between sexual experiences and pragmatic skill, but not education, suggests sexual education and experiential learning opportunities for transition-aged autistic youth may be insufficient to support the level of engagement autistic adults desire. For instance, sexual education for autistic youth may need to provide information about how to effectively communicate about sexuality given the pragmatic language challenges of autistic individuals.

Within-group analyses for the autistic group revealed that pragmatic language skills correlated with Vocabulary Accuracy scores but not general verbal ability. Recent work suggests task demands influence pragmatic skills, such that increased task difficulty corresponds with reduced pragmatic skills (de Marchena & Eigsti, 2016). The increased demand of defining sexual terminology compared to the neutral words presented in the WASI-II vocabulary section may explain the pattern of performance on both measures. Among autistic individuals, hierarchical linear regression revealed that pragmatic scores predicted sexual vocabulary accuracy above and beyond recognition accuracy and general verbal ability. This suggests that the ability to socially communicate ones thoughts about sexual terms is an important skill, distinct from ones knowledge of sexual health or general verbal ability.

Within-group differences in the non-autistic sample revealed a similar pattern. Correlations showed that self-reported communication abilities, as indexed by the AQ Communication subscale, were correlated with sexual vocabulary accuracy, pragmatics, and recognition knowledge. Hierarchical linear regression revealed pragmatic scores predicted sexual vocabulary accuracy beyond both recognition knowledge and self-reported communication abilities. This similarly suggests that socially communicating about sexual terms requires additional skills beyond anatomical knowledge or perceived ability to communicate with peers.

These findings in both groups suggest that, although a participant's ability to be factually accurate in their descriptions of sexual terminology may be related to general communication abilities, effectively communicating this knowledge to others is a distinct skill. As a whole, our findings relating the ability to effectively communicate about sexual health to pragmatic language performance, general language skills, and accuracy performance lend additional insight into the shortcomings of current sex education practices—particularly for autistic people who tend to have challenges navigating socially complex interactions. Our work highlights a need to provide instruction on the discussion of sexual health and romantic relationships. This is a critical skill in order for individuals to communicate effectively with health care providers and potential partners and provides a foundation for navigating conversations about sexual consent. That is, our results emphasize that specific pragmatic language skills are necessary—rather than knowledge alone—in order to effectively participate in these contexts. Sexual education curricula that simply provide information without developing the skills required to discuss it with others may limit its effectiveness for autistic people.

Although participants in both groups reported similar anatomical knowledge and formal sex education, the literature suggests significant differences in the informal sexual health education received by autistic adults versus their non-autistic peers. Studies have shown differences in how autistic adults receive information about sexual health (Brown-Lavoie et al., 2014). Autistic individuals are less likely to receive information about dating, sex, and sexual health from social sources compared to their non-autistic (Brown-Lavoie et al., 2014). In fact, Pecora et al. have shown that autistic women are most likely to gain their knowledge of sexual health from the media, rather than social conversations (2020). Although sex education and the media may provide access to some of the information sought by autistic adults, both have critical drawbacks that may contribute to the gap between skillful behaviors of autistic and non-autistic individuals in the realms of dating and sex. As an example, in a study by Hannah and Stagg (2016), autistic adults identified needing to be explicitly taught "dirty talk"—a topic that goes beyond the bounds of normative school sex education and is typically learned through social sources, such as friends and family. Without access to social sources willing to teach about these topics, attempts by autistic adults to supplement sex education with information from sources such as movies, television, and pornography may present them with an unrealistic picture of romantic and sexual activities. Autistic individuals appear to have reduced opportunities to learn and practice context-specific pragmatic skills needed to communicate about their sexual health, desires, and experiences. Consequently, although young adults without autism often have the benefit of incorporating multiple perspectives—parents, peers, providers, sex education classes, internet resources—into their conceptualization of sex and dating behaviors, autistic adults are often left with only the internet and school-sponsored sex education. The differential abilities in pragmatic skill demonstrated in the current study may reflect consequences of the lack of social conversations regarding sex and healthy dating relationships.

