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Examining Visual Attention Patterns among Asexual and Heterosexual Individuals

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ABSTRACT

Asexuality has garnered much attention, and empirical data support its classification as a sexual orientation. Asexuality is defined as a lack of sexual attraction to others, with approximately 1% of the population falling in this category. As theoretical models situate attention as a central component of sexual response, the current study examined attentional processing of erotic stimuli in asexuals and heterosexuals. We hypothesized that heterosexual participants would have initial and controlled visual attention patterns favoring erotic images over non-erotic images. We predicted that asexual participants would have significantly smaller or non-existent differences in attention to erotic versus non-erotic images. Ninety-five adults completed an eye-tracking task viewing erotic and non-erotic images. Eye-tracking data showed no group differences in initial attention to erotic images. For controlled attention, there was a large effect size in the hypothesized direction. Heterosexual participants exhibited more and longer fixations on erotic images, whereas asexuals exhibited a more even distribution of attention across image types. Exploratory analysis of group differences in the association between visual attention and ratings of sexual attractiveness revealed a complex pattern of differences, with some indication of a stronger association between total fixation and sexual attraction for heterosexual participants. These findings suggest that differences in attention to sexual stimuli may represent key underlying differences between asexual and allosexual orientation. Findings also contribute to the larger literature on visual attention and attraction.

Introduction

Eye-Tracking in Sexuality Research

Theoretical models emphasize the importance of attention in eliciting and maintaining sexual response and arousal (Dewitte, 2016; Janssen et al., 2000; Toates, 2009). Specifically, the incentive motivational model regards attending to incentive stimuli as a trigger for subsequent motivated sexual behavior (Toates, 2009). Thus, evaluation of attention patterns may divulge information about sexual behavior differences among different sexual orientations and genders. Although myriad studies have been conducted to examine the relationship between attention and sexual response, research has not yet evaluated this link among asexually-identifying persons. The goal of this study was to improve our understanding of asexuality by exploring the role of attention in sexual response for individuals who experience a lack of sexual attraction. Not only is examining an understudied population important for refining existing knowledge gaps but asexuality research also highlights the variability of human sexuality in general and thus, enables a greater understanding of sexual attraction/orientation as a whole.

Attention is used to prioritize and select the most motivationally salient stimuli for further processing (MacLeod et al., 2017). Visual attention, the acquisition of visual information (Henderson et al., 1989), can be assessed through visual fixations measured by eye-tracking methodology (Henderson & Hollingworth, 1999). Specifically, eye-tracking enables the assessment of both initial and controlled attention. *Initial attention* is the covert automatic allocation of attentional resources and precedes controlled attention. As an index of attentional capture or early attentional processing of salient cues, initial attention is commonly assessed by individuals' *time to first fixation* and *first fixation duration* on a given stimulus. *Controlled attention* is the overt allocation of attention and provides an index of sustained attentional processing of salient cues. Controlled attention is assessed most commonly through *total number of fixations* and *total fixation duration* on an area of interest (Hermans et al., 1999; Rohner, 2002). Generally, emotional stimuli appear to better capture initial and controlled attention than neutral stimuli, resulting in a shorter time to first fixation, longer total fixation durations, and a greater number of total fixations (Calvo & Lang, 2004; Hermans et al., 1999; Rohner, 2002).

Extant sexuality research has affirmed the utility of eye-tracking to examine attentional processing of sexual stimuli with robust evidence that visual attention can be used as an index of sexual interest and attraction (Dawson & Chivers, 2016, 2018, 2019; Dawson et al., 2017; Rieger & Savin-Williams, 2012; for review, see Milani et al., 2020). Eye-tracking studies have demonstrated that men of varied sexual orientations consistently display initial and controlled attentional bias toward their sexually preferred targets (Dawson & Chivers, 2016; Morandini et al., 2019, 2020; Rieger & Savin-

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Williams, 2012). Specifically, gynephilic (i.e., attracted to women) and androphilic (i.e., attracted to men) men exhibited biased attention toward female and male targets, respectively, while more equal distribution was observed in ambiphilic (i.e., attracted to both men and women) men. For women, an attentional bias toward female targets has been observed among ambiphilic and exclusively/predominantly gynephilic women (Dawson et al., 2017; Rieger & Savin-Williams, 2012). In androphilic women, patterns of visual attention to preferred male and nonpreferred female targets appear to be dependent on the stage of attentional processing (i.e., initial versus controlled attention; Dawson & Chivers, 2016, 2018, 2019; Milani et al., 2020). That is, both preferred male and nonpreferred female targets elicit an initial attentional bias, whereas preferred male targets garner more attention and elicit a controlled attentional bias (Dawson & Chivers, 2016, 2018, 2019). These studies have also showed that for allosexual men and women, patterns of controlled attention are highly correlated with self-reported sexual attraction ratings to sexual images (r = .47 to .76; Dawson & Chivers, 2016).

Taken together, sexual cues capture and sustain attention in men and women with some variability observed as a function of sexual orientation. However, visual attention patterns of asexual individuals in this context remain unknown. As asexual participants experience less sexual attraction, they may lack the attentional bias toward sexually salient stimuli that is exhibited by their allosexual (i.e., non-asexual) counterparts. Stronger differences may be observed for controlled attention than for initial attention given that more robust findings have been observed for the former in extant research (Dawson & Chivers, 2016, 2018, 2019; Milani et al., 2020; Morandini et al., 2019, 2020; Rieger & Savin-Williams, 2012). Similarly, the association between controlled attention and sexual attraction ratings is likely higher than that between initial attention and sexual attraction ratings (Dawson & Chivers, 2016).

Asexuality and Eye-Tracking

Asexuality is generally defined as a sexual orientation characterized by a lack of sexual attraction (Bogaert, 2015; Brotto & Yule, 2017). Research suggests that asexuals may account for 0.4–1% of the total population (Aicken et al., 2013; Bogaert, 2004). Among self-identified asexuals, there is significant heterogeneity in how individuals define their asexuality (Carrigan, 2011; Scherrer, 2008). The Asexual Visibility and Education Network (AVEN), an online community seeking to create acceptance and discussion of asexuality, describes the asexual community as one with considerable diversity of sexual needs and experiences. Within the asexual community, terms such as demisexual, gray-A, and A-fluid are also used to describe differing degrees of experience of sexual attraction (Carrigan, 2011). Experience of romantic attraction also varies throughout the asexual community. In a qualitative study by Scherrer (2008), several participants shared that they were romantically, but not sexually, attracted to others, allowing for the designation of romantic versus aromantic asexuality. Among romantic asexuals, diverse romantic attractions, including heteroromantic, homoromantic, and bi- and pan-romantic, are reported (Antonsen et al., 2020; Brotto et al., 2010; Scherrer, 2008; Zheng & Su, 2018). Thus, while asexuality is defined as a lack of sexual attraction, some asexual individuals may experience some levels of sexual attraction and/or romantic attraction toward others. This positions asexuality as a sexual orientation that occurs on a spectrum, with different subtypes on the nature of the attraction and context.

