Sexual Arousal and Masculinity-Femininity of Women

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This research was supported by the American Institute of Bisexuality and the United States Department of Agriculture (NYC-321421).

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Abstract

Studies with volunteers in sexual arousal experiments suggest that women are, on average, physiologically sexually aroused to both male and female sexual stimuli. Lesbians are the exception because they tend to be more aroused to their preferred sex than the other sex, a pattern typically seen in men. A separate research line suggests that lesbians are, on average, more masculine than straight women in their nonsexual behaviors and characteristics. Hence, a common influence could affect the expression of male-typical sexual and nonsexual traits in some women. By integrating these research programs, we tested the hypothesis that male-typical sexual arousal of lesbians relates to their nonsexual masculinity. Moreover, the most masculine-behaving lesbians, in particular, could show the most male-typical sexual responses. Across combined data, Study 1 examined these patterns in women's genital arousal and self-reports of masculine and feminine behaviors. Study 2 examined these patterns with another measure of sexual arousal, pupil dilation to sexual stimuli, and with observer-rated masculinity-femininity in addition to self-reported masculinity-femininity. Although both studies confirmed that lesbians were more male-typical in their sexual arousal and nonsexual characteristics, on average, there were no indications that these two patterns were in any way connected. Thus, women's sexual responses and nonsexual traits might be masculinized by independent factors.

Keywords: sexual orientation; sexual arousal; sex-typed behavior; masculinity-femininity

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Studies with volunteers in sexual arousal experiments indicate that women's sexual orientation is weakly reflected in their relative level of physiological sexual arousal to male and female sexual stimuli. Specifically, women in these experiments show, on average, substantial sexual arousal to sexual stimuli depicting both males and females. Lesbians constitute an exception to this general finding because they tend to be more aroused to their preferred sex (females) than their less preferred sex (males). This pattern is male-typical in the sense that stronger arousal to the preferred sex is more commonly found in men than women (Chivers, Rieger, Latty, & Bailey, 2004; Chivers, Seto, & Blanchard, 2007; Rieger et al., 2015; Rieger & Savin-Williams, 2012a). A separate body of research indicates that lesbians are, on average, more masculine than straight women in their nonsexual behaviors, appearances, and interests (Johnson, Gill, Reichman, & Tassinary, 2007; Lippa, 2008b; Rieger, Linsenmeier, Gygax, Garcia, & Bailey, 2010; Valentová & Havlíček, 2013). The present research attempted to integrate these two established lines of research findings. We hypothesized that male-typical sexual arousal of lesbians is linked to their nonsexual masculinity. Furthermore, the most masculine-behaving lesbians, in particular, could show the most male-typical patterns of sexual arousal. The theoretical assumption underlying these predictions was that there are common factors that lead to masculinization of both sexual and nonsexual behaviors in some women. By using a pooled set of data that yielded samples of 115 and 345 women (depending on the conducted analyses) we tested these hypotheses with respect to women's genital arousal and pupil dilation to sexual stimuli.

Female Sexual Orientation and Sexual Arousal

Women's, unlike men's, sexual attraction patterns may be less affected by a partner's sex and more affected by contextual, cultural, and social factors (Baumeister, 2000; Diamond, 2008; Rupp & Wallen, 2008; Savin-Williams, 2005). These variables include pair bonds, attachment history, educational experiences, religious beliefs, and acculturation (Peplau, 2001; Peplau, 2003). Because these variables might alter women's capacity for sexual response more so than men's, they could lead to greater variability in women's reported sexual attraction, arousal and orientation (Peplau, 2003; Wallen, 1995).

In addition to these differences in their reported attraction patterns, women and men can differ in their physiological sexual responses. Based on the responses from volunteers in sexual arousal research, women are, on average, sexually aroused to both male and female sexual stimuli, regardless of their sexual orientation. Contrarily, most men are sexually aroused to either males or females, consistent with their sexual orientation. This sex difference was described with both measures of sexual arousal used in the present research: genital response (Bossio, Suschinsky, Puts, & Chivers, 2014; Chivers et al., 2004; Chivers, Roy, Grimbos, Cantor, & Seto, 2014; Chivers et al., 2007) and pupil dilation while viewing sexual stimuli (Rieger et al., 2015; Rieger & Savin-Williams, 2012a). Across these measures, the link of sexual orientation with physiological responses to the same sex or other sex is considerably weaker in women than in men because women respond more strongly to both sexes, $.21 < r's < .24$, $-.03 <$ 95% CI's $< .43$, and, $74 < r's < .84$, $.58 <$ 95% CI's $< .95$, respectively (Rieger et al., 2015).