Potential behavioral consequences of reduced pragmatic language would include difficulty raising conversations

about sensitive topics like sexuality or consent, failure to recognize cues that romantic advances may be unwelcome, trouble understanding innuendos while flirting with a partner, and difficulty identifying situations where formal verses slang sexual terminology may be culturally appropriate. Difficulties with pragmatics may offer insight into findings that autistic adults show lesser sexual awareness—defined as the knowledge of one's own sexuality and concern about how one presents sexually to others—compared to their peers (Bush, 2018; Hannah & Stagg, 2016). With fewer social sources of information and without education that focuses on the socioemotional and communicative aspects of relationships, autistic adults are potentially left at a disadvantage when it comes to expressing their sexual desires and understanding the intentions of a potential partner.

The findings of the present study suggest that, in order to continue bridging the gap between autistic adults' desires and the experiences they are equipped to obtain, future sex education likely needs to go beyond biology and contraception and focus additionally on the social and communicative aspects of relationships and building awareness of sexual health.

Limitations and Future Directions

There is a rich autism literature focused on pragmatic language and a growing literature examining sexual behavior. However, to our knowledge, this is the first study to evaluate pragmatic language skills within a sexual knowledge-based task. Given the nascent literature, we developed scoring criteria for vocabulary accuracy and pragmatic skills for the current study. Interrater reliability was good, although these measures have yet to be validated; therefore, our results should be interpreted with caution. Relatedly, we used only written samples to evaluate pragmatic abilities. Written samples may provide particularly useful insight into communication challenges in an age when much of our social communication is digital (e.g., with dating applications commonly used for meeting new partners). Future research may benefit from an exploration of whether these communication difficulties persist in verbal communicative scenarios such as in conversations with potential partners or while flirting.

The current study offers a snapshot of what behavioral experiences for autistic people may look like; however, the autism spectrum is very broad. Participants needed an estimated IQ greater than 70 to participate in this study; therefore, our findings may not generalize across the entire autism spectrum. There has been an increase in literature suggesting the need for sex education for those with intellectual disabilities (Solomon et al., 2019). As we emphasize in the current study, sex education is not a one-size-fits-all endeavor. Future research should investigate whether and how the needs of autistic people with lower IQ may differ.

Additionally, the autistic and non-autistic groups compared were unequal in number. Despite the differences in group sample size, Levene's test of equality of error variances were not significant in any of the models tested, suggesting that differences in variance within groups did not contribute to the findings. Further, groups were not matched for age or sex. Both samples were skewed female compared to expected sex ratios, and the non-autistic sample was younger; however, age and assigned sex were non-significant in most models, and we controlled for them statistically when they were significant. Further research may benefit from investigating these questions with more equally matched groups.

Given that the group of autistic adults was significantly older, it is possible they had more time to obtain sexual knowledge and romantic experiences compared to the younger non-autistic group. However, recognition knowledge was the only outcome that differed by age in our analyses, suggesting that age had a relatively minor impact on our findings among two groups of young adults. Given literature suggesting a later age of sexual debut for autistic adults (Bejerot & Eriksson, 2014), future research with both younger adolescents and older adults may find notable differences that would help the field understand the developmental trajectory of these skills.

Consistent with the literature, autistic adults reported a broader range of sexual orientations and gender identities compared to the non-autistic group (Dekker et al., 2017; Gotham et al., 2015). However, the current sample was underpowered to examine how differences in sexual orientation and gender identity may relate to accuracy and pragmatic skill. Future research on these differences may add nuance to our understanding of social-sex education—allowing researchers to explore whether and how sexual orientation and gender identity influence the way one communicates about sex. Moreover, growing research suggesting higher rates of asexuality in the autistic population should be considered when evaluating desires and specific topics to address in sex education tailored to autistic adults (Bush et al., 2021).

