WHAT IS SEXUAL ORIENTATION AND HOW DOES IT WORK?

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WHAT IS SEXUAL ORIENTATION AND HOW DOES IT WORK?

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What is sexual orientation and how does it work? Despite the growth of a substantial research program in recent decades, basic questions remain about how sexual orientation is to be defined, what causes people to have different sexual orientations, and how sexual orientation varies between individuals and across different cultures. This dissertation addresses these questions from three different directions in three papers. The first paper examines the variability of sexual orientation across different degrees of bisexuality, and asks the question of whether the degree to which one is bisexual is associated with personality traits related to sexual openness. The paper presents data from two convenience samples gathered online in the Falls of 2010 and 2011, with sexual minorities over-sampled to achieve adequate statistical power over the entire Kinsey scale distribution. Study 1 found evidence that bisexuality was associated with elevated sexual sensation seeking and sexual excitability, and Study 2 found evidence for elevated sexual curiosity, and that this association was independent of the Big Five. The second paper examines whether the developmental contexts presented by different cultures lead to outcomes in sexual orientation and gender presentation. The paper presents data from field work conducted in the summer of 2015 in Mumbai, India, in which participants from three categories of sexual and gender minorities unique to India—hijra, kothi, and panthi—were interviewed about their sexual attractions, behavior, and gender atypicality. In addition, participants completed a computer-mediated image-rating task in which their viewing time of sexually attractive male and female swimsuit models was covertly measured. The third paper investigated whether sexual orientation "orients" the automatic capture of covert visual attention by images of nude men and women

presented briefly (100ms) in peripheral vision. Data was gathered in the Spring of 2011. The sample consisted of heterosexual, homosexual, and bisexual men and women (N = 78). We found that covert attention capture reflected the sexual orientation of heterosexual and homosexual men, bisexual men and women, and homosexual men. Heterosexual women, in contrast, had their attention captured by female images, contrary to their sexual orientation.

BIOGRAPHICAL SKETCH

Matthew Christian Stief was born in Martinez, California on February 13, 1983. He received his BA in 2005 in Anthropology from the University of California at Santa Cruz, and his MA in 2009 in Human Sexuality Studies from San Francisco State University.

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Thank you.

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STUDY #1

Bisexuality is associated with elevated sexual sensation seeking, sexual curiosity, and sexual excitability

Matthew C. Stief, Gerulf Rieger, & Ritch Savin-Williams

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Bisexuality is associated with elevated sexual sensation seeking, sexual curiosity, and sexual excitability

Abstract

Sexual orientation is typically assumed to be independent of factors such as personality. Although this is probably accurate for heterosexual and homosexual orientations, personality may play a role in bisexuality. It was hypothesized that bisexuality is potentiated by personality traits that allow sexual behavior to occur independently of sexual response systems that are specifically ‘‘oriented’’ to male or female sexual stimuli. If so, such traits should be elevated in bisexual women and men. Because female sexual response is relatively independent of the sex of the partner it was also hypothesized that such relationships would be stronger for bisexual women than bisexual men. This was tested in two online studies. Study 1 (N = 828) tested for elevated levels of two relevant personality traits; sexual sensation seeking and sexual excitability. Study 2 (N = 655) assessed sexual curiosity, and tested whether the relationship between sexual curiosity and bisexuality was independent of the Big Five. Elevated levels of sexual sensation seeking and sexual curiosity were found for bisexual women and men; only bisexual women reported elevated levels of sexual excitability. The predicted sex difference was found for each trait, and sexual curiosity was elevated independently of the Big Five.

Keywords: Bisexuality; Sexual orientation; Personality; Sexual sensation seeking; Sexual excitability; Sexual curiosity

Introduction

Sexual orientation is typically assumed to be uninfluenced by traits like personality. While some correlations between sexual orientation and personality have been found, researchers have typically assumed that such correlations are caused by a third variable, such as prenatal hormones (Lippa, 2005). This is probably accurate for heterosexuality and homosexuality, which a large body of evidence suggests is determined prenatally (Hines, 2011). Bisexuality, however, introduces a continuous dimension of variability that may be susceptible to influences like personality. The ratio of relative responsivity to male or female stimuli varies enormously between individuals (Laumann, Gagnon, Michael, & Michael, 1994), across time (Savin-Williams & Ream, 2007), and in different contexts (Diamond, 2008). Very little is known about what determines this variation. One possibility is that personality traits that influence the relative dominance of "oriented" and "unoriented" sexual response systems (Diamond, 2006; Diamond & Wallen, 2011) may move people toward or away from exclusive sexual orientations. In particular, personality traits associated with sexual novelty seeking may motivate bisexual behavior independently of an oriented erotic response. If so, elevated levels of such traits would push people toward the non-exclusive center of the sexual orientation continuum.

Personality and Sexual Orientation

Oriented systems are those that are sensitive to information about the sex of potential mates in sexual stimuli, and generate an excitatory response only to males or females. Such systems are particularly involved in approach motivation and behavior, and are called *proceptive* (Beach, 1976; Diamond, 2006; Wallen, 1990). Unoriented systems are those that generate an excitatory response to sexual stimuli regardless of the sex of the potential mate. Such systems are primarily involved in preparing the body for sexual intercourse, and are called *arousability*

(Beach, 1976; Diamond, 2006; Wallen, 1990). The two systems are neurologically and physiologically distinct (Agmo, 1999). Sexual orientation is most relevant to approach motivation in that initial approach is the first point at which the sex of potential mates is determined (Diamond, 2006; Diamond & Wallen, 2011). The arousability system primarily operates after sexual contact has been initiated, and therefore need not strongly distinguish between sexes (Diamond, 2006; Diamond & Wallen, 2011). Anything that allows sexual contact to occur independently of the proceptive system, therefore, should make bisexual behavior more likely.

Personality traits related to sexual novelty seeking may provide proceptivity-independent motivation. For people whose proceptive systems are primarily oriented toward one sex, sexual contact with the non-preferred sex will be novel. Supporting this possibility, heterosexual men with the long form of the dopamine D4 receptor gene, associated with novelty seeking, were five times more likely to have had sex with both men and women than those with the short form, and homosexual men with the long form had six times as many female sex partners (Hamer, 2002). A substantial body of research exists on sexual novelty-seeking (for a review see, Hoyle, Fejfar, & Miller, 2000). Most of this research has centered on a measure of sensation seeking adapted for research on sexuality termed sexual sensation seeking (Kalichman & Rompa, 1995). General sensation seeking is theorized to predict novel sexual behavior and sexually permissive attitudes (Zuckerman, 1994), and is correlated with number of unfamiliar sexual partners (Fisher & Misovich, 1990; Zuckerman & Kuhlman, 2000).

Based on these relationships, the Sexual Sensation Seeking Scale (Kalichman & Rompa, 1995) was developed to optimize the construct for the sexual domain. It successfully predicts behaviors related to sexual novelty-seeking such as extra-dyadic sexual behavior (Wiederman &

Hurd, 1999), number of 1-night stands (Gaither & Sellbom, 2003), the diversity of sexual images a person is willing to view (Gaither, Sellbom, & Meier, 2003), and anal sex in women (Gaither & Sellbom, 2003). Another approach to sexual novelty seeking is derived from Eysenck's system of attitudinal predispositions to sexuality, two factors of which (sexual curiosity and promiscuity) are relevant (Eysenck, 1970). Rieger et al. (2013) recently developed a "sexual curiosity" scale based on items from these factors that is conceptually similar to sexual sensation seeking. The two scales primarily differ in that they focus on behavioral and attitudinal tendencies, respectively. Despite this difference, Rieger et al. (2013) found that they were highly correlated (.72), and concluded that they likely tap the same underlying trait from complementary behavioral and attitudinal perspectives. Critically, both scales contain no items referring to the sex of potential mates, ensuring the non-triviality of any potential relationship with bisexuality.

It is also possible that the absolute sensitivity of the arousability system may make it more likely to operate independently of proceptivity. If such an effect exists, however, it is likely to be weaker than that of sexual novelty-seeking because it would not provide motivation for bisexual contact to occur. Self-report scales for the sensitivity of the arousability system have been developed to assess the sources of sexual dysfunction (Janssen, Vorst, Finn, & Bancroft, 2002). The most influential model in this area posits a dual-control model of sexual response consisting of interacting excitatory and inhibitory systems (Bancroft, 1999). The excitatory component of this model is conceptually identical to arousability, which was primarily developed in the context of animal sexual behavior (Beach, 1976). Bisexual women have been found to score higher on sexual excitability than heterosexual or homosexual women (Sanders, Graham, & Millhausen, 2008).

Each of these traits, sexual sensation seeking/sexual curiosity and sexual excitability, are therefore hypothesized to push people toward the bisexual center of the sexual orientation continuum. To test this, I predicted that bisexual men and women would show elevated levels of each these traits relative to people with heterosexual or homosexual orientations.

Sex Differences

Female sexual response has been shown to be consistently less dependent on the sex of the partner compared to men (Chivers, Rieger, Latty, & Bailey, 2004). Consistent with this, men experience consistently high proceptivity levels mediated by consistently high testosterone levels (Udry, 1988), while women experience cyclical proceptivity governed by hormones released during ovulation and possess a correspondingly independent arousability system (Diamond & Wallen, 2011; Penton-Voak & Perrett, 2000). Additionally, women report higher rates of bisexual behaviors and sexual attractions, and self-identify as bisexual at a greater rate than men (Laumann et al., 1994; Savin-Williams & Ream, 2007). Women's sexuality is also more likely to change over time (Diamond, 2008; Dickson, Paul, & Herbison, 2003). Taken together, these data suggest that female sexual orientation is less determined by prenatal factors, and more open to the potential influence of personality. Therefore, sexual sensation seeking, sexual excitability, and sexual curiosity were hypothesized to be more elevated in women than in men.

Role of the Big Five

Few studies relating the Big Five to sexual orientation have included bisexual samples. In one study, of the five major personality dimensions, extraversion had the largest and most consistent effect on sexuality, correlating with more sexual partners, more frequent sex, more diverse sexual behaviors, and higher sexual satisfaction (Barnes, Malamuth, & Check, 1984). It might, therefore, be expected to facilitate arousability. However, a different study using the five

major personality dimensions (Lippa, 2008) has found that bisexual women and homosexual men had elevated levels of neuroticism compared to heterosexual and homosexual women, and bisexual and heterosexual men, respectively. No other significant effects were found for the other five major dimensions, including extraversion. This is not surprising, because, although the major personality dimensions have a consistent effect on sexual attitudes (Eysenck, 1970), their effect on sexual behavior is weak (Heaven, Fitzpatrick, Craig, Kelly, & Sebar, 2000). Sexual sensation seeking has also been shown to have good discriminant validity relative to the Big Five, with a predictable pattern of weak or nonsignificant correlations (Gaither & Sellbom, 2003). Based on this reasoning, bisexuality's relationship with sexual sensation seeking/sexual curiosity and sexual excitability is predicted to be independent of the Big Five.

The Present Research

The present research consists of two studies using two independently gathered convenience samples recruited through online sources. Study 1 tested for elevated levels of sexual sensation seeking (Gaither & Sellbom, 2003) and sexual excitability (Janssen et al., 2002), and the predicted larger effect in bisexual women. Study 2 tested for elevated levels of sexual curiosity (Eysenck, 1970; Rieger et al., 2013), the independence of this effect from the Big Five, and the predicted sex difference.

Study 1.1

Method

Participants and procedure.

A total of 934 participants completed an online questionnaire. Eleven were removed for inconsistent answers and 95 did not complete items used in the analyses, resulting in a sample of 828. Participants were recruited through the websites Facebook and Craigslist in Fall 2011.

Sexual minority participants were also recruited through mailing lists for lesbian, gay, and bisexual students. Recruitment targeted sexual minorities in order to obtain an adequate sample size across the sexual orientation continuum. Participants had a chance to win one $100 and ten $10 prizes.

Half (48%) of participants were women. Ages ranged from 18 to 39. The mean age (with SD) was 23.47 (5.06). The most common ethnicities were Caucasian (65%), Asian/Pacific Islander (9%), Hispanic (9%), Mixed/Multi-racial (9%), and African American/Black (6%). Regarding sexual orientation identity, participants were asked "Which of the following best describes you?" The possible responses were "exclusively straight," "mostly straight," "bisexual," "mostly gay/lesbian," and "exclusively gay/lesbian." Percentages for each response were, respectively, 48%, 17%, 19%, 8%, 8% for women and 41%, 11%, 11%, 9%, 28% for men.

Measures.

Sexual orientation. Sexual orientation was measured using degrees of other-sex versus same-sex sexual attractions and fantasies. Participants indicated what percentage of their current sexual attractions was directed at males or females. The same question was asked for current sexual fantasies. Female and male percentages were forced to sum to 100. Same-sex attraction and fantasy were highly correlated for both men, $r(430) = .97$, $p < .001$, and women, $r(386) = .89$, $p < .001$. Sexual orientation was computed as the mean of same-sex attraction and fantasy percentages, resulting in a sexual orientation score ranging from zero (*exclusively heterosexual*) to 100 (*exclusively homosexual*). The continuous measure correlated strongly with sexual orientation identity for both men (See Table 1.1).

Table 1.1 *Summary of Intercorrelations, Means, and Standard Deviations for Sexual Orientation Identity, Sexual Orientation, Age, Sexual Sensation Seeking, and Sexual Excitability*

	1	2	3	4	5	*M* *(SD)*
1. SOID[a]	1	.90***	.24***	.09‡	.09‡	2.13 (1.31)
2. SO[b]	.96***	1	.25***	.13**	.09‡	31.92 (33.31)
3. Age	.15**	.19***	1	.26***	.15**	22.42 (4.25)
4. Sexual Sensation Seeking[c]	-.02	-.01	.32***	1	.53***	2.36 (.64)
5. Sexual Excitability[c]	.10*	.08	.11*	.37***	1	2.69 (.49)
M *(SD)*	2.73 (.49)	44.88 (43.62)	24.43 (5.53)	2.63 (.59)	2.85 (.52)	

Note. Female data are shown above the diagonal; male data are shown below the diagonal.
[a] Ranges from 1 (exclusively straight) to 5 (exclusively gay/lesbian).
[b] Ranges from 0 (exclusively heterosexual) to 100 (exclusively homosexual).
[c] Ranges from 1 (low) to 4 (high).
‡ p = .08 $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Sexual sensation seeking. Sexual sensation seeking was measured using a 10-item scale (Kalichman & Rompa, 1995). The scale (Kalichman & Rompa, 1995) demonstrated good test-retest reliability (.78) and internal consistency (.75). It also correlated strongly (.53) with a simultaneously developed sensation seeking scale stripped of sex-specific items (Kalichman & Rompa, 1995). Items are answered in a 4-point Likert scale from 1 (*not at all like me*) to 4 (*very much like me*). An example item is, "I like to have new and exciting sexual experiences and sensations." Scores were computed as the mean response. Cronbach's α for the current sample was .81 for men and .84 for women.

Sexual excitability. Sexual excitability was measured using the propensity for sexual excitation sub-scale of the Sexual Inhibition and Excitation Scale (Janssen et al., 2002). The

sub-scale consists of 6 items answered in a 4-point Likert scale from 1 (*strongly agree*) to 4 (*strongly disagree*). It differs from conceptually similar scales such as erotophobia-erotophilia (Fisher, Byrne, White, & Kelley, 1988) in that it focuses on self-reported physiological response rather than behavioral or attitudinal tendencies. An example item is, "When a sexually attractive stranger accidentally touches me, I easily become aroused." The sub-scale (Janssen et al., 2002) demonstrated good test-retest reliability (.76) and internal consistency (.89). Scores were computed as the mean response. Cronbach's α in the present sample was .76 for men and .71 for women.

Results

The hypothesis that bisexuality would be associated with elevated levels of sexual sensation seeking and sexual excitability was tested with hierarchical quadratic regression. An elevated level of a trait in bisexual participants is indicated by an inverted-U shape quadratic curve. If such an effect is present the quadratic coefficient should be significant and negative.

Table 1.2 presents the results of these models for both sexual sensation seeking and sexuality excitability. The predicted inverted-U shaped effect was found and was highly significant for both traits. Step 1 demonstrates the predicted quadratic relationships in the simplest models. Step 2 further tested the predicted relationship by adding sex and age as control variables. Controlling for sex and age strengthened the predicted quadratic effects of sexual orientation with sexual sensation seeking and sexual excitability.

Table 1.2 *Hierarchical Quadratic Regression Analyses Predicting Sexual Sensation Seeking and Sexual Excitability With Sexual Orientation and Controls*

	Sexual Sensation Seeking		Sexual Excitability	
	β	ΔR^2	β	ΔR^2
Step 1 – Basic Model		$.05^{***}$		$.02^{***}$
Sexual Orientation	$.27^{***}$		$.19^{***}$	
Sexual Orientation^2	$-.29^{***}$		$-.13^{**}$	
Step 2 - Controls		$.13^{***}$		$.04^{***}$
Sexual Orientation^2	$-.34^{***}$		$-.17^{***}$	
Sex[a]	$.24^{***}$		$.17^{***}$	
Age	$.24^{***}$		$.10^{**}$	
Step 3 – Interactions with Sex		$.01^{*}$		$.01^{*}$
Sexual Orientation^2	$-.32^{***}$		$-.17^{***}$	
Sex*Sexual Orientation	$-.10^{*}$		-.06	
Sex*Sexual Orientation^2	$.23^{**}$		$.22^{**}$	
Total R^2		$.19^{***}$		$.07^{***}$

Note. For brevity only the quadratic sexual orientation term is displayed in subsequent steps.
[a]Female = 0; Male = 1.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

The hypothesis that the inverted-U shaped relationships would be stronger in women, was tested in Step 3 by interacting sex and the quadratic effects. The hypothesis was confirmed for both traits. Sex differences were further investigated in separate analyses for women and men. For sexual sensation seeking, the quadratic term was significant for both women, $\beta = -.50$, $p < .001$, $\Delta R^2 = .12$, and men, $\beta = -.25$, $p < .001$, $\Delta R^2 = .05$, suggesting that the negative quadratic effect is present in both women and men, but larger in women. Figure 1 illustrates the quadratic relationships with sexual sensation seeking in women and men.

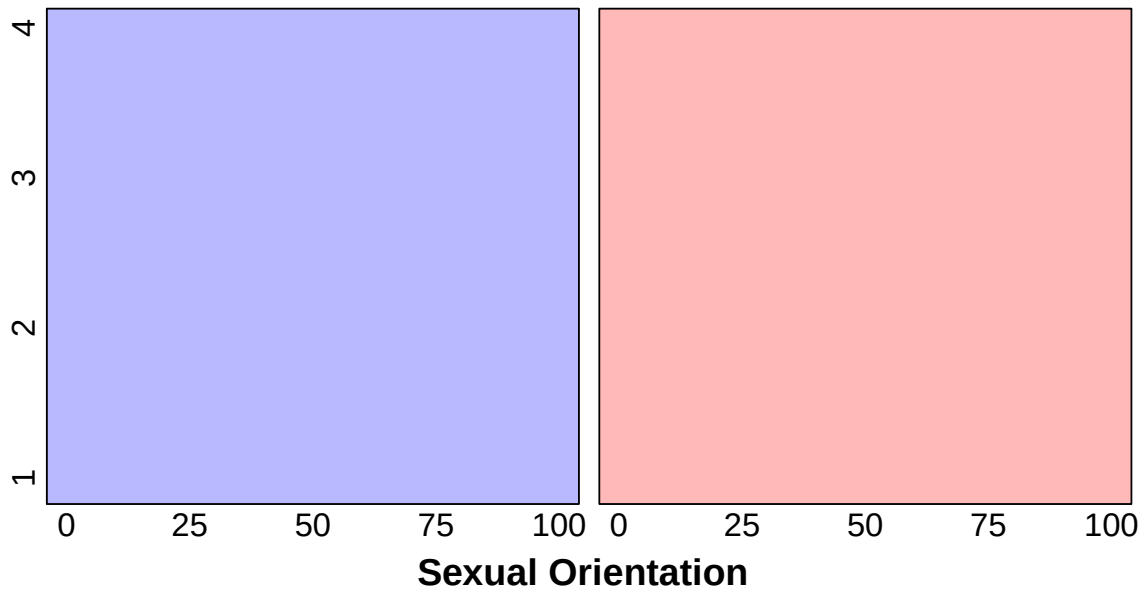

Figure 1.1. Inverted-U shape quadratic relationships between sexual orientation and sexual sensation seeking.

