Automatic attention to sexual images of men and women in androphilic, ambiphilic, and gynephilic women.

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Abstract

Attentional resources might be automatically attracted to highly motivational stimuli such as a possible sexual partner. We tested whether attention would be automatically attracted to images of men vs women in women with a self-reported sexual attraction to men (androphilic), women (gynephilic) or to both men and women (ambiphilic) in a dot-probe paradigm. While androphilic women showed a small bias towards the male images, both ambiphilic and gynephilic women showed a strong bias towards the female images. The results show that these early automatic processes of attention are towards women in this sample of ambiphilic women and therefore inconsistent with their self-report sexual preferences.

Keywords: bisexual, ambiphilia, gynephilia, androphilia, spatial attention, dot-probe paradigm.

Automatic attention to sexual images of men and women in ambiphilia.

Many studies have now established that women's sexual reactions to various stimuli do not correspond very closely with their self-reported attractions (Chivers, 2017; Suschinsky, Dawson, & Chivers, 2017). The lack of correspondence may be due to different measures being reliant upon different stages of the sexual response. Several models of sexual response (Dewitte, 2016; Janssen, Everaerd, Spiering, & Janssen, 2000; Spiering, Everaerd, & Janssen, 2003) contain stages of both automatic processes and controlled processes. Self-report measures of sexual attraction are the end-product of these processes and are heavily reliant on controlled processes. However, other measures may be more reliant on the automatic early evaluation processes. Hence, it is possible that measures that rely more on these automatic processes may give a different picture of sexual attraction than self-report measures or other measures that rely on the controlled processing of the stimuli. In this paper we looked to see if women's automatic allocation of attention to images of men and women corresponds with their self-reported sexual preferences for androgenic (attraction to men), gynephilic (attraction to women) and ambiphilic (attraction to men and women) women.

Given that our sensory systems have a limited capacity to process information there is a need for them to be directed to stimuli that might be particularly important. So, for instance, we may choose to look at carefully and attend to something if we think it might attack us or be something we can eat. These attentional processes are also thought to be under the control of both automatic and controlled processes (Nakayama & Mackeben, 1989) and can be measured by the actual movement of the sensory organs (e.g., through overt eye movements) or through movements of attention without eye movements - covert attention (Posner & Petersen, 1990).

Stimuli that portray sexual content would, presumably, also be likely to attraction attention given their importance.

The dot-probe task aims to measure covert movement of attention. In a typical dot-probe paradigm two images are presented each side of a fixation mark, and then a target is presented at the location of one the images at the time of the removal of the images. The idea is that if attention has been attracted to one of the images more than the other then a target (a "dot-probe") appearing at this location would be better processed (e.g., faster reaction times and/or fewer errors) than a target appearing at the other location. The technique has been used to study sexual attraction. For instance, Prause, Janssen, and Hetrick (2008) compared sexual images to neutral images. They found that people were slower for targets appearing at the location of sexual image compared to the location of the neural image. This is the opposite of their prediction and what might be expected from the idea that sexual images attract attention. The reasons for this result are unknown but the authors speculate that the attention to the sexual images may have engaged the participant and left fewer resources available to process the target. Other studies have reported no significant bias either towards or away from sexual stimuli (Nolet, Emond, Pfaus, Gagnon, & Rouleau, 2021; Novák, Bártová, Vagenknecht, & Klapilová, 2020) while yet others have found the expected bias towards sexual stimuli though with small effect sizes (Brauer et al., 2012; Doornwaard, van den Eijnden, Johnson, & ter Bogt, 2014; Kagerer et al., 2014; Mechelmans et al., 2014; Pekal, Laier, Snagowski, Stark, & Brand, 2018).

While the study of Prause et al. (2008) and the others reviewed above compared images of sex to neutral stimuli, Snowden, Curl, Jobbins, Lavington, and Gray (2016) compared images of men to images of women. Heterosexual (gynephilic) men showed a strong dot-probe effect with faster reaction times to probes at the location of images of women compared to those at the

location of images of men. However, heterosexual (androphilic) women had similar reaction times to probes either location. The authors interpret their results in terms of the idea that the automatic sexual appraisals of gynephilic men are category-specific, whereas those of androphilic women are not category-specific and note the similarity of these results to those found in studies of genital responses (Chivers, Rieger, Latty, & Bailey, 2004). However, this study did not examine the response of non-heterosexual participants of either gender. It should be noted that the study of Ziogas, Habermeyer, Kawohl, Habermeyer, and Mokros (2021) also examined automatic spatial attention to images of men and women in both gynephilic and androphilic men and found no evidence for an attentional bias in either group.

