

Implicit Sexual Associations in Heterosexual and Homosexual Women and Men

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Abstract Patterns of genital arousal to sexual stimuli are somewhat different between men and women. Heterosexual males and homosexual males show clear category specific arousal that is consistent with their self-reported sexual preference. However, heterosexual women do not show this category specificity. In the present study, we attempted to measure a person's automatic appraisals of stimuli with respect to the concept of sex via the use of implicit measures (the Implicit Association Test and the priming task). In three experiments, we showed that heterosexual females did not show a sex-related category specific response in favor of male versus female stimuli. However, this lack of specificity was not due to a lack of sex-related appraisals, but by equal appraisals of both male and female stimuli. On the other hand, heterosexual men, homosexual men, and homosexual women all showed automatic sex-related appraisals of stimuli that were category specific and in line with their self-reported sexual preference. The study shows difference in the pattern of sexual interest between genders at the earliest stages of the evaluation of a stimulus.

Keywords Sexual attraction · Implicit Association Test · Priming task · Gay men · Lesbians · Sexual orientation

Introduction

Sexual interest or attraction can be defined as the predisposition to respond to a certain category of stimulus (e.g., adult females)

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in a sexual manner. Sexual arousal typically refers to the pattern of physiological response to the stimulus, but can also encompass psychological and behavioral measures (e.g., Chivers, 2005). It is assumed that sexual arousal is related to sexual interest. Sexual orientation, on the other hand, describes a pattern of emotional, romantic, and/or sexual attractions to the opposite sex, the same sex, both, or neither. Sexual orientation also refers to a person's sense of personal and social identity based on those attractions and to the membership in a community of others who share them (e.g., Savin-Williams, 2006).

Patterns of sexual attraction appear to differ between men and women. For men, a strong negative correlation between other-sex attraction and same-sex attraction has been reported (Lippa, 2006; Lippa & Arad, 1997) and this category-specific attraction was heightened as a function of sex drive. Men with a high sex drive had an almost exclusive attraction to other-sex partners if heterosexual or same-sex partners if homosexual. Women reported a more bisexual pattern of attraction than men did and the strong negative correlation between other-sex and same-sex attraction was not found (Pattatucci & Hamer, 1995). Indeed, for women, a higher sex drive was associated with increased attraction to both sexes (Lippa, 2006). Women tend to be more flexible and variable in their sexual attraction than men (Baumeister, 2000; Diamond, 2003), though there is no significant difference in the rate of same-sex relationships between men and women (Laumann, Gagnon, Michael, & Michaels, 1994).

Genital arousal can be recorded via either measurement of penile tumescence (penile plethysmography, PPG) for males or via blood flow responses in the vagina via photoplethysmography. Genital responses to images of sexual activity are quite category specific for males. Chivers, Seto, and Blanchard (2007) showed that heterosexual men had the greatest response to female–female sex and the least to male–male sex. Homosexual men showed the opposite pattern of results. On the other hand, in contrast to their subjective reports, heterosexual women showed

little category specific sexual arousal to these stimuli. Chivers, Seto, Lalumiere, Laan, and Grimbos (2010) noted from a meta-analysis of over 100 studies that genital arousal and self-reported arousal are well correlated in males ($r = .66$), but much less correlated in females ($r = .26$). It is clear from these results that sexual arousal may not be a unitary concept in that the subjective report of arousal may differ from that measured via the physiological response of the genitals.

Arousal to a sexual stimulus can be seen as one point in a complex process of the evaluation of the stimulus. Janssen, Everaerd, Spiering, and Janssen (2000) have developed a conceptual model that contains both elements of the explicit and implicit processing of the stimuli. They noted that any stimulus undergoes automatic processing appraisal that may, or may not, lead to conscious awareness. This automatic appraisal involves mechanisms that give the stimulus emotional meaning and involves the processes of encoding and matching of stimuli in memory (such as the categorization of the stimulus as sexually attractive). The appraisal then leads to response generation that can lead to changes in attention, subjective experiences, and genital response. We note that other models, such as that of Singer (1984), also include an initial reaction to a stimulus that involves the automatic evaluation of the stimulus in terms of its sexual significance, followed by orienting, approach, and arousal.

Based on these ideas, researchers have developed measures that can appraise each of these stages. For instance, many studies have employed measures of attentional processes. One often used technique is that of viewing time (e.g., Abel, Huffman, Warberg, & Holland, 1998) where the time spent looking at particular pictures is used as a gauge of the person's sexual interest in them. It should be acknowledged that viewing time could also be affected by factors other than just sexual attraction.

The appraisal stage of the Janssen et al. model is clearly critical in understanding a person's sexual response to a stimulus as this appraisal stage governs later response generation. However, research into this appraisal stage is hampered by the automatic nature of the appraisal. The most commonly used technique to investigate this appraisal process is to ask for the person's self-report. However, it is now accepted that many functions that are automatic may not be available for our introspection. Further, in some instances, such as in cases of sexual deviance, the person may not report accurately their sexual appraisals. Some researchers have tried to examine the influence of this appraisal stage on later genital responses (e.g., Ponseti & Bosinski, 2010), but this relies on a chain of events that make the interpretation of these interesting results less clear cut.