For sexual excitability, only the female model was significant, $p < .001$, $\beta = -.33$, $\Delta R^2 = .06$; the male model was in the predicted direction but did not reach significance, $p = .13$, $\beta = -.08$, $\Delta R^2 = .01$. Figure 1.2 illustrates the resulting significant quadratic relationship for women and the corresponding non-significant curve for men.

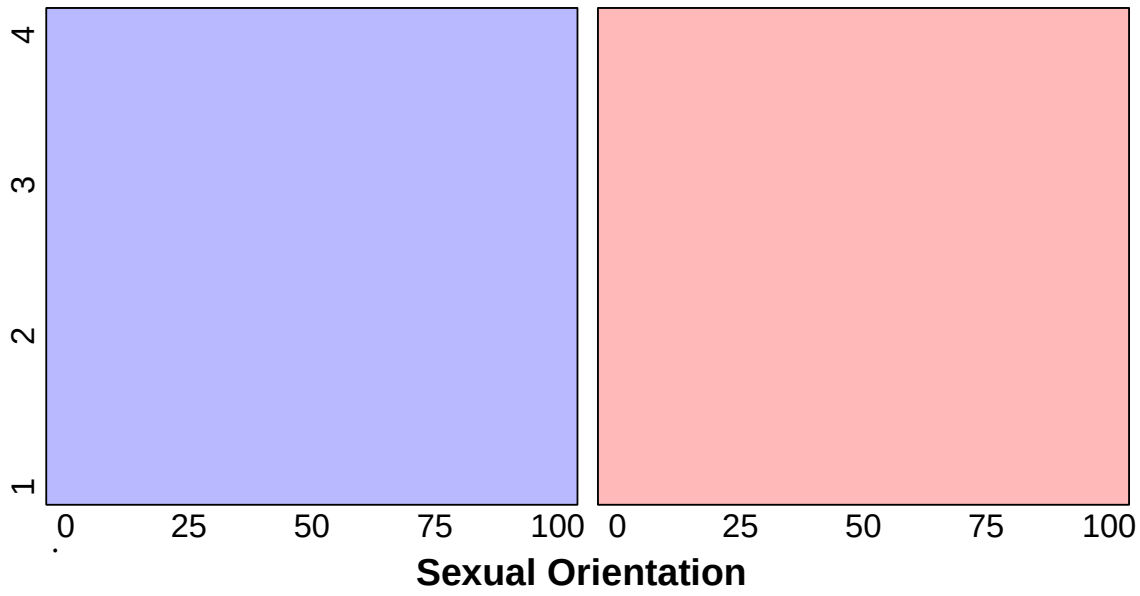

Figure 1.2. Inverted-U shape quadratic relationship between sexual orientation and sexual excitability for women and the corresponding non-significant curve for men.

Study 2 extends these results to sexual curiosity, a measure similar to sexual sensation seeking, but differing from it in focusing on attitudinal rather than behavioral tendencies. Study 2 also includes data on the Big Five, clarifying the relationship between the sexual curiosity, a trait specific to the domain of sexuality, and the five major personality dimensions.

Study 1.2

Method

Participants and procedure.

A total of 667 participants completed an online questionnaire. Eleven were removed for inconsistent answers, and 40 did not complete items used in the analyses, resulting in a final sample of 616. Participants were recruited through the websites Facebook and Craigslist in the Fall of 2010. Sexual-minority participants were also recruited through mailing lists for lesbian, gay, and bisexual students. Recruitment targeted sexual minorities in order to obtain an adequate sample size across the sexual orientation continuum.

Half (53%) of participants were women. Mean ages (with *SD*) were 24.6 (7.46) for men and 23.25 (6.00) for women. The most common ethnicities were Caucasian (58%), Asian/Pacific Islander (21%), Mixed/Multi-racial (11%), Hispanic (5%), and African American/Black (5%). Participants self-reported sexual orientation identity in a 7-point Kinsey scale from 0 (*exclusively straight*) to 6 (*exclusively gay*). Percentages for each response were, respectively, 38%, 12%, 6%, 7%, 6%, 11%, 19% for women, and 37%, 11%, 5%, 5%, 6%, 9%, 27% for men.

Measures.

Sexual orientation. Sexual orientation was measured as in Study 1. Same-sex attractions and fantasies were highly correlated for both men, $r(289) = .98$, $p < .001$, and women, $r(327) = .93$, $p < .001$. The resulting continuous sexual orientation measure also correlated strongly with self-reported sexual orientation for men (See Table 1.3).

Table 1.3 *Summary of Intercorrelations , Means, and Standard Deviations for Sexual Orientation Identity, Sexual Orientation, Age, Sexual Curiosity, and the Big Five*

	1	2	3	4	5	6	7	8	9	*M* (*SD*)
1. SOID[a]	1	.93	.04	.28***	-.03	.02	.06	-.02	.16**	4.11 (2.73)
2. SO[b]	.95***	1	.11*	.27***	-.04	.03	.06	.01	.13	41.37 (38.45)
3. Age	.04	.06	1	.07	-.00	.11	.07	-.07	.19**	23.16 (5.43)
4. Sexual Curiosity[c]	.20***	.20***	.15*	1	.24**	-.09	-.11	.04	.13ǂ	3.22 (1.38)
5. Extraversion[c]	.20**	.22**	-.17*	.01	1	.20**	-.04	-.11	.31***	4.49 (1.62)
6. Agreeableness[c]	.09	.09	.01	-.00	.05	1	.10	-.35***	.14*	5.11 (1.10)
7. Conscientiousness[c]	.07	.07	.04	-.11	.05	.19*	1	-.19**	.03	5.38 (1.21)
8. Neuroticism[c]	.09	.09	.01	.03	.00	-.34***	-.33***	1	-.13ǂ	3.52 (1.47)
9. Openness to Experience[c]	.05	.06	-.13	-.00	.19**	.07	.15*	-.15*	1	5.68 (1.11)
M (*SD*)		47.62 (42.99)	24.20 (6.34)	4.00 (1.27)	4.30 (1.60)	4.89 (1.14)	5.29 (1.21)	3.34 (1.39)	5.67 (1.04)	

Note. Female data are shown above the diagonal; male data are shown below the diagonal.
[a] Ranges from 1 (exclusively straight) to 9 (exclusively gay/lesbian).
[b] Ranges from 0 (exclusively heterosexual) to 100 (exclusively homosexual).
[c] Ranges from 1 (low) to 7 (high).
ǂ p = .07 * $p < .05$. ** $p < .01$. *** $p < .001$.

Sexual curiosity. Sexual curiosity was measured with a 10-item scale, using items adapted from the sexual curiosity and sexual promiscuity factors of the Inventory of Attitudes to Sex (Eysenck, 1970; Rieger, Rosenthal, Cash, Linsenmeier, Bailey, & Savin-Williams, 2013). Sexual curiosity is defined as an attitudinal tendency organized around a predisposition to seek out and respond favorably to sexual novelty (Rieger et al., 2013). Items are answered in a 7-point Likert scale from 1 (*strongly agree*) to 7 (*strongly disagree*). An example item is "If I were invited to an orgy, I would accept." Eysenck's treatment of sexual curiosity as an attitudinal tendency predated more recent work on the general curiosity trait construct, so external

correlations to conceptually related measures have not been performed (Kashdan et al., 2009). Addressing this lack, Rieger et al. (2013) found that sexual curiosity correlated most strongly with sexual sensation seeking (.73), and only moderately with non-sexual or general sensation seeking (.24) (Hoyle et al., 2002; Kalichman & Rompa, 1995). Correlations with two measures of general curiosity were also only moderate at .32 for the Curiosity and Exploration Inventory-II (Kashdan et al., 2009), and .33 for 10-item Curiosity/Interest in the World Scale (Peterson & Park, 2009). These data suggest that, despite its name, the sexual curiosity scale is probably broadly identical to sexual sensation seeking in tapping an underlying trait organized around responses to sexual novelty. Scores were computed as the mean response. Cronbach's α was .88 for men and .91 for women.

Big Five. The Big Five were measured using the Ten Item Personality Measure, developed to be brief yet maintain construct validity (Gosling, Rentfrow, & Swann, 2003). Items were answered in a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Each trait was measured using two items. Scores were computed as the mean response. Cronbach's αs were extraversion, .82, agreeableness, .37, conscientiousness, .62, neuroticism, .69, and openness to experience, .56. The low inter-item reliability for some traits is due to the use of minimally overlapping items in a short measure, which is necessary to capture the sub-factors of each trait as fully as possible (Gosling et al., 2003). Despite this, because agreeableness had such low internal consistency and is not theoretically relevant, it was not included in analyses.

Results

As in Study 1, hypotheses were tested using hierarchical quadratic regression analyses. Table 1.4 presents the results of these analyses.

Table 1.4 *Hierarchical Quadratic Regression Analyses Predicting Sexual Curiosity With Sexual Orientation and Controls*

	β	ΔR^2
Step 1 – Basic Model		.14***
Sexual Orientation	.34***	
Sexual Orientation^2	-.29***	
Step 2 – Controls		.11***
Sexual Orientation^2	-.35***	
Sex[a]	-.31***	
Age	.09**	
Step 3 – Big Five		.03*
Sexual Orientation^2	-.36***	
Extraversion	.13**	
Conscientiousness	-.09†	
Neuroticism	-.00	
Openness to Experience	.01	
Step 4 – Interactions with Sex		.00
Sexual Orientation^2	-.30***	
Sex*Sexual Orientation	.14	
Sex*Sexual Orientation^2	-.08	
Total R^2		.27***

Note. For brevity only the quadratic sexual orientation term is displayed in subsequent steps.
[a]Male = 0; Female = 1.
†$p = .054$. *$p < .05$. **$p < .01$. ***$p < .001$.

Step 1 confirms the quadratic relationship between sexual orientation and sexual curiosity. Step 2 further tests this effect by controlling for sex and age. The quadratic effect remained significant, and was strengthened, after the addition of the controls. Step 3 extended Study 1 by testing whether the relationship with sexual curiosity is independent of the five major personality dimensions. The quadratic effect was slightly weakened but remained highly significant.

Step 4 tested the predicted sex difference by interacting sex and the quadratic sexual orientation effect. Unlike in Study 1, the interaction was not significant. Sex differences were further investigated in separate analyses for women, β = -.44, $p < .001$, ΔR^2 = .15, and men, β = -.35, $p < .001$, ΔR^2 = .11. Figure 1.3 illustrates the resulting quadratic relationships. Note that despite the nonsignificant interaction with sex, the female model has a larger standardized coefficient and variance explained, consistent with the predicted sex difference.

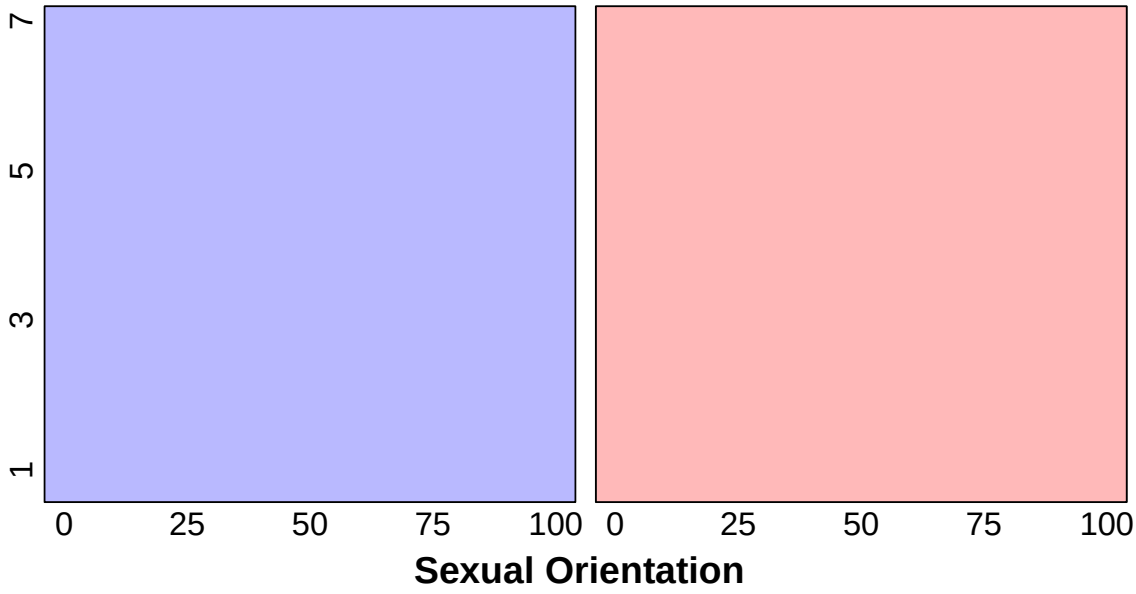

Figure 1.3 Inverted-U shape quadratic relationships between sexual curiosity and sexual orientation.

Discussion

The present research indicates that bisexuality is associated with elevated levels of three personality traits: sexual sensation seeking, sexual curiosity, and sexual excitability. Findings were strongest for traits that motivate novel sexual behavior—sexual sensation seeking and

sexual curiosity. Bisexual participants had higher levels of both sexual sensation seeking and sexual curiosity than heterosexual and homosexual participants. In contrast, only bisexual women had elevated levels of sexual excitability. A consistent pattern of evidence was found that these effects were larger in women. Although sex differences were not significant for sexual curiosity, separate male and female analyses showed that in the female model standardized regression coefficients were larger for the female sample, consistent with the proposed sex difference. Finally, the relationship between bisexuality and sexual curiosity, a trait specific to the sexuality domain, was independent of the Big Five.

These data support a view of sexual orientation emphasizing the interaction of multiple factors. Although this is typically assumed for any psychological process, in the case of sexual orientation factors other than prenatal androgens have largely been ignored in modern research. Although it is clear that prenatal organizational effects are important determinants of sexual orientation, the impracticality of research on human perinatal neural development makes post-natal development an important area of inquiry. The present findings suggest that personality may be a source of such post-natal factors.

While the present research suggests the existence of arousability-driven bisexuality, there is also evidence that proceptivity-driven bisexuality exists. Recent research has documented for the first time a sample of men who self-identify as bisexual and exhibit genital arousal to both males and females elevated beyond that of self-identified heterosexual and homosexual men (Rosenthal, Sylva, Safron, & Bailey, 2011). However, previous genital arousal studies are more consistent with arousability-driven bisexuality. Rieger et al. (2005) found that bisexual men showed genital response patterns that were, as a whole, indistinguishable from those of heterosexual and homosexual men (Rieger, Bailey, & Chivers, 2005; Tollison, Adams, &

Tollison, 1979). The more recent study differed from previous studies in using more stringent inclusion criteria, including extended sexual relationships with both males and females (Rosenthal et al., 2011). The failure to detect strong bisexual arousal to erotic video stimuli in a laboratory setting may have resulted from a sampling strategy that drew from a broad population of self-identified bisexual men consisting of different types. Laboratory studies using video stimuli are particularly well suited to elicit a response in the proceptive system because proceptivity needs to be sensitive to such stimuli in order to reliably generate approach motivation toward the reproductively appropriate target. Studies using video stimuli are unlikely to to detect those whose capacity for bisexual response depends on tactile stimuli.

Limitations and Future Research

However, this is not the only possible interpretation of the present results. An additional possibility is that the association between bisexuality and elevated levels of sexual sensation seeking, sexual curiosity, and sexual excitability is driven by a failure to accurately measure bisexuality through self-report. This point relies on the distinction between sexual orientation, defined as a pattern of psychophysiological response to sexual stimuli (Bailey, 2009), and the self-perception or self-report of sexual orientation (Cass, 1996). Rather than influence bisexual responsivity, and thus sexual orientation, personality may make people more likely to inaccurately report bisexual attractions and fantasies. Recent work by Preciado and Peplau (2011) has found that heterosexual women with lower need for structure were more likely to report a capacity for bisexual behavior and desire. They suggest that need for structure influences the way that people interpret ambiguous arousal states, with people low in need for structure being more likely to attribute arousal in a way discordant with their heterosexual self-concept. People may also be more likely to report non-exclusive sexual attractions and fantasies

because they view them as being consistent with self-concepts of sexual sensation seeking, sexual curiosity, or sexual excitability. A converse scenario is also possible. People whose bisexuality is driven by proceptivity may develop sexual self-schema based on their bisexual experience (Anderson & Cyranowski, 1994) that is consistent with elevated scores on sexual sensation seeking, sexual curiosity, and sexual excitability.

The evidence currently available is unable to distinguish between these possiblities. The issue is further complicated by the possibility that self-perception and past experience may itself influence sexual response. For example, a low need for structure may potentiate independently functioning arousability by decreasing motivation to reconcile arousability-derived sexual arousal with a self-concept based on the orientation of the proceptive system. Additionally, arousability-driven bisexual experience may spark a feedback loop of positive conditioning, leading to a distinct pattern of sexual responsivity in adulthood (Hoffman, 2012). Such a scenario is suggested by a recent finding that bisexual men had uniquely elevated genital arousal to video pornography of a bisexual "three-way," something that should be unique to their sexual history (Cerny & Janssen, 2011). It is also possible that a common etiological factor underlies both bisexuality and personality. Recalling this possibility, recent work suggests that a common genetic factor underlies both nonheterosexuality and personality traits associated with psychiatric vulnerability (Zietsch, Verweij, Bailey, Wright, & Martin, 2011; Zietsch et al., 2012). Although this work has focused on psychopathology, it is possible that nonclinical traits associated with sexual nonexclusivity show a similar pattern.

The present research is obviously unable to address this complicated set of possiblities. Future research will have to distinguish between self-report and non-self-report measures of sexual orientation, using measures such as genital arousal (Rieger et al., 2005), pupil dilation

(Rieger & Savin-Williams, 2012), and viewing time (Lippa, 2013). The relevance of arousability and proceptivity would be more firmly supported by assessing traits such as sexual excitability directly using similar psychophysiological measures, and by relating personality to the context-dependent variability typical of sexual fluidity in women (Diamond, 2006). A more systematic investigation of an array of related personality traits may also reveal fruitful relationships. Research associating genetics and heritability with both sexual orientation and personality traits is also indicated. Although much work remains to be done, the present research suggests that such a research program is likely to yield important results, particularly in terms of how individual differences in personality relate to how people experience and describe their sexual orientation.