"Female-typical" physiological sexual arousal could therefore be described as significant and mostly nonspecific sexual arousal to both males and females, regardless of preference, whereas "male-typical" sexual arousal as stronger sexual responses to the

preferred sex than to the less preferred sex (Chivers et al., 2007). This difference is not absolute. For example, a proportion of bisexual-identified men are sexually aroused to both males and females (Rieger et al., 2013) and are in this sense "female-typical." Although these men are likely less common than men with sexual orientations and arousal towards one preferred sex (Rosenthal, Sylva, Safron, & Bailey, 2011), these findings highlight that "male-typical" and "female-typical" arousal does not apply to all men and women. Likewise, there is considerable variability across sex in physiological sexual arousal to male or female stimuli (Rieger et al., 2015; Figures1-4). Some men and women have sexual responses that are contrary to the general trend. Our descriptions of sex differences in sexual arousal therefore apply only on average, and part of the observed variability could be explained by other factors than sex, such as the behavioral masculine and feminine traits examined in this research.

Other measures indicate similar sex differences in sexual response. The assessments via reaction time (Wright & Adams, 1994; Wright & Adams, 1999), viewing time (Ebsworth & Lalumière, 2012; Lippa, 2012; Lippa, 2013), thermography (Huberman & Chivers, 2015), or neuroimaging while viewing stimuli (Costa, Braun, & Birbaumer, 2003; Sylva et al., 2013) suggest that women's responses to sexual stimuli are less linked to their sexual orientation than are men's. Across these measures, women, more than men, respond more strongly to males and females, and less specifically to their preferred sex.

Sex-specific selection pressures might explain this general sex difference in the association of sexual orientation with sexual response. Men have likely evolved with a strong sex drive (Baumeister, 2000) and strong sexual arousal towards sexually relevant targets (Bailey, 2009), and their combination facilitates prompt sexual responses required

for reproduction. Women may have evolved to be sexually responsive in sexual context-dependent situations in order to avoid genital injury. Support for this hypothesis is derived from comparisons across species and cultures. Forced copulation in several species (Galdikas, 1985; McKinney, Derrickson, & Mineau, 1983; Thornhill, 1980) and in most human societies (Palmer, 1989; Sanday, 1981) indicate that it may have occurred throughout human evolution (Thornhill & Thornhill, 1983). Because forced copulation can lead to genital trauma (Slaughter, Brown, Crowley, & Peck, 1997), the female response to any sexual stimulus could have evolved in part to mitigate this risk. For this mechanism, women may have physiological sexual responses to a variety of sexual stimuli, including stimuli representing both consensual and forced sexual acts (Suschinsky & Lalumière, 2011), sexual activities of non-human primates, and male and female sexual stimuli (Chivers et al., 2004; Chivers et al., 2007). Such ultimate explanation is difficult to prove, but regardless of the underlying mechanism, women's unique physiological sexual responses to either sex have been repeatedly reported (Bossio et al., 2014; Chivers & Timmers, 2012; Suschinsky, Lalumière, & Chivers, 2009).

However, women's sexual responses are moderated by their sexual orientation. On average, straight women are more likely to show no significant differences in their sexual responses to both male and female sexual stimuli. In contrast, lesbians are more sexually aroused to same-sex stimuli (women) than to other-sex stimuli (men). This difference between straight women and lesbians is not strong, but has been observed both for their genital arousal (Chivers et al., 2004; Chivers et al., 2007; Rieger et al., 2015) and pupil dilation to sexual stimuli (Rieger et al., 2015; Rieger & Savin-Williams, 2012a). When bisexual women were studied, they were in-between straight women and lesbians in their

arousal patterns to the same sex or other sex (Rieger et al., 2015; Rieger & Savin-Williams, 2012a; Timmers, Bouchard, & Chivers, 2015). Across studies and measures, the association of women's sexual orientation with their sexual response to the same sex over the other sex is small but consistent, $.21 < r's < .24$, $-.03 < 95\%$ CI's $< .44$ (Rieger et al., 2015), even though the effect can be more pronounced if sexual response is assessed with pupil data rather than genital arousal (Rieger & Savin-Williams, 2012a).