To date, only two examinations using eye-tracking methodology have included asexual participants (Bradshaw et al., 2021; Brown et al., 2021). The goal of these studies was to examine differences in initial and controlled visual attention to sexual cues between asexuals and women with Sexual Interest/Arousal Disorder (SIAD; American Psychiatric Association [APA], 2013). The authors predicted that asexual participants would non-preferentially view erotic and non-erotic images, whereas women with SIAD would look more quickly (i.e., initial attention) and look longer (i.e., controlled attention) at erotic relative to non-erotic images. Using a forced-attention paradigm that presented paired images consisting of one erotic and one non-erotic image that compete for attention, findings affirmed that while heterosexual women with SIAD displayed a preference for erotic images – as indicated by looking more quickly and for a longer duration – asexual participants did not (Bradshaw et al., 2021; Brown et al., 2021). However, no comparisons were made in this study to a non-clinical control group, thus limiting the possibility for drawing conclusions specifically about asexuality versus allosexuality independent of a clinical diagnosis. As well, these studies did not report on any associations between visual attention patterns and sexual attraction ratings. Thus, comparison of asexuals to non-clinical allosexuals using eye-tracking attentional measures warrants further investigation.

Current Study

The current study aimed to assess attentional processing of erotic stimuli across asexual (men, women, and nonbinary individuals) and allosexual (men and women) participants. Specifically, we used a forced-attention paradigm with eye-tracking methodology and compared visual attention patterns across five groups: asexual men, asexual women, asexual nonbinary individuals, heterosexual men, and heterosexual women. Based on existing research, we hypothesized that allosexual participants would initially look more quickly at erotic images than non-erotic images and have longer first fixation durations at erotic images. For controlled attention, we predicted that allosexual participants would look more and for longer at erotic stimuli, through a greater number of fixations and longer total fixation durations on erotic than non-erotic stimuli. Finally, we expected that allosexual participants would rate erotic images as more sexually attractive than non-erotic ones. We hypothesized that these differences in responses to erotic versus non-erotic stimuli would be either significantly smaller or non-existent for asexual participants. We also conducted an exploratory analysis of the relationship between visual attention variables and ratings of sexual attractiveness and potential differences in the strength of such relationship for asexual versus allosexual participants.

Method

Participants

Participants were recruited from advertisements placed online (e.g., university paid-studies list, hospital electronic mailing lists, Facebook, Instagram, Reddit, asexuality.org (AVEN), and other online discussion boards), flyers posted throughout the community (e.g., coffee shops, community centers, and university boards), and advertisements placed on public transit (e.g., city buses and SkyTrain). Participant eligibility was assessed via a short telephone screening. To be eligible to participate, self-identified asexual and allosexual participants were required to be over 18 years of age, be able to read and write English fluently, have normal or corrected-to-normal vision, and be right-handed. Participants were not eligible if they reported eye diseases (e.g., macular degeneration and glaucoma) or color blindness.

Of 122 individuals who contacted the study coordinator and expressed an interest in the study, a total of n = 113 completed the telephone screening to determine eligibility. Two individuals did not meet the eligibility criteria (i.e., were not fluent in English) and 16 individuals dropped out prior to completing all components of the study – either due to scheduling conflicts or unspecified reasons. Our final sample of n = 95 completed all components of the study and were recruited from university paid-studies list (n = 53), Facebook (n = 16), public transit (n = 8), word of mouth (n = 5), university boards (n = 4), Reddit (n = 3), AVEN (n = 3), and hospital electronic mailing lists (n = 3). Our analyses included 26 heterosexual men (M_{age} = 24.77, SD = 6.28), 30 heterosexual women (M_{age} = 25.10, SD = 4.74), 13 asexual men (M_{age} = 25.08, SD = 5.35), 18 asexual women (M_{age} = 25.28, SD = 5.72), and 8 asexual non-binary individuals (M_{age} = 24.63, SD = 7.27). In terms of sample size, although a large effect size (η^2 = .31) was reported in Brown et al.'s (2021) study employing a similar paradigm with asexual and allosexual women, we calculated *a priori* sample size based on a more conservative medium effect size given that gender differences in visual attention have not been examined in asexual populations. Thus, to detect our effects for an interaction between group and the repeated measures factor (i.e., erotic and non-erotic images) based on a medium effect (η^2 = .06, power = .90, alpha = .05, between-measures correlation of .50), we required a total sample size of 70 (n = 14 per group). This power analysis was performed for intended ANOVA analysis with outcomes averaged across 20 trials. The final analysis of the data, however, was performed using a multi-level approach, which utilized all 20-trial data and therefore provides considerably more power.

Procedure

Interested participants contacted the study coordinator via e-mail and scheduled a telephone screening to assess eligibility and review the study procedures. Eligible participants received a copy of the consent form via e-mail and those who were interested in proceeding with participation scheduled an appointment for the in-laboratory assessment. Prior to the in-laboratory session, an e-mail confirming the date and time of the session was sent to participants along with an individualized Qualtrics survey link to complete the online questionnaire package containing demographic and sexuality-related questions. Informed consent was obtained twice: first, electronically before commencing the online questionnaire package, and second, on paper before the in-laboratory assessment.

Upon arriving at the laboratory, a trained research coordinator provided participants with a thorough overview of the study procedures and obtained written consent. Participants were seated in a comfortable chair facing a computer monitor equipped with the eye tracker at a viewing distance of approximately 60 cm. Once participants were ready to begin, participants were left alone in the private testing room and the study coordinator communicated with them via an intercom system for the duration of the task. Prior to starting the experimental task, the eye tracker was calibrated using the standard calibration procedure, which involved having participants follow a calibration fixation dot with their eyes as closely as possible as it moved around the display screen.

The experimental task involved the presentation of a pair of images (one erotic and one non-erotic) appearing side-by-side and competing for attention (i.e., forced-attention paradigm). The location of each image type was counterbalanced (i.e., erotic image on the left/non-erotic image on the right or erotic image on the right/non-erotic image on the left). A fixation cross was shown in the middle of the screen for 1 second before each image pair to ensure that all participants were looking at the center of the screen before stimulus onset. Each of the 20 image pairs were shown for 10 seconds and participants were instructed to view the images as they normally would. Following previously used methodology in eye-tracking research (e.g., Dawson & Chivers, 2016), participants rated how sexually attracted they were to each image on a 10-point Likert scale after viewing each pair of images. This yields a motivated-viewing paradigm (rather than free-viewing) and may be considered more directive given that participants had to view both images in order to provide ratings for each. When the experimental task was completed, participants were debriefed and thanked for their participation. Participants received reimbursement ($25 CAD) for their participation in the study. This study was approved by the Behavioral Research Ethics Board at the University of British Columbia as well as the Vancouver Coastal Health Research Institute research ethics board.

Experimental Stimuli

Visual stimuli were presented on a desktop monitor across 20 experimental trials and contained pairs of colored images obtained from freely accessible Internet websites. Each pair contained one explicit erotic and one non-erotic image. Erotic images depicted a mixed-sex dyad engaging in sexual activity and non-erotic images depicted a fully clothed man and woman engaging in a non-erotic, non-romantic interaction. Using Adobe Photoshop software, all images were matched for size (960 × 640 pixels) and luminance, brightness, contrast, and color were manually adjusted to be consistent across images.