STUDY #2

The sexual orientation and gender presentation of *hijra*, *kothi*, and *panthi* in Mumbai, India

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The sexual orientation and gender presentation of *hijra*, *kothi*, and *panthi* in Mumbai, India

Abstract

Cultural categories related to sexuality and gender vary considerably cross-culturally. While Western cultures categorize people primarily in terms of sexual attractions (i.e. gay, straight, bisexual), many cultures distinguish between groups based on additional issues such as gender role presentation and position preference in anal sex (i.e. insertive/receptive). The current study gathered data on three categories of natal males in Mumbai, India – *hijra*, *kothi*, and *panthi* (N = 93). *Hijra* are androphilic (sexually attracted to adult men), typically sexually receptive, transgender, sometimes castrated, and live in fictive kinship networks that are hierarchically organized. *Kothi* are also androphilic, typically sexual receptive and relatively feminine but less so than *hijra*; unlike *hijra*, *kothi* are never castrated. *Hijra* and *kothi* were understood by some participants to be mutually compatible, and so three groups were identified – those endorsing *hijra* only (n = 11), *kothi* only (n = 22), and both *hijra* and *kothi* (n = 22). *Panthi* (n = 38) are the masculine insertive partners of *hijra* and *kothi*. Measures employed were self-report and viewing time measures of sexual attraction, sexual behavior and position preference, self-described masculinity/femininity, recalled childhood gender atypicality, gendered occupational preferences, and gender presentation milestones (i.e. wearing female clothes, castration). All *hijra* and *kothi* groups were found to be exclusively androphilic in viewing time and self-reported sexual attractions, and to be gender-atypical on all measures. *Panthi* were found to be relatively male-typical and to have a bisexual pattern of viewing time and self-reported sexual attractions. *Kothi* were found to be less extreme in their female-typicality and to report less female gender presentation milestones than *hijra* or *hijra*/*kothi*. Most *hijra* and *hijra*/*kothi* and all *kothi* said that they were not castrated. Contrary to the manner in which they are socially defined, a third of

panthi report having been receptive in anal sex, and a third of all *hijra* and *kothi* groups report having been insertive at some time.

Keywords: Sexual Orientation; Sexual Identity; Gender Atypicality; India; *Hijra*; *Kothi*; *Panthi*

Introduction

Sexual orientation is often said to be socially constructed (Stein, 1990). Exactly what is meant by this varies, but a common argument is that the idea of sexual orientation was created by cultural/social/historic forces that are "irreducibly particular" to a specific time and place (Halperin, 1995). For the homosexual this time and place is Western Europe and the United States from the 18th century to the present (Foucault, 1979). In this view it makes no sense to talk about homosexuality in ancient Greece or modern Papua New Guinea because a homosexual is, by definition, a person living in the modern West (McIntosh, 1968), or in a globalized cultural sphere emanating from the West (Altman, 1996). The alternative view is dubbed "essentialism," or the idea that sexual orientations consist of invariable "essences" regardless of culture (Norton, 1997; Stein, 1990).

In contrast, an influential trend in recent psychological science defines sexual orientation as a pattern of psychophysiological reactivity to male or female sexual stimuli, with an emphasis on genital arousal (e.g. Bailey, 2009), but including other domains such as pupil dilation (e.g. Rieger & Savin-Williams, 2012; Rieger et al., 2015), and neural activity (e.g. Poepple, Langguth, Rupprecht, & Laird, 2016), as well as cognitive-behavioral measures like viewing time (e.g. Israel & Strassberg, 2009). This approach allows for a defensible version of essentialism, where the psychophysiological *trait* sexual orientation is distinguished from the *expression* of that trait in terms of behavior, the *identities* assigned to those possessing that trait by the self and others, and the *meanings* associated with the trait in a particular culture.

Sexual Orientation across Cultures

This definition of sexual orientation allows us to discuss the sexual orientations of people who live in cultures where sexuality is organized very differently. One of the most prominent such cross-cultural differences is the extent that natal male *androphilia* (predominant sexual attraction and arousal to adult males) is linked to gender role enactment. In the West, natal male androphilia is typically *sex-gender congruent*, meaning that natal males whose sexual orientation is androphilic usually occupy the gender-role typical of their sex, and their androphilia is understood to be consistent with a male-typical gender role (VanderLaan, Ren, & Vasey, 2013). In contrast, in many cultures worldwide natal male androphilia takes a *transgendered* form, in which natal male androphiles adopt a highly feminine gender role and are sometimes identified as a "third gender" that is distinct from the categories of "men" and "women" (Herdt, 1996). Examples of such third-gender categories are numerous, and a non-exhaustive list include *hijra* in India (Nanda, 1990; Reddy, 2005), *fa'afafine* in Samoa (Vasey & Bartlett, 2007), *kathoey* in Thailand (Jackson, 2003), *waria* in Indonesia (Boellstorff, 2003), *bakla* in the Phillipines (Manalansan, 2003), and *muxes* in the Yucatan (Chiñas, 1992).

While most cross-cultural research on sexuality is anthropological, a growing psychological literature has recently emerged, driven mainly by work out of Paul Vasey's lab at the University of Lethbridge in Canada, which focuses on the transgender natal male androphiles of Samoa called fa'afafine (reviewed in Vasey & VanderLaan, 2014), as well as their cisgender male partners (Petterson, Dixson, Little, & Vasey, 2015, 2016). This literature is informed, in part, by the prenatal hormone theory of sexual orientation, which proposes that heterosexual attraction is part of a sex-typical psychophysiological and behavioral phenotype (Arnold, 2009). Sex-atypical non-heterosexual attractions are hypothesized to result from variation in androgen

levels during a critical period of fetal neurodevelopment when the basis for these adult sex differences are being established (Boa & Swaab, 2011).

One of the major predictions of the prenatal hormone theory is that sex-atypical sexual attractions will be accompanied by other types of sex-atypical behavior and cognition, reflecting altered sexual differentiation of areas of the brain other than those responsible for sexual attraction and arousal (Boa & Swaab, 2011). Confirming this prediction, on average natal male androphiles have been found to be more gender-atypical than their heterosexual peers on gender diagnosticity measures such as self-described masculinity and femininity (Lippa, 2000), gendered occupational preferences (Lippa, 2005), recalled childhood behavior (Bailey & Zucker, 1995; Cardoso, 2005; 2009; Whitam, 1980), and childhood separation anxiety (Vasey, Gothreau, Bartlett, & Vasey, 2011). Recall-based findings have been strengthened by prospective studies showing that gender nonconforming male children were more likely to identify as homosexual in adulthood (Green, 1985; Singh, 2012), and by findings that independent raters viewing childhood home videos rated prehomosexual children significantly more gender nonconforming than preheterosexual children (Rieger, Linsenmeir, Gygax, & Bailey, 2008).

Cross-cultural research has replicated these findings. Gender-atypical self-described masculinity/femininity has been found for natal male androphiles in China (Zheng et al., 2011) and among Asian and Hispanic Americans in the United States (Lippa & Tan, 2001). Greater recalled childhood gender-atypicality has been found in Samoa (Bartlett & Vasey, 2006), Brazil (Cardoso, 2005; 2009; Whitam 1980), Guatemala (Whitam, 1980), the Phillipines (Whitam, 1980), Iran (Besharat, Karimi, & Saadati, 2016), Japan (Petterson, Wrightson, & Vasey, 2017), Turkey (Cardoso, 2009), and Thailand (Cardoso, 2009). Greater recalled childhood separation anxiety has been found in Samoa (Vasey, VanderLaan, Gothreau, & Bartlett, 2011). More female-

typical occupational preferences have been found in a cross-national sample of 53 countries (Lippa, 2010), as well as China (Zheng et al., 2011), and Samoa (Semenyna & Vasey, 2016).

The present study extends this research program to the Indian cultural context, where there are, among others, two prominent categories of natal male androphilia – *hijra* and *kothi* – and the category *panthi*, referring to their sexual and romantic partners. Simple definitions of these terms are elusive, and a detailed explanation follows.

Hijra

Hijra are a third-sex category similar to other such groups in many cultures (Boellstorff, 2003; Chiñas, 1992; Jackson, 2003; Manalansan, 2003; Vasey & Bartlett, 2007). *Hijra* exist throughout South Asia, including India (Nanda, 1990; Reddy, 2005), Bangladesh (Khan et al., 2009) and Pakistan (Kahn, Rehan, Qayyum, & Khan, 2008). The present study focuses on *hijra* living in Mumbai, India. It must be understood that, while a recognized part of Indian society, the social status of *hijra* is very low, and they are excluded from mainstream social and economic life (Khan et al., 2009). Though similar to other third-sex groups such as the Native American berdache in being understood to have the power to bless and curse (Callender & Kochems, 1983), for hijra this power does not convey elevated social status (Reddy, 2005, p. 13). *Hijra* are commonly expelled from their families at a young age, denied education, and most *hijra* are illiterate (Khan et al., 2009). *Hijra*, like other social groups in India, are associated with a traditional occupation, in this case ritualized dancing at weddings and births, as well as begging for donations from shop owners while offering blessings and threatening to curse (Nanda, 1990). *Hijra* are excluded from all other occupations, and the income from their traditional occupation is low and reported to be decreasing in recent years (Khan et al., 2009; Reddy, 2005, pp. 48-49).

As a result the large majority of *hijra* today are sex workers (Khan et al., 2009; Nanda, 1990, pp. 52-54; Reddy, 2005).

Indian society understands *hijra* to be born intersex and to be impotent and asexual, and this is believed to be the source of their power to bless and curse the fertility of others (Nanda, 1990). However, most Indians are mistaken in believing *hijra* to be intersex and asexual. Almost all *hijra* are born biologically male, and many *hijra* are sexually active, both in terms of sex work and in non-commercial relationships (Kalra & Shah, 2013; Nanda, 1990, pp. 122-125). However, this sexual activity is taboo. In order to realize the expectation that they will not have intact male genitals, *hijra* traditionally become castrated, however this practice is far from universal (Nanda, 1990, p. 14; Reddy, 2005, p. 72). Because sexual activity is in conflict with their traditional occupation, *hijra* that engage in sex work (i.e. most *hijra*) are regarded as lessened in status and compromised in their ability to bless and curse (Reddy, 2005, p. 15). Thus, while men who seek out sex with *hijra* do not face social sanction, the *hijra* themselves do (Reddy, 2005, p. 48). Despite this taboo, within their social networks *hijra* generally understand themselves to be androphilic, though senior *hijra* will often insist that *hijra* are asexual when speaking to outsiders (Reddy, 2005, p. 48).

When *hijra* are castrated it is usually after several years of formal participation in the *hijra* community (Nanda, 1990, p. 118). *Hijra*, who are typically estranged from their biological families, live in artificial kinship networks structured around the relationship between a senior *hijra* (or *guru*) who sponsors a young aspirant *hijra* (or *chela*) in their formal induction into the *hijra* community (Nanda, 1990, pp. 43-47). Castration is therefore related to seniority and status within these artificial kinship networks, which, in turn, is associated with increased financial

status. However, this elevation in status does not extend to society at large, where even senior and castrated *hijra* remain marginalized (Khan et al.,2009).

Kothi* and *Panthi

Hijra are part of a larger system of gender-atypical natal male androphiles that are referred to using a variety of terms, with substantial regional variation (Boyce, 2007; Cohen, 1995; 2005; Nanda, 1990; Reddy, 2005). The most prominent of these terms is *kothi*. In her 2005 ethnography Gayatri Reddy describes a group of *hijra* who describe themselves as just one type of a broader category of gender atypical natal male androphiles that they termed *kothi* (Reddy, 2005, p. 33). In the words of one of Reddy's (2005) *hijra* participants: "All of us are *kothi*s, and our husbands are *panthi* (p. 46) and "Like in any family, there are different children who do different things, it is like that with us. All *kothi*s belong to one family, but we are also each of us different at the same time" (p. 52). The extent that this understanding extends to other regions in India is unclear, however, and it has been argued that *kothi* is increasingly coming to be understood as an identity category distinct from *hijra* (Boyce, 2007, p. 196). A related term, *panthi*, simultaneously refers to all masculine men, and specifically to the masculine sex partners of *hijra* and *kothi* (Reddy, 2005, p. 46).

Unlike *hijra*, the terms *kothi* and *panthi* are not widely understood in South Asian society as referring to types of natal male androphiles (Reddy, 2005, p. 45). Rather, as they are generally used *kothi* and *panthi* have meanings comparable to "sissy" or "butch" in American English, though even these senses are not universally understood in all regions and communities. However, in recent decades communities of natal male androphiles in India have come to self-identify using them, and their meaning in this sense is understood in many parts of India within

these communities (Boyce, 2007; Cohen, 2005). Cohen (2005) and Boyce (2007) argue that *kothi* and *panthi* have come to form an identity category that developed in response to public health efforts that have target "men who have sex with men" in India as vectors of HIV/AIDS transmission." Cohen (2005) states that: "in years of conversations with numerous men who have sex with men, no one in memory ever uttered the words *kothi* or *panthi* until the mid 1990s" (p. 272). However, use the term has spread and it is now widely used as an identity term (Boyce, 2007; Reddy, 2005).

Given this background, assigning an exact definition to *kothi* and *panthi* is difficult. In general, *kothi* are natal male androphiles who primarily take the receptive role in anal sex with men and are gender atypical to some degree. The degree of their gender atypicality varies, and may range from a daily feminine gender role presentation (e.g., female clothing, long hair) to a generally masculine appearance with some behavioral gender atypicality, making them intermediate between sex-gender congruent and transgender forms of natal male androphilia. The term "*panthi*" can refer to "men" in general, but when adopted as an identity category it refers to the sexual partners of *hijra* and *kothi*. Self-identified *panthi* are masculine in terms of gender role presentation and primarily take the insertive role during anal intercourse, particularly in relation to *hijra* and *kothi*. These *panthi* are masculine in the gender role and primarily sexually insertive, particularly in relation to *hijra* and *kothi*. *Panthi*/*kothi* are thus similar to the *activo*/*pasivo* distinction in Latin culture (Carballo-Diéguez et al., 2004).

The present study gathered a sample of self-identified *hijra*, *kothi*, and *panthi*, and collected data on self-reported sexual orientation, sexual behavior and sexual position preference, and gender presentation. Gender atypicality measures included self-described masculinity and femininity (Zheng et al., 2011), occupational preferences (Lippa, 1998), and

recalled childhood gender atypicality (Bartlett & Vasey, 2006). Participants were asked about their sexual history with women and natal males (i.e. both cisgender and transgender), and their engagement in insertive or receptive anal sex with natal males. *Hijra* and *kothi* participants were asked whether they engaged in various milestones related to presenting in a female gender role such as wearing female clothes, taking female hormones, and undergoing genital surgery. Traditionally, *hijra* undergo a surgical procedure they call *nirvan*, which consists of removal of the penis (penectomy) and the testicles (orchidectomy). The procedure is typically performed by a senior *hijra* with no medical supervision and does not include the construction of a neovagina (Kalra & Shah, 2013).

In addition, an objective measure of sexual orientation—viewing time—was administered by asking participants to rate the attractiveness of male and female "swimsuit models" while covertly recording the amount of time between stimulus onset and participant response. As such, "viewing time" reflects the time required to respond to the task of rating attraction (Imhoff et al., 2010, 2012). Heterosexual and homosexual men and women exhibit longer viewing time in response to respond to images of their preferred sex (Imhoff et al., 2010; Israel & Strassberg, 2009; Rullo, Strassberg, & Israel, 2010), and this effect has been replicated for in Samoa for men and fa'afafine (Petterson et al., 2015, 2016). Viewing time can also take a uniquely bisexual pattern, whereby the responses of bisexually-identified participants to stimuli of men and women are more similar to each other then they are to those of heterosexual and homosexual men and women (Ebsworth & Lalumiere, 2012; Lippa, 2013), a result also found for Samoan men who are the cisgender sexual partners of fa'afafine (Petterson et al., 2015, 2016).

In sum, the goal of this study was to gather data on the three axes of *hijra*, *kothi*, and *panthi* identity – sexual attraction, insertive/receptive sexual behavior, and gender presentation.

Related goals were to replicate previous research linking natal male androphilia with gender atypicality in the Indian cultural context, and to further establish the applicability of Western sexual orientation construct across cultural boundaries.

Method

Participants

All participants were recruited in Mumbai, India, over a period of four months in the summer of 2015. All were born and raised in India and currently residents of Mumbai. Recruitment proceeded through snowball-sampling procedure. An initial pool of *hijra* participants was recruited through a *hijra* guru leading a *hijra*-focused public health organization called the Sakhi Char Chowghi Trust located in Malad, a slum in the western suburbs of Mumbai. This *guru* referred a pool of *hijra* and *kothi*-identified participants, and these participants were then asked if they knew of any other *hijra*, *kothi*, or *panthi*-identified individuals who would be willing to participate. These new participants then referred others, and this process continued until an adequate sample size was achieved. Anyone who self-identified as *hijra*, *kothi*, or *panthi* was eligible for inclusion. In addition to this first network, additional referral chains were generated by approaching individuals on the street who appeared to be *hijra* (i.e. apparently natal males dressed in traditional women's clothing), asking them if they identified as such, and inviting them to participate. Participants were incentivized to participate through a cash gift of 300 Indian Rupees (approximately $4.49). The final sample size for this study was 93.

Participants were provided a list of identity categories including *hijra*, *kothi*, and *panthi*, and were asked to indicate which terms described them. In order to investigate possible overlap

between identity categories participants were permitted to endorse multiple categories. Participants were thus categorized into four groups; *panthi* (n = 38), *hijra* only (n = 11), *kothi* only (n = 22), and *hijra*/*kothi* (n = 22). All participants reported that they were assigned the male sex at birth except for one *hijra*-identified participant who indicated that they were born intersex. This participant was included in all analyses in the *hijra*-only group.

Participant demographics are summarized in Table 2.1. The age range for *hijra* was 18-40 (M = 31.67, SD = 7.38), that of *kothi* was 18-50 (M = 29.05, SD = 7.93), that of *hijra*/*kothi* 19-38 (M = 28.43, SD = 4.75), and that of *panthi* 18-40 (M = 24.79, SD = 6.27). A one-way analysis of variance (ANOVA) for group differences in age was significant, $F(3, 89) = 4.29$, $p = .007$. Age was found to correlate significantly with viewing time in the attractiveness rating task, $r = .1$, $p < .001$. Age was also significantly negatively correlated with attractiveness ratings, $r = -.13$, $p < .001$. However, age was not significantly correlated with the difference between responses to male and female images in viewing time or attractiveness rating, and was thus not controlled for in analyses of such difference scores. Age was controlled for in all other analyses. No variables that could have a confounding influence on the variables of interest differed between groups.

Table 2.1 *Demographics*

	Hijra	Hijra/Kothi	Kothi	Panthi
	% (*n*)	% (*n*)	% (*n*)	% (*n*)
Religion				
Hindu	72.7 (8)	54.5 (12)	72.7 (16)	55.3 (21)
Muslim	37.5 (3)	36.4 (8)	18.2 (4)	39.5 (15)
Other	-	9.1 (2)	4.5 (1)	5.3 (2)
Education				
Illiterate, no formal educ.	27.3 (3)	18.2 (4)	22.7 (5)	15.8 (6)
Literate, no formal educ.	-	18.2 (4)	18.2 (4)	5.3 (2)
Primary	36.4 (4)	22.7 (5)	13.6 (3)	18.4 (7)
Intermediary	18.2 (2)	9.1 (2)	9.1 (2)	10.5 (4)
Secondary	9.1 (1)	18.2 (4)	4.5 (1)	21.1 (8)
Higher Secondary	-	9.1 (2)	13.6 (3)	13.2 (5)
Undergraduate/College	9.1 (1)	-	4.5 (1)	10.5 (4)
Graduate/Above	-	4.5 (1)	13.6 (3)	2.6 (1)
Occupation				
Professional	9.1 (1)	9.1 (2)	9.1 (2)	2.6 (1)
Clerical, Shop-owner	-	-	-	13.2 (5)
Worker – Skilled	-	-	4.5 (1)	18.4 (7)
Worker – Unskilled	-	4.5 (1)	4.5 (1)	31.6 (12)
Sex Worker	72.7 (8)	59.1 (13)	68.2 (15)	-
Dancing/Begging	18.2 (2)	27.3 (6)	4.5 (1)	-
Student	-	-	4.5 (1)	18.4 (7)
Living Arrangements				
Extended Family	18.2 (2)	18.2 (4)	18.2 (4)	57.9 (22)
Roommates	9.1 (1)	4.5 (1)	9.1 (2)	28.9 (11)
Boyfriend/Girlfriend	-	4.5 (1)	4.5 (1)	-
Alone	9.1 (1)	4.5 (1)	27.3 (6)	10.5 (4)
Hijra household	63.6 (7)	59.1 (13)	40.9 (9)	2.6 (1)
Relationship Status				
Single	72.7 (8)	90.9 (20)	72.7 (16)	78.9 (30)
Dating	27.3 (3)	9.1 (2)	18.2 (4)	5.3 (2)
Married (to a woman)	-	-	9.1 (2)	15.8 (6)

Procedure

Participants completed an orally administered questionnaire in Hindi followed by a viewing time task presented on a laptop computer. The questionnaire was translated and back-translated by two professional translators fluent in Hindi and English, and then edited for local intelligibility and accuracy by two research assistants also fluent in Hindi and English. Interviews and recruitment were conducted by Indian research assistants fluent in Hindi and English. All participants were fluent in Hindi, and were encouraged to ask for clarification if they did not understand a question. Combined duration for interview and viewing time task for each participant was approximately one hour. The viewing time task always followed the questionnaire, so any fatigue effects were equivalent for each group.