Given the problems of possible lack of awareness and of possible dissimulation in other sensitive areas of psychological research, such as the measurement of racial attitudes, social psychologists have developed measures of cognition that use indirect or "implicit" techniques. For instance, the priming task, where the presentation of a priming stimulus influences the processing of a target stimulus, has been used to examine the automatic evaluation

of faces of different races (e.g., Fazio, Jackson, Dunton, & Williams, 1995). These methods have been applied to the field of sexual interest/attraction (e.g., Gray & Snowden, 2009; Snowden, Craig, & Gray, 2011).

Prominent among these methods is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). In the IAT, the participant must perform a dual classification task. For example, the participant has to classify pictures as either flowers or insects and words as either pleasant (e.g., "happy") or unpleasant (e.g., "cancer"). In one block of trials, the flower pictures and pleasant words share a response button (and the insect pictures and unpleasant words). On the next block of trials, the relationship is reversed (so that flowers and unpleasant are paired). If the concept of insect is associated with unpleasant in the mind of the participant, the presentation of the insect will cause a representation of both "insect" and "unpleasant" to be activated. If both of these activations lead to the same action (the pressing of the left button), performance should be fast and accurate. If the two representations lead to different actions (wanting to press both buttons), response competition occurs and performances deteriorate (it is slower and/or less accurate). Hence, the difference in performance between these blocks of trials gives us a measure of the extent to which two concepts are automatically associated in the mind of the person.

Snowden, Wichter, and Gray (2008) applied the IAT technique to the study of sexual attraction to stimuli. Male participants classified pictures as either male or female and words as either sexually-related or not sexually-related. Heterosexual men showed very different scores than homosexual men. Perhaps not surprisingly, they were fast when the concepts of sex and females were paired, while the homosexual men were fast when sex and male were paired. Indeed, the IAT could be used as an almost perfect predictor of the person's stated sexual orientation. The two groups' scores also differed markedly on a priming task that used the same stimuli. This provides face validity that these implicit techniques are able to measure the sex-related appraisal of the stimuli. Hence, we term the effects revealed by these implicit techniques as a "sex-related appraisal" of the stimulus. In the present study, we used these techniques to examine sex-related appraisal in a female sample.

As mentioned previously, there is good evidence that the sexual arousal of heterosexual women is not category specific when measured via physiological arousal. The picture for lesbians is less clear. Chivers, Rieger, Latty, and Bailey (2004) measured vaginal responses to male and female stimuli in both heterosexual and homosexual women. They found that responses occurred to both gender stimuli with approximately similar magnitude for both the heterosexual and the lesbian groups. Hence, the responses were not category specific for either group. This result appears to suggest the difference in category specificity is a male versus female difference. In support of this, they showed that male-to-female transsexuals showed a category specific response even though these individuals now defined themselves as female. On

the other hand, Chivers et al. (2007) found that lesbians showed a greater genital response to female nudes or to females masturbating than males doing the same activities. Hence, this study showed a category-specific pattern of arousal for lesbians. Rullo, Strassberg, and Israel (2010) used an implicit measure of sexual interest, how long the person viewed pictures of either sex, and found that both gay men and lesbian women showed category specific responses.

In Experiment 1, we attempted to examine the automatic sex-related appraisal of pictures of male and females using implicit techniques for female participants. Based on the work of Chivers et al. (2004, 2007), we predicted that heterosexual females would not show a strong category specific appraisal. While this is the prediction of a ‘null result,’ it can be contrasted with the very strong effects that are obtained for both heterosexual and homosexual men (Snowden et al., 2008). For the lesbian group, our predictions were less clear. The sex-related appraisal of a stimulus should have an influence on genital reactions and on measures of attention, yet the results from these two techniques have not always been in agreement. One explanation may lie in the idea that automatic and deliberative processes (or impulsive and reflective) are responsible for the two results. The automatic route appears to be important for initial genital reaction, while a deliberate route may govern reported sexual interest or observed sexual interest (via viewing time). Our implicit measures of cognition hope to measure this automatic appraisal of the stimuli. On the basis that category-specific responses have been found for lesbians (Chivers et al., 2007), we hypothesised that our results would also be indicative of category-specific sex-related appraisals.

Experiment 1: Sex/Gender in Heterosexual Females and Lesbians

Method

Participants

We recruited heterosexual females via the School of Psychology’s Participant panel, and homosexual women via the Gay and Lesbian Society at Cardiff University and through word of mouth. The advert to recruit these groups specifically asked for female participants who were homosexual (but did not exclude those who were bisexual). Participants were paid for their time.

A total of 55 participants completed a demographic information questionnaire detailing age, gender, and sexuality. Participants identified themselves as heterosexual or as lesbian using a scale created from the question “How would you identify your sexuality” with the responses “lesbian” and “heterosexual” as anchors to classify participants’ self-labelling of their sexual orientation. Using this method 36 women described themselves as heterosexual and 19 as lesbian. The mean age of the lesbian group was 23 years ($SD = 3.0$) and ranged between 18

and 30 years. The heterosexual group’s mean age was 21 years ($SD = 1.5$) and ranged between 18 and 23 years.