Apparatus

Eye movements were recorded using a SensoMotoric Instruments (SMI) RED desktop eye tracker in combination with the SMI Experiment Suite software. The SMI is a contact-

free, remote sensor eye tracker that uses an infrared camera to track pupil movement. The eye-tracking system is discreetly attached to the bottom of a standalone 22-inch computer monitor with a resolution of 1920 × 1050 pixels. The SMI has a sampling rate of 120 Hz, a spatial resolution of 0.03°, and an accuracy of 0.4°. This system is compatible for use with most eyeglasses and contact lenses, and automatically compensates for small head movements, which eliminates the need for a chin rest to immobilize the head.

Measures

Eye-tracking Measures

To analyze visual attention to the erotic and non-erotic images in each stimulus pair, we used the SMI BeGaze software to create two regions of interest (ROI): 1) erotic image; and 2) non-erotic image. To examine initial attention, we extracted two dependent variables for each ROI: time to first fixation and first fixation duration. *Time to first fixation* can be defined as the length of time for a shift in visual attention to a specific area of a visual stimulus. *First fixation duration* can be defined as the time visual attention remains in a specific area the very first time that the area is fixated on.

To examine controlled attention, we extracted two dependent variables for each ROI: total number of fixations and total fixation duration. *Total number of fixations* can be defined as the number of times the participant's gaze (lasting a minimum of 100 ms) landed in the ROI. *Total fixation duration* can be defined as the total amount of time (in milliseconds) a participant fixated on an ROI.

Post-stimulus Sexual Attraction Ratings

Following the presentation of each pair of images, participants were asked to rate their sexual attraction to each erotic and non-erotic image on a 10-point scale ranging from 0 (*not at all sexually attracted*) to 9 (*very sexually attracted*). Higher scores indicate higher self-reported sexual attraction ratings.

Demographics, Sexual Orientation, Gender

Demographic questions included age, ethnicity, education, income, sexual and romantic orientation, relationship status, length of current relationship, number of sexual and romantic partners, presence of sexual difficulties, and history of non-consensual sexual contact. We also administered the Asexuality Identification Scale (AIS; Yule et al., 2015) as a valid measure of participants' asexual identity, as well as the Female Sexual Distress Scale – Revised (FSDS-R; Derogatis et al., 2008) to assess sexual distress – measures described below. Sexual orientation was assessed multiple times throughout the study. During the telephone screening, participants were asked "Which of the following best describes your sexual orientation?" and were provided with the following response options: asexual, bisexual, heterosexual, and lesbian/gay. Sexual orientation was also assessed in different formats (i.e., multiple choice, open-ended question) as part of the demographic questionnaire as well as the Asexuality Identification Scale (AIS; Yule et al., 2015). In 18.9% of cases (n = 18), participants used the open-ended text-boxes to further describe their sexual orientation (e.g., "gray-asexual," "pansexual, gray-asexual," "heteroromantic gray ace," "questioning," "demisexual to asexual," "autochorisexual," "bicurious, actively only heterosexual," etc.). For consistency, we used self-report responses obtained during the telephone screening to group participants into asexual versus allosexual groups. For gender, we used responses obtained from our demographic gender question, which included the following response options: man, nonbinary, and woman. We also included a yes/no question regarding trans experience (i.e., their gender identity did not align with their sex at birth).

Twenty-four men identified as heterosexual. There were two men who disclosed trans experience but who also identified as heterosexual men. They did not differ from heterosexual men on our variables of interest and as such, were included in the heterosexual men group. Thirty women identified as heterosexual. Thirteen men and 18 women identified as asexual. The asexual nonbinary group consisted of eight individuals who identified as nonbinary and/or disclosed trans experience.

Asexual Identity

The *Asexuality Identification Scale* (AIS; Yule et al., 2015) is a valid measure to assess participants' asexual identity independent of whether an individual self-identified as asexual. Psychometric validation of this measure was conducted to evaluate construct validity and the measure showed excellent discriminant, incremental, as well as convergent validity (Yule et al., 2015). This 12-item measure asks participants to rate the applicability of various statements (e.g., "I lack interest in sexual activity") on a scale ranging from 1 (*completely false*) to 5 (*completely true*). Responses were summed to create a total AIS score with a possible range of 12–60. Higher scores indicate a greater tendency to endorse traits that may indicate asexuality. Specifically, a cutoff score of 40/60 has been proposed to distinguish asexual from allosexual participants (Yule et al., 2015). The AIS showed strong internal consistency in the present sample, with a Cronbach's alpha of 0.97.

Sexual Distress

The *Female Sexual Distress Scale – Revised* (FSDS-R; Derogatis et al., 2008) is a 13-item scale that assesses sexual distress independent of specific domains of sexual function (e.g., sexual desire, erectile function). The FSDS-R does not contain gender-specific content and has also been validated in samples of men (Santos-Iglesias et al., 2018). As such, we refer to it as the *Sexual Distress Scale* (SDS) in this paper. Responses are provided on a scale ranging from 0 (*never*) to 4 (*always*), and a total SDS score of all items was computed with a possible range of 0–52. Higher scores indicate higher levels of sexuality-related distress. In the present sample, Cronbach's alpha was 0.95.

Data Analysis

Each of five main dependent variables (four visual attention measures and stimulus sexual attractiveness ratings) was analyzed using a multilevel mixed model analysis evaluating main effects of the within-group factor we call image (change in response from non-erotic to erotic stimulus) and the between-group factor we call group comparing the five groups of

participants, as well as the interaction of the within- and between-subject factors (changes in responses from non-erotic to erotic stimulus were compared between the five groups). Non-erotic and erotic stimuli were nested within 20 trials (20 different pairs of stimuli were used) which were nested within participants. In order to account for potential differences between pairs of images, initial models tested two random factors – trial and participant intercepts. Including the random effect of trial did not explain any additional variance and it made the models unstable (not positive definite matrix). This indicates that the stimuli were perceived as similar across 20 pairs and the random effect of trial was removed from the final models. Significant group main effects and interactions were followed by post-hoc comparisons using Bonferroni adjustment for multiple testing – raw p values were multiplied by the number of comparisons and should be compared against the usual .05 threshold of significance (Jafari & Ansari-Pour, 2019). This method is more convenient for the reader as it allows them to employ the usual $p < .05$ criterion while being logically and mathematically equivalent to presenting raw p values and comparing them to an adjusted significance p value. Significant interaction was probed with two levels of post-hoc comparisons. First, the difference between erotic and non-erotic images on four eye-tracking measures and sexual attractiveness ratings were computed for each group and tested for significance. The p values were multiplied by 5 to adjust for five comparisons. Next, those group differences were compared to each other and tested for significance, and the p values were multiplied by 10 (10 comparisons). These results are reported in the Results section.

The two initial attention measures were non-normally distributed, resulting in non-normal distribution of residuals. For those two measures, bootstrapping was used (2000 samples) in order to obtain robust standard errors and confidence intervals. The pattern of significant effects was unchanged. Additionally, a set of first fixation duration scores for one participant in asexual nonbinary group was identified as extreme influential outliers (more than 3 standard deviations from the mean), affecting size and significance of effects). Results are therefore reported with and without the data for this participant according to recommended practice (Aguinis et al., 2013).