Measures

Attractiveness rating and viewing time. In the viewing time task participants were presented with a series of 120 photos of "swimsuit models" (60 men and 60 women) using the computer program PsychoPy (Pierce, 2007). Full body photographs of men and women wearing swimsuits or similar minimal clothing were selected from the Internet. Models were chosen whose skin tone was similar to those prevalent in India, which is an ethnically diverse country. An initial pool of 300 photos (150 men and 150 men) was gathered and pretested using an Internet-based convenience sample recruited through Facebook. During pretesting attractiveness ratings were obtained for each photo. The final stimuli set was selected so that the range, mean, and variance of the attractiveness ratings was approximately equal for the male and female stimuli sets.

During the viewing time task participants were asked to rate how sexually attracted they felt to the person in each photo on a scale from 1 (not at all sexually attracted) to 7 (extremely sexually attracted). Photos were presented in random order, except for a set of 10 photos (5 men and 5 women) which were presented in a fixed order at the beginning of the session for training purposes. These were not included in analyses.

Instructions were given verbally in Hindi to allow for the participation of illiterate subjects and the rating scale was shown in Hindi numerals on a sliding scale. Participants made their selection with a mouse. Participants unfamiliar with personal computers were given instruction in how to use the mouse and evaluated for competence before proceeding. All participants were permitted to complete the task regardless of the level of task competence achieved. Rather, task competence was assessed by recording the total number of mouse clicks made for each image. As only a single mouse click was necessary for task performance an excessive number of clicks was interpreted as an inability to perform the task. Three participants were excluded from analyses of attractiveness rating and viewing time for this reason. Participants were asked to focus on their own sexual feelings, and not on how they thought others might evaluate the picture. Viewing time was captured by PsychoPy without participants' knowledge as the time from picture onset to rating selection. Photo rating sessions took approximately 5-10 minutes. No participants indicated that they guessed that their viewing times were a measure of interest.

Self-reported sexual orientation. Participants reported their *Kinsey score* on a 9-point Kinsey scale with the following points, 1 ("only sexually attracted to women"), 2 ("nearly always sexually attracted to women and rarely sexually attracted to men"), 3 ("mostly sexually attracted to women and occasionally sexually attracted to men"), 4 ("primarily sexually attracted

to women and more than occasionally sexually attracted to men"), 5 ("more or less equally sexually attracted to the women and men"), 6 ("primarily sexually attracted to men and more than occasionally sexually attracted to women"), 7 ("mostly sexually attracted to men and occasionally sexually attracted to women"), 8 ("nearly always sexually attracted to men and rarely sexually attracted to women"), 9 ("only sexually attracted to men"). Participants rated their sexual attractions for the previous year and their lifetimes. Lifetime and previous year Kinsey scores were highly correlated (r = .94) and were averaged to compute their 9-point Kinsey score from 1 (exclusively heterosexual) to 9 (exclusively homosexual).

Androphilia (sexual attraction to adult men) and *gynephilia* (sexual attraction to adult women) were measured using the Homo-Heteroerotic Motivation Scale (Fleischman, Fessler, & Cholakians, 2015). The scale consists of homoerotic and heteroerotic subscales, each consisting of five items such as "The idea of kissing a (wo)man seems sexually arousing to me." Participants responded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The resulting heteroerotic (α = .92) and homoerotic (α = .73) motivation scores were computed as the mean of each subscale. Because the sample consisted entirely of natal males, the heteroerotic motivation score was a measure of gynephilia, and the homoerotic motivation score was a measure of androphilia.

Sexual behavior and position preference. Participants were asked about their *sexual life history* and their *sexual position preference* in taking the insertive or receptive role in anal sex with natal males. Participants answered yes or no to whether, in their lifetime, they had ever had sex with a natal male (i.e. both cisgender and transgender), been the insertive partner with a natal male, been the receptive partner with a natal male, and had sex with a woman. Participants were

also asked to rate their preferred position in anal sex with natal males (Zheng, Hart, & Zheng, 2012) on a scale from 1 (exclusively insertive) to 5 (exclusively receptive).

Gender presentation. Participants were asked whether they had reached various *transition milestones* in presenting a female gender role. Participants responded yes or no to whether they; wore their hair long in a female style, lived in female clothes, had ever taken female hormones, had undergone any type of feminizing surgery, and had undergone any type of genital surgery.

Participants reported their *self-perceived masculinity* by rating their agreement with the statements "I am a masculine person" and "I act, appear, and come across to others as being masculine" on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Zheng et al., 2011). S*elf-perceived femininity* was reported using an analogous pair of questions. Self-perceived masculinity (r = .92) and femininity (r = .89) scores were computed as the mean of each pair.

Recalled childhood gender-atypicality was measured using the Female-Typical Behavior and Male-Typical Behavior Subscales of the Childhood Gender Identity Scale (Bartlett & Vasey, 2006), which is an adaptation of the psychometrically validated Gender Identity Questionnaire for Children (Johnson et al., 2004). The Female-Typical Behavior Subscale consists of six items asking participants to report how often they engaged in various female-typical activities such as "playing with girls' toys and girls' games" or "doing girls' chores." The Male-Typical Behavior Subscale consisted of five analogous items. Participants responded on 5-point Likert-type scale (1 = never, 2 = less than half the time, 3 = half the time, 4 = more than half the time, 5 =

always/every time). Scores were computed as the mean for the female (α = .93) and male (α = .91) scales respectively.

Gender-related occupational preferences were measured using a scale developed by Richard Lippa (1998). Participants were read a list of nine occupations that men and women have been found to differ in the strength of their interest in pursuing. Example occupations are "construction worker" and "florist." Participants were asked how much they would like to pursue each occupation and responded on a 7-point Likert Scale ranging from 1 (strongly dislike) to 7 (strongly like). Translation into Hindi was not necessary in this case, as the English terms were well understood and familiar to participants. Because all participants were natal males the scale was computed as a measure of gender-atypical occupational preferences ranging from 1 (completely gender-typical) to 7 (completely gender-atypical), with male-typical occupations reverse-coded and the score computed as the mean of all ten items (α = .75).

Data Analysis

Analyses were conducted using R 3.3.1. Viewing time and sexual attractiveness ratings were analyzed as difference scores between responses to images of men and response to images of women. Mean sexual attractiveness ratings and viewing times to male and female images were computed for each participant. Difference scores were calculated by subtracting the attractiveness rating (or viewing time) for female images from that for male images such that a difference score of zero indicated an equal response to both men and women (i.e. a perfectly bisexual response), a positive score indicated a greater response to men, and a negative score a greater response to women.

Results

Sexual Orientation

Attractiveness ratings. Mean and standard deviation values for attractiveness ratings and viewing times for men and women by group are displayed in Table 2.2.

Table 2.2 *Mean and Standard Deviation of Self-Reported Sexual Attractiveness Ratings and Response Latencies (in seconds) For Images of Men and Women*

	Hijra		Hijra/Kothi		Kothi		Panthi	
	M	SD	M	SD	M	SD	M	SD
Attractiveness rating[a]								
Women	1.54	1.14	1.91	1.30	2.53	1.74	4.01	1.97
Men	5.33	2.05	4.39	2.03	4.67	2.07	4.40	1.97
Response latency								
Women	1.95	1.70	2.17	1.79	2.13	2.11	2.58	2.22
Men	2.53	2.10	2.74	1.97	2.65	2.25	2.57	2.22

[a] Attractiveness ratings ranged from 1 (not at all attractive) to 7 (extremely attractive.

Difference scores for each group with mean and 95% confidence intervals are displayed in Figure 2.1.

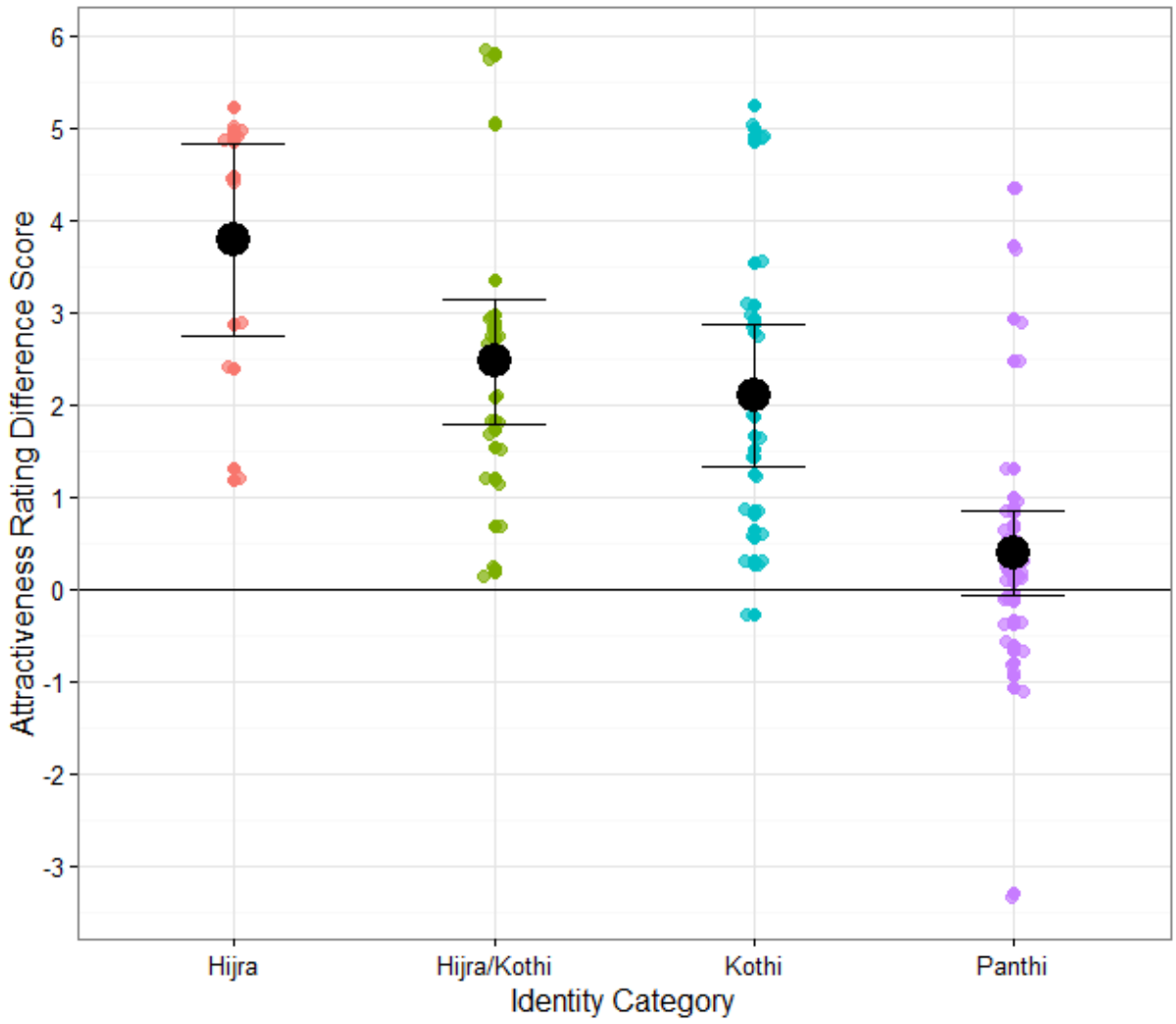

Figure 2.1 Mean attractiveness rating difference scores with 95% confidence intervals for hijra, hijra/kothi, kothi, and panthi.

A one-way ANOVA found that mean attractiveness rating difference scores differed significantly by group, $F(3, 86) = 17.85$, $p < .001$. A post hoc Tukey-Kramer test found *panthi* difference scores to be significantly lower (i.e. less male-biased) than that of *hijra* ($p_{adj} < .001$, Cohen's $d = -2.42$), *hijra/kothi* ($p_{adj} < .001$, Cohen's $d = -1.45$), and *kothi* ($p_{adj} < .001$, Cohen's *d*

= -1.13). *Kothi* difference scores were significantly less male-biased than those of *hijra* (p_{adj} = .02, Cohen's *d* = -.99). *Kothi*/*hijra* and *hijra* difference scores were not significantly different.

Additional analyses were conducted to determine whether mean attractiveness rating differences scores for each group differed from an equal response to men and women. To test for this possibility the absolute value of the difference scores was computed, resulting in a scale ranging from 0 (perfectly bisexual attraction) to 5 (perfectly monosexual attraction). Mean and standard deviations for the absolute value of attractiveness rating difference scores were as follows – *hijra* (*M* = 3.79, *SD* = 1.54), *hijra*/*kothi* (*M* = 2.47, *SD* = 1.54), *kothi* (*M* = 2.13, *SD* = 1.71), and *panthi* (*M* = .88, *SD* = 1.1). A one-way ANOVA found significant group difference in the absolute value of mean attractiveness ratings difference scores, $F(3, 86) = 13.69$, $p < .001$, with *panthi* significantly closer to perfect bisexuality than *hijra* ($p_{adj} < .001$, Cohen's *d* = -2.17), *hijra/kothi* ($p_{adj} < .001$, Cohen's *d* = -1.19), or *kothi* ($p_{adj} < .01$, Cohen's *d* = -.87). *Hijra* were also found to be significantly more extreme in their monosexuality than *kothi* ($p_{adj} = .01$, Cohen's *d* = 1.02). *Panthi* therefore showed a relatively bisexual pattern of attractiveness ratings. An additional one-sample t-test was conducted to test whether the absolute value of *panthi* attractiveness ratings difference scores differed significantly from zero. This test was significant, $t(34) = 4.7$, $p < .001$, indicating that *panthi* varied from theoretically perfect bisexuality, or equal attraction to both sexes.

Viewing time. Viewing times were windsorized at 15 seconds to ensure that viewing times not associated with active task completion were excluded (1.1% of trials). The cutoff of 15 seconds was chosen for convenience and because it retained the majority of viewing times. The remaining viewing times (in seconds) ranged from .41 to 14.87, with a mean of 2.46 (*SD* = 2.09).

Difference scores in milliseconds for each group with mean and 95% confidence intervals are displayed in Figure 2.2.

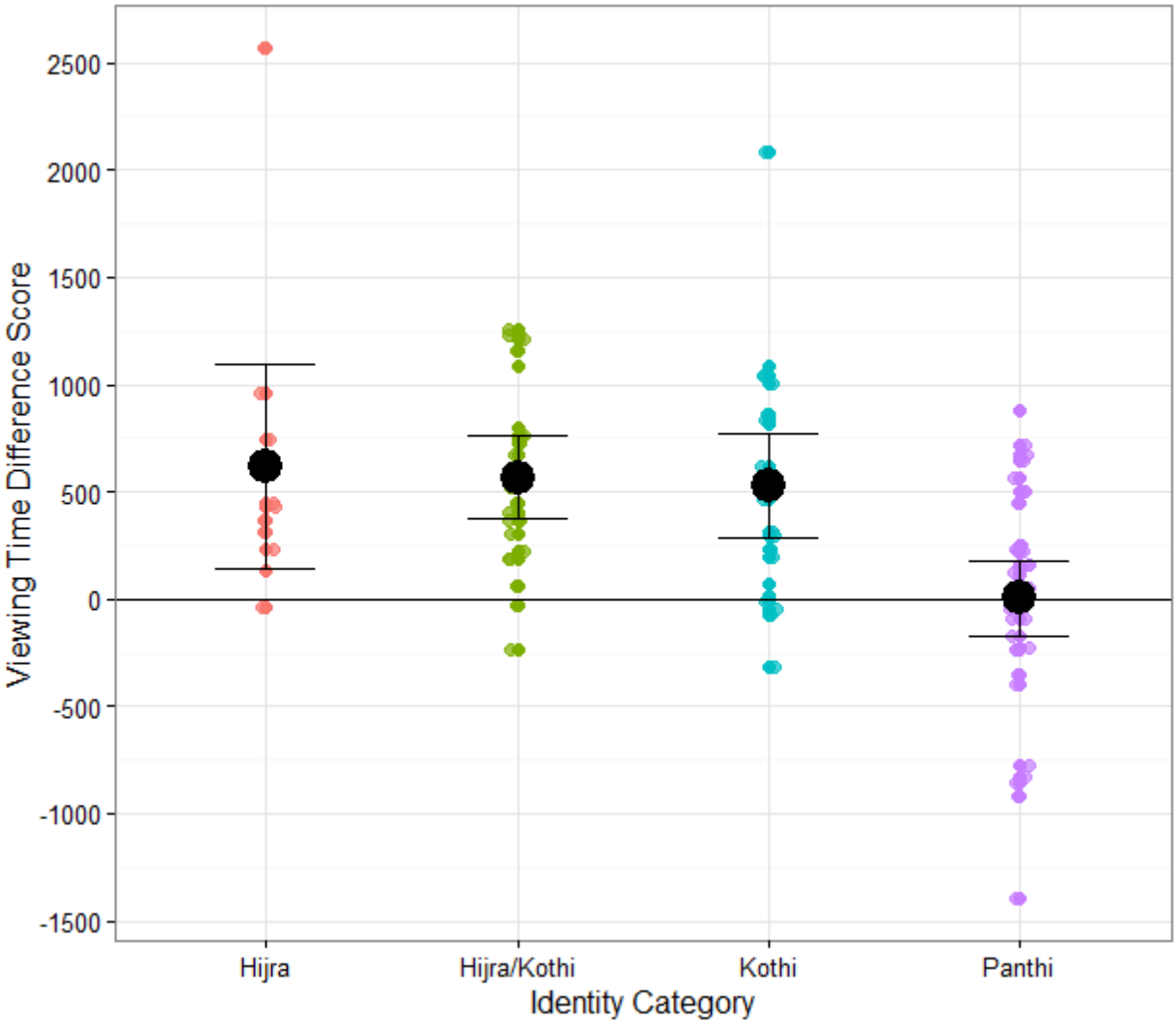

Figure 2.2 Mean viewing time difference scores (in milliseconds) with 95% confidence intervals for hijra, hijra/kothi, kothi, and panthi.

A one way ANOVA found that difference scores differed significantly by group, $F(3, 86) = 7.98$, $p < .001$. A post hoc Tukey-Kramer test found *panthi* difference scores to be significantly

lower than that of *hijra* (p_{adj} = .006, Cohen's *d* = -1.01), *hijra*/*kothi* (p_{adj} = .001, Cohen's *d* = -1.19), and *kothi* (p_{adj} = .002, Cohen's *d* = -.99). *Hijra*, *hijra*/*kothi*, and *kothi* difference scores did not differ significantly.