Measures

Feeling Thermometer Direct ratings of sexual interest in males and females were obtained via the use of a feeling thermometer. Participants were asked to rate their feelings towards the concept of “sex with men” by circling a number on a scale of 1–100, where 1 represents the concept of “cold/unfavorable” and 100 the concept of “warm/favorable.” A similar device was used to measure rating of the concept of “sex with women.”

Implicit Association Test The IAT requires the participant to categorise stimuli, via pressing one of two buttons, as they appear (one by one) on the computer screen. We represented the concept of “male” by the use of eight pictures of males and the concept “female” with eight pictures of females. As can be seen in Appendix 1, the pictures were of the head and torso of fully clothed individuals in the age range 20–40 years. In previous research, we have shown that deviant sex-related appraisals (relating to children and sex) could be elicited without the use of erotic or nude picture (where there are obvious ethical problems in using such images) (Brown, Gray, & Snowden, 2009) and we, therefore, wanted to establish that normal sex-related appraisals could also be found using stimuli where there are fewer ethical concerns. The pictures were chosen from a larger range taken from an online catalogue. The pictures were chosen because they received a rating of between 6 and 8 in a pilot experiments where they were rated on a scale of 1 (unattractive) to 10 (attractive) by 30 participants (15 male, 15 female). The concepts of “sexually attractive” and “sexually unattractive” were represented by words (see Appendix 1). As the IAT is thought to work at the level of categories rather than exemplars (De Houwer, 2001), we did not explicitly try to match the pictures or words on any other specific dimensions (e.g., frequency, color, etc.).

We used an IAT that contained only two stages. In the first stage, participants classified male pictures or sexually attractive words on the left button and female pictures or sexually unattractive words on the right button. Practice for this stage showed four randomly selected exemplars from each category once for a total of 16 presentations. Error feedback was given in the form of a red “X.” In the experimental stage, all 16 words and 16 pictures were presented in a random order for three blocks, creating a total of 96 presentations. No error feedback was given in the test stage. The second stage was identical save that the left button now represented female or sexually attractive, and the right button male or sexually unattractive.

Procedure

Participants read an information sheet that stated that they would be asked about their sexuality, that they would complete

two computer-based tasks that employed these stimuli (the pictures and words were presented below this) and that their details and results would be confidential. Following this, participants completed both explicit measures indicating their attitude towards the target concepts “sex with men” and “sex with women” by circling the appropriate numbers on the relevant feeling thermometer scales. The first sex/gender-IAT was then administered. After a short-break, half of the participants (randomly chosen) then were retested on the sex/gender-IAT in order to obtain a measure of the reliability of the test.

Data Reduction

We used the scoring method recommended by Greenwald, Nosek, and Banaji (2003). Errors within each IAT stage were penalized by substitution of error trial RTs with a score derived by adding a constant of 600 ms to the mean RT for that IAT stage. The final IAT score (D) was then calculated as the difference between the mean RTs for the initial and reversed IAT stage scores divided by the pooled SD for both stages. In our scale, sexual attraction to women produced a positive score and sexual attraction to men a negative score.

To make comparisons simple, we also produced a single score for the feeling thermometer by subtracting the scores for attraction to men from the scores for attraction to women; thus, someone who described sexual attraction to men as 100 and sexual attraction to women as 10 would get a score of -90 and someone who gave a sexual attraction to men a score of 20 and sexual attraction to women as 80 would receive a score of $+60$.¹

Results

The heterosexual women had negative score on the feeling thermometer ($M = -74.4$, $SD = 26.4$, range -20 to -100) and the lesbians had a positive score ($M = +73.7$, $SD = 22.6$, range $+20$ to $+100$). This difference was significant, $t(53) = 20.70$, $p < .001$, $d = 5.69$. There was no overlap in scores between the groups and all heterosexual women had a negative score (indicating greater sexual attraction to men) and all lesbians had a positive score (indicating greater sexual attraction to women).

Mean IAT scores are shown in Fig. 1 (left side). Both the heterosexual and the lesbian women gave positive scores that were indicative of sexual attraction to females. For the heterosexual women, the score was significantly different from zero

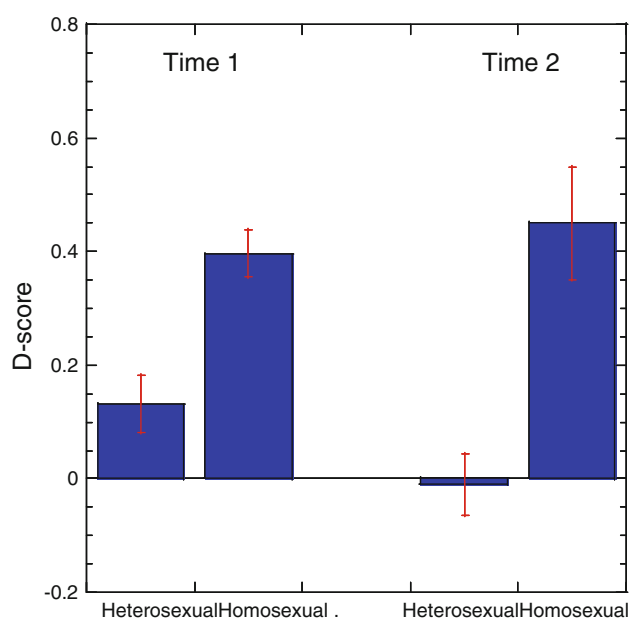


Fig. 1 Mean D -scores from the IAT in Experiment 1 are plotted for the heterosexual and lesbian women. Error bars represent ± 1 SEM

and had a small effect size, $t(36) = 2.68$, $p < .05$, $d = 0.45$. For the lesbian group, the effect was also significant and produced a very large effect size, $t(18) = 9.52$, $p < .001$, $d = 2.18$. The difference between the lesbian and heterosexual women’s scores was significant, $t(53) = 3.54$, $p < .001$, $d = 1.24$.