The exploratory analyses of group differences in the strength of the gaze variables and sexual attraction relationship were conducted on responses to erotic images using a series of multi-level random intercept models. Each of the four gaze variables was entered as a predictor of sexual attractiveness rating in a separate model together with interaction terms between gaze variable and group in order to examine potential differences between asexual and allosexual participants in the degree to which gaze measures predicted sexual attraction. All possible two-group comparisons were examined. These analyses were considered exploratory and provided unique opportunity to gain insight into effects that have not been examined in the literature (differences in the strength of association between gaze and sexual attraction for people who are asexual versus those who are allosexual). Therefore, we decided to report the results without any adjustment for multiple comparisons to provide maximum information about possible effects that can guide future research, lead to novel hypotheses, and replication endeavors. We are aware that such decision inflates Type I error, and we caution about it in our discussion. However, we believe that due to the importance of this unique opportunity to explore this previously uncharted area, the concerns with Type II error (missing true effects) are prioritized (Fiedler et al., 2012).

Results

Sample Characteristics

The five groups (asexual men, asexual women, asexual nonbinary, heterosexual men, and heterosexual women) were similar in several demographic variables, including age, ethnicity, education, income, length of current relationship, and sexual difficulties (Table 1). As well, no significant group differences were observed for sexual concerns, with the majority of our participants (86.2%) reporting no sexual difficulties. No significant group differences were observed in levels of sexual distress, although asexual nonbinary individuals reported the lowest sexual distress.

As indicated in Table 1, a one-way ANOVA revealed significant group differences on the Asexuality Identification Scale, as expected, with each of the asexual groups (men, women, and nonbinary) having significantly higher scores on the AIS relative to heterosexual men and women. The asexual groups did not significantly differ from each other on this measure nor did heterosexual men and women. When examining the number of sexual partners, compared to asexual men, heterosexual men and women reported significantly more sexual partners. Similarly, compared to asexual nonbinary individuals, heterosexual men and women reported more sexual partners. No significant group differences were observed between heterosexual men and women. As well, asexual women did not significantly differ in the number of sexual partners relative to all other groups. We also found a group difference for number of romantic partners, such that heterosexual women reported having significantly more romantic partners than asexual men. No other group differences were observed. Chi-square tests revealed that relationship status differed across groups, such that a greater number of asexual men, asexual women, and asexual nonbinary individuals reported being single relative to heterosexual women. No statistically significant differences were found between heterosexual men and heterosexual women and between heterosexual men and each of the asexual groups. In terms of romantic orientation, we found significant group differences, such that a greater number of asexual men, asexual women, and asexual nonbinary individuals reported no romantic attractions (i.e., aromantic) relative to heterosexual men and women. The groups also differed in their experiences of non-consensual sexual contact. While heterosexual men reported no incidences, similar levels of endorsement were observed across heterosexual women, asexual women, and asexual nonbinary individuals, followed by asexual men. In sum, asexuals were less like heterosexuals with respect to the number of sexual and romantic partners, relationship status, romantic orientation, and experiences of non-consensual sexual contact.

Table 1. Sociodemographic information for participants.

Variable *M* (SD)	Heterosexual Men (n = 26)	Heterosexual Women (n = 30)	Asexual Men (n = 13)	Asexual Women (n = 18)	Asexual Nonbinary (n = 8)	One-Way ANOVA		
						F	p	η^2
Age	24.8 (6.3)	25.1 (4.7)	25.1 (5.3)	25.3 (5.7)	24.6 (7.3)	0.03	.998	0.00
Asexual Identity (AIS)*	17.1 (5.1)	18.9 (5.6)	48.2 (7.6)	48.7 (5.9)	46.5 (9.8)	128.47	< .001	0.85
Sexual Distress	14.2 (12.0)	14.0 (11.1)	11.1 (13.3)	14.2 (11.7)	4.9 (7.0)	1.25	.298	0.05
Relationship length in yrs.	1.4 (2.3)	1.9 (2.7)	0.5 (1.7)	1.2 (2.5)	0.6 (1.4)	1.04	.392	0.05
Number of sexual partners*	6.0 (6.4)	8.0 (8.4)	1.2 (1.7)	3.1 (5.2)	0.6 (0.9)	4.38	.003	0.17
Number of romantic partners*	3.0 (3.1)	7.0 (9.4)	1.0 (1.9)	2.9 (3.6)	2.1 (2.2)	3.22	.016	0.13

Variable (%)	Heterosexual Men (n = 26)	Heterosexual Women (n = 30)	Asexual Men (n = 13)	Asexual Women (n = 18)	Asexual Nonbinary (n = 8)	Chi-Square	
						χ^2	p
Romantic Orientation*						16.39	.003
Aromantic	0	0	15.4	11.8	37.5		
Romantic	100.0	100.0	84.6	88.2	62.5		
Relationship status*						15.41	.004
Single	50.0	30.0	76.9	77.8	75.0		
Dating/committed relationship	50.0	70.0	23.1	22.2	25.0		
Sexual Difficulties	11.5	16.7	8.3	22.2	0	2.97	.563
Non-Consensual Sexual Contact*	0	39.3	15.4	38.9	37.5	14.98	.005
Ethnicity						4.44	.349
Black	0	6.7	0	0	0		
East Asian	34.5	33.3	7.7	11.8	12.5		
South Asian	11.5	3.3	15.4	0	25.0		
Southeast Asian	0	3.3	0	5.9	0		
Hispanic	7.7	3.3	0	5.9	0		
Arab/West Indian	0	0	7.7	0	0		
White/Caucasian	46.2	46.7	69.2	70.6	50.0		
Other	0	3.3	0	5.9	12.5		
Level of education						2.79	.593
High school	7.7	6.7	7.7	5.6	12.5		
Attended some college	50.0	40.0	46.2	38.9	62.5		
College degree	34.6	36.7	15.4	38.9	25.0		
Post-graduate degree	7.7	16.7	30.8	16.7	0		
Annual income category						2.10	.717
<$20,000	31.8	22.2	22.2	29.4	28.6		
$20,000 – $39,999	18.2	14.8	11.1	11.8	0		
$40,000 – $59,999	13.6	14.8	22.2	29.4	42.9		
$60,000 – $79,999	0	18.5	11.1	17.6	14.3		
$80,000 – $99,999	9.1	11.1	22.2	0	14.3		
$100,000 – $119,999	9.1	0	0	0	0		
$120,000 – $139,999	4.5	3.7	0	0	0		
$140,000 – $159,999	0	7.4	0	5.9	0		
>$160,000	13.6	7.4	11.1	5.9	0		

Table presents comparisons between the five groups. One-way ANOVAs evaluated group differences in age, asexual identification, sexual distress, current relationship length, and number of sexual and romantic partners. Chi-square tests of homogeneity examined group differences in romantic orientation, relationship status (single vs. dating/partnered), sexual concerns (yes vs. no), non-consensual sexual contact (yes vs. no), ethnicity (White/Caucasian vs. all other categories), level of education (no college degree vs. college degree), and annual income (above $59,999 vs. below median).

*Groups differed on variable of interest, $p < .05$.

Experimental Dependent Variables

The effects from multilevel mixed model analyses including estimated marginal means are presented in Table 2.