As with attractiveness ratings, the absolute value of viewing time difference scores was computed to determine whether group scores differed from an equal response to women and men. Mean and standard deviations for the absolute value of viewing time difference scores were as follows – *hijra* (*M* = .63, *SD* = .7), *hijra*/*kothi* (*M* = .59, *SD* = .4), *kothi* (*M* = .57, *SD* = .5), and *panthi* (*M* = .38, *SD* = .33). A one-way ANOVA failed to find group differences, $F(3,86) = 1.54$, $p = .21$. To increase power, *hijra*, *hijra*/*kothi*, and *kothi* groups were combined into a single primarily monosexual group and compared to *panthi* using an independent-samples t-test. This test indicated that *panthi* scores were significantly lower, $t(87.9) = -2.35$, $p = .02$. *Panthi* thus had relatively bisexual viewing times compared to *hijra*, *hijra*/*kothi*, and *kothi*. An additional one-sample t-test using a test value of zero was conducted to test whether *panthi* viewing times differed from an equal response to men and women. This test was significant, $t(34) = 6.93$, $p < .001$, indicating that the *panthi* varied from theoretically perfect bisexuality, or equal attraction to both sexes.

Self-reported sexual orientation. Group means and standard deviations for Kinsey score and homo-heteroerotic motivation scores are displayed in Table 2.3.

Table 2.3 *Group Means and Standard Deviations of Self-Report Measures of Sexual Orientation*

	Hijra		Hijra/Kothi		Kothi		Panthi	
	M	SD	M	SD	M	SD	M	SD
Kinsey Score	8.95[a]	.15	8.95[a]	.22	8.11[a]	1.57	4.37[b]	1.81
Heteroerotic Motivation	1.24[a]	.34	1.77[a]	.97	2.04[a]	1.04	3.95[b]	.75
Homoerotic Motivation	4.75[a]	.25	4.47[a]	.64	4.34[a]	.58	3.60[b]	.57

Note. Kinsey scores ranged from 1 (exclusively heterosexual) to 9 (exclusively homosexual). Heteroerotic and Homoerotic Motivation scores ranged from 1 to 5.
[a-b] Mean values with different superscripts in each column indicate significant differences group differences maintain a familywise error rate of $\alpha = .05$.

A one-way ANCOVA, controlling for age, indicated significant group differences for Kinsey score, $F(3, 87) = 69.27$, $p < .001$, $\eta_p^2 = .7$. *Hijra*, *hijra*/*kothi*, and *kothi* mean Kinsey scores were all exclusively or near exclusively homosexual and did not differ significantly. The mean *panthi* Kinsey score was in the bisexual range, and post hoc pairwise comparisons (adjusted using a Bonferroni correction with the alpha level adjusted to $\alpha = .017$), found *panthi* to be significantly lower (i.e. less exclusively homosexual) than *hijra* ($p_{adj} < .001$, Cohen's $d = -2.85$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = -3.13$), and *kothi* ($p_{adj} < .001$, Cohen's $d = -2.17$). A one-sample t-test was performed to test whether *panthi* Kinsey scores differed from a perfectly bisexual test value of 5, indicating equal attraction to both men and women. This analysis found that *panthi* Kinsey scores was significantly less than 5, $t(37) = -2.14$, $p = .04$, Cohen's $d = -.71$, meaning that they were shifted toward greater sexual attraction to women than men.

Separate one-way ANCOVAs of homo-heteroerotic motivation scores, controlling for age, indicated significant group differences for homoerotic motivation, $F(3, 86) = 19.48$, $p < .001$, $\eta_p^2 = .4$, and heteroerotic motivation, $F(3, 86) = 47.76$, $p < .001$, $\eta_p^2 = .62$. All groups reported high homoerotic motivation scores. *Panthi* reported significantly lower homoerotic motivation scores than *hijra* ($p_{adj} < .001$, Cohen's $d = -2.19$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = -1.47$), and *kothi* ($p_{adj} < .001$, Cohen's $d = -1.29$). *Hijra*, *hijra*/*kothi*, and *kothi* homoerotic motivation scores did not differ significantly. *Panthi* reported elevated heteroerotic motivation scores compared to other groups significantly greater than *hijra* ($p_{adj} < .001$, Cohen's $d = 3.88$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = 2.59$), and *kothi* ($p_{adj} < .001$, Cohen's $d = 2.2$). *Hijra*, *hijra*/*kothi*, and *kothi* heteroerotic motivation scores were near the bottom of the range and did not differ significantly.

Bivariate correlations between all measures of sexual orientation are displayed in Table 2.4.

Table 2.4 *Bivariate Correlations between Measures of Sexual Orientation*

		1	2	3	4
1.	Kinsey Score				
2.	Homoerotic Motivation	.76***			
3.	Heteroerotic Motivation	-.83***	-.62***		
4.	Attractiveness Rating	.58***	.47***	-.58***	
5.	Viewing Time	.38***	.27**	-.32**	.47***

** $p < .01$
*** $p < .001$

Sexual Behavior and Position Preference

The entire sample reported having had sex with a man in their lifetime except for one *panthi*. The majority of *panthi* reported having had sex with a woman in their lifetime (76.3%). While no *hijra* reported having had sex with a woman, two *hijra*/*kothi* and two *kothi* reported having done so.

Consistent with their culturally defined roles, *hijra*, *hijra*/*kothi*, and *kothi* all reported preferring to be the exclusively or near exclusively receptive partner in anal sex, and *panthi* the exclusively or near exclusively insertive partner. Mean position preference scores, ranging from 1 (exclusively insertive) to 5 (exclusively receptive), for each group were $M = 4.82$, $SD = .4$ for *hijra*, $M = 4.47$, $SD = .7$ for *hijra*/*kothi*, $M = 4.77$, $SD = .43$, for *kothi*, and $M = 1.86$, $SD = .82$ for *panthi*. A one way ANCOVA, controlling for age, found that position preference scores differed significantly by group, $F(3, 84) = 125.27$, $p < .001$, $\eta_p^2 = .82$. Bonferroni corrected post hoc pairwise comparisons found *panthi* mean position preference score to be significantly lower (i.e., indicating greater endorsement of insertive role preference) than that of *hijra* ($p_{adj} < .001$, Cohen's $d = -3.92$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = -3.33$), and *kothi* ($p_{adj} < .001$, Cohen's $d = -4.14$). *Hijra*, *hijra*/*kothi*, and *kothi* difference scores did not differ significantly.

Consistent with their culturally defined role, all *hijra*, all *kothi*, and most *hijra*/*kothi* (81.8%) reported having been the receptive partner in anal sex with men. Similarly consistent, most *panthi* reported having been the insertive partner in anal sex with men (81.6%).

Inconsistent with their culturally defined role, almost half of *kothi* reported having been the insertive partner in anal sex (40.9%), as well as minorities of *hijra* (18.2%) and *hijra*/*kothi*

(18.2%). In similar contradistinction to their culturally defined role, a third of *panthi* (34.3%) reported having been the receptive partners during anal intercourse.

Gender Presentation

Group means and standard deviations for gender presentation measures are displayed in Table 5.

Table 2.5 *Group Means and Standard Deviations of Measures of Gender Typicality*

	Hijra		Hijra/Kothi		Kothi		Panthi	
	M	SD	M	SD	M	SD	M	SD
Self-Described Masculinity	1.04^{a}	.15	1.25^{a}	.74	1.84^{b}	1.15	4.79^{c}	.42
Self-Described Femininity	4.73^{a}	.41	4.82^{a}	.45	4.43^{a}	.87	1.36^{b}	.81
Childhood Male Typicality	1.47^{a}	.71	1.94^{a}	.96	1.97^{a}	.85	4.22^{b}	.81
Childhood Female Typicality	4.76^{a}	.34	4.77^{a}	.44	$4.17^{a\dagger}$	.84	2.23^{b}	.92
Occupational Preferences	5.19^{a}	1.04	5.43^{a}	.82	$4.70^{a\dagger}$	1.22	3.69^{b}	.75

Note. Self-described and childhood masculinity and femininity scores range from 1 to 5. Occupational preferences score ranges from 1 (most male typical) to 7 (most female typical).
$^{a\text{-}c}$ Mean values with different superscripts in each column indicate significant differences Bonferroni corrected to maintain a familywise error rate of $\alpha = .05$.
† $p = .07$.

Transition milestones. Percentages of *hijra*, *hijra*/*kothi*, and *kothi* reporting having reached transition milestones for female gender presentation are displayed in Table 2.6.

Table 2.6 *Percentage Reporting Female Gender Presentation Milestones for Hijra, Hijra/Kothi, and Kothi*

	Hijra		Hijra/Kothi		Kothi	
	n	%	*n*	%	*n*	%
Wearing hair long	9	81.8	20	90.9	10	45.5
Wearing women's clothes	9	81.8	20	90.9	11	50
Taking female hormones	5	45.5	6	27.3	3	13.6
Any feminizing surgery	5	45.5	10	45.5	4	18.2
Any genital surgery	3	27.3	6	27.3	0	-

While almost all *hijra* and *hijra*/*kothi* had long hair and wore women's clothes, only half of *kothi* did so. Consistent with their culturally defined role, no *kothi* reported undergoing castration. Contrary to mainstream Indian understanding, but consistent with the ethnographic literature, most *hijra* and *hijra*/*kothi* had not been castrated, and about half had never had any feminizing medical intervention of any kind. A substantial minority of *kothi* reported taking female hormones or undergoing some type of feminizing surgery.

Self-described masculinity/femininity. Separate one way ANCOVAs, controlling for age, found significant group differences for self described masculinity $F(3,87) = 174.55$, $p < .001$, $\eta_p^2 = .86$, and self-described femininity $F(3, 86) = 153.62$, $p < .001$, $\eta_p^2 = .84$. Bonferroni corrected post hoc pairwise comparisons found that *panthi* described themselves as significantly less feminine than *hijra* ($p_{adj} < .001$, Cohen's $d = -4.52$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = -4.92$), and *kothi* ($p_{adj} < .001$, Cohen's $d = -3.67$). *Hijra*, *hijra*/*kothi*, and *kothi* self-described

femininity was not significantly different. *Panthi* described themselves as significantly more masculine than *hijra* ($p_{adj} < .001$, Cohen's $d = 10.01$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = 6.38$), and *kothi* ($p_{adj} < .001$, Cohen's $d = 3.83$). *Kothi* also described themselves as significantly more masculine than *hijra* ($p_{adj} = .02$, Cohen's $d = .84$), and *hijra*/*kothi* ($p_{adj} = .05$, Cohen's $d = .62$). *Hijra* and *hijra*/*kothi* self-described masculinity did not differ significantly.

Childhood gender typicality. Separate one way ANCOVAs, controlling for age, found significant group differences for childhood male typicality, $F(3, 82) = 55.79$, $p < .001$, $\eta_p^2 = .67$, and childhood female typicality, $F(3, 86) = 76.25$, $p < .001$, $\eta_p^2 = .73$. Bonferroni corrected post hoc pairwise comparisons found that *hijra* ($p_{adj} < .001$, Cohen's $d = 3.05$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = 3.27$), and *kothi* ($p_{adj} < .001$, Cohen's $d = 2.18$) exhibited significantly higher childhood female typicality compared to *panthi. Hijra*, *hijra*/*kothi*, and *kothi* childhood female typicality did not differ significantly. *Panthi* reported significantly higher childhood male typicality than *hijra* ($p_{adj} < .001$, Cohen's $d = 3.48$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = 2.62$), and *kothi* ($p_{adj} < .001$, Cohen's $d = 2.73$). *Hijra*, *hijra*/*kothi*, and *kothi* childhood male typicality did not differ significantly.

Gendered occupational preferences. A one way ANOVA found significant group differences in gendered occupational preferences, $F(3, 87) = 18.77$, $p < .001$, $\eta_p^2 = .39$. Bonferroni corrected post hoc comparisons found that mean *panthi* occupational preference scores were lower (i.e. less female-typical) than *hijra* ($p_{adj} < .001$, Cohen's $d = -1.82$), *hijra*/*kothi* ($p_{adj} < .001$, Cohen's $d = -2.24$), or *kothi* ($p_{adj} < .001$, Cohen's $d = -1.06$). No other differences were significant.

Discussion

The current study investigated the sexual orientation, sexual behavior, and gender presentation of three categories of natal male androphile in Mumbai, India – *hijra*, *kothi*, and *panthi*. Unlike the Western categories gay, lesbian, and bisexual, which are defined purely in terms of sexual attraction, *hijra*, *kothi*, and *panthi* are defined in terms of a combination of sexual attraction, position preference in anal sex (insertive/receptive), and gender presentation. The categories *hijra* and *kothi* were found to not be mutually exclusive, and a sample endorsing both terms was included.

Self-reported sexual orientation and viewing time and attractiveness ratings of male and female "swimsuit models" were used to characterize the sexual orientations of each group. Despite endorsing different identity categories, *hijra*, *hijra*/*kothi*, and *kothi* were found to have similarly androphilic orientations. These results applied equally whether sexual orientation was measured on the Kinsey Scale, in separate androphilic and gynephilic dimensions, using subjective attractiveness ratings to male and female "swimsuit models," or covertly measured viewing time of the same stimuli. Viewing time and subjective attractiveness rating results replicated similar finding for gay-identified men in the West (Lippa 2013), and for Samoan *fa'afafine* (transgender natal male androphiles) to male and female faces (Petterson et al, 2015). These data, therefore, justify speaking of *hijra*, *kothi*, *fa'afafine*, and gay men as sharing a common androphilic orientation, despite differences in how their attractions are culturally elaborated. These data also contradict the claim made by some *hijra* that *hijra* are asexual with respect to their sexual feelings (Reddy, 2005, p. 48).

Panthi were found to be bisexual in their self-reported sexual orientation, and to have a uniquely bisexual pattern of viewing time and attractiveness ratings. These results extend previous findings of uniquely bisexual response in bisexual-identified men in Canada (Ebsworth & Lalumière, 2012) and the United States (Lippa, 2013), and further establish the existence of bisexual sexual orientation. This result also mirrored that reported for the analogous cisgender male partners of *fa'afafine* in Samoa (Petterson et al., 2015). As with the cisgender partners of *fa'afafine, panthi* viewing time and attractiveness ratings were relatively bisexual but consisted of a range of male and female-biased responses.

Consistent with ethnographic accounts, *hijra*, *hijra*/*kothi*, and *kothi* were found to be feminine in their gender presentation. These results extend previous findings for elevated female-typical traits in gay men in the West for self described masculinity/femininity (Lippa, 2000), recalled childhood behavior (Bailey & Zucker, 1995), and occupational preferences (Lippa, 2005). They also add to a growing list of cross-cultural replications for self-described gender atypicality (Lippa & Tan, 2001; Zheng et al., 2011), recalled childhood gender atypical behavior (Bartlett & Vasey, 2006; Besharat et al., 2016; Cardoso, 2005; 2009; Petterson et al., 2017), and occupational preferences (Lippa, 2010; Semenyna & Vasey, 2016; Zheng et al., 2011). *Panthi* were found to be relatively male-typical on all measures other than their sexual attraction to men, compared to the other groups.

As the distinction between *hijra* and *kothi* is disputed and in flux (Boyce, 2007; Cohen, 2005; Reddy, 2005), this study looked for differences between those endorsing *hijra*, *kothi*, and both *hijra* and *kothi* identities. Consistent with Reddy's (2005) contention that *hijra* is a type of *kothi*, more than half of those who endorsed the *hijra* identity also endorsed *kothi*. Inconsistent

with Reddy (2005), a substantial number of *hijra* (n = 11) and *kothi* (n = 22) did not understand the categories to overlap.

In general, *hijra*, *hijra*/*kothi*, and *kothi* groups were similar. No differences on any measure were detected between those endorsing only *hijra* and those endorsing both *hijra* and *kothi*. Those endorsing only *kothi*, however, were found to be less extreme than *hijra* and *hijra*/*kothi* in their male-biased attractiveness ratings, and less extreme in their female gender presentation. Consistent with the ethnographic literature, no *kothi* reported undergoing castration, and approximately half as many *kothi* as *hijra* or *hijra*/*kothi* reported wearing female clothes and their hair long. Almost half of *kothi* reported having been the insertive partner in anal sex with a man, more than double the rate among *hijra* and *hijra*/*kothi*. This greater prevalence of insertive sexual behavior can be interpreted as a less strict adherence to a feminine gender role. However, when reporting their *preferred* sexual position no differences were detected. While each group was equal in self-described femininity, *kothi* described themselves as significantly more masculine. This is not, however, to say that *kothi* were not gender-atypical – when compared to *panthi* large differences were detected for all gender presentation measures.

Limitations

It should not be inferred that the social organization of sexuality and gender described in the present study extends to all of Indian society. The snowball-sampling method used makes it likely that each of the presently observed sub-samples has characteristics that are idiosyncratic to the social network utilized for recruitment, limiting the generalizability of the present findings.

Future Research

To the author's knowledge the present study represents the first quantitative, psychological data ever gathered on the sexual orientation and gender atypicality of Indian sexual minorities. In addition, it is only the third study to gather non-self-report data on the sexual orientation of a non-Western population (see Petterson et al., 2015; 2016). Therefore a great deal remains unknown. No measures distinguished between *hijra* and *hijra*/*kothi* groups. It remains an area of future research to try to determine why some *hijra* also identity as *kothi* and others do not.

Additionally, India is large and linguistically diverse and regional differences in terminology are substantial, and may correspond to differences in the way these and similar identity categories are understood. Differences between urban and rural populations are plausible and should be investigated. For example, the impact of social networks influenced by HIV/AIDS and identity politics has probably influenced large urban centers more than rural areas or small cities. The present sample was primarily of low socioeconomic status (SES), with a median income of about 150 USD per month. The extent that identity formation in higher SES groups is organized around the same axes of attraction, position preference, and gender presentation needs to be investigated. It is likely that higher SES is associated with greater adoption of Western identity categories. The extent that *hijra*, *kothi*, *panthi*, and other emic identity categories are salient to the identity formation of higher SES populations should be investigated.

Many sexual minorities in India do not necessary identify using any particular terms (Khan, 2001). An adequate investigation of sexual orientation in India would access these populations. Methodological issues present themselves as most studies rely of self-identification as a criteria for participant inclusion. For populations that do not self-identify, reporting same-sex behavior is a practical alternative criteria for inclusion, with the caveat that it does not

necessarily imply any particular sexual orientation. An empirical investigation of the extent that psychophysiological reactivity varies among “men who have sex with men” would be a valuable contribution to our understanding of the relationship between sexual behavior and orientation.

Regional variations in terminology have yet to be adequately explored. The in-depth ethnographic studies (Nanda, 1990; Reddy, 2005) that have been performed may have limited applicability to other parts of India, and may be out of date as the meanings of terms and their incorporation into identity formation changes (Boyce, 2007; Cohen, 2005). It is unknown whether differences in terminology necessarily imply differences in meaning, or whether regions that use the same terms necessarily share the same meanings. The population of self-identified *hijra* in Karachi, Pakistan (Khan et al., 2009) is plausibly distinct from that in Hyderabad, India (Reddy, 2005).