Finally, as a result of restrictions from the coronavirus pandemic, some testing was limited or conducted online. As the ADOS-2 has not been validated for virtual administration, we did not collect this measure from participants who were assessed virtually. Furthermore, the online survey methods used with young non-autistic adults prevented the measurement of IQ and general verbal ability. Given the comparison group was recruited from a university psychology research website, we expect that the verbal ability of the comparison group was at least as high as the autistic group. In order to understand within group differences related to communication ability, we used self-report of communication skills on the Autism Quotient as a proxy of general

verbal ability. Nonetheless, this scale is clearly different from the formal cognitive assessment of the WASI-II and within-group analyses should be conducted in future work using the same measure of general verbal ability.

Conclusions

The current study assessed knowledge, communication, and behavioral profiles among autistic adults and non-autistic college students. Autistic adults presented with fewer partnered experiences and poorer pragmatic skill compared to their non-autistic counterparts. Autistic and non-autistic adults presented similar profiles in sex education experiences, perceived knowledge, and accuracy of sexual knowledge. Further analyses revealed that, for both groups, pragmatic skill predicted accuracy in defining anatomical terms above and beyond verbal IQ or self-reported communication abilities. Collectively, results of this study indicate that autistic adults have similar knowledge regarding sex and romance compared to their non-autistic peers; however, autistic adults have more difficulty communicating this knowledge effectively.

Author contributions All authors contributed to the study's conception and design. Material preparation and data collection were performed by BHK, PV, and RC. Analyses were performed by BHK and SF. The first draft of the manuscript was written by BHK and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding This work was supported by the National Institutes of Health (NIMH R03MH113966; PIs: Faja/Pantalone).

Declarations

Conflict of interest The authors declare that they have no conflict of interest to disclose.

Ethical Approval This study was approved by the Human Subjects Divisions at Boston Children's Hospital and the University of Massachusetts Boston.

References

Austin, E. J. (2005). Personality correlates of the broader autism phenotype as assessed by the Autism Spectrum Quotient (AQ). *Personality and Individual Differences, 38*(2), 451–460. https://doi.org/10.1016/j.paid.2004.04.022

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger Syndrome/High-Functioning Autism, Males and Females, Scientists and Mathematicians. *Journal of Autism and Developmental Disorders,* https://doi.org/10.1023/A:1005653411471

Bejerot, S., & Eriksson, J. M. (2014). Sexuality and gender role in autism spectrum disorder: A case control study. *PLoS ONE, 9*(1), e87961. https://doi.org/10.1371/journal.pone.0087961

Booth, T., Murray, A. L., McKenzie, K., Kuenssberg, R., O'Donnell, M., & Burnett, H. (2013). Brief Report: An Evaluation of the AQ-10 as a Brief Screening Instrument for ASD in Adults. *Journal of Autism and Developmental Disorders, 43*(12), 2997–3000. https://doi.org/10.1007/s10803-013-1844-5

Brown-Lavoie, S. M., Viecili, M. A., & Weiss, J. A. (2014). Sexual knowledge and victimization in adults with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*(9), 2185–2196. https://doi.org/10.1007/s10803-014-2093-y

Burke, S. L., Wagner, E., Marolda, H., Quintana, J. E., & Maddux, M. (2019). Gap analysis of service needs for adults with neurodevelopmental disorders. *Journal of Intellectual Disabilities*. https://doi.org/10.1177/1744629517726209

Bush, H. H. (2018). Dimensions of sexuality among young women, with and without autism, with predominantly sexual minority identities. *Sexuality and Disability*. https://doi.org/10.1007/s11195-018-9532-1

Bush, H. H., Williams, L. W., & Mendes, E. (2021). Brief report: Asexuality and young women on the autism spectrum. *Journal of Autism and Developmental Disorders, 51*(2), 725–733. https://doi.org/10.1007/s10803-020-04565-6

Constantino, J. N., & Gruber, C. P. (2012). Social responsiveness scale second edition (SRS-2): Manual. Western psychological services (WPS).

Capps, L., Losh, M., & Thurber, C. (2000). "The frog ate the bug and made his mouth sad": Narrative competence in children with autism. *Journal of Abnormal Child Psychology, 28*(2), 193–204. https://doi.org/10.1023/A:1005126915631

Celce-Murcia, M., Dornyei, Z., & Thurrell, S. (1995). Communicative competence: A pedagogically motivated model with content specifications. *Issues in Applied Linguistics, 6*(2), 5–35.