Initial Attention

For time to first fixation, there was a main effect of image (shorter time to first fixation for erotic stimuli) which was qualified by a significant interaction between group and image type. Pairwise comparisons indicated that four groups (heterosexual men, heterosexual women, asexual women, and asexual nonbinary individuals) more quickly attended to the erotic images relative to the non-erotic images as indicated by a shorter time to first fixation. For asexual men, time to first fixation to the erotic image versus non-erotic image did not significantly differ. Examination of the interaction contrasts indicated that the difference between erotic and non-erotic stimuli for asexual men was not only non-significant but also significantly lower than the same difference for heterosexual men and women (p's < .001). No other interaction contrasts were significant.

For first fixation duration, a significant main effect of image type was found, such that, on average, erotic images had longer first fixations than non-erotic images by 26 milliseconds across groups. There was also a significant main effect of group which, when followed by post-hoc comparisons, indicated that when averaged across non-erotic and erotic images, asexual nonbinary individuals had significantly longer first fixation durations than all other groups (p's < .008). This group effect disappeared when the influential outlier was removed from the analysis (Table 2). Asexual men, asexual women, heterosexual men, and heterosexual women did not significantly differ on this variable. There was no significant interaction between group and image type for first fixation duration.

Controlled Attention

For total fixation duration, there was a main effect of image (greater fixation duration for erotic stimuli), which was qualified by a significant interaction between group and image type. Pairwise comparisons indicated that all five groups spent more time fixating on erotic than on non-erotic images; however, those differences were about five times larger for allosexual than for asexual participants. Examination of the interaction contrasts revealed that the difference between erotic and non-erotic stimuli for all asexual groups was similar (not significantly different) but it was significantly lower than the same

Table 2. Estimated marginal means for multilevel mixed model analyses examining the effect of image (non-erotic to erotic) on study outcomes in five groups of asexual and heterosexual participants.

	Group					Main effects		2-way interaction
Measure/ Stimulus	Asexual nonbinary	Asexual women	Asexual men	Heterosexual women	Heterosexual men	Image	Group	Image by Group
						F	*F*	*F*
Time to first fixation								
Non-erotic	1541.34	1622.12	1323.66	1688.59	1684.01	195.29	0.28	6.95
Erotic	810.46	913.67	1070.21	786.44	663.12	<.001	.887	<.001
Difference	−730.88	−708.45	−253.44	−902.15	−1020.89			
Cohen's d	−0.42	−0.41	−0.15	−0.52	−0.59			
p value*	<.001	<.001	.214	<.001	<.001			
First fixation duration								
Non-erotic	360.59	286.84	291.31	270.13	265.96	12.61	4.59	0.84
Erotic	406.51	298.32	320.08	284.82	305.91	<.001	.002	.502
Difference	45.92	11.48	28.77	14.69	39.96			
Cohen's d	0.23	0.06	0.15	0.07	0.20			
p value*	.301	1.000	.667	1.000	.016			
First fixation duration with influential outlier removed								
Non-erotic	330.35	286.84	291.31	270.13	265.96	11.12	2.32	0.75
Erotic	365.70	298.32	320.08	284.82	305.91	<.001	.063	.556
Difference	35.35	11.48	28.77	14.69	39.96			
Cohen's d	0.18	0.06	0.15	0.08	0.21			
p value*	.790	1.00	.590	1.00	.011			
Total fixation duration								
Non-erotic	4216.06	3873.08	4138.54	3110.31	3325.66	448.56	2.10	80.52
Erotic	4652.98	4347.80	4483.67	5264.26	5341.99	<.001	.087	<.001
Difference	436.92	474.72	345.13	2153.95	2016.33			
Cohen's d	0.31	0.33	0.24	1.51	1.41			
p value*	.028	<.001	.027	<.001	<.001			
Total fixation count						*p*	*p*	*p*
Non-erotic	10.29	10.67	10.57	9.09	8.96	290.17	1.55	65.54
Erotic	10.74	11.69	11.28	14.20	13.62	<.001	.193	<.001
Difference	0.45	1.02	0.70	5.11	4.66			
Cohen's d	0.12	0.27	0.19	1.35	1.23			
p value*	1.000	.002	.189	<.001	<.001			
Sexual attraction rating								
Non-erotic	0.96	0.28	0.32	1.52	2.07	1242.75	97.22	409.55
Erotic	0.95	0.64	0.83	5.12	6.46	<.001	<.001	<.001
Difference	−0.01	0.36	0.51	3.60	4.38			
Cohen's d	−0.01	0.22	0.31	2.16	2.62			
p value*	1.000	.003	<.001	<.001	<.001			

Note. All models had random subject intercepts.
* *p* values are Bonferroni adjusted (raw *p* values multiplied by 5)

difference for allosexual groups (p's < .001). This difference was not significantly different between heterosexual men and women.

Similar results (main effect of image type qualified by interaction) were found for total number of fixations. Pairwise comparisons indicated that both heterosexual men and women fixated more times on erotic images than on non-erotic ones. Among asexual participants, this difference was only significant for asexual women and was about five times smaller than for heterosexual participants. Examination of the interaction contrasts revealed that the difference between erotic and non-erotic images in the total number of fixations for the three asexual groups was similar (not significantly different) but it was significantly lower than the same difference for either heterosexual men or women (p's < .001). This difference was not significantly different between heterosexual men and women.

Post-Stimulus Sexual Attraction Ratings

There were significant main effects of image (erotic images rated higher on sexual attractiveness than non-erotic ones) and of group (heterosexual men scoring higher than all other groups and heterosexual women scoring higher than asexual groups) which were qualified by a significant interaction between group and image type. Pairwise comparisons showed that all groups considered erotic images to be more sexually attractive than non-erotic ones except for nonbinary asexual individuals for whom there was no difference. Examination of the interaction contrasts revealed that the difference between erotic and non-erotic images in sexual attractiveness ratings was greater for heterosexual men than for any other group (p's < .001) and was greater for heterosexual women than any of the asexual groups (p's < .001).

Gaze Predicting Sexual Attraction

Regression coefficients showing the strength of association between gaze variables and sexual attractiveness ratings are presented in Table 3. Time to first fixation significantly predicted sexual attractiveness ratings for heterosexual women and asexual men (shorter time to first fixation was associated with higher sexual attractiveness ratings). Examination of interaction effects showed that the regression coefficients for those two groups were significantly different from the regression coefficient for heterosexual men (which was in the positive direction, small, and non-significant). First fixation duration time did not predict sexual attraction for any of the groups, and there were no interaction effects. Total fixation duration significantly predicted sexual attractiveness ratings for heterosexual men, heterosexual women, and asexual nonbinary participants (higher total fixation duration was associated with higher sexual attractiveness ratings). Interaction effects indicated that the regression coefficients for heterosexual women and men were significantly larger than the coefficient for asexual women, which was small and non-significant. Finally, total fixation count significantly predicted sexual attraction for heterosexual women and men (higher fixation count was associated with higher attractiveness ratings) and did not reach significance for any of the asexual groups. There were no significant interaction effects indicating that, despite different significance patterns, there were no significant group differences in the association between fixation count and sexual attraction.