One study did not report that lesbians had stronger genital responses to the same sex than other sex (Peterson, Janssen, & Laan, 2010), but because this study did not include distinct male and female stimuli, it is difficult to compare to the aforementioned studies. Based on that aforementioned research, the overall finding is that lesbians respond physiologically stronger to the same sex than to the other sex. In a similar fashion, other measures of sexual response, reaction time (Wright & Adams, 1994; Wright & Adams, 1999) and viewing time (Ebsworth & Lalumière, 2012; Lippa, 2012; Lippa, 2013), indicate that lesbians have, on average, greater responses to the same sex than the other sex, whereas straight women do not show a difference in their responses. Stronger sexual arousal to one sex, congruent with someone's reported sexual orientation, is usually found in men. In this sense, lesbians show a more male-typical sexual arousal pattern compared with other women.

Female Sexual Orientation and Masculinity-Femininity

Just as some patterns of sexual arousal are more male-typical and other more female-typical, so do nonsexual behaviors vary in their sex-typicality. Studies on this topic usually fall under the rubric of research on "masculinity" and "femininity." Conceptualizations of masculinity and femininity have been heavily debated over the

decades (Constantinople, 1973; Lippa, 2005a; Spence & Buckner, 1995). One approach is to define masculinity and femininity as opposite poles of an encompassing psychological and behavioral trait (Lippa, 1991; Lippa, 2005a; Lippa, 2005b; Lippa, 2008b). One-dimensional self-ratings of adulthood masculinity-femininity exhibit correlates pointing to that trait's construct validity, including correlates with gender-typed occupational and recreational interests (Lippa, 1991; Lippa, 1995a; Lippa, 1995b), recalled childhood masculinity-femininity (Bailey, Dunne, & Martin, 2000; Lippa, 2008a; Rieger & Savin-Williams, 2012b), and observer-ratings of masculinity-femininity in childhood and adulthood (Lippa, 1998; Rieger, Linsenmeier, Gygax, & Bailey, 2008; Rieger et al., 2010).

There is a possible core to masculinity-femininity that contains sexual orientation in addition to gender-typed self-concepts, interests, appearances, vocal patterns, and nonverbal displays (Lippa, 2005b; Rieger et al., 2010). That is, sexual orientation differences in masculinity-femininity within each sex reflect those usually seen between the sexes. In one meta-analysis, lesbians reported more masculine and less feminine interests and self-concepts than straight women; conversely, gay men were more feminine and less masculine than straight men (Lippa, 2005b). These effects were large in women and men, $1.28 < d's < 1.46$, $1.18 < 95\%\ CI < 1.56$, and $0.60 < d's < 1.28$, $0.50 < 95\%\ CI < 1.38$, respectively. In another meta-analysis, lesbians recalled more masculine and less feminine childhood behaviors than straight women; the converse was found for gay men and straight men (Bailey & Zucker, 1995). These effects were also large, $d = 0.96$, $0.26 < 95\%\ CI < 1.66$, and $d = 1.31$, $0.45 < 95\%\ CI < 3.08$, respectively.

Prospective studies suggest that this difference in masculinity-femininity can be observed in young children prior to the development of their adult sexual orientation (Drummond, Bradley, Peterson-Badali, & Zucker, 2008; Green, 1987; Rieger et al., 2008; Steensma, van der Ende, Verhulst, & Cohen-Kettenis, 2013). Similarly, sexual orientation differences in masculinity-femininity in adulthood can be observed by others based on motor behaviors, speech patterns, and physical appearance (Johnson et al., 2007; Rieger et al., 2010; Valentová & Havlíček, 2013). In addition, facial features of straight and gay men and women are differently perceived (Rule, Ambady, Adams, & Macrae, 2008; Rule, Ambady, & Hallett, 2009) and it is possible that this difference is related to masculinity-femininity.