Clegg, J., Hollis, C., Mawhood, L., & Rutter, M. (2005). Developmental language disorders - a follow-up in later adult life. Cognitive, language and psychosocial outcomes. *Journal of Child Psychology and Psychiatry, 46*(2), 128–149. https://doi.org/10.1111/j.1469-7610.2004.00342.x

Cohen, N. J., Menna, R., Vallance, D. D., Barwick, M. A., Im, N., & Horodezky, N. B. (1998). Language, social cognitive processing, and behavioral characteristics of psychiatrically disturbed children with previously identified and unsuspected language impairments. *Journal of Child Psychology and Psychiatry, 39*(6), 853–864. https://doi.org/10.1111/1469-7610.00286

de Marchena, A., & Eigsti, I. M. (2016). The art of common ground: Emergence of a complex pragmatic language skill in adolescents with autism spectrum disorders. *Journal of Child Language*. https://doi.org/10.1017/S0305000915000070

Dekker, L. P., van der Vegt, E. J. M., van der Ende, J., Tick, N., Louwerse, A., Maras, A., Verhulst, F. C., & Greaves-Lord, K. (2017). Psychosexual functioning of cognitively-able adolescents with autism spectrum disorder compared to typically developing peers: The development and testing of the teen transition inventory- a self- and parent report questionnaire on psychosexual functionin. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-017-3071-y

Deliens, G., Papastamou, F., Ruytenbeek, N., Geelhand, P., & Kissine, M. (2018). Selective pragmatic impairment in autism spectrum disorder: Indirect requests versus irony. *Journal of Autism and Developmental Disorders, 49*, 2938–2952.

Dewinter, J., Vermeiren, R., Vanwesenbeeck, I., & van Nieuwenhuizen, C. (2016). Adolescent boys with autism spectrum disorder growing up: Follow-up of self-reported sexual experience. *European Child and Adolescent Psychiatry, 25*(9), 969–978. https://doi.org/10.1007/s00787-016-0816-7

Dewinter, J., de Graaf, H., & Begeer, S. (2017). Sexual orientation, gender identity, and romantic relationships in adolescents and adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*(9), 2927–2934. https://doi.org/10.1007/s10803-017-3199-9

Diclemente, R. J., Pies, C. A., Stoller, E. J., Straits, C., Olivia, G. E., Haskin, J., & Rutherford, G. W. (1989). Evaluation of school-based AIDS education curricula in San Francisco. *Journal of Sex Research, 26*(2), 188–198. https://doi.org/10.1080/00224498909551505

Eales, M. J. (1993). Pragmatic impairments in adults with childhood diagnoses of autism or developmental receptive language disorder. *Journal of Autism and Developmental Disorders, 23*(4), 593–617. https://doi.org/10.1007/BF01046104

Eigsti, I. M., de Marchena, A. B., Schuh, J. M., & Kelley, E. (2011). Language acquisition in autism spectrum disorders: A developmental review. *Research in Autism Spectrum Disorders, 5*(2), 681–691. https://doi.org/10.1016/j.rasd.2010.09.001

Fourie, L., Kotzé, C., & Van der Westhuizen, D. (2017). Clinical and demographic factors associated with sexual behaviour in children with autism spectrum disorders. *South African Journal of Psychiatry*. https://doi.org/10.4102/sajpsychiatry.v23i0.862

Gallagher, T. M. (1999). Interrelationships among children's language, behavior, and emotional problems. *Topics in Language Disorders, 19*(2), 1–15. https://doi.org/10.1097/00011363-199902000-00003

Gilmour, L., Schalomon, P. M., & Smith, V. (2012). Sexuality in a community based sample of adults with autism spectrum disorder. *Research in Autism Spectrum Disorders, 6*(1), 313–318. https://doi.org/10.1016/j.rasd.2011.06.003