Discussion

Summary of Findings

This study was the first to assess group differences in the attentional processing of erotic stimuli between asexual (men, women, and nonbinary individuals) and allosexual (men and women) participants. Eye-tracking findings revealed that for four out of the five groups (i.e., asexual women, asexual nonbinary individuals, heterosexual men, and heterosexual women), initial attention was captured by the erotic images, as indicated by a faster time to first fixation on erotic images relative to non-erotic images. Asexual men were the only group to show no differences in their time to first fixation across erotic and non-erotic images. For controlled attention, all participants looked significantly longer at erotic images; however, that difference was approximately five times larger for allosexual than for asexual participants, indicating that the latter group distributed their visual attention more evenly across erotic and non-erotic images. Similar findings were revealed for the total number of fixations – asexual nonbinary and asexual women showed a similar number of total fixations across both types of images, while a much higher number of fixations for erotic images were recorded for heterosexual women and men. Self-reported attraction ratings for the experimental stimuli revealed that allosexual participants found erotic images more attractive relative to non-erotic images. Among asexual participants, such a difference was found for women and men but it was 9–10 times smaller than the same difference for allosexual participants. Examining group differences in the strength of the relationship between gaze variables and sexual attraction ratings revealed a complex pattern of differences between asexual and allosexual participants, with some indication of a stronger association between total fixation measures and sexual attraction for allosexual participants. Thus, despite the modest sample size and having relatively stringent effect size goals (i.e., medium size), clear group differences emerged for controlled attention.

Visual Attention Patterns

For initial attention, our findings for time to first fixation and first fixation duration did not support our hypotheses that relative to asexual participants, allosexual participants would more quickly orient to erotic images and show longer first durations for erotic images. We found that heterosexual men and women, as well as asexual women and asexual nonbinary individuals, all oriented more quickly to erotic images. Asexual men did not differ in their time to first fixation to erotic and non-erotic images. For first fixation duration, we found no group differences such that both asexual and allosexual groups exhibited longer first fixations for erotic compared to non-erotic images. An evolutionary perspective provides one explanation for the finding that initial attention appears to be automatically captured by erotic images for most individuals. It

seems plausible that evolutionary pressures would create attentional systems that are aptly suited to detecting sexual cues given that this would facilitate sexual response and potentially reproductive output (Imhoff et al., 2010; Redouté et al., 2000). Another possible explanation for our initial attention findings could be that despite the widespread accessibility of sexualized content, for most individuals, sexual content captures attention because it stands out relative to neutral content (Lykins et al., 2006). This novelty factor may have impacted the automatic allocation of attention. That is, most participants' first gaze landed on erotic images (i.e., attention was more quickly oriented toward erotic images relative to non-erotic images), and these images sustained initial attention across all groups as evidenced by longer first fixation durations on erotic images. Regarding the pattern of time to first fixation we observed for asexual men, it may be that the sample size hindered our ability to adequately detect differences in time to first fixation to the erotic image versus non-erotic image in this group. Taken together, our results suggest that salience of erotic images may automatically capture attention regardless of sexual interest and attraction.

For controlled attention, our findings supported our hypotheses such that allosexual participants looked more and had longer fixations on erotic images, whereas differences in responses to erotic vs. non-erotic images were significantly smaller for asexual participants. Our results corroborated Brown et al.'s (2021) finding that asexual participants had smaller dwell times on erotic images compared to heterosexual women with sexual difficulties. For allosexual participants, erotic images depicting sexual activity were far more salient than non-erotic images, consistent with previous research (Lykins et al., 2006). Such images may not have been motivationally salient enough for asexual individuals, resulting in a smaller difference with regard to the allocation of controlled attention on erotic versus non-erotic images.

Furthermore, prior eye-tracking research has suggested strong associations between controlled attention and self-reported sexual attraction ratings (Dawson & Chivers, 2016, 2018, 2019; Dawson et al., 2017). Among our sample, allosexual participants provided significantly higher sexual attraction ratings for erotic images compared to asexual participants. However, when we examined the association between visual attention and self-reported sexual attraction ratings, a complex pattern of findings emerged between asexual and allosexual participants. For initial attention, time to first fixation predicted attraction ratings for only two groups: heterosexual women and asexual men. For heterosexual women, it may be that factors such as sexual motivation influence implicit processing of sexual stimuli and result in quantitative differences between allosexual men and women. For example, research has shown that ratings of sexual disgust were negatively correlated with gaze times toward nude images in women but not in men (Bradley et al., 2015). It is interesting that asexual men's time to first fixation predicted attraction ratings given that they were the only group for whom time to first fixation did not significantly differ across erotic and non-erotic images. It may be that the small sample size (as previously discussed) and inflated Type I error may have influenced these findings; as such, caution must be taken when interpreting these results. For controlled attention, total fixation duration predicted attraction ratings for heterosexual men, heterosexual women, and asexual nonbinary individuals. These results provide support for the previously established relationship between visual attention to sexual cues and sexual attraction ratings or the motivation to attend to such cues for allosexual individuals (Dawson & Chivers, 2016). The asexual nonbinary participants also showed that these patterns of results should be further examined, given the small sample size for this group. The reasons why asexual men and women did not show this association also deserves further study.

Limitations and Future Directions

Despite our modest sample size, some clear differences emerged between the asexual and allosexual groups (e.g., controlled attention). We acknowledge that our study may have been underpowered to some degree given the small *n* in at least one group; however, the multi-level approach utilizing data from every trial likely compensated for any power limitation. While in-person recruitment of populations with low prevalence estimates may be a challenge, employing online gaze tracking methods may enable recruitment of larger and more diverse samples (i.e., across the ace umbrella) and be a fruitful avenue for future research examining visual attention patterns of asexual individuals.

Volunteers of sexuality studies typically report more positive sexual attitudes, less sexual guilt, more sexual experiences, and more exposure to erotic stimuli (Strassberg & Lowe, 1995). Although we acknowledge that the generalizability of our findings may be limited due to such volunteer bias, it should be noted that a recent study (Dawson et al., 2019) examining the effects of individual difference variables, including sexual orientation, on volunteer bias in sexuality research demonstrated no significant sexual attraction differences for willingness to volunteer.

Another limitation involves the use of stimuli depicting mostly Caucasian heteronormative targets. Although we used a stimulus set containing similar looking models across images to enhance study consistency, some asexual participants questioned our decision to do so and indicated that including stimuli that better reflect diversity (e.g., stimuli depicting nonbinary individuals, different ethnicities, same-sex couples) would have been more relevant and of interest to them. For example, our nonbinary participants may have felt that they were not represented in the portrayals. To draw more definitive conclusions about asexual individuals' visual attention patterns, future studies should not only include more inclusive and diverse samples (i.e., participants that represent identities across the asexual umbrella), but researchers should also include stimuli that better reflect diversity in such samples.

Some participants also reported being unsure about what was meant by "sexually attracted" during the post-stimulus sexual attraction rating task. While analyses excluding participants who explicitly reported confusion did not impact our results, we recognize that other asexual participants may have also felt similar confusion without explicitly reporting it to the researchers. Another limitation is that this study was limited to asexual and allosexual participants, and as such did not represent the full diversity of allosexual populations. Thus, future research, particularly those being included in other sexual

Table 3. Random coefficient analysis coefficients for gaze measures and gaze by group interaction predicting sexual attractiveness ratings of erotic images.