Compliance with Ethical Standards

This study was funded by the Department of Human Development, Cornell University.
All procedures performed in studies involving human participants were in accordance with the ethical standards of the Cornell University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

STUDY #3

Sexual orientation orients covert attention capture

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Under review

Sexual orientation orients covert attention capture

Abstract

Previous studies have found that visual attention preceding the execution of an eye movement is automatically recruited by sexual stimuli presented in peripheral vision in what is called *covert attention capture*. These findings have been further shown to mirror self reported sexual orientation among heterosexual men, though not heterosexual women. We tested whether covert attention was automatically captured by images of the preferred sex among a range of sexual orientations, including heterosexual, bisexual, and homosexual men and women. We found that homosexual men responded more quickly to probes following male images than those following female images, and that heterosexual men responded more quickly to probes following female than male images. Homosexual women responded more quickly to probes following female images, but the effect was weaker than that for heterosexual and homosexual men. Bisexual men and women responded equally quickly to probes following male and female images. Surprisingly, heterosexual women responded more quickly to probes following female images than male images. These results suggest that early attentional processes are reliable measures of the sexual orientation of men, but are less reliable for women.

Keywords: sexual orientation, gender, spatial attention, covert attention capture, dot-probe task

Sexual Orientation Orients Covert Attention Capture

Sexual orientation is typically defined as sexual attraction and arousal to people of the opposite sex, same sex, or both sexes. The most common way of measuring sexual attraction and arousal has been to ask people to introspect and describe their feelings to the researcher. However, self-report measures of sexual orientation have several limitations. Most importantly, they rely on the willingness and ability of participants to report their self-perceptions honestly and accurately (Catania et al., 1990). In forensic contexts, or for populations where non-heterosexual orientations are socially undesirable, this honesty and accuracy cannot be relied on (Kalmus & Beech, 2005). More subtly, reliance on self-report conflates psychological processes involved in self-perception and self-representation, which are more properly the domain of identity, with the psychophysiological responsivity involved in sexual orientation itself.

In addition to social bias, participants may not be aware of small variations in sexual response that are nevertheless of scientific interest. For example, participants whose objective sexual response profiles differ in small but reliable ways from perfect heterosexuality, i.e., "mostly straights" (Savin-Williams & Vrangalova, 2013) may not attend to, remember, or report such responses because they are inconsistent with their heterosexual identity. Such a scenario would be consistent with self-perception theory (Bem, 1972), which argues that the character of internal states such as emotion and arousal are inferred from context including past behavior and self-perceptions. Heterosexual identity in this context can be considered a type of cognitive schema and it has been well established that information inconsistent with such schema tend to be ignored (Fiske, 1982).

To address these limitations several types of non-self report measures of sexual orientation have been developed. They fall under two broad categories: physiological, which correspond to the sexual arousal component of sexual orientation, and cognitive/behavioral, which focus on the sexual attraction component.

Physiological Measures

Physiological measures focus mainly on genital arousal, using penile plethysmography for men, which records changes in penile volume as a measure of blood flow into the penis (Freund, 1963; Rosen & Keefe, 1978), and vaginal photoplethymography for women, which detects changes in the color of light reflected from the walls of the vaginal canal as a measure of blow flow into vaginal tissues (Hatch, 1979). Changes in pupil dilation have also been found to occur in response to preferred sexual stimuli in men (Attard-Johnson, Bindemann, & O Ciardha, 2016; Rieger & Savin-Williams, 2012) and such changes have been found to correlate with penile arousal (Rieger et al., 2015). The reliability of pupil dilation as a measure of sexual interest has also been strengthened by its replication with non-explicit sexual stimuli (i.e., with clothed models) in which a smaller but reliable effect is detected (Watts, Holmes, Savin-Williams, & Rieger, 2016). The use of non-sexually explicit stimuli has the advantage of being usable with populations in which sexually explicit stimuli may not be culturally or age-appropriate. Genital arousal measures have the advantage of being an unambiguously sexual response to sexual stimuli, whereas pupil dilation may also reflect heightened emotional arousal for nonsexual reasons such as disgust (Bradley, Miccoli, Escrig, & Lang, 2008), although the importance of this reservation is reduced by the Rieger et al. (2015) finding that they are highly correlated.

Cognitive/Behavioral Measures

Cognitive/behavioral measures of sexual orientation have been primarily organized around the information processing model of sexual response (Janssen, Everaerd, Spiering, & Janssen, 2000). The model proposes that sexual response is governed by a combination of automatic and controlled cognitive processes, with automatic processes being particularly relevant during the initial orienting of attention to sexual stimuli in the environment, triggering the sexual response cycle, the later stages of which are dominated by conscious attentional control (Barlow, 1986; Janssen et al., 2000).

These early cognitive aspects of sexual response relate to questions regarding the definition of sexual orientation. If sexual orientation is defined as sexual desire for men, women, or both, then the question is raised, "What exactly is meant by sexual desire?" Is sexual desire distinct from sexual arousal, or are they the same thing? Typical sexual desire is thought of as being a subjective experience instantiated in the central nervous system, while sexual arousal is thought of in terms of physiological arousal and the peripheral nervous system, and has been characterized as the subjective awareness of sexual arousal (Everaerd, Laan, Both, & Spiering, 2001), and a type of emotional experience involving approach motivation, the expectation of reward, and the awareness of physiological/autonomic arousal (Everaerd, 1989). How, then, are we to measure objectively what is defined as a subjective experience?

The most common response to this problem has been to focus on visual attention. Visual attention plays a central role in gathering reproductive information (Krupp, 2008) and the generation of sexual arousal (de Jong, 2009). Gaze patterns for nude figures are likely structured by evolution to bias attention toward reproductively relevant features. Suschinsky (2007) found that heterosexual men fixated more often on reproductively relevant body regions (e.g., breasts

and genitals) compared to other parts of the body, and that figures with lower waist-to-hip ratios received the most fixations. Another study systematically varied the waist-to-hip ratio and breast size of female figures and found that heterosexual men showed more first fixations toward the breast and the waist than other body parts, including the face (Dixson, Grimshaw, Linklater, & Dixson, 2011). Therefore cognitive processes involved in biased attentional processing are likely to be part of how sexual orientation is psychophysiologically operationalized.

Studies have tended to focus on either the direct measurement of eye movements (e.g. Fromberger et al., 2012; Harris, Rice, Quinsey, & Chaplin, 1996), which are argued to correspond to directed subjective interest, or on reaction time experiments designed to infer differences in cognitive processing when viewing different types of sexual stimuli. The latter type of experiment comes in a variety of forms, such as the Choice Reaction Task (Wright & Adams, 1994), the Implicit Association Task (Gray, Brown, MacCulloch, Smith, & Snowden, 2005), and viewing time inferred from response time (Lippa, 2013).

Category Specificity

One of the major findings—as well as a conceptual challenge—of the research program on non-self report measures of sexual orientation has been the sex difference in what is called the *category specificity* of sexual response, with men showing a category specific sexual response more often and on more measures than women. That is, on the whole men have been found to show a pattern of physiological and cognitive/behavioral response that closely matches their subjective sexual desire, and to demonstrate sexual responses that distinguish strongly between male and female stimuli for men with heterosexual and homosexual orientations. This finding is consistent with research showing that women are more likely to be bisexual than men (Baumeister, 2000; Laumann, Gagnon, Michael, & Michaels, 1994; Peplau, 2001) and that

women's sexuality has been found to be more variable than that of men both between individuals and over time (Baumeister, 2000). Males respond more to visual sexual stimuli than females, and more to the sexes of the people involved, while women respond more to the content (Rupp & Wallen, 2009). Self-reported sexual arousal and genital arousal has been found to be highly correlated in men (Blanchard, Klassen, Dickey, Kuban, & Blak, 2001; Chivers, Rieger, Latty, & Bailey, 2004; Chivers, Seto, & Blanchard, 2007; Freund & Blanchard, 1989; Freund & Watson, 1991; Huberman & Chivers, 2015; Rieger, Chivers, & Bailey, 2005; Rosenthal, Sylava, Safron, & Bailey, 2012; Seto, Lalumiere, & Blanchard, 2000; Suschinsky, Lalumiere, & Chivers, 2009; Tollison, Adams, & Tollison, 1979) but uncorrelated in heterosexual women (Chivers & Bailey, 2005; Chivers et al., 2004; 2007; Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010; Chivers & Timmers, 2012; Huberman & Chivers, 2015; Peterson, Janssen & Laan, 2010; Steinman, Wincze, Barlow, & Mavissakalian, 1981; Suschinsky et al., 2009; Wincze & Qualls, 1984). In general, all of these findings point to a tendency toward *variability* and *non-exclusivity* in females' sexuality.

In addition to between-sex differences, within-sex differences have also been found between exclusively heterosexual women and women with any level of gynephilia (sexual attraction to adult women) (Bouchard, Timmers, & Chivers, 2015; Chivers et al., 2007; Chivers, Bouchard, & Timmers, 2015; Rieger, Savin-Williams, Chivers, & Bailey, 2016; Timmers, Bouchard, & Chivers, 2015). While exclusively heterosexual women consistently show a category non-specific genital response, women with any degree of gynephilia (i.e., exclusive lesbians and bisexual women) show a stronger genital response to female stimuli than male stimuli (Bouchard et al, 2015; Chivers et al., 2015; Timmers et al., 2015)

Notably, while findings on these within-sex differences have been very consistent for genital arousal, results for self-reported subjective arousal have been mixed. While some studies have found category specific subjective arousal in exclusively heterosexual women (Chivers et al., 2015 [Study 2]) other have found category non-specificity (Chivers et al., 2015 [Study 1]; Chivers et al., 2007). Similarly, women reporting any degree of gynephilia have sometimes reported category specific subjective arousal (Chivers et al., 2007) and sometimes not (Chivers et al., 2015).

Research in the attentional domain using the information processing model of sexual response has been pursued to help clarify these results from genital arousal and subjective self report. For example, the Implicit Association Test and priming have been used in sex research to test the extent that male and female stimuli are appraised as sexual (Snowden & Gray, 2013; Snowden, Wichter, & Gray, 2008). In these experiments male and female stimuli are paired with each other or a neutral control and participants are asked to categorize them as sexual or not; faster response times are interpreted as a closer association. Heterosexual women have been shown to appraise male and female stimuli as sexual equally as quickly (i.e., have shown a category non-specific response), whereas heterosexual men, homosexual men, and homosexual women all show a category-specific response to their preferred sex (Snowden & Gray, 2013). These results replicate the within-sex difference found in the genital arousal domain and suggest that the within-sex differences in genital arousal are linked to earlier attentional processes, and are somehow disconnected from processes more closely related to subjective sexual arousal. This is consistent with previous findings that early automatic attention capture is more directly responsible for activating genital arousal, while later consciously controlled attentional processes are more important for subjective arousal (DeWitte, 2016; Janssen et al. 2000). Pupil dilation

experiments, also directly related to early automatic attentional processes, have found a similar pattern of results, in that exclusively homosexual women show a greater response to female stimuli, while exclusively heterosexual and bisexual women showing a category non-specific response (Rieger & Savin-Williams, 2012; Rieger et al., 2015). This finding is similar to but distinct from the within-sex differences found in genital arousal studies, in which any level of gynephilia was sufficient for a category specific female biased response. In the case of pupil dilation only women who report exclusively gynephilic attractions demonstrated a category specific response.

The category non-specific response of exclusively heterosexual women has also been demonstrated using eye tracking studies. Gaze patterns have been shown to be directed by affective response (Calvo & Lang, 2004; Mogg, Gamer, & Bradley, 2007; Wenzlaff et al, 2015). These findings have been extended to sexual interest, with heterosexual men and women tending to initially direct their gaze to their preferred gender more often as well as displaying more and longer fixations, and with distinct gaze patterns associated with sexual attractiveness judgments (Hall, Hogue, & Guo, 2011; Lykins, Meana, & Strauss, 2006; Nummenmaa, Hietanen, Santtila, & Hyona, 2012; Tsujimura et al., 2009). Such studies have mirrored the pupil dilation results just reported, with exclusively heterosexual and bisexual women demonstrating a category non-specific response (Dawson, Suschinksy, & Lalumiere, 2012; Ebsworth & Lalumiere, 2012; Imhoff, Schmidt, Weib, Young, & Banse, 2012; Israel & Strassberg, 2009; Lippa, 2013; Lippa, Patterson, & Marelich, 2010; Lykins, Meana,& Kambe, 2006; Lykins, Meana, & Strauss, 2008; Nummenmaa, Hietanan, Santtila, & Hyona, 2012; Rieger et al, 2015; Rullo, Strassberg & Miner, 2015; Rupp & Wallen, 2009) and exclusively homosexual women demonstrating a category

specific female-bias (Ebsworth & Lalumiere, 2012; Lippa,2012; Rieger et al., 2015; Rullo, Strassberg, & Israel, 2010).

One exception to the consistent pattern of results that exclusively heterosexual women show a category non-specific response has recently been demonstrated (Dawson & Chivers, 2016). It differs from the attentional studies so far cited using a forced attention paradigm, which presents a pair of separate images presenting figures of either gender, rather than using a single image containing either a combination of male and female figures or a single male or female figure. Because the task and position of the image is structured such that attention can only be directed to one image or the other, biases in attention can be attributed to the gender of the target. Using this paradigm, Dawson and Chivers (2016) demonstrated a category specific bias to male targets among exclusively heterosexual women, and a parallel bias in subjective sexual attraction to male targets. However, these results only held for total viewing time; in the domain of initial fixations the previous category non-specific response was replicated.

A further study using exclusively heterosexual women as well as women of varying degrees of gynephilia replicated and extended these results (Dawson, Fretz, & Chivers, 2016). First fixation latency results mirrored previous studies, finding a category non-specific response for exclusively heterosexual women, and a category specific female-bias for women with a substantial degree of gynephilia. Replicating Dawson and Chivers (2016), however, later consciously controlled attention patterns, mirroring self reported subjective sexual attraction, found a category specific male bias among exclusively heterosexual women and a category specific female bias among women with a substantial degree of gynephilia. These results were interpreted to suggest that heterosexual women's category non-specificity is primarily driven by early automatic attentional processes, with later consciously controlled attentional processes

allowing for a category specific response. Put another way, heterosexual women's heterosexuality is driven by later attentional processes involved in engrossment and subjective sexual arousal, while their early attentional processes are "unoriented."

Male Bisexuality

If category specificity is the hallmark of heterosexual or homosexual sexual orientations, then someone with a bisexual orientation should show a category non-specific response. Several studies have used non-self report measures to try to establish such a response pattern. This research has focused mainly on bisexual men because of the complexity of the category specificity results obtained for women as just discussed, a complexity that makes interpreting a category non-specific response as characteristic of a bisexual orientation problematic. In contrast, heterosexual and homosexual men have shown an extremely consistent category specific response to their preferred sex in all domains (Chivers et al., 2004; 2007; 2010; Chivers & Timmers, 2012; Dawson & Chivers, 2016; Huberman & Chivers, 2015; Lippa, 2012; 2016; Rieger et al., 2005; 2015; Ronspies et al., 2015; Rullo et al., 2010; Suschinsky et al. 2009; Tollison et al., 1979; Wincze & Qualls, 1984) making a category non-specific response among bisexual men easier to interpret as reflecting their sexual orientation.

Such a category non-specificity has been found for bisexual men in several domains, including phallometry and attentional paradigms (Ebsworth & Lalumiere, 012; Lippa, 2013; 2016; Rosenthal, Sylva, Safron, & Bailey, 2012; Rullo et al., 2015; Stief, 2016). Notably, only two phallometric studies of bisexual men have been done to date and they provided conflicting results. One study found a male bias rather than category non-specificity (Rieger et al., 2005), and the later study found the expected category non-specificity (Rosenthal et al., 2012). The Rosenthal et al. (2012) study used approximately the same experimental paradigm as the Rieger

et al (2005) study but restricted bisexual participants to those who had strong bisexual attractions in the last year, at least two sexual partners of each sex, and a romantic relationship with partners of each sex. This conflicting evidence suggests that self-identified bisexual men consist of at least two populations, one showing a strong genital arousal to sexual stimuli of both sexes and the other not. The question of what distinguishes self-identified bisexual men who do not show a bisexual pattern of genital arousal from men who demonstrate exclusively heterosexual and homosexual orientations therefore presents itself.

Covert Attention and the Dot-Probe Task

An additional cognitive-behavioral measure of sexual orientation not yet discussed is the dot-probe task. The dot-probe task is a standard paradigm in cognitive psychology that can be used to measure an early stage of attentional processing known as covert attention (see Frewen, Dozois, Joanisse, & Neufeld, 2008). In it a fixation cross is presented first, followed by two stimuli, called cues, which appear at two points of equal distance from the fixation cross for a short period. In general, one cue is of theoretical interest and the other serves as a control. For example, the cue of interest might be an angry face, and the control cue a neutral face. The cue stimuli then disappear and in the location previously occupied by one of the cues a target stimulus called the probe appears, usually some type of dot. Participants are tasked with responding to some feature of the probe, such as its location, color, or form. If participants' covert attention has been captured by the cue, then they will respond faster and more accurately to probes which follow (Posner, 1980). The typical interpretation of the dot-probe task is that the two images in the cue compete for attention, and faster and more accurate response times will result when one stimulus gains more attention processing resources than the other. For fast cue duration times (200ms or less), these processes can be safely inferred to be entirely automatic, as

this is generally believed to be too fast for conscious deliberation to take place (Muller & Rabbitt, 1989).

Covert attention is theorized to be involved in the planning and execution of eye movements (Peterson, Kramer, & Irwin, 2004). Two types of eye movements are typically distinguished—fixations and saccades. Saccades can be either reflexive or voluntary, and involve the rapid switching of the fovea from one part of the visual field to another. Fixations are periods when the fovea remains fixed on one part of the visual field except for small partially random movements around a central fixation point. The large majority of information acquisition occurs during fixation (Henderson & Hollingworth, 1999) and visual attention corresponds with the area of fixation (Just & Carpenter, 1976). Information is acquired from peripheral vision, however, and plays a necessary role in the generation of the pattern of reflexive and voluntary eye movements involved in the perceptual processing of complex natural scenes (Henderson, 2003). Covert visual attention occurs when information from the peripheral visual field triggers a chain reaction that includes the rapid allocation of processing resources and a corresponding increase in neural activity to the neurons associated with that part of the visual field (Hillyard, Vogel, & Luck, 1998), followed by muscular contractions culminating in a reflexive saccade to that location (Deubel & Schneider, 1996; Hoffman & Subramaniam, 1995; Peterson et al.,2004)

Involuntary covert attention capture has been hypothesized to be particularly involved when stimuli are evolutionarily relevant, such as the abrupt-onset of a new object signaling a sudden and potentially dangerous change in the environment (Theeuwes, Kramer, Hahn, & Irwin, 1998). Abrupt-onset is likely driven purely by low-level perceptual features such as luminance (Yantis & Hillstrom, 1994), but involuntary attention capture has been demonstrated for more complex evolutionarily relevant stimuli such as angry faces (Mogg et al., 2007) or

potentially threatening animals such as snakes (Ohman, Flykt, & Esteves, 2001). Because automatic covert shifts of attention are designed to precede an overt saccade, eye tracking studies that measure the direction of the first saccade and fixation provide relevant data. For example, it has been found that images containing both positive and negative emotional content received more initial fixations than neutral control images (Calvo & Lang, 2004; Nummenmaa, Hyona, & Calvo, 2006). These more complex stimuli require the involvement of brain regions involved in object recognition (Duebel & Schneider, 1996). Object recognition has been found to occur rapidly, with a minimum of 50-80ms of processing time being sufficient (Kirchner & Thorpe, 2006), and to occur for objects presented in peripheral vision, although performance diminishes rapidly the further in the periphery the object is presented due to poor resolution of spatial detail (Thorpe, Gegenfurtner, Fabre-Thorpe, & Bulthoff, 2001).