Dawson, Fretz, and Chivers (2017) used a paradigm that has some resemblance to the dot-probe paradigm. Two images (one of a man and one of a woman) appeared simultaneously at either side of a fixation mark and they monitored overt eye movements in relation to these two stimuli. They found that androphilic women spent more time looking at the images of men which is in line with their self-reported attractions. However, their time taken to move the eyes was approximately equal whether this movement was to a male target or a female target and suggest this measure is reflective of more automatic processes. Again, these results point to the idea that in androphilic women the automatic sexual appraisals of a stimuli are category non-specific, while the more controlled processes are category-specific. The study of Dawson et al. (2017) also contained women that were not exclusively androphilic. Gynephilic women showed strong category-specific responses (supportive of attraction to women) for both their first fixation latencies and their total fixation duration. Ambiphilic women showed approximately equal total fixations times to images of men and women but faster latencies to images of women. So, for all

groups the time spent looking at the images was consistent with their self-reported attractions, but their latency to first fixation was only congruent with this in the gynephilic group.

While the study of Dawson et al. (2017) is important there are some limitations. First, the latency to first eye movement is necessarily a measure of automatic processes. Studies have shown that while the covert movement of attention is automatic, the overt movement of the eyes is not (though it is likely to be influenced by automatic processes – see Hunt, Reuther, Hilchey, & Klein, 2019). It is also noteworthy that the latencies to eye movements in their study was over 1000 ms. This is clearly long enough for controlled processes to have a strong influence, if not total control, of the movement (Müller & Rabbitt, 1989).

In the present study we have used the dot-probe paradigm to examine responses to sexual images in women with androphilic, ambiphilic, and gynephilic preferences according to their self-reported categorisation. The images used appeared only very briefly on the screen (200 ms) in an attempt to isolate early automatic evaluations of these stimuli. On the basis of our previous results and those of Dawson et al. (2017) we predicted that androphilic women would show approximately equal attraction to both men and women, whereas both ambiphilic and gynephilic women would show strong attractions to the images of women but not of men.

Methods

The study was conducted in two parts in order to obtain a large sample of women with a range of self-reported sexual orientations. All procedures for these experiments were given ethical permission from the Ethical Committee of the School of Psychology, **** University and the Ethical Committee of the Department of Psychology, **** University.

Participants.

The CU sample were recruited from a range of advertisements using Facebook and Twitter. We also handed out leaflets and recruited participants from various events including BiFest Wales, PrideCymru mardi gras, and the LGBT+ Society of **** University. We encouraged participants to inform their friends about the experiment. We did not advertise for one or more particular group of people or sexual interest but stressed that we were interested in human sexuality and that we wished to test people of all sexual interests. The leaflets/advertisements asked for participants willing to take part in our experiments. They stated that the experiments would involve images of a sexual nature and we would be asking them about their sexual interests and behaviors. People who agreed to be contacted gave contact details. They were then contacted to arrange a time to be tested. In all, 73 women were successfully recruited through this method. Their mean age was 24.2 (SD = 6.2, range 18 – 51) and with a mean Kinsey score (see below) of 2.5 (SD = 2.0 range 0 – 6). No other demographic information was taken.

The SU sample were recruited from a range of advertisements across the University campus and on using Facebook and Twitter. The leaflets/advertisements asked for participants willing to take part in our experiments. They stated that the experiments would involve images of a sexual nature, would involve the viewing of images of naked people, and we would be asking them about their sexual interests and behaviors. People who agreed to be contacted gave contact details. They were then contacted to arrange a time to be tested. In all, 96 women were successfully recruited through this method. Their mean age was 27.9 (SD = 9.8, range 18 – 56) and with a mean Kinsey score (see below) of 2.3 (SD = 2.3 range 0 – 6). No other demographic information was taken.

Procedures.

Before testing took place, participants were given a detailed information sheet that explained the nature of the experiments and questionnaires and that the data from the tasks would be kept confidentially. They were encouraged to ask questions about the tasks and procedures. They were allowed to see a sheet of paper on which all the stim They then signed a consent form. We then asked them to fill out the demographic questionnaire that included questions about how they described themselves in terms of their sexuality, the Kinsey scale (Kinsey, Pomeroy, & Martin, 1948), and a feeling thermometer about their sexual interests. Participants then completed a battery of tests that looked at different aspects of their sexuality and included both physiological recordings and behavioural tasks. The dot-probe task was completed as the last task in this series.