Gaze measure	*b*	*SE*	*p*	95% CI for *b*
Time to first fixation				
Asexual nonbinary	− .073 [a, c]	.107	.498	−0.28, 0.14
Asexual women	− .074 [a, c]	.056	.183	−0.18, 0.03
Asexual men	− .153 [b, c]	.067	.022*	−0.28, −0.02
Heterosexual women	− .126 [b, c]	.052	.015*	−0.23, −0.02
Heterosexual men	.044 [a]	.063	.485	−0.08, 0.17
First fixation duration				
Asexual nonbinary	.014	.250	.955	−0.48, 0.50
Asexual women	− .196	.317	.536	−0.82, 0.43
Asexual men	.159	.331	.632	−0.49, 0.81
Heterosexual women	− .406	.244	.097	−0.89, 0.07
Heterosexual men	.043	.237	.856	−0.42, 0.51
Total fixation duration				
Asexual nonbinary	.156 [a, c]	.076	.041*	0.01, 0.31
Asexual women	.039 [a]	.051	.443	−0.06, 0.14
Asexual men	.105 [a, c]	.060	.078	−0.01, 0.22
Heterosexual women	.225 [b, c]	.043	<.001***	0.14, 0.31
Heterosexual men	.242 [b, c]	.045	<.001***	0.15, 0.33
Total fixation count				
Asexual nonbinary	.036	.031	.245	−0.02, 0.10
Asexual women	.020	.018	.261	−0.01, 0.06
Asexual men	.027	.023	.238	−0.02, 0.07
Heterosexual women	.038	.014	.007**	0.01, 0.07
Heterosexual men	.058	.016	< .001***	0.03, 0.09

Note. CI = confidence interval; All models had random intercepts.
Timed gaze variables (the first three predictors) are expressed in seconds so the *b* coefficient expresses changes in sexual attractiveness rating for one second change in a gaze variable.
Significant interactions between group and gaze variable are expressed with superscript letters – coefficients which do not share the same letter superscript are significantly different at $p < .05$. Lack of superscripts indicates lack of significant interactions.
* $p < .05$, ** $p < .01$, *** $p < .001$.

minority populations, should critically explore the terminology used in questions and ensure that all questions/statements are understandable and relevant for the populations being examined.

Implications

Our findings add to the burgeoning field of asexuality research and provide further evidence that asexuality is distinct from allosexuality. Our visual attention findings revealed that while all participants preferentially gazed at erotic images relative to non-erotic images, the difference for asexual individuals was five times less. These data provide further support for asexual individuals' lack of sexual attraction to others, given that research suggests that controlled attention patterns to erotic stimuli are consistent with self-reported sexual attraction (Dawson & Chivers, 2016, 2018, 2019; reviewed in Milani et al., 2020). Our study replicates the previous eye-tracking study on a sample of asexual women (Brown et al., 2021) and adds to the body of literature demonstrating the relationship between controlled attention patterns and sexual attraction ratings.

That initial attention to erotic images did not differ as a function of sexual orientation suggests that automatic processing of erotic cues commands attentional resources, given that they are novel and salient relative to non-erotic cues. Controlled attention to erotic images differed as a function of sexual orientation – specifically in the magnitude of the differences observed – consistent with theoretical models of sexual response that posit that attention is allocated toward incentivized stimuli (Dewitte, 2016; Janssen et al., 2000; Toates, 2009). That is, erotic images likely communicate incentivized sexual information to allosexual individuals, and thus, capture and sustain their attention. Although erotic images also captured and sustained attention in asexual individuals, erotic images may lack incentivization to the same degree for asexual individuals relative to allosexual individuals and thus, a much smaller effect for controlled attention pattern for erotic versus non-erotic stimuli is observed. These findings add to the small but important body of literature investigating links between visual attention patterns and sexual attraction. For individuals who lack sexual attraction, erotic cues are not as incentivized and not as prioritized, consistent with theoretical models.

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References

Aguinis, H., Gottfredson, R. K., & Joo, H. (2013). Best-practice recommendations for defining, identifying, and handling outliers. *Organizational Research Methods*, *16*(2), 270–301. https://doi.org/10.1177/1094428112470848

Aicken, C. R. H., Mercer, C. H., & Cassell, J. A. (2013). Who reports absence of sexual attraction in Britain? Evidence from national probability surveys. *Psychology & Sexuality*, *4*(2), 121–135. https://doi.org/10.1080/19419899.2013.774161

American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.).

Antonsen, A. N., Zdaniuk, B., Yule, M., & Brotto, L. A. (2020). Ace and aro: Understanding differences in romantic attractions among persons identifying as asexual. *Archives of Sexual Behavior*, *49*(5), 1615–1630. https://doi.org/10.1007/s10508-019-01600-1

Bogaert, A. F. (2004). Asexuality: Prevalence and associated factors in a national probability sample. *The Journal of Sex Research*, *41*(3), 279–287. https://doi.org/10.1080/00224490409552235

Bogaert, A. F. (2015). Asexuality: What is it, and why it matters. *Annual Review of Sex Research*, *52*(4), 362–379. https://doi.org/10.1080/00224499.2015.1015713

Bradley, M. M., Costa, V. D., & Lang, P. J. (2015). Selective looking at natural scenes: Hedonic content and gender. *International Journal of Psychophysiology*, *98*(1), 54–58. https://doi.org/10.1016/j.ijpsycho.2015.06.008

Bradshaw, J., Brown, N., Kingstone, A., & Brotto, L. (2021). Asexuality vs. sexual interest/arousal disorder: Examining group differences in initial attention to sexual stimuli. *PLoS ONE*, *16*(12), e0261434. https://doi.org/10.1371/journal.pone.0261434

Brotto, L. A., Knudson, G., Inskip, J., Rhodes, K., & Erskine, Y. (2010). Asexuality: A mixed-methods approach. *Archives of Sexual Behavior*, *39*(3), 599–618. https://doi.org/10.1007/s10508-008-9434-x

Brotto, L. A., & Yule, M. A. (2017). Asexuality: Sexual orientation, paraphilia, sexual dysfunction, or none of the above? *Archives of Sexual Behavior*, *46*(3), 619–627. https://doi.org/10.1007/s10508-016-0802-7

Brown, N. B., Peragine, D., VanderLaan, D. P., Kingstone, A., & Brotto, L. A. (2021). Cognitive processing of sexual cues in asexual individuals and heterosexual women with desire/arousal difficulties. *PLOS ONE*, *15*(5), e0251074. https://doi.org/10.1371/journal.pone.0251074

Calvo, M. G., & Lang, P. J. (2004). Gaze patterns when looking at emotional pictures: Motivationally biased attention. *Motivation and Emotion*, *28*(3), 221–243. https://doi.org/10.1023/B:MOEM.0000040153.26156.ed

Carrigan, M. (2011). There's more to life than sex? Difference and commonality within the asexual community. *Sexualities*, *14*(4), 462–478. https://doi.org/10.1177/1363460711406462

Dawson, S. J., & Chivers, M. L. (2016). Gender-specificity of initial and controlled visual attention to sexual stimuli in androphilic women and gynephilic men. *PLOS ONE*, *11*(5), e0155651. https://doi.org/10.1371/journal.pone.0155651