Correlations were then performed in order to test the relationship between the feeling thermometer and the IAT measures. Considering the whole sample, the feeling thermometer score was positively correlated with the IAT score, giving a moderate effect size, $r(53) = .45$, $p < .01$. For the heterosexual women alone, there was also a moderate and significant correlation, $r(34) = .30$, $p < .05$, but the correlation for the lesbian women was not significant, $r(17) = -.25$.

Data for the re-test are also shown in Fig. 1 (right). The pattern of results was similar to the first administration of the IAT in that the lesbian group produced a score illustrative of a sexual attraction to females, $t(9) = 4.51$, $p < .01$, $d = 1.43$. However, the heterosexual women did not show any significant result, $t(17) < 1$. The groups were statistically different, $t(26) = 4.47$, $p < .01$, $d = 1.70$. The test–retest correlation was strong, $r = .53$, $N = 28$, $p < .01$.

Discussion

The results indicate that heterosexual females have either a mild sexual attraction to women or no differential appraisal between male and females. The lesbian group showed clear category specific results indicative of attraction to females. Hence, our initial hypotheses were supported.

¹ It could be argued that sexual attraction is not on a bipolar scale as people can be attracted to both males and females. In places where we have used this composite analysis, we have also run analyses using the two concepts separately. The pattern of results reported was not substantially changed by this. Results are available from the corresponding author.

Experiment 2: A Comparison of Male Versus Female Sexual Associations

Snowden et al. (2008), using the sex/gender IAT, showed that heterosexual men had sex-related appraisals of female stimuli whereas homosexual men produced a score indicated of sex-related appraisals of male stimuli. Unfortunately, the present experiment using females and the previous one using males differed in various details. Perhaps the most striking of these differences was that Snowden et al.'s study used images that had erotic content, while the images used in Study 1 were not erotic (there were also some other minor differences in procedure). Hence, the differences between the studies may be due to the erotic content rather than the different gender groups. To test this notion, we attempted to replicate the findings of Study 1 in a further sample of females and to use exactly the same stimuli and procedures in a sample of males. We also took advantage of this new sample to extend our results to examine at whether these results would also be obtained in a different test of implicit cognition (a priming task).

Method

Participants

Participants were recruited as in Experiment 1 and were paid for their time. The sample consisted of 51 participants. Sexual orientation was determined as in Experiment 1. There were 18 heterosexual females (M age = 19.4 years, SD = 0.85), 18 were heterosexual males (M age = 20.0 years, SD = 1.27), 7 were homosexual females (M age = 20.4 years, SD = 1.27), and 8 were homosexual males (M age = 24.9 years, SD = 9.41).

Measuring

Implicit Association Task The IAT was an attempted replication of the IAT described in Experiment 1. Due to changes in equipment and software, there were slight differences. Of note, there was no feedback as to the correctness of the response on any trials. Further, we only used four of the eight exemplars of pictures and words in Fig. 1. Participants completed 16 practice trials and 96 experimental trials in each block (total of 32 practice and 192 experimental trials). For each group, half the participant completed the female-sex (male-not sex) block of trials first, while the others completed the male-sex (female-not sex) block of trials first.

Priming Task The priming task used the same stimuli (pictures and words) as the IAT. On each trial, a prime was presented (a picture of either a male or female face) for 200 ms, followed by a blank screen (20 ms). It should be noted that all primes were suprathreshold at this duration. The target word was then presented and remained until the participant responded. There was

a 2,000 ms interval between trials to make sure any priming had dissipated. The experiment consisted of 128 trials that were derived from eight pictures (four males, four females) being presented as primes to eight words (four sex, four not-sex) each presented twice. All trials types were randomly interleaved.

The participant's task was to classify each word as either "sexually attractive" (e.g., appealing) or "sexually unattractive" (e.g., repugnant) and to do this quickly while trying to avoid errors. They were told to ignore all the pictures.