Straight and gay men and women further differ in some sexually dimorphic neuroanatomical structures and their functions (Rahman & Yusuf, 2015). Lesbians and gay men are, on average, more similar to the other sex in their hypothalamic activation in response to human pheromones (Berglund, Lindström, & Savic, 2006; Savic, Berglund, & Lindström, 2005), and in their cerebral asymmetry and functional connections (Savic & Lindström, 2008), which possibly affect differences in linguistic processing (Rahman, Cockburn, & Govier, 2008). Furthermore, gay men are more female-typical than straight men in spatial processing such as mental rotation, whereas lesbians are, to a smaller degree, more male-typical than straight women (Rahman & Wilson, 2003b). Similar sex-dimorphic differences between lesbians and straight women have been observed for their otoacoustic emissions, minute sounds emitted by the inner ear that are usually more common in men than women (McFadden & Champlin, 2000). Neurological structures and cognitive functioning may therefore be partly sex-atypical in women and men with

same-sex sexual orientations, and this is possibly due to differentiations of neural circuits during early development (Rahman, 2005; Savic, Garcia-Falgueras, & Swaab, 2010).

In sum, there is a robust link between sexual orientation and masculinity-femininity, even though the magnitude of the effect varies by measure (Lippa, 2008b; Rieger et al., 2010; Rieger & Savin-Williams, 2012b). For example, sexual orientation is more closely linked to self-reports of masculinity-femininity in childhood than in adulthood; yet, with observer-ratings from these time periods the opposite tends to the case (Bailey et al., 2000; Rieger et al., 2008; Rieger et al., 2010). The exact meaning of these differences is unclear. However, because of these variations, any relationship of sexual orientation with both sexual arousal and masculinity-femininity might further depend on which measure of masculinity-femininity is used. We examined this possibility in Study 2.

In addition to variation across measures, there is further variation within measures, which can differ by sexual orientation (Lippa, 2005b; Lippa, 2008b; Lippa, 2015; Rieger et al., 2008; Rieger et al., 2010). In a meta-analysis, lesbians were more variable than straight women in their self-reported masculinity-femininity and in sex-typed occupational and recreational interests (Lippa, 2005b). Differences in variation are not always found. In other data from 1383 women, lesbians were more variable than straight women in their self-reported masculinity-femininity, but not in their sex-typed occupational interests (Lippa, 2015). In other studies, lesbians were more variable in their observer-rated masculinity-femininity, but not their self-reported adulthood or childhood masculinity-femininity (Rieger et al., 2008; Rieger et al., 2010). Thus, although not always confirmed, lesbians can be more variable in their masculinity-femininity than straight women.

When bisexual women were studied, they were intermediate between straight women and lesbians in their masculinity-femininity, with lesbians being consistently more masculine and less feminine than straight women (Lippa, 2005b; Lippa, 2008b). This finding corresponds with their aforementioned pattern of physiological sexual arousal, as bisexual women are somewhat more male-typical in their arousal than straight women, but less so than lesbians (Rieger et al., 2015; Rieger & Savin-Williams, 2012a; Timmers et al., 2015). Thus, a prediction is that for both sexual and nonsexual behaviors, bisexual women are more male-typical than straight women but less so than lesbians.

Female Sexual Orientation, Sexual Arousal, and Masculinity-Femininity

The review this far suggests that lesbians are in general more male-typical than straight women in their physiological sexual arousal (Rieger et al., 2015) and their behavioral masculinity-femininity (Lippa, 2008b). If there is a common factor that influences male-typical sexual and nonsexual behaviors in women, then a hypothesis is that because lesbians are more masculine, on average, they also show male-typical sexual arousal, on average. Hence, overall differences in masculinity-femininity between women might explain the effect of sexual orientation on female sexual arousal. Such hypothesis suggests that women's masculinity-femininity mediates the relationship of their sexual orientation with their sexual arousal to the same or other sex.