Gotham, K., Marvin, A. R., Taylor, J. L., Warren, Z., Anderson, C. M., Law, P. A., Law, J. K., & Lipkin, P. H. (2015). Characterizing the daily life, needs, and priorities of adults with autism spectrum disorder from Interactive Autism Network data. *Autism*. https://doi.org/10.1177/1362361315583818

Grice, H. P. (1975). Logic and conversation. In Cole, P., & Morgan, J. L. (Eds.), *Speech Acts* (pp. 41–58). BRILL. https://doi.org/10.1163/9789004368811_003

Hancock, G., Stokes, M. A., & Mesibov, G. (2020). Differences in romantic relationship experiences for individuals with an autism spectrum disorder. *Sexuality and Disability, 38*(2), 231–245. https://doi.org/10.1007/s11195-019-09573-8

Hannah, L. A., & Stagg, S. D. (2016). Experiences of sex education and sexual awareness in young adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-016-2906-2

Hartas, D. (2012). Children's social behaviour, language and literacy in early years. *Oxford Review of Education*. https://doi.org/10.1080/03054985.2012.699748

Helland, W. A., Lundervold, A. J., Heimann, M., & Posserud, M.-B. (2014). Stable associations between behavioral problems and language impairments across childhood—The importance of pragmatic language problems. *Research in Developmental Disabilities*. https://doi.org/10.1016/j.ridd.2014.02.016

Hellemans, H., Colson, K., Verbraeken, C., Vermeiren, R., & Deboutte, D. (2007). Sexual behavior in high-functioning male adolescents and young adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 37*(2), 260–269. https://doi.org/10.1007/s10803-006-0159-1

Hellemans, H., Roeyers, H., Leplae, W., Dewaele, T., & Deboutte, D. (2010). Sexual behavior in male adolescents and young adults with autism spectrum disorder and borderline/mild mental retardation. *Sexuality and Disability, 28*(2), 93–104. https://doi.org/10.1007/s11195-009-9145-9

Kelley, E., Paul, J. J., Fein, D., & Naigles, L. R. (2006). Residual language deficits in optimal outcome children with a history of autism. *Journal of Autism and Developmental Disorders, 36*(6), 807–828. https://doi.org/10.1007/s10803-006-0111-4

Konstantareas, M. M., & Lunsky, Y. J. (1997). Sociosexual knowledge, experience, attitudes, and interests of individuals with autistic disorder and developmental delay. *Journal of Autism and Developmental Disorders, 27*(4), 397–413. https://doi.org/10.1023/A:1025805405188

Lord, C., Rutter, M., DiLavore, P., Risi, S., Gotham, K., & Bishop, S. (2012). Autism Diagnostic Observation Schedule, Second Edition (ADOS-2). Western Psychological Services.

Lord, C. (1996). Language in high-functioning adolescents with autism: Questions about deviance and delay. In D. Cicchetti & S. L. Toth (Eds.), *Rochester symposium on developmental psychopathology: Adolescence: Opportunities and challenges*, Vol. 7. pp. 149–165. Rochester: University of Rochester Press

Lewis, F. M., Woodyatt, G. C., & Murdoch, B. E. (2008). Linguistic and pragmatic language skills in adults with autism spectrum disorder: A pilot study. *Research in Autism Spectrum Disorders, 2*(1), 176–187. https://doi.org/10.1016/j.rasd.2007.05.002

Liles, B. Z., Duffy, R. J., Merritt, D. D., & Purcell, S. L. (1995). Measurement of narrative discourse ability in children with language disorders. *Journal of Speech, Language, and Hearing Research, 38*(2), 415–425. https://doi.org/10.1044/jshr.3802.415

McCrimmon, A. W., & Smith, A. D. (2013). Review of the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II). *Journal of Psychoeducational Assessment, 31*(3), 337–341. https://doi.org/10.1177/0734282912467756

Mogavero, M. C., & Hsu, K. H. (2020a). Dating and courtship behaviors among those with autism spectrum disorder. *Sexuality and Disability, 38*(2), 355–364. https://doi.org/10.1007/s11195-019-09565-8