Stimuli and materials.

Kinsey Scale.

Sexual attraction was evaluated by a Kinsey scale with seven options. Option 0 was labelled as "*Exclusively attracted to the other gender",* option 3 was labelled as *"Equally attracted to both genders"* and option 6 was labelled as "*Exclusively attracted to the same gender*". The seventh option was an "*X*" and was labelled "*non-sexual or other*".

Feeling thermometer.

Direct ratings of feelings toward the construct pairs "sex with men" and "sex with women" were obtained using the feeling thermometer, which employs the heuristic of a thermometer. Participants rated feelings from "cold/unfavourable" at zero to "warm/ favourable" at one hundred by circling the appropriate number on the scale.

Dot Probe task

The dot-probe task was the same as that used by (Snowden et al., 2016). The participant's task was to identify the location (left vs. right) of a small faint test dot (1 cm diameter, grey

approximately 40 cd/m^2) on a white background (approximately 80 cd/m^2) that appeared after the cueing pictures. Each trial commenced with a fixation cross (1000 ms) in the middle of the screen. This was followed by the cue stimulus (200 ms). The cue always consisted of two images, for instance one of a woman and one of a man, each centred 12 cm from the middle of the screen. The cue was then replaced with the test stimuli (the dot) which was also centred 12 cm from the middle of the screen and remained until a response was made.

The stimuli used as cues consisted of eight pictures of men (all pictures were taken from the International Affective Picture System (IAPS: Lang, Bradley, & Cuthbert, 1997); IAPs nos.: 4460, 4470, 4490, 4503, 4520, 4534, 4550, 4561) and eight pictures of women (IAPs nos.: 4002, 4003, 4141, 4142, 4210, 4232, 4235, 4240). The pictures all depicted a single person either nude or partially dressed. We made an approximate attempt to match the pictures according to pose, ethnicity, etc. but no formal measurements were made. Images were presented in color.

To make the cues each of the eight male pictures was chosen in turn and a picture from the females was chosen as a foil. Foils were chosen to approximately match the male picture in terms of features such as the race of the person and their approximate pose. Cues were produced with the male on the left (and female on right), and with the male on the right (and female on left), resulting in 16 cues. The process was then repeated using the next best foil, so that we had a total of 32 cues.

The experiment consisted of 192 trials: 64 contained male vs female cues whose data are reported here. The experiment also had trails that compared male cues to neutral cues (64 trials), and female cues to neutral cues (64 trials). Data from these comparisons to neutral trials are not presented here for brevity but are available in the Supplementary materials. The target appears at either location on a random basis and the order of trials was randomised for each participant. Reaction times and errors were recorded.

Data Reduction. Trials on which errors occurred were removed but recorded. Four participants data were removed due to excessive error rates (> 25%). RTs less than 300 ms or greater than 1000 ms were removed then the mean RT for each of the conditions was calculated for each participant. The data from the RTs were inspected visually and appeared skewed so were transformed by a reciprocal transform. The transformed data showed no departure from a normal distribution (Kolmogorov-Smirnov) and were used for the statistical analyses. However, the raw data are used for the figures and tables. Given the small differences in the tasks between the two samples (and possible differences in the nature of the samples) we first performed tests with sample (CUvs SU) as a factor. However, no interactions involving this variable were found and so this was not included in the main analyses.

Results

Feeling Thermometer.

For the explicit ratings the data were bimodal and hence non-parametric statistics were used. No differences were found across the two samples and so only the combined data is reported. For the Feeling Thermometer, androphilic women gave more highly favourable ratings to sex with men than sex with women (95.6 vs 19.7; Z = 7.58, $p < .001$; $g = 4.12$) while gynephilic women showed the opposite bias (16.1 vs 90.9; Z = 5.16, $p < .001$; $g = 3.25$). The ambiphilic women showed slightly higher ratings to sex with men (82.7 vs 72.7; Z = 2.10, $p = .04$ (two-tailed); $g = 0.41$.

Dot Probe Task.

Data from one androphilic participant were corrupted and could not be used. Five participants were removed due to excessive error rates (> 25%).

The RT data are shown in Figure 1 (left panel). A two (target: target after male, target after female) by three (group: androphilic, ambiphilic, gynephilic) ANOVA showed no main

effect of group ($F(2, 160) = 1.58$, $p = .21$, $\eta_p^2 = .02$) but a main effect of target ($F(1, 160) = 83.74$, $p < .001$, $\eta_p^2 = .34$). This was modified by a significant interaction between group and target ($F(2, 160) = 9.52$, $p < .001$, $\eta_p^2 = .11$.