Alternatively, an interaction of sexual orientation with behavioral masculinity-femininity could explain why some women show male-typical sexual arousal. As reviewed above, the effect of lesbians' stronger arousal to their preferred sex is small in magnitude, and there is considerable variability in women's arousal patterns (Chivers et al., 2007; Rieger et al., 2015). It is therefore possible that only some (but not all) lesbians

drive the effect that links their sexual orientation to stronger sexual arousal towards the same sex. There is also considerable variation in behavioral masculinity-femininity that is sometimes (although not always) stronger in lesbians (Lippa, 2005b; Lippa, 2008b; Lippa, 2015; Rieger et al., 2008; Rieger et al., 2010). Hence, some lesbians are especially masculine, compared both to straight women and other lesbians. Perhaps these are the women, in particular, who respond sexually more to their preferred sex than the other sex. Thus, the most masculine-behaving lesbians (compared both to straight women and less masculine-behaving lesbians) could show the most male-typical sexual arousal.

Because straight women's sexual arousal is, in general, not specifically directed towards males or females, whereas for lesbians there is a trend for more arousal towards their preferred sex, we had less clear predictions for straight women than for lesbians regarding how their masculinity-femininity could distinguish their sexual arousal. Thus, the hypothesis about an interaction of sexual orientation with masculinity-femininity focuses on the prediction that for lesbians masculinity-femininity differentiates their sexual arousal patterns, whereas for straight women we made no predictions. We note though, that the moderation analyses reported below included testing for the possibility that straight women differed in their sexual arousal, depending on their masculinity-femininity. These analyses also allowed exploring how masculinity-femininity affected sexual arousal, regardless of women's sexual orientations.

What factors could explain that lesbians are on average, if not some of them in particular, more male-typical in both their sexual arousal and nonsexual behaviors? Both prenatal and early postnatal androgen exposure predict masculinized behaviors in the early development of boys and girls (Auyeung et al., 2009; Lamminmäki et al., 2012). In

addition to their effects on sex-typed morphology (Arnold, 2009), these early androgen exposures influence masculine behaviors, interests, and cognitive abilities throughout the life course (Berenbaum & Beltz, 2011). Early gonadal influences are also prominent candidates for the co-development of sexual orientation with masculinity-femininity (Hines, 2011) and for the variation of masculinity-femininity within sexual orientations (Bailey & Zucker, 1995). In one study, lesbians with masculine self-concepts had more masculine anatomical features (i.e., a higher waist-to-hip ratios) than other women, possibly because these women have been exposed to higher levels of androgens during development (Singh, Vidaurri, Zambarano, & Dabbs, 1999). Furthermore, these women exhibited higher levels of salivary testosterone; this could also suggest greater developmental androgenization, at least to the extent that developmental androgens may be reflected in their levels in later life (Auyeung, Lombardo, & Baron-Cohen, 2013; Romeo, Richardson, & Sisk, 2002; Schulz, Molenda-Figueira, & Sisk, 2009).

These gonadal influences, in combination with genetic influences (Bailey et al., 2000; Burri, Cherkas, Spector, & Rahman, 2011) or even epigenetic influences (Ngun & Vilain, 2014) could explain the co-development of sexual orientation and masculinity-femininity. They may also account for associations of sexual orientation with masculine behaviors and male-typical sexual arousal in women.

Notably, it is little understood to what degree gonadal influences affect physiological sexual arousal. Elevated androgen levels in adulthood can enhance sexual motivation in both males and females (Bancroft, 2005; Jones, Ismail, King, & Pfaus, 2012), but whether they influence male-typical physiological sexual responses in either sex is unknown. However, if data suggested that masculine behaviors and male-typical

arousal of lesbians are interrelated, such findings would at least be consistent with the proposal that an underlying factor (hormonal or otherwise) accounts for such pattern.

Overview of Studies

Based on the reviewed literature, the following hypotheses were tested:

Hypothesis 1. Lesbians will show, on average, stronger sexual arousal to the same sex than to the other sex, whereas straight women will not, on average, differ in their arousal to the same sex or other sex.

Hypothesis 2. Lesbians will report and show, on average, greater masculinity and less femininity than straight women in their nonsexual self-concepts and behaviors.