It has been argued that this process of natural scene perception has necessarily been shaped by natural selection to preferentially and rapidly detect and respond to evolutionarily relevant stimuli in the environment (Ohman et al., 2001). In general, there is substantial evidence that the emotional content of stimuli guide selective attention and enhance processing (Bradley et al., 2003; Junghofer, Schupp, Stark, & Vaitl, 2005; Sabatinelli, Bradley, Fitzsimmons, & Lang, 2005). Lang and colleagues have argued that the presentation of emotional stimuli engage motivational systems and have presented evidence to that effect in the form of autonomic responses, the modification of the startle response, as well as self reports (Lang, Bradley, & Cuthbert, 1998c). In particular, it has been argued that selective pressure would be strongest for stimuli that represent danger, as these most require a rapid response. Thus, the dot-probe task has been used to test for the automatic capture of covert attention by threatening stimuli (Lipp & Derakshan, 2005; Mogg & Bradley, 1999; Mogg et al., 2007; Ohman et al., 2001).

Similarly, the information processing model of sexual response hypothesizes the existence of a processing stage where sexually relevant perceptual features are selected and automatically trigger attentional allocation (Barlow, 1986; Janssen et al., 2000). It has been established that even sexual stimuli presented so briefly that they are not consciously perceived can affect later sexual response, indicating that neural structures exist which are specialized for the early detection and processing of sexual stimuli (Janssen et al, 2000; Spiering, Everaerd, & Elzinga, 2002). Given that sexual behavior is central to inclusive fitness, it is plausible that sexual stimuli are prioritized in natural scene perception in a way similar to threatening stimuli (Anokhin et al, 2006), although the need for rapid response is less than in the case of potential threats. As with threat avoidance, sexual desire represents a motivational state to facilitate the behaviors appropriate for taking advantage of the biologically relevant part of the environment being sensed (i.e. a sexually attractive member of the same species). In both cases attention needs to be directed toward biologically relevant stimuli and the organism prepared for action (Lang, Bradley, & Cuthbert, 1997). Consistent with this, in measures of skin conductance and startle response the largest effects were found for threat stimuli and erotic stimuli, supporting the central importance of biological relevance (Bradley et al., 2001). It has also been argued that the fast and automatic genital arousal measured in most participants represents this sort of "gearing up" of the body, even before conscious awareness of motivation comes into play (Janssen, Prause, & Geer, 2000).

This raises the question of whether people with different sexual orientations select sexually relevant perceptual features differently, or if differential patterns of sexual response occur at later stages of the sexual response cycle. In the context of investigating the physiological and behavioral characteristics of sexual orientation, we can therefore ask whether these early

attentional processes are “oriented” toward men, women, or both. Or, alternatively, early attentional processes might respond to any type of sexual content, with only later stages responding preferentially to one sex or the other. If, therefore, covert attention capture were demonstrated to be “oriented” by sexual orientation, the brain regions involved in such rapid object recognition may be inferred to be part of the “endophenotype” of sexual orientation (Ponseti et al., 2006).

The Dot Probe Task and Sexual Orientation

There have been three studies that have used sexual stimuli as cues in the dot-probe task (Prause, Janssen, & Hetrick, 2008; Kagerer et al., 2014; Snowden, Curl, Jobbins, Lavington, & Gray, 2016). By analogy to other evolutionarily relevant stimuli such as threat, sexually attractive images should attract attention and therefore enhance reaction time and accuracy to probes which follow them. However, contrary to this logic, the first such study (Prause et al., 2008) found that the detection of probes following a sexual cue was in fact slower than those following a neutral cue. In addition, this effect was enhanced among individuals reporting higher sexual desire, and for more intense stimuli showing actual intercourse rather than nudes. Furthermore, these effects held for both men and women, and no sex differences were detected.

Slower reaction times to probes following preferred sexual cues are consistent with a previously documented phenomenon termed the *sexual content induced delay effect* (Geer & Bellard, 1996; Wright & Adams, 1994). Studies demonstrating these effects typically pair a sexual stimulus with some unrelated task. Impairments in task performance are interpreted as attentional adhesion or engrossment to the sexual stimulus to the detriment of the task. However, in these studies, the task to be performed and the sexual stimuli are presented simultaneously, while in the dot-probe task the sexual cue precedes the dot-probe detection task by some latency

interval. Both Prause et al. (2008) and Kagerer et al (2014) used a cue to target interval of 500ms, which is the most commonly used interval in dot-probe experiments, while Snowden et al. (2016) use a shorter cue to target interval of 200ms. An appropriate cue to target interval should allow processing resources that are taken up by adhesion and engrossment to the sexual cue to be reallocated to the dot-probe detection task, while still being prioritized to that part of the visual field and thus enhancing target detection.

Contrary to Prause et al. (2008), the second study by Kagerer et al. (2014) found that participants responded faster to probes following images of sexual activity including both a man and a woman than to a neutral cue. Both Prause et al. (2008) and Kagerer et al. (2014) used a sexual cue consisting of men and women engaged in sexual activity, paired with a neutral cue. They were testing, therefore, the capture of attention by sexual stimuli per se, rather than the differential capture of attention by male versus female targets. The third paper by Snowden et al. (2016) is the only dot-probe study to date to use a pair of separate images of men and women as cues. In this scenario, a participant with a heterosexual or homosexual orientation is predicted to respond to their sexually preferred sex as the evolutionarily relevant cue, with the non-preferred sex functioning as the neutral cue. Snowden et al. (2016 [Study 1]) applied this paradigm to a sample of heterosexual men and women and found that heterosexual men responded faster to probes following images of women than to those following images of men. No difference in reaction time was found for heterosexual women. This result is consistent with Kagerer et al. (2014) in replicating the enhanced reaction time for evolutionarily relevant stimuli established in the dot-probe literature, and contrary to Prause et al. (2008), in not detecting a sexual content induced delay effect. It also replicates previous category specificity findings, with heterosexual men showing a category specific response and heterosexual women showing a non-category

specific response. Additionally, while the Kagerer et al. (2014) study was not able to test for category specificity directly, the fact that a dot-probe effect was detected for men and not for women is consistent with the category specificity literature.

To clarify the source of this sex difference, Snowden et al. (2016 [Study 2]) conducted a second experiment using three sets of cues, one with male and female images, one with a male image and a neutral image, and one with a female image and a neutral image. This is distinct from Prause et al. (2008) and Kagerer et al. (2014), both of which paired images of sexual activity including a man and a woman to a neutral image, as well as the first experiment reported in Snowden et al. (2016), which used pairs of images of individual men and women. Consistent with the first experiment, they found that heterosexual men responded faster to probes following the female image in the male-female condition as well as the female-neutral condition, and that no effect existed in the male-neutral condition. Contrary to the first study, however, heterosexual women were found to respond significantly faster to probes following female images than to those following male images in the male-female condition. In the male-neutral condition there was a non-significant trend in the direction of a faster response following male images (7.8ms, $p = .08$), and a larger significant effect in the female-neutral condition (22.1 ms, $p < .01$). Thus, surprisingly it appears that heterosexual women have their attention captured preferentially by women, despite this being their non-preferred sex. The self-identified heterosexual sample described in Snowden et al. (2016 [Study 2]) behaves similarly to previous studies, which found that any level of gynephilia in women was associated with a category specific female-bias (Bouchard et al, 2015; Chivers et al., 2015; Timmers et al., 2015). These three studies thus provided mixed evidence for use of the dot-probe task as a measure of sexual orientation— with Prause et al. (2008) finding longer reaction times to sexual stimuli and Kagerer et al. (2014) and

Snowden et al. (2016) finding shorter reaction times—consistent with previous dot-probe studies using fearful stimuli (Mogg et al., 2007; Ohman et al., 2001).

The present study applies the dot-probe paradigm utilized by Snowden et al. (2016) to a broader sample of sexual orientation, including heterosexual, bisexual, and homosexual men and women. Given that Prause et al. (2008) and Kagerer et al. (2014) used similar stimuli and cue to target intervals, it is unclear what caused the discrepancy in their results. However, the replication of Kagerer et al. (2014) by Snowden et al. (2016) and its overall consistency with previous dot probe literature leads us to predict faster reaction times following preferred sexual cues for sexual orientation groups that have previously shown strong category specific effects, i.e. heterosexual and homosexual men and homosexual women. Bisexual men are predicted to demonstrate a category non-specific response. Despite reporting sexual attraction to both men and women, based on the findings described above bisexual women are predicted to demonstrate a female-biased category specific response, but one which is weaker than those for heterosexual men and homosexual men and women. For heterosexual women the preponderance of evidence suggests that a category non-specific response is to be expected, however a female bias as in Snowden et al. (2016 [Study 2]) is also plausible.

Method

Participants

Participants were recruited from the campus of a large university in Western New York State. Recruitment occurred via flyers, mailing lists, and in-class announcements advertising for volunteers to take part in a study on human sexuality. Participants were graduate and undergraduate students of age 18 or older, and they were compensated $20 for participation. Gay, lesbian, and bisexual participants were oversamples to achieve an adequate sample size for each group. Sexual minority groups were targeted for recruitment in advertising for the study, and once an adequate sample of straight-identified men and women was achieved such participants were excluded from participation.

On arrival at the laboratory, participants read a consent form explaining that they would be asked to view and respond to sexually explicit pictures, as well as to fill out a short survey of demographic information. After being given an opportunity to ask questions, participants signed a consent form. Participants were then asked to confirm that they were right-handed and had normal vision in both eyes. If they answered no to either question, they were excluded from further participation. Participants then completed the questionnaire measures.

Ninety-six participants completed the study. Three participants were excluded for excessive (> 25%) incorrect responses, and five for excessive eye movements away from the fixation cross (> 25%). Data from an additional ten participants was lost due to computer error. The final sample size was 78 (41 men and 37 women). Participants reported their sexual orientation on a 7-point Kinsey scale consisting of 1 (exclusively heterosexual), 2 (mostly

heterosexual), 3 (bisexual leaning heterosexual), 4 (bisexual), 5 (bisexual leaning homosexual), 6 (mostly homosexual), and 7 (exclusively homosexual).

In order to achieve statistically adequate sub-sample sizes for each sexual orientation identity group, Kinsey scores 1-2 were combined to form a heterosexual group, 3-5 a bisexual group, and 6-7 a homosexual group. The sub-sample sizes for participants endorsing each Kinsey score and for the three consolidated sexual orientation identity groups are presented in Table 3.1. Mean age and Kinsey Score for each sexual orientation group are presented in Table 3.2.

Table 3.1 *Sub-Sample Sizes for Self Reported Sexual Orientation Identity on a 7-Point Kinsey Scale and 3-Point Consolidation Used For Statistical Analyses*

	Men	Women		Men	Women
	n	*n*		*n*	*n*
1. Exclusively Heterosexual	13	8	Heterosexual	18	16
2. Mostly Heterosexual	5	8			
3. Bisexual Leaning Heterosexual	5	9	Bisexual	10	11
4. Bisexual	1	1			
5. Bisexual Leaning Homosexual	4	1			
6. Mostly Homosexual	2	5	Homosexual	13	10
7. Exclusively Homosexual	11	5			
Total	41	37			

Table 3.2 *Mean (SD) Age and 7-Point Kinsey Score for Consolidated 3-Point Sexual Orientation Identity Groups*

	Age	Kinsey Score
	M (*SD*)	*M* (*SD*)
Men		
Heterosexual	24.11 (5.11)	1.28 (.46)
Bisexual	28.80 (14.70)	3.90 (.99)
Homosexual	23.62 (4.33)	6.85 (.38)
Women		
Heterosexual	20.50 (2.68)	1.50 (.52)
Bisexual	20.09 (1.64)	3.27 (.65)
Homosexual	24.50 (5.32)	6.50 (.53)

Stimuli and apparatus

Five hundred male pictures and five hundred female pictures were gathered from pornographic websites. Each picture featured one nude person. Pictures were selected according to the following criteria: a vertical orientation, a neutral upright posture, complete nudity, performing no action and holding no objects, and no unusual backgrounds. Five hundred pairs of male and female pictures were created, with each pair approximately matched for luminance.

All stimuli were presented on a computer screen (refresh rate 80 Hz; resolution of 1280 x 1200 pixels). The experiment was conducted in a sound-attenuated laboratory with a low level of background luminance. The E-Prime program (Schneider, Eschman, & Zuccoloto, 2002) was used to present the stimuli and record the responses of the participants.

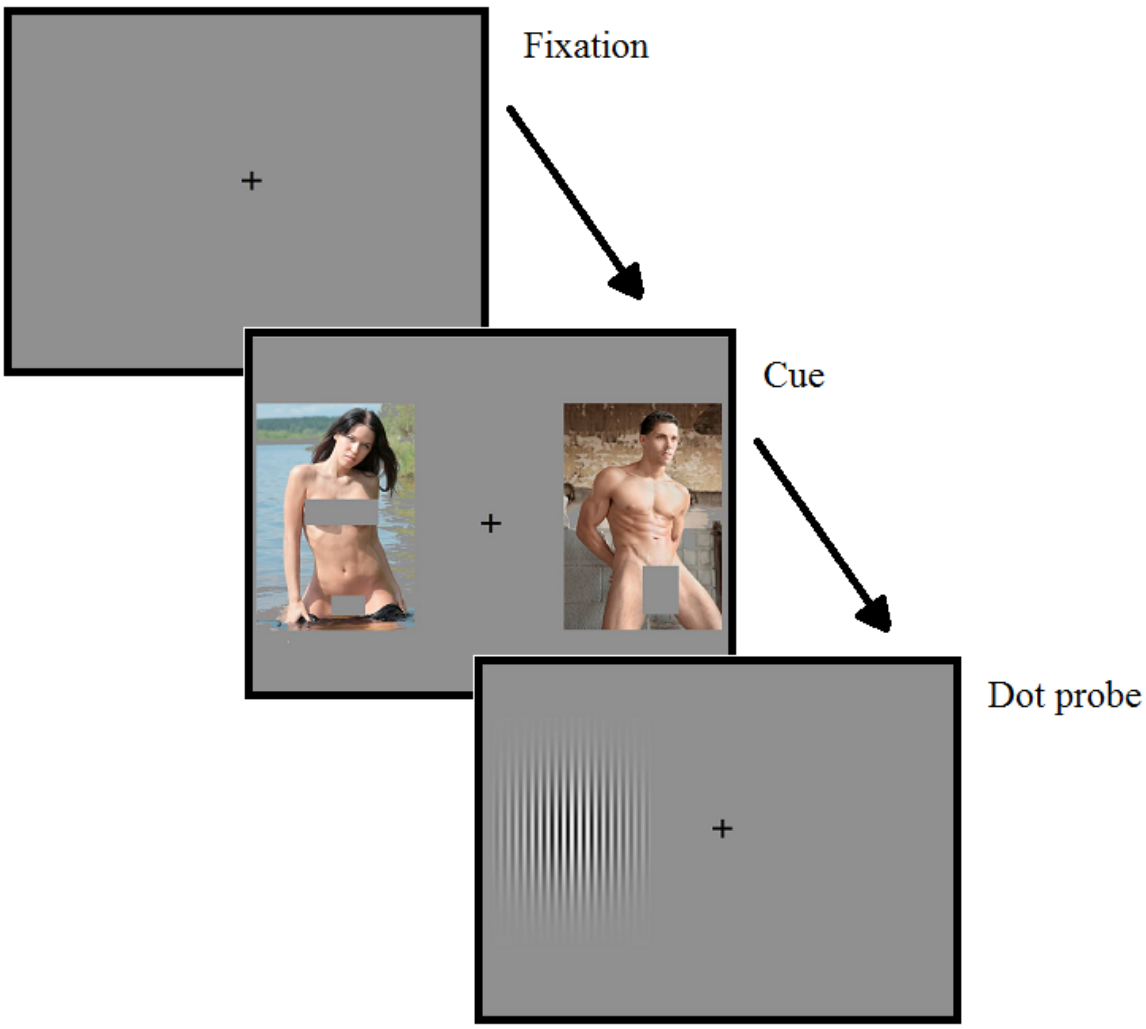

Figure 3.1. Depiction of events in a dot-probe trial.

Figure 3.1 illustrates the stimulus sequence. A black fixation cross was presented at the center of a uniform grey background (40 cd/m^2) throughout each trial. Each trial began with display of the fixation cross for 500ms +/- 50ms of random jitter. Following this, a cue display was presented for 100ms consisting of a pair of male and female pictures (each 12.6° width x 18.9° height) presented at 10° of eccentricity to the left and right of fixation. The left or right

position of the male and female pictures was randomized. After a 50ms gap in which only the fixation cross was displayed, a probe consisting of a single vertically oriented Gabor patch (9.45° Gaussian-enveloped sinusoidal grating) was presented either to the left or right of fixation at 10° eccentricity.

Procedure

The experiment consisted of 1000 trials, with the first 10 trials used for training purposes and not included in analyses. Each of the 500 pairs of male and female images was therefore presented twice in random order, with the left or right position of each pair also randomized. Participants viewed the display at a distance of 60cm, with their heads stabilized by a chin rest. They were asked to keep their gaze on the fixation point throughout the trial. The task required the participant to signify the location (left vs. right) of the probe. If the probe was to the left they pressed the left “CTRL” key on the computer keyboard; if the probe was to the right they pressed the right “ALT” key. The probe remained until a response was made or to a maximum duration of 1000ms. If the participant had not responded in that time, the experiment proceeded to the next trial. For trials in which no probe appeared, the fixation cross was presented alone for 500ms before proceeding to the next trial. Reaction time and accuracy were recorded. No feedback on performance was given after each trial.

Participants were asked to try not to blink during trials. To help them to not blink, a blank rest screen appeared after every four trials. On a rest screen participants could proceed immediately by pressing the “SPACE” button on the keyboard, or take time to close their eyes and rest before proceeding.

Statistical Analysis

The raw RT data was trimmed by removing trials with RTs faster than 200ms. Trials were capped at 1000ms. If participants did not respond within 1000ms the experiment proceeded to the next trial and no RT was recorded. Therefore there was no need to remove unusually slow RTs. Trials in which participants incorrectly located the target were coded as errors. One participant was excluded from further analysis due to excessive error rates (> 25% of trials). Because the experiment was designed to assess covert attention it was necessary to remove trials in which participants shifted their gaze from the fixation cross to the probe, because this would indicate overt rather than covert attention. Eye movements were detected using electrooculograph recordings taken from four electrodes placed around the eyes. Five participants were excluded from further analysis due to excessive eye movements (> 25% of trials). Prior to analysis trials, were removed which contained errors (M = 2.8%, SD = 3.8, range = .01-21.4%), or eye movements (M = 2.3%, SD = 3.2, range = 0-16.3%).

If the probe followed a female sexual cue, the trial was labeled female concordant, if the probe followed a male sexual cue, the trial was labeled male concordant. In one third of trials the probe appeared on the left, in a third it appeared on the right, and in a third no probe appeared. Probe position and absence varied randomly from trial to trial. Trials in which no probe appeared were not included in any analyses.

We used R Version 3.3.2 (R Core Team, 2016) and *lme4* (Bates, Maechler, Bolker, & Walker, 2015) to perform a linear mixed effects analysis of differences in reaction time between sexual orientation groups. As fixed effects, we entered the gender of the participant (male/female), the sexual orientation identity group of the participant (heterosexual/bisexual/homosexual), the age of the participant, the visual hemifield the probe

appeared (right/left), the gender concordance of the trial (male/female), and a three way interaction between participant sex, participant sexual orientation, and trial gender congruence. Age was included as it has been found to be associated with increased reaction times (MacDonald, Nyberg, Sandblom, Fischer, & Backman, 2008). As random effects, we had intercepts for participant ID and trial number. Random slopes were not included in the model. P-values for fixed effects were obtained using the *lmerTest* package with denominator degrees of freedom estimated using the Satterthwaite approximation (Kuznetsova, Brockhoff, & Christensen, 2016). Interactions were interpreted with contrasts performed using the *lsmeans* package (Lenth, 2016).