In order to understand this interaction, we calculated a bias towards women score as the RTs for the trials when the target appeared at the location of the male cue compared to when it appeared at the location of the female image (RT_{male}_RT_{female}) and these are plotted in Figure 1 (right panel). The score was significantly different from zero for all three groups (androphilic = 7.7 ms: $t(76) = 3.04$, $p = .003$, $d = 0.35$; ambiphilic = 39.8 ms: $t(42) = 5.98$, $p < .001$, $d = 0.75$; gynephilic = 45.7 ms: $t(42) = 5.40$, $p < .001$, $d = 0.73$). However, the size of this effect was smaller for the androphilic group in comparison to the amphiphilic group ($\Delta = 32.1$ ms: $t(118) = 4.11$, $p < .001$, $g = 0.78$) and in comparison to the gynephilic group ($\Delta = 38.0$ ms: $t(118) = 3.23$, $p = .002$, $g = 0.61$). The ambiphilic and gynephilic groups did not differ significantly ($\Delta = 5.9$ ms: $t(84) = 0.79$, $p = .43$, $g = 0.17$).

Reliability

The reliability of the dot-probe task was examined via a split-half reliability test. The trials were divided into odd and even trials and the bias scores were calculated for each set of trials. These scores were correlated ($r = 0.22$, $p = .005$) which translated to a reliability index of 0.36 after applying the Spearman-Brown formula for loss of trials due to splitting.

Discussion

The data clearly show a discord between the self-report ambiphilic women in terms of their explicit statement of approximately equal sexual attraction to men and women (with a slight preference towards men) and the automatic attraction of spatial attention which was strongly towards women.

Comparison to Previous Dot Probe Tasks

While the dot-probe task has been used extensively to examine automatic attention to sexual vs not-sexual images (see Strahler, Baranowski, Walter, Huebner, & Stark, 2019) there are few studies that have examined preferred vs non-preferred sexual stimuli (e.g., male vs female stimuli) and non that have examined this issue in non-androphilic women. In two studies, (Snowden et al., 2016) found that androphilic women either did not show any gender bias or a small bias (≈ 17 ms) towards female stimuli. However, the present study found a small bias (≈ 8 ms) towards male stimuli. Together these data suggest that any bias is small and might well depend upon the sample used. In contrast, both the ambiphilic and gynephilic women had a clear bias towards the female stimuli with medium to large effect sizes.

The dot-probe task aims to examine covert movements of attention. However, attention can also be inferred from the overt movements of the eye which were thought to be tightly linked to covert attention (e.g. Moore & Fallah, 2001), but more recent evidence is suggesting a looser connection (see Hunt & Kingstone, 2003; Li, Pan, & Carrasco, 2021). Some studies have presented two images (one of each gender) simultaneously in a paradigm that strongly resembles that of the dot-probe paradigm and examined patterns of eye-movements. For instance, Vásquez-Amézquita et al. (2019) showed that androphilic women's initial gaze direction was approximately equally distributed to either image whereas gynephilic women tended initially to fixate the female image (see also Dawson & Chivers, 2019; Dawson et al., 2017; Vásquez-Amézquita et al., 2018). Notably, these studies also found that a measure of "controlled attention" (the amount of time spent looking at each image) showed a different pattern of results with androphilic women spending more time looking at the male images, and gynephilic women looking more at the female images. The study of Dawson et al. (2017) also included a sample (n = 37) of ambiphilic women. Here the initial attention was towards the female stimuli (with a

large effect size). Hence, the results of these studies of initial eye-fixations are very consistent with the pattern of results presented here using the dot-probe paradigm.

Limitations and Future Directions.

The main limitation of the present study lies in the poor reliability of the dot-probe task. This appears to be a general problem for this paradigm rather than one confined to the measure of sexual attraction (Jones, Christiansen, & Field, 2018; Schmukle, 2005; Staugaard, 2009). This unreliability severely hampers any attempt to use such a paradigm as a test of an individual's status or change in such status (Price et al., 2015). It also means that the effect sizes we report here might well be much larger if the paradigm can be made to be more reliable (Parsons, Kruijt, & Fox, 2019). This area is being actively explored in terms of possible new scoring procedures (Evans & Britton, 2018; Price, Brown, & Siegle, 2019) and recommendations for the details of the task (Aday & Carlson, 2019).