Hypothesis 3. If lesbians are more male-typical than straight women in both their sexual arousal and their nonsexual behaviors, then the relationship of female sexual orientation with sexual arousal will be mediated by their nonsexual masculine behaviors.

Hypothesis 4. Alternatively, the most masculine-behaving lesbians, in particular, will show stronger sexual arousal to the same sex than to the other sex, both compared to straight women and less masculine-behaving lesbians. Thus, the relation of sexual orientation and sexual arousal will be moderated by nonsexual masculine behaviors.

The present research investigated these hypotheses by combining published data (Chivers et al., 2004; Rieger et al., 2015; Rieger & Savin-Williams, 2012a) and unpublished data on the relationship of sexual orientation and physiological sexual response. By merging these data, analyses offered better information on the magnitude of the effect of female sexual orientation on physiological sexual arousal. Moreover, the effect of masculinity-femininity on sexual arousal has not been previously reported.

Present analyses investigated whether women's levels of masculinity-femininity mediated or moderated the relationship of their sexual orientation with sexual response.

Study 1 examined these hypotheses in 115 to 152 women (numbers varied by analyses) whose genital arousal and self-reported adulthood masculinity-femininity were assessed. Study 2 tested these hypotheses in 186 to 345 women whose sexual response was assessed via their pupil dilation, and for who, in addition to their reported adulthood masculinity-femininity, self-reports from childhood and observer-ratings of adulthood behaviors were available. Studies 1 and 2 were kept separate because the majority of genital arousal data could only be linked to reported adulthood masculinity-femininity, and the majority of reported childhood masculinity-femininity and observer-rated adulthood masculinity-femininity were linked to pupil data. If these different measures yielded similar findings, it would support the robustness of the effect of gender-typed behaviors on the relationship of sexual orientation with female sexual arousal.

Study 1

Study 1 combined two datasets (Chivers et al., 2004; Rieger et al., 2015) to examine patterns of female genital arousal. As described below, these datasets differed in some aspects of their methodologies. However, these differences did not statistically moderate the relationships of sexual orientation with genital arousal or reported masculinity-femininity. For the sake of simplicity, and because the overarching goal of this research was to examine patterns across all available data, these non-significant differences between studies are not reported in the following results.

Method

Participants. Advertisements for the studies were placed in newspapers and websites, either in Chicago (Chivers et al., 2004) or close to a Northeast university (Rieger et al., 2015). A total of 173 women were recruited. For 21 of these women, no substantial genital responses were detected (i.e., at least 0.5 SD maximum arousal to a sexual stimulus as compared to a neutral stimulus, Chivers et al., 2004) and were thus excluded from analyses. Excluding these participants did not affect the direction or significance of results; in general, exclusion was statistically beneficial because it yielded slightly stronger effects. The remaining 152 women self-identified as "straight" (n = 31), "mostly straight" (n = 41), "bisexual leaning straight" (n = 14), "bisexual" (n = 10), "bisexual leaning lesbian" (n = 18), "mostly lesbian" (n = 19), and "lesbian" (n = 19). The average age (*SD*) was 24.41 (5.17) years. The most common ethnicity was Caucasian (63%), followed by Hispanic (13%), Black (10%), and mixed ethnicities (9%). Education was coded as 1 (no high school), 2 (some high school), 3 (high school diploma), 4 (some college), 5 (college graduate), and 6 (postgraduate student or degree). The average education (*SD*) was 4.46 (.86); the median was 4.00. The most common education was "some college" with 62%, with 36% being currently in college.

Distributions of age, ethnicity, and education by sexual orientation are shown in Table 1. Analyses of variance indicated that participants with lesbian identities were older than other women, $p = .001$, $R^2 = .10$, and had more education, $p = .004$, $R^2 = .12$. The proportion of being Caucasian did not significantly differ across sexual orientation groups, $\chi^2(6) = 6.73$, $p = .35$. As we report below, these differences had little effect on the associations of sexual orientation, masculinity-femininity, and sexual arousal.

Measures.