To calculate the priming effect, the trials on which female pictures preceded sex words and male pictures preceded not sex words were combined to produce a "female sex-prime." A "male sex-prime" was calculated from the combined male-sex word and female-not sex words trials.²

Each participant completed the two implicit tasks, with the order (IAT vs. prime) counterbalanced across participants. As there are no published algorithms for producing a D -type score for the priming task, we decided to present the reaction times for the IAT task so that they could be easily compared to the priming task.³

Results

Implicit Association Test

The results from the IAT are shown in Fig. 2. A three-way ANOVA (gender, sexual orientation, and IAT condition) showed a significant interaction, $F(1, 47) = 47.5$, $p < .001$. To further understand this complex pattern of results, we performed a series of planned t -tests (based on our previous results). The heterosexual men were faster when the female, rather than male, pictures were paired with the sex words, $t(16) = 10.80$, $p < .001$; $d = 2.60$. The homosexual men were faster when the male pictures were paired with the sex words, $t(7) = 2.49$, $p < .05$; $d = 0.88$. The heterosexual women were slightly faster when the female pictures were paired with the sexual words, $t(17) = 2.19$, $p < .05$; $d = 0.52$. The lesbians were considerably faster when the female pictures were paired with the sexual words, $t(6) = 3.12$, $p < .05$; $d = 1.18$.

Priming Task

The results from the priming task are shown in Fig. 3. A three-way ANOVA (gender, sexual orientation, and IAT condition) showed a significant interaction, $F(1, 47) = 16.23$, $p < .001$. The

² We also performed a supplementary analysis using only the trials where sex words were presented and then divided as to whether they were preceded by a male or female prime. The pattern of results reported here was the same for both methods.

³ A supplementary analysis using the D -scoring algorithm confirms the pattern of results reported here for the IAT task.

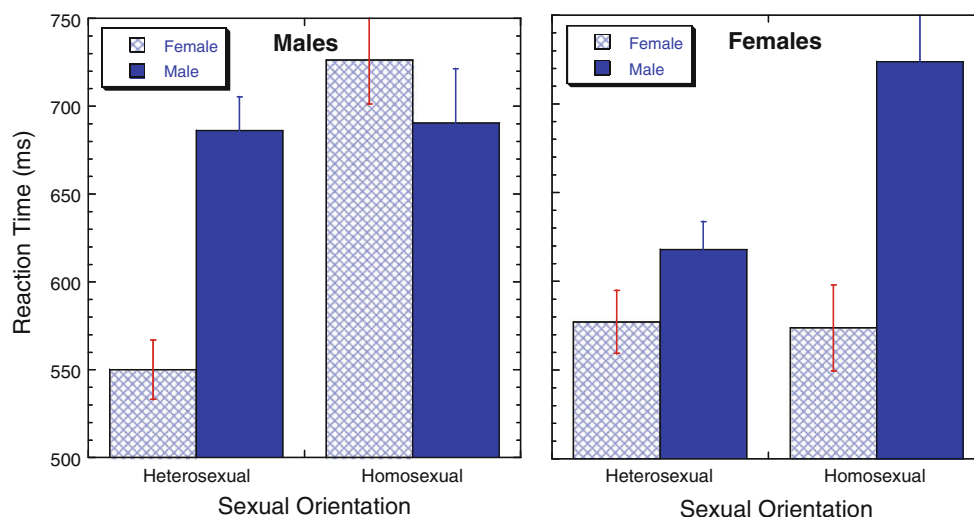


Fig. 2 Mean reaction times scores (ms) from the IAT in Experiment 2 are plotted for male participants (*left section*) and female participants (*right section*). *Light bars* represent trials on which females and sex shared a response button (and male-not sex the other button), while the

dark bars represent trials on which males and sex shared a response button (and female-not sex the other button). Error bars represent ± 1 SEM

heterosexual men were faster when the female, rather than male, pictures primed with the sex words, $t(17) = 4.09, p < .001; d = 0.96$. The homosexual men were faster when the male pictures primed the sex words, $t(7) = 2.80, p < .05; d = 0.99$. The heterosexual women did not differ in their RTs when primed with pictures from either gender, $t(18) < 1; d = 0.22$. The lesbian women were faster when the female pictures primed the sexual words, $t(6) = 2.42, p < .05; d = 0.92$.

Discussion

For the male participants, our results replicated those of Snowden et al. (2008) in showing category specific sex-related appraisal of the stimuli for both the IAT and the priming task. For the female participants, we were able to replicate the results of Experiment 1. We found either no category specific sex-related appraisal or a slight sex-women appraisal for heterosexual females. For the lesbian group, both tasks produced clear results indicative of category specific sex-related appraisal for female stimuli.

Experiment 3: Is a Lack of Gender Specific Female Sex Associations Due to Attraction to Neither or Both Genders?

Having established the lack of gender specific association to sex in heterosexual females, we next attempted to understand its origin. It seems possible that the lack of category specific response could occur because (1) there are sex-related appraisal of both the female and male stimuli, but these are of approximately similar magnitude and therefore no category specific effect is produced

or (2) females may show low sex interest overall (e.g., Petersen & Hyde, 2011) and neither the male nor the female stimuli evoke any sex-related appraisals. The data from studies of sexual arousal (e.g., Chivers et al., 2004, 2007) suggest that heterosexual females are aroused by both male and female images, rather than not aroused by either type of image.

We constructed IATs in which the concept of male was paired with “neutral” to see if the person would have greater sex-related appraisals to male stimuli than to a neutral concept. A similar IAT was constructed for the concept of female versus neutral. Our hypotheses, based on the findings of Chivers et al. (2004, 2007), were that males would show a strong sex-related appraisal for the female versus neutral task, but not for the male versus neutral task. For females, we predicted sex-related appraisal to both the male versus neutral and the female stimuli versus neutral tasks. We also used our usual sex/gender IAT to compare to these tasks.