Linear mixed effects models have increased in usage recently for reaction time studies as they possess several advantages over traditional approaches that aggregate trials over subjects and/or items (Baayen, Davidson, & Bates, 2008; Baayen & Milin, 2010). Most importantly, linear mixed effects models allow for variability resulting from individual differences between participants to be accounted for in the model, increasing statistical power (Baayen & Milin, 2010). Linear mixed effects models also have the advantage of allowing for trial-by-trial sequential effects to be accounted for, such as increased reaction times due to fatigue, or decreased reaction times due to task learning, facts that would violate the independence assumption of the general linear model were it applied at the trial level (Welford, 1980; Sanders, 1998).

Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity, but substantial deviations from normality were present, as is typical of reaction time data which has a positively skewed distribution (Whelan, 2010). To account for this, the log transformation of reaction time was computed. However, because transformation can alter the

relative impact of early and late components of the reaction time distribution (Ratcliff, 1993), all analyses were performed on both transformed and untransformed data.

Results

The results of the linear mixed effects model are displayed in Table 3.3. The linear mixed effects model showed a significant three-way interaction between participant sex, participant sexual orientation, and trial gender congruence (untransformed: $F(2,47786) = 19.49$, $p < .001$, log transformed: $F(2,47728) = 20.10$, $p < .001$), indicating that sexual orientation groups had significantly different reaction times for male and female congruent trials. Note that in the presence of a significant three-way interaction, lower order effects are not interpretable. There was no significant effect of participant age or probe hemifield presentation. The pattern of significant effects was identical for the untransformed and log transformed models.

Table 3.3. *Linear Mixed Effects Analyses for Untransformed and Log Transformed Reaction Times in Milliseconds*

	Untransformed RTs							Log Transformed RTs						
Variable	Estim.	*SE*	*df*	*t*	*p*	Var.	*SD*	Estim.	*SE*	*df*	*t*	*p*	Var.	*SD*
Fixed effects														
Intercept	414.00	28.25	71	14.65	< .001			6.00	.07	71	88.10	< .001		
Gender – Female (G-F)	-18.36	21.44	71	-.86	.39			-.04	.05	71	-.81	.42		
Congruence – Male (C-M)	1.50	1.75	47750	.86	.39			.00	.00	47720	.11	.92		
Sex. Ori. – Het. (SO-Het)[a]	-12.18	18.62	72	-.66	.51			-.02	.04	71	-.46	.65		
Sex. Ori. – Hom. (SO-Hom)[a]	-1.31	19.88	71	-.07	.95			.00	.05	71	.03	.98		
Age	-.05	.84	71	-.06	.95			.00	.00	71	.06	.95		
Probe Hemifield – Right	-.03	.63	47740	-.05	.96			-.00	.00	47700	-.77	.44		
G-F*C-M	.79	2.41	47760	.33	.74			.00	.01	47730	.89	.37		
G-F*SO-Het	-9.53	26.00	72	-.37	.72			-.03	.06	71	-.44	.66		
G-F*SO-Hom	-7.00	29.11	71	-.24	.81			-.02	.07	71	-.24	.81		
C-M*SO-Het	7.84	2.20	47760	3.57	< .001			.02	.01	47730	4.08	< .001		
C-M*SO-Hom	-8.51	2.31	47750	-3.68	< .001			-.02	.01	47720	-3.53	< .001		
G-F*C-M*SO-Het	-7.03	3.09	47770	-2.27	.02			-.02	.01	47740	-2.37	.02		
G-F*C-M*SO-Hom	11.65	3.32	47750	3.51	< .001			.03	.01	47720	3.51	<.001		
Random effects														
Participant						2112.47	45.96						.01	.11
Trial number						29.64	5.44						.00	.01
Residual						4690.07	68.48						.02	.15

Note. Degrees of freedom are calculated using the Satterthwaite approximation. *SE* = standard error.
[a] The reference group for sexual orientation is bisexual.

Given the significant three-way interaction, contrasts were used to test for significant differences to male and female congruent trials within sexual orientation groups. Contrast results are displayed in Table 3.4.

Table 3.4. *Female Congruent – Male Congruent Untransformed and Log Transformed Reaction Time Contrast Estimates in Milliseconds*

	Untransformed RTs					Log Transformed RTs				
Group	Estimate	*SE*	*df*	*t*	*p*	Estimate	*SE*	*df*	*t*	*p*
Men										
Bisexual	-1.50	1.75	47754.13	-.86	.39	-.00	.004	47721.48	-.11	.91
Heterosexual	-9.34	1.33	47735.80	-7.02	< .001	-.02	.003	47700.55	-6.87	< .001
Homosexual	7.01	1.52	47748.82	4.62	< .001	.02	.003	47715.28	5.25	< .001
Women										
Bisexual	-2.29	1.66	47749.80	-1.38	.17	-.01	.004	47716.48	-1.40	.16
Heterosexual	-3.11	1.41	47732.01	-2.21	.03	-.01	.003	47697.77	-2.83	< .01
Homosexual	-5.43	1.71	47737.15	-3.18	< .01	-.01	.004	47702.89	-.3.41	< .001

Note. Negative estimates indicate faster reaction times to female-congruent probes in milliseconds. Results are averaged over right and left probe hemifield presentation. Degrees of freedom are calculated using the Satterthwaite approximation. *SE* = standard error.

Results were broadly consistent with predictions. Heterosexual and homosexual men showed significant category specific responses, with heterosexual men responding significantly faster to female congruent trials, and homosexual men responding significantly faster to male congruent trials. Bisexual men showed a category non-specific response, and did not differ significantly in their response to male and female congruent trials. Homosexual women demonstrated a significant category specific response, responding faster to female congruent than male congruent trials.

However, inconsistent with prediction, heterosexual women demonstrated a significant category specific response *away* from their preferred sex, instead responding faster to female

congruent trials than male congruent trials. Results did not differ in significance between untransformed and log transformed models.

Discussion

The results of the present study almost entirely confirmed hypotheses. The present study is the first to apply the dot-probe task to sexual minority populations. Results for these populations were as predicted by the typical interpretation of the dot-probe task, in which sexually preferred stimuli automatically capture covert visual attention and enhance task performance for probes appearing in the part of the visual field occupied by the preferred sexual cue. As predicted, homosexual men were similar to heterosexual men in showing a strong category specific response to their preferred sex of approximately the same effects size. Homosexual women also followed the predicted pattern in showing a significant but weaker category specific female bias. Contrary to previous results that bisexual men respond similarly to gay men, results for bisexual men replicated those documenting a characteristically bisexual pattern of response.

The results from the only previous study to test for automatic covert attention capture using cues of a single sex (Snowden et al., 2016) were replicated for heterosexual men and partially replicated for heterosexual women. Interestingly, the present study replicated Snowden et al. (2016 [Study 2]), which paired female images with neutral controls, in finding that heterosexual women show a category specific female bias. This is somewhat surprising, because the experimental procedure used in the current study is approximately identical to that used in Snowden et al. (2016 [Study 1]), which joined virtually all previous research in other response domains in finding that heterosexual women showed a category non-specific response (Bouchard

et al., 2015; Chivers et al., 2007; 2015; Rieger et al., 2016; Timmers et al., 2015). Consistent with the general tendency toward category non-specificity, however, the category specific effect for heterosexual women found in the present study and Snowden et al. (2016 [Study 2]) was substantially weaker than that found for men.

One explanation for this finding may be that the sampling procedures used in the present study and Snowden et al. (2016) were not sufficient to exclude women with some level of gynephilia from the "exclusive" heterosexual women category. In the present study, the need to achieve adequate sub-sample size necessitated combining participants with exclusively heterosexual Kinsey scores with participants reporting minimal levels of gynephilic attraction, a population argued to be distinct from exclusive heterosexuals (Savin-Williams & Vrangalova, 2013). The present results would thus be consistent with previous studies finding that women with any level of gynephilic attraction demonstrated a category specific female bias (Bouchard et al, 2015; Chivers et al., 2015; Timmers et al., 2015). However, this conclusion is contradicted by the finding that bisexual women, who reported a greater level of gynephilic attraction, did not show a similar female bias. Alternatively, the female bias demonstrated by the heterosexual women in the present study may not result from sexual attraction, but rather from an alternate source such as the need for social comparison (Tiggerman & McGill, 2004).

Because the cue duration time in the present experiment was extremely short (100ms), it can be assumed that the processes involved in the evaluation of the male and female images and the preferential allocation of processing resources toward the sexually preferred image occurs entirely automatically. The dot-probe paradigm using short cue durations is thus a method for tapping into the automatic attention capture stages of the information processing model of sexual response hypothesized by Janssen et al. (2000). The present study provides further evidence for

the validity of the dot-probe task assessing how a person's attention is automatically captured by a particular type of sexual stimulus. It thus has potential for use in forensic contexts where a person may be motivated to conceal the object of their sexual attraction, such as in cases of pedophilia (e.g., Snowden, Craig, & Gray, 2011).

These results join Snowden et al. (2016) and Kagerer et al. (2014) in failing to replicate the sexual content induced delay effect demonstrated by Prause et al. (2008) in the dot-probe task. As previously noted, while the Prause et al. (2008) results are consistent with the sexual content induced delay literature, the dot-probe task differs in important ways from those that demonstrated the sexual content induced delay effect (Wright & Adams, 1994; Geer & Bellard, 1996). In sexual content induced delay studies the target to be detected appears superimposed over the sexual stimulus. In contrast, in the dot-probe paradigm, the sexual cue stimulus end, followed by a cue-to-probe interval of some length, followed by the probe. The continued presence of the sexual stimulus would continue to engage attention, reducing the processing resources available for probe detection. In the dot-probe paradigm the prioritization of processing resources allocated to the area of the visual field previously occupied by the sexual stimuli is sustained long enough to enhance probe detection without interfering with it by continuing to adhere attention to itself.

It is plausible that more intense sexual cues and shorter cue to target durations would allow for greater attentional adhesion and engrossment and therefore impaired rather enhanced task performance in the dot-probe task. However, the contradiction between Prause et al. (2008) and Kagerer et al. (2014) is not well explained by this, as the experimental parameters utilized in both studies are extremely similar. Both use similar sexual cues consisting of male-female pairs at varying levels of sexual explicitness, both use the same cue to target duration of 500ms, and

both use probes of similar detection difficulty. Because the sexual cues used in the present study and Snowden et al. (2016) consist of solitary male and female figures, they are likely to be less arousing than the male-female pairs engaged in explicit sexual activity used in Prause et al. (2008) and Kagerer et al. (2014) and therefore less likely to elicit attentional adhesion and engrossment. In addition, the cue duration in the present study was also extremely short (100ms), decreasing the intensity as a sexual stimulus and decreasing the likelihood of attentional adhesion.

In explaining their finding of a delayed response in the dot-probe task, Prause et al. (2008) note that many of the evolutionary relevant stimuli used in previous dot-probe studies had a negative emotional valence, such as angry faces (Mogg et al., 2007) or threatening animals (Ohman et al. 2001). They argue that in cases where the cue stimuli were positively valenced, the biases have been toward prolonged rather than shorter response times, citing two studies, one comparing smokers and non-smokers response to images of people smoking (Hogarth, Mogg, Bradley, Duka, & Dickinson, 2003) and one comparing people with varying levels of sensitivity to food cues to food related words (Johansson, Ghaderi, & Andersson, 2004). In Hogarth et al. (2003), heavy smokers were found to respond more slowly to probes following images of people smoking compared to a neutral control. Johansson et al. (2004) divided participants into high and low scoring groups on a measure of tendency to eat whatever is in the environment regardless of satiety, a trait associated with obesity, and found that high scorers responded more slowly to food-related words than to neutral words. Prause et al. (2008) interpreted both results as confirming that positive stimuli valence is associated with longer rather than shorter response times in the dot-probe task. However, Prause et al. (2008) failed to note that both studies did succeed in demonstrating faster response times for smokers and light smokers (Hogarth et al.,

2003), and for those scoring low on the obesity-related measure (Johansson et al., 2004), and the stimuli is positively valenced for these groups as well. Therefore, the dot probe literature, prior its application to sex research, does provide evidence that positively valenced stimuli capture attention in the same way that negatively valenced stimuli does.

Given these findings, a more plausible explanation for the slower reaction times in the case of heavy smokers and high scorers on the obesity related measures is that they actively train themselves to direct their attention away from stimuli that they know are causing them health problems. It is worth noting that these findings are cause for reservations when inferring that because the type of attention capture measured by the dot-probe task is not under direct volitional control that it cannot be influenced by extended training. In a forensic context, it is plausible that a person with socially undesirable sexual desires could actively train themselves to direct their attention away from the object of their sexual attraction in a way that would nullify the dot-probe effect. This is in contrast to their ability to consciously choose to affect the outcome of single trials, which remain too fast for deliberative reasoning to take place.

Limitations and Future Research

Future research could seek to bridge measures of covert attention capture such as the present study with those recording initial saccades to sexual targets using eye tracking. An intermediate mechanism that may prove useful are microsaccades, which are small random displacements of the retinal image when viewing a stationary scene that have been found to be biased in the direction of a future saccade in concert with covert attention (Engbert & Kliegl, 2003). These microsaccade patterns have the advantage of being totally immune to conscious control, unlike gaze patterns which are controlled by a combination of automatic and consciously

controlled processes (Engbert & Kliegl, 2003). Future research on the early time course of the processing of visual stimuli could further pinpoint the neural substrate of this sexual discrimination process using techniques with a high degree of temporal sensitivity, such as electroencephalography (Feng, Wang, Wang, Gu, & Luo, 2012).

Another area of promising research is the investigation of within-sex differences among women at different periods of fertility associated with differing hormone levels. Women have been shown to be more "oriented" when they are at the peak of their fertility; for example, research on gaze patterns found that women at peak fertility look more at genitals than faces or background features when compared to both men and women using contraceptives (Rupp & Wallen, 2007). The extension of this research into the dot-probe domain would be of interest when applied to women of varying androphilic and gynephilic attraction levels.

Having established the basic validity of the dot-probe task for studying sexual response by replicating the results of Snowden et al. (2016) for heterosexual men and women and extending them to homosexual and bisexual orientations, the stage is now set for future research to investigate the effect of variations in the parameters used. The effect size demonstrated in the present study was approximately the same (~10ms) to that found in Kagerer et al. (2014), but much smaller than the ~100ms effect produced by Snowden et al. (2016). Prause et al. (2008) does not provide raw reaction time scores and so cannot be compared. The larger effect size produced by Snowden et al. (2016) is likely due to experimental parameters such as task difficulty and differing cue to target intervals. Snowden et al. (2016) used a smaller probe that contrasted less with the background than the relatively large Gabor patch used in the present study, and the performance enhancement due to covert attention capture is likely to have a greater impact under more challenging task conditions (Snowden, Wiley, & Muir, 2001). Kagerer

et al. (2014) used a similarly small probe to Snowden et al. (2016), but their substantially longer cue to target interval (500ms) when compared to Snowden et al. (200ms) and the present study (100ms) is likely to have led to a weaker effect. Future research should minimize cue to target interval and maximize task difficulty in order to increase power. Further variations in cue durations could be examined systematically. Future research could vary the perceptual characteristics of the probe such as size and luminance. In addition, in the studies discussed so far, participants were tasked with merely detecting the location of the probe. Additional experiments could instead use tasks such as detecting the orientation of a bar (e.g. vertical or horizontal), or many others of varying degrees of difficulty.

The present study was not able to achieve sufficient sample size to distinguish women with exclusively heterosexual attractions, typically found to be category non-specific, from those with minimal gynephilic attractions, who tend to show a category specific female bias in several response domains. Future research using the dot-probe task paradigm should employ more stringent sampling criteria to distinguish between these two groups, and utilize the neutral control paradigm used by Snowden et al. (2016 [Study 2]) to clarify this issue.

One limitation of the present study is that, while it may be reliably inferred that attention has been allocated preferentially to one sex or the other when a dot-probe effect is detected, the present data do not tell us why this allocation occurred. The information processing model of sexual response predicts such an attentional allocation as part of the way that animals detect potential mates in a natural environment and focus their attention on those mates as part of the initiation of the positive feedback loop of sexual arousal leading to copulation (Janssen et al., 2000). However, alternative hypotheses may be put forward, such as the idea that heterosexual men find male genitals disgusting and their attention is repelled by the male image, which makes

it appear as if the female image was capturing their attention. Future research will be necessary to distinguish between these hypotheses.

The present study did not gather data on how attractive participants found each image. Previous research found sex differences in the category specificity of the level of sexual attraction reported in response to images of nude men and women, with women tending to rate both males and females similarly regardless of sexual orientation (Bradley, Codispoti, Sabatinelli, & Lang, 2001). Thus, the effects produced in dot-probe paradigm experiments may be driven by differences in the extent that men and women actually find the images sexually attractive, with the level of sexual attraction being the impetus behind the capture of attention. Future research could address this point by either explicitly varying the attractiveness level of the men and women presented or by simplifying the stimuli (e.g., to an outline) to an extent sufficient for object recognition but not attractiveness evaluation.

However, given the short cue durations utilized in both the Snowden study (200ms) and the present study (100ms), it may be that there is insufficient time for attractiveness evaluation to occur and therefore what is happening is a sort of object-recognition process where the images are simply categorized as male or female. In the present study, it was assured that the sexual cue was only processed through peripheral vision by using an electrooculograph to detect eye movements and exclude trials where they were detected. This is in contrast to the three other dot-probe studies using sexual cue stimuli, which did not explicitly control for eye movements. Human vision is only able to perceive fine details within two degrees of central vision focused on the foveal region of the retina (Rayner & Pallatsek, 1992). Therefore, it is unlikely that the differential processing of sexual stimuli demonstrated in the present study is the result of processes such as attractiveness judgments, which are dependent upon fine details. The

assessment of sexual attractiveness typically involves fixating the gaze on the target, extended gaze duration, and a characteristic pattern of saccades around the body and face (Fromberger et al., 2012; Lykins, Meana, & Kambe, 2006). In light of the briefness of the cue duration used in the present experiment, this suggests that there are rapid object-recognition processes occurring that quickly determine whether a perceived object is a male or a female based on a global visual gestalt based on gross perceptual features of the figure, evaluated in terms of global similarity to preferred sexual targets stored in memory (Blanchard, Kuban, Blak, Klassen, Dickey, & Cantor, 2012).

It should also be noted that the use of erotic images, which are natural biologically relevant visual stimuli, as "cues" in this experiment represents a recent trend in the study of visual processing toward ecological validity and an attempt to understand the complexity of visual processing, rather than simplifying the design as much as possible (Felsen & Dan, 2005). While simplified designs are useful for clarity and focus, this expansion into natural stimuli represents an important step, particularly with regard to understanding the role of motivation and emotion in perception (Lang et al., 1998; Cuthbert et al., 2000).

In general, the present results provide support for the idea that the mechanisms underlying sexual orientation are asserting themselves at the level of the capture and maintenance of attention. It has been argued that a single attentional mechanism selects objects for perceptual processing and recognition and then provides the information to the motor processes necessary to initiate an eye movement (Deubel & Schneider, 1996). Thus, the differential response pattern found in the present study indicates that gender-specific perceptual features are processed during the early stages (< 100ms) of visual processing, and this processing is "oriented" toward the preferred gender. Because early perceptual processing is necessarily

restricted to specific parts of the brain relative to later processing, which is more distributed, this finding may be useful for guiding later neurobiological work examining the details of the neurobiological mechanisms involved in sexual orientation in a way that is not as tractable for later distributed sexual response.

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