Dawson, S. J., Fretz, K. M., & Chivers, M. L. (2017). Visual attention patterns of women with androphilic and gynephilic sexual attractions. *Archives of Sexual Behavior*, *46*(1), 141–153. https://doi.org/10.1007/s10508-016-0825-0

Dawson, S. J., & Chivers, M. L. (2018). The effect of static versus dynamic stimuli on visual processing of sexual cues in androphilic women and gynephilic men. *Royal Society Open Science*, *5*(6), 172286. http://dx.doi.org/10.1098/rsos.172286

Dawson, S. J., & Chivers, M. L. (2019). The effect of task demands on gender-specificity of attentional biases in androphilic women and gynephilic men. *Personality and Individual Differences*, *146*, 120–126. https://doi.org/10.1016/j.paid.2019.04.006

Dawson, S. J., Huberman, J. S., Bouchard, K. N., McInnis, M. K., Pukall, C. F., & Chivers, M. L. (2019). Effects of individual difference variables, gender, and exclusivity of sexual attraction on volunteer bias in sexuality research. *Archives of Sexual Behavior*, *48*(8), 2403–2417. https://doi.org/10.1007/s10508-019-1451-4

Derogatis, L., Clayton, A., Lewis-D'Agostino, D., Wunderlich, G., & Fu, Y. (2008). Validation of the Female Sexual Distress Scale – Revised for assessing distress in women with hypoactive sexual desire disorder. *The Journal of Sexual Medicine*, *5*(2), 357–364. https://doi.org/10.1111/j.1743-6109.2007.00672.x

Dewitte, M. (2016). Gender differences in implicit processing of sexual stimuli. *European Journal of Personality*, *30*(2), 107–124. https://doi.org/10.1002/per.2031

Fiedler, K., Kutzner, F., & Krueger, J. I. (2012). The long way from α-error control to validity proper: Problems with a short-sighted false-positive debate. *Perspectives on Psychological Science*, *7*(6), 661–669. https://doi.org/10.1177/1745691612462587

Henderson, J. M., & Hollingworth, A. (1999). High-level scene perception. *Annual Review of Psychology*, *50*(1), 243–271. https://doi.org/10.1146/annurev.psych.50.1.243

Henderson, J. M., Pollatsek, A., & Rayner, K. (1989). Covert visual attention and extrafoveal information use during object identification. *Perception & Psychophysics*, *45*(3), 196–208. https://doi.org/10.3758/BF03210697

Hermans, D., Vansteenwegen, D., & Eelen, P. (1999). Eye movement registration as a continuous index of attention deployment: Data from a group of spider anxious students. *Cognition & Emotions*, *13*(4), 419–434. https://doi.org/10.1080/026999399379249

Imhoff, R., Schmidt, A. F., Nordsiek, U., Luzar, C., Young, A. W., & Banse, R. (2010). Viewing time effects revisited: Prolonged response latencies for sexually attractive targets under restricted task conditions. *Archives of Sexual Behavior*, *39*(6), 1275–1288. https://doi.org/10.1007/s10508-009-9595-2

Jafari, M., & Ansari-Pour, N. (2019). Why, when and how to adjust your P values? *Cell Journal (Yakhteh)*, *20*(4), 604–607. https://doi.org/10.22074/cellj.2019.5992

Janssen, E., Everaerd, W., Spiering, M., & Janssen, J. (2000). Automatic processes and the appraisal of sexual stimuli: Toward an information processing model of sexual arousal. *The Journal of Sex Research*, *37*(1), 8–23. https://doi.org/10.1080/00224490009552016

Lykins, A. D., Meana, M., & Kambe, G. (2006). Detection of differential viewing patterns to erotic and non-erotic stimuli using eye-tracking methodology. *Archives of Sexual Behavior*, *35*(5), 569–575. https://doi.org/10.1007/s10508-006-9065-z

MacLeod, J., Stewart, B. M., Newman, A. J., & Arnell, K. M. (2017). Do emotion-induced blindness and the attentional blink share underlying mechanisms? An event-related potential study of emotionally-arousing words. *Cognitive, Affective, & Behavioral Neuroscience*, *17*(3), 592–611. https://doi.org/10.3758/s13415-017-0499-7

Milani, S., Moscovitz, A., & Dawson, S. J. (2020). *Gender and sexual attraction effects in visual attention to sexual cues* [Manuscript submitted for publication]. Department of Psychology, University of British Columbia.

Morandini, J. S., Veldre, A., Holcombe, A. O., Hsu, K., Lykins, A., Bailey, J. M., & Dar- Nimrod, I. (2019). Visual attention to sexual stimuli in mostly heterosexuals. *Archives of Sexual Behavior*, *48*(5), 1371–1385. https://doi.org/10.1007/s10508-019-1419-4

Morandini, J. S., Spence, B., Dar-Nimrod, I., & Lykins, A. D. (2020). Do bisexuals have a bisexual viewing pattern? *Archives of Sexual Behavior*, *49*(2), 489–502. https://doi.org/10.1007/s10508-019-01514-y

Redouté, J., Stoléru, S., Grégoire, M., Costes, N., Cinotti, L., Lavenne, F., Le Bars, D., Forest, M. G., & Pujol, J. (2000). Brain processing of visual sexual stimuli in human males. *Human Brain Mapping*, *11*(3), 162–177. https://doi.org/10.1002/1097-0193(200011)11:3<162::AID-HBM30>3.0.CO;2-A

Rieger, G., & Savin-Williams, R. C. (2012). The eyes have it: Sex and sexual orientation differences in pupil dilation patterns. *PLOS ONE*, *8*(8), e40256. https://doi.org/10.1371/journal.pone.0040256

Rohner, J. (2002). The time-course of visual threat processing: High trait anxious individuals eventually avert their gaze from angry faces. *Cognition and Emotion*, *16*(6), 837–844. https://doi.org/10.1080/02699930143000572

Santos-Iglesias, P., Mohamed, B., Danko, A., & Walker, L. M. (2018). Psychometric validation of the Female Sexual Distress Scale in male samples. *Archives of Sexual Behavior*, *47*(6), 1733–1743. https://doi.org/10.1007/s10508-018-1146-2

Scherrer, K. S. (2008). Coming to an asexual identity: Negotiating identity, negotiating desire. *Sexualities*, *11*(5), 621–641. https://doi.org/10.1177/1363460708094269

Strassberg, D. S., & Lowe, K. (1995). Volunteer bias in sexuality research. *Archives of Sexual Behavior*, *24*(4), 369–382. https://doi.org/10.1007/BF01541853

Toates, F. (2009). An integrative theoretical framework for understanding sexual motivation, arousal, and behavior. *The Journal of Sex Research*, *46*(2–3), 168–193. https://doi.org/10.1080/00224490902747768

Yule, M. A., Brotto, L. A., & Gorzalka, B. B. (2015). A validated measure of no sexual attraction: The Asexuality Identification Scale. *Psychological Assessment*, *27*(1), 148–160. https://doi.org/10.1037/a0038196

Zheng, L., & Su, Y. (2018). Patterns of asexuality in China: Sexual activity, sexual and romantic attraction, and sexual desire. *Archives of Sexual Behavior*, *47*(4), 1265–1276. https://doi.org/10.1007/s10508-018-1158-y