Method

Participants and Procedure

Participants were recruited from the participant panel of the School of Psychology, Cardiff University. The advertisement asked for volunteers to participate in an experiment on sexual preferences and attitudes. All were paid or received course credit for their time. A total of 43 people volunteered (23 males). Self-reported sexual orientation was assessed via a simple 3-point scale (heterosexual, bisexual or homosexual). As this study was interested in heterosexual individuals, the data from six participants (four male) were excluded as they reported being bisexual

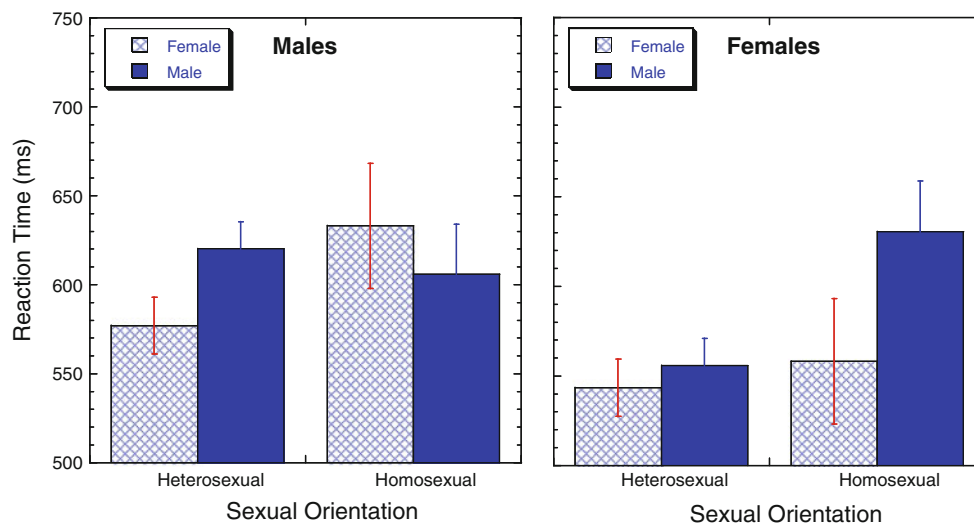


Fig. 3 Mean reaction times scores (ms) from the priming task in Experiment 2 are plotted for male participants (*left section*) and female participants (*right section*). *Light bars* represent trials on which females pictures preceded sex words (and male picture preceded not-sex words),

while the *dark bars* represent trials on males pictures preceded sex words (and female picture preceded not-sex words). Error bars represent ± 1 SEM

or homosexual. In addition, one participant decided to withdraw their data without any further explanation, and another was excluded due to too many invalid responses on the IAT, suggesting that they did not understand the task. Therefore, the final analysis used data from 17 females (M age = 20.2 years, $SD = 0.98$) and 18 males (M age = 20.8 years, $SD = 1.47$).

The sex/gender IAT was very similar to that used in Experiment 2, except that we used eight exemplars of each of the genders (which included those used in Experiment 2). Two novel IATs were constructed by replacing the female pictures by neutral pictures (to form a sex/male IAT) or by replacing the male pictures by neutral pictures (to form a sex/female IAT). The neutral pictures were chosen from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1997: picture numbers 1450, 1600, 1620, 1812, 5010, 7009, 7200, and 7211) for their approximately neutral valence, no obvious connection to the concepts of male or female, and low to moderate arousal levels, though no formal attempt was made to match these variables to the male or female pictures. For the sex/male IAT, participants were instructed to press the left button for male pictures or sex words and the other button of neutral pictures and not sex words, in one block of trials. On the other block of trials, these instructions were changed so that the male pictures and not sex words were paired (and therefore the neutral pictures and sex words were paired). The sex/female IAT was constructed in the same way.

All participants first completed the sex/gender IAT (with order of male-sex or female-sex as the first block of trials being counterbalanced). Half of the participants then completed the male-neutral sex IAT (the neutral-sex block of trials was always presented first within this IAT), followed by the female-neutral sex IAT, while the other half of the participants completed these in the reverse order.

In line with Experiment 1, the reaction times and errors were used to calculate a D -score for each of the participants for each of the IATs.

Results

The results are shown in Fig. 4. For the sex/gender IAT, we replicated our previous findings: performance was best for males when female and sex were paired, $t(17) = 4.43$, $p < .001$; $d = 1.05$. Females did not show any difference when male versus females were paired with sex words, $t(14) = < 1$; $d = -0.13$. The difference between male and female scores was significant, $t(31) = 3.29$, $p < .01$; $d = 1.16$.

For the sex/male IAT, males did not show a significant difference in performance when male or neutral stimuli were paired with the sex words, $t(17) = < 1$, $d = 0.03$. Females performed better when male pictures were paired with the sex words than when neutral pictures were paired with the sex words, $t(16) = 4.27$, $p < .01$; $d = 1.04$. This difference in scores between the genders was also significant, $t(33) = 3.42$, $p < .01$; $d = 1.16$.