The second limitation comes from the selection of the stimuli used as cues. For comparison purposes we chose to use the same cue stimuli for all three groups of women in the present study. However, it is possible that what is sexually attractive (in either a man or a woman) might differ as a function of sexual orientation. Bespoke studies using only images that are seen as attractive by the individual being tested may be warranted.

The present study chose to use a cue to target interval of 200 ms to isolate the early automatic components of visual attention. However, most studies using the dot-probe paradigm tend to use somewhat longer intervals (with 500 ms being the modal value). Further studies may wish to examine the importance of the cue to target interval and the possible later influence of more controlled processes with respect to attentional capture. Likewise, while we also used trials that contained neutral cues (see Supplemental Materials) we did not use a condition where both cues were neutral. Such trials have been used in previous research (not related to sexual

attraction) to examine whether the attentional effects are due to the fast capture of attention by the cue, or due to a slower disengagement from the cue (see Koster, Crombez, Verschuere, & De Houwer, 2004).

Author contributions.

Robert Snowden helped design the study, performed the statistical analysis, and contributed to the writing of the manuscript. Aimee McKinnon contributed to participant recruited, testing and data analysis, and commented on the manuscript. Nicola Gray helped design the study, contributed to participant recruitment and helped write the manuscript.

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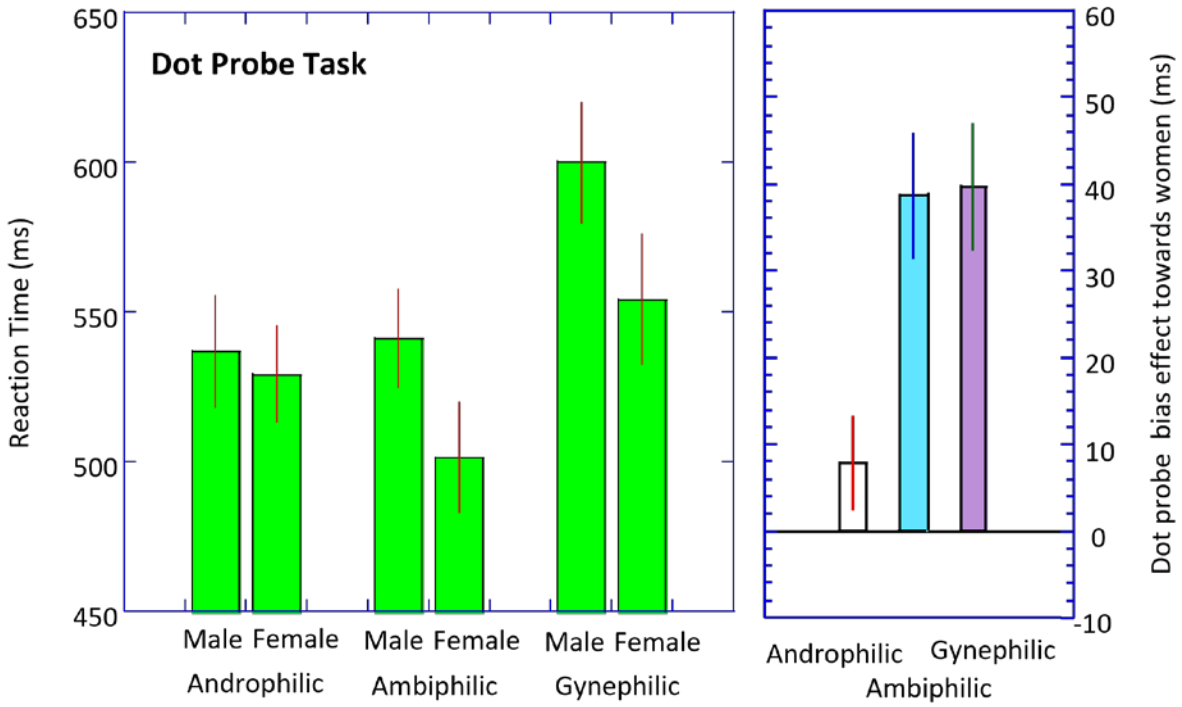
Figure 1. Left panel. Reaction times are plotted for targets appearing at the location of the male image and female image for the three groups. Error bars represent ± ! SEM. Right panel. Bias score towards women ($RT_{men} - RT_{women}$) are plotted for the three groups. Error bars represent ± ! SEM.



Supplemental Information

Figure. Left panel. Reaction times are plotted for targets appearing at the location of the male or female images, male or neutral images, and female or neutral images, for the three groups. Error bars represent ± ! SEM. Right panel. Bias scores towards the first category (female, make, female respectively) are plotted for the three groups. Error bars represent ± ! SEM.