Mogavero, M. C., & Hsu, K. H. (2020b). Dating and courtship behaviors among those with autism spectrum disorder. *Sexuality and Disability*. https://doi.org/10.1007/s11195-019-09565-8

Nadig, A., Vivanti, G., & Ozonoff, S. (2009). Adaptation of object descriptions to a partner under increasing communicative demands: A comparison of children with and without autism. *Autism Research*. https://doi.org/10.1002/aur.102

Norbury, C. F., & Bishop, D. V. M. (2003). Narrative skills of children with communication impairments. *International Journal of Language & Communication Disorders, 38*(3), 287–313. https://doi.org/10.1080/1368203100001081 33

Ousley, O. Y., & Mesibov, G. B. (1991). Sexual attitudes and knowledge of high-functioning adolescents and adults with autism. *Journal of Autism and Developmental Disorders, 21*(4), 471–481. https://doi.org/10.1007/BF02206871

Pecora, L. A., Hooley, M., Sperry, L., Mesibov, G. B., & Stokes, M. A. (2020). Sexuality and gender issues in individuals with autism spectrum disorder. *Child and Adolescent Psychiatric Clinics of North America*. https://doi.org/10.1016/j.chc.2020.02.007

Penny, R. E. C., & Chataway, J. E. (1982). Sex education for mentally retarded persons. *Australia and New Zealand Journal of Developmental Disabilities, 8*(4), 204–212. https://doi.org/10.3109/13668258209018763

Solomon, D., Pantalone, D. W., & Faja, S. (2019). Autism and adult sex education: A literature review using the information–motivation–behavioral skills framework. *Sexuality and Disability, 37*(3), 339–351. https://doi.org/10.1007/s11195-019-09591-6

Stevenson, J. L., & Hart, K. R. (2017). Psychometric properties of the autism-spectrum quotient for assessing low and high levels of autistic traits in college students. *Journal of Autism and Developmental Disorders, 47*(6), 1838–1853. https://doi.org/10.1007/s10803-017-3109-1

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. *Handbook of autism and pervasive*

developmental disorders: Diagnosis, development, neurobiology, and behavior (3rd ed., Vol. 1, pp. 335–364). Wiley.

Teitcher, J. E. F., Bockting, W. O., Bauermeister, J. A., Hoefer, C. J., Miner, M. H., & Klitzman, R. L. (2015). Detecting, preventing, and responding to "Fraudsters" in internet research: Ethics and tradeoffs. *Journal of Law, Medicine & Ethics, 43*(1), 116–133. https://doi.org/10.1111/jlme.12200

Trotter, E. C., & Alderson, K. G. (2007). University students' definitions of having sex, sexual partner, and virginity loss: The influence of participant gender, sexual experience, and contextual factors. *Canadian Journal of Human Sexuality*, *16*(1/2), 11.

Turner, D., Briken, P., & Schöttle, D. (2019). Sexual dysfunctions and their association with the dual control model of sexual response in men and women with high-functioning autism. *Journal of Clinical Medicine*, *8*(4), 425. https://doi.org/10.3390/jcm8040425

Volden, J. (2004). Conversational repair in speakers with autism spectrum disorder. *International Journal of Language & Communication Disorders, 39*(2), 171–189. https://doi.org/10.1080/13682820410001663252

Walsh, J. L., & Ward, L. M. (2010). Magazine reading and involvement and young adults' sexual health knowledge, efficacy, and behaviors. *Journal of Sex Research, 47*(4), 285–300. https://doi.org/10.1080/00224490902916009

Wechsler, D. (2011). *Wechsler abbreviated scale of intelligence—second edition (WASI-II)*. NCS Pearson.

Whitehouse, A. J. O., Watt, H. J., Line, E. A., & Bishop, D. V. M. (2009). Adult psychosocial outcomes of children with specific language impairment, pragmatic language impairment and autism. *International Journal of Language & Communication Disorders, 44*(4), 511–528. https://doi.org/10.1080/13682820802708098

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.