For the sex/female IAT, we found that males now showed better performance when the female pictures were paired with the sex words, $t(17) = 8.36$, $p < .001$; $d = 1.97$. Females also performed better when female pictures were paired with the sex words, $t(16) = 3.55$, $p < .01$; $d = 0.86$. Despite the faster performance when female and sex were paired, the effect was larger in the male group, $t(33) = 3.40$, $p < .01$; $d = 1.15$.

Discussion

The results of Experiment 3 showed that males have a strong sex-related appraisal of pictures of females, but did not show any

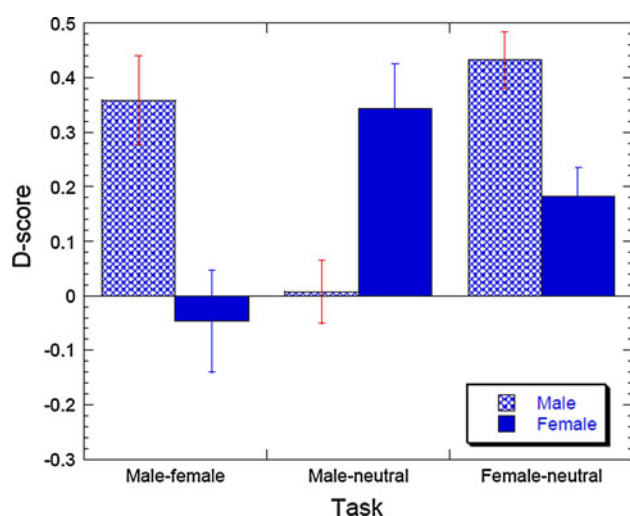


Fig. 4 D-scores from the IAT in Experiment 3 are plotted for the three tasks (male vs. female, male vs. neutral, and female vs. neutral). *Light bars* represent data from male participants and *dark bars* represent data from female participants. Error bars represent ± 1 SEM

sex-related appraisal of male stimuli over neutral stimuli. Again, this is evidence of a clear category specific attraction to female stimuli.

We aimed to see if females, who do not show category specificity on our sex-IAT (this was confirmed again in this experiment), would show no sex-related appraisal of either male or female stimuli or would show sex-related appraisal of both male and female stimuli. In line with our hypothesis, we found the latter result.

General Discussion

We used implicit measures to assess sex-related appraisals of gender. The three experiments appeared to present a clear pattern of results. Heterosexual men, gay men, and lesbian women showed a pattern of gender-specific sex-related appraisals that was consistent with their self-proclaimed sexual orientation and self-reported sexual interest. On the other hand, heterosexual women did not show a strong category gender-specific sex-related appraisal. Instead, they appeared to have sex-related appraisal of both male and female stimuli.

We have suggested that the indirect measures we used (IAT and priming) reflect an early, automatic evaluation of the stimuli in terms of a sex-related appraisal. According to theories such as Janssen et al. (2000), this appraisal can stimulate further actions, such as genital arousal and allocation of attention. Further, deliberative process may also occur and these could then alter this initial automatic evaluation. As such, we would expect the results from our study to mirror those that have used genital arousal or simple measures of early attention.

Studies of genital arousal are consistent in showing that males have a category specific response to their stated preferred stimuli

(e.g., adult females for heterosexual men), while heterosexual females do not show category specific responses. Indeed, they appear to have some arousal to both male and female stimuli (e.g., Chivers et al., 2004). Our study, which used a very different measure, was in agreement with these results. For lesbians, all our results were consistent with the notion of a category specific sex-related appraisal to female stimuli. Whether the genital arousal response of lesbians is category specific is less clear. Chivers et al. (2007) found a categorical response to video depictions of females undergoing a range of activities from nudes to having intercourse. Chivers et al. (2004) report that both heterosexual and lesbian women showed strong genital responses to depictions of both male and female sexual stimuli. However, it is noticeable in their data (see their Fig. 2) that the greatest genital response was to stimuli depicting female–female sex, therefore also suggesting a degree of category specificity to their stated preferred stimulus.

A common worry in experiments involving invasive techniques, such as PPG, to measure sexual response, and in particular those recruiting females, is that the sample is not representative of the general population. It has been shown that those who volunteer are more sexually experienced, have more liberal attitudes related to sex, and have more interest in sexually explicit materials than those who do not volunteer (Wolchik, Spencer, & Lisi, 1983). While we did not take any measures of this, it would seem likely that such volunteer bias is reduced (and possibly none existent) for these cognitive measures that are based on RTs. Our own experience is that no one who came to our laboratory for the study did not consent to take part. Likewise, everyone who started the study completed it, and none reported any distress or embarrassment related to the study. Hence, the use of indirect measures such as IAT may be far more acceptable to most people than those that directly measure sexual arousal.

What Causes Female Lack of Specificity?

It has been suggested that the female genital response may be overwhelmed by intense stimuli. Hence, experiments that use explicit films may produce a response no matter what the gender of the actors (e.g., Chivers et al., 2007) and, therefore, they appear as category non-specific. The stimuli we used could not be regarded as intense or explicit. As illustrated in Appendix 1, the stimuli were simply pictures of the heads of female and males. Therefore, we were able to show a lack of category specificity for heterosexual females at this “low intensity” level of the stimulus, though its intensity was enough to evoke category specific responses in males.

A second argument that has been suggested is that females identify more with the actors in such erotic films whereas men attend to the physical characteristics of the stimuli (Symons, 1979). Hence, females may be more aroused by films that allow themselves to identify with the actors and are, therefore, more aroused by films of female–female sex than of male–male sex (Chivers et al., 2004). Our paradigm(s), where the images of just

the head of a person is presented for a very brief time, would not seem to allow for this type of actor-identification mechanism to be used and it seems an unlikely explanation for the results found in the present study, though it may well influence experiments that use more lengthy depictions of characters.

Theories of female sexual ambiguity and malleability already exist. For example, Baumeister (2000) reviewed a large assortment of evidence to conclude that females have far greater erotic plasticity than males. He suggested several possible reasons for this, ranging from adaptations to superior male physical and political power, evolutionary pressures that lead males to seek many partners while women must evaluate partners more carefully (termed the centrality of female change from no to yes), and the idea that women have a milder sex drive than males. Our experiments did not address the reasons for the lack of category specificity in females, whether this is innate or learned, nor its relation to the notion of plasticity, malleability, or ambiguity.

Lesbians

It is possible to consider lesbians as either like heterosexual females but with a sexual attraction to females, or to consider them like more like heterosexual males. Bem (2000) advised “if you want to understand the sexuality of gay men, think of them as men; if you want to understand the sexuality of lesbians, think of them as women” (p. 544). The data from our studies disagree with the notion expressed by Bem and are suggestive that lesbians’ sex-related appraisals are similar to heterosexual males. Like heterosexual males, the lesbians showed an IAT indicative of a strong sexual bias towards females, rather than the category non-specificity of heterosexual females. This finding appears to agree with those produced by studies of genital arousal (Chivers et al., 2007), subjective sexual arousal (Chivers et al., 2004), and viewing times (Rullo et al., 2010). All these results point to lesbians showing a category specific response indicative of attraction to females. We note, however, that lesbians can differ in the stability of their identity (see Diamond, 2005) and further work is needed to examine the effect of temporal stability of sexual identity on these different measures of sexual attraction/appraisal.

Limitations

The major limitation of the present experiment(s) was that they cannot inform us as to whether a sex-related appraisal, as defined via the IAT or priming technique, to a specific gender is causal to a person’s sexual orientation, or whether the person’s sexual orientation and experiences are causal to the sex-related appraisals. Of course, this is also true of many other measures related to sexual arousal or sexual attraction. It would be of

interest to get an indication of at what stage of development these sex-related appraisals begin to occur and the extent to which these are part of a biologically defined program of development, or a consequence of the environment and social influences to which the child is subjected (e.g., Bem, 1996). Given that the IAT and related tests appear to be able to index such sex-related appraisals without recourse to the use of sexually explicit stimuli, they may well prove a valuable instrument with which to explore the development of sexual attraction.

In the present experiments, we used stimuli that lacked erotic or any sexually explicit content and still obtained clear evidence of sex-related appraisals. We note that the pattern of results, at least for males, appears similar to when we used erotic/naked images (Snowden et al., 2008). It would be of interest to see if females also maintain their category non-specific under conditions where the stimuli are more explicitly sexual. If our understanding of the IAT and priming task as indicators of early sex-related appraisals is correct, then we should expect a similar pattern of results, and, perhaps, even greater effects.

One possible problem with our results is that we (deliberately) did not counter-balance the order of the stages of presentation within the IAT. However, as noted in the Method section, any order effect should have served to produce a result that showed heterosexual females to be more attracted to men. Hence, our finding that they were not attracted to men (and may even have greater attraction to women) is not a confound of this order. For the lesbians, any effect of order should have been to lessen the magnitude of attraction to females. Hence, the finding of significant attraction to females comes despite this possible bias. We should also note that the IAT is only a relational measure. So, for instance, the strong associations between sex and women shown in the lesbian group could result from sexual attraction to women or sexual repulsiveness to men (or any combination). Further experimentation, including such techniques as single-category IATs (Karpinski & Steinman, 2006) or other implicit techniques (Nosek & Banaji, 2001), would be of value in assessing such issues.

Conclusion

Implicit measurements, such as the IAT and the priming task, appear to be able to measure automatic sex-related appraisals of a stimulus. The results suggested that heterosexual women showed sex-related appraisals to both male and female stimuli of similar magnitude and thus appeared category non-specific. On the other hand, lesbians and both straight and gay men show automatic sex-related appraisals consistent with their self-reported preferred stimulus. The different pattern of sexual associations across heterosexual men and gay men versus heterosexual women and lesbians suggest that that they are not merely ‘mirror images’ of each other, but may reflect the outcome of very different processes

(Baumeister, 2000; Udry & Chantala, 2006). Indirect measurements of sexual associations may well help in elucidating the processes by which sexual orientation is developed.

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Appendix 1

Words and pictures used in the experiments. In the experiments, these pictures appeared in color.

Sexually attractive	Sexually unattractive
Arousing	Forbidding
Erotic	Repulsive
Attractive	Disgusting
Stimulating	Repugnant
Sensual	Repellent
Exciting	Ugly
Appealing	Revolting
Sexy	Repelling

Males



Females



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