Sexual orientation. Using Kinsey-type scales (Kinsey, Pomeroy, Martin, & Gebhard, 1953), participants either reported their sexual orientation identities and fantasies for the last year and their adulthood in general (Chivers et al., 2004), or their sexual orientation identities, attractions, and fantasies in adulthood (Rieger et al., 2015). Measures were highly correlated in each dataset (p's < .0001, .80 < r's < .96, .70 < 95% CI's < .99), and averaged within participants. For this composite, a score of 0 represented exclusively straight, a score of 3 bisexual with equal preferences, and a score of 6 exclusively lesbian.

Note that even though we focus in our interpretations on a difference between straight women (Kinsey scores 0-1) and lesbians (Kinsey scores 5-6), the data included bisexual women (Kinsey scores 2-4). In the majority of analyses, bisexual women fell in-between straight women and lesbians in their arousal and masculinity-femininity scores. We address this finding in the General Discussion.

Masculinity-femininity. In one dataset (Chivers et al., 2004), women were asked how masculine and how feminine they were. Similar brief questions about masculinity-femininity have demonstrated congruent validity because of correlates with gender-typed recreational and occupational interests, observer-ratings of masculinity-femininity, and reported childhood masculinity-femininity (Lippa, 1991; Lippa, 1998; Lippa, 2008a). Answers to these questions were given on 7-point scales, ranging from 1 (strongly disagree) to 7 (strongly agree). Masculine and reversed feminine scores were correlated, p < .0001, r = .64, 95% CI [.42, .79] and reliable (Cronbach's α = .78). These scores were averaged such that higher scores indicated more masculinity and less femininity.

In this dataset (Chivers et al., 2004), masculinity-femininity data were available for 48 out of the 85 women. This information was originally collected via a paper questionnaire, and electronically entered long after all data collection had been completed; at which point questionnaire data from 37 women were no longer retrievable. Because of this limitation, we report analyses below that investigated possible systematic differences between women for whom such data were available or missing.

In the other dataset (Rieger et al., 2015), adulthood masculinity-femininity was reported by all 67 women with the 10-item Continuous Gender Identity Scale, which exhibits modest to strong correlates with other measures of reported and observed masculinity-femininity (Rieger et al., 2008; Rieger et al., 2010). Statements included: "Most people see me as more masculine than other women" and "My mannerisms are less feminine than those of other women." Answers were given on 7-point scales, ranging from 1 (strongly disagree) to 7 (strongly agree). Item-reliability (Cronbach's α) was .91. Responses to items were averaged and higher scores represented greater masculinity.

Stimuli. In one dataset (Chivers et al., 2004) sexual stimuli included 2 male and 2 female stimuli, showing videos of either two males or two females engaged in sexual activities. In addition, two nature documentaries were shown for the assessment of participants' baseline arousal. In the other dataset (Rieger et al., 2015), 3-minute videos of 3 male stimuli and 3 female stimuli were used. These videos depicted either a male or female model masturbating. Six 2-minute videos were taken from a nature documentary for assessing baseline genital responses.

Genital arousal. A BIOPAC MP100 data acquisition unit and the program AcqKnowledge recorded genital responses every 5 milliseconds. Women's genital

arousal was assessed via change in vaginal pulse amplitude (VPA) using vaginal photoplethysmographs (Janssen, Prause, & Geer, 2007). The VPA signal was sampled at 200 Hz and high-pass filtered at 0.5 Hz with 16 bits resolution. VPA was measured as peak-to-trough amplitude for each vaginal pulse. VPA signals indicate changes of vaginal blood flow and exhibit both convergent and discriminant validity of female sexual response (Suschinsky et al., 2009).

Procedure. Participants provided written informed consent and were seated in a room facing a screen. In private they inserted the photoplethysmograph. First, participants watched an adaptation stimulus (a nature video) to establish baseline response. Next, in one dataset they randomly watched the sexual videos and the other nature video; between videos, participants worked on questionnaires and mental tasks (e.g., counting backwards) to facilitate a return to baseline (Chivers et al., 2004). In the other dataset participants watched, in random order, sexual stimuli alternating with nature scenes that facilitated a return to baseline (Rieger et al., 2015). Finally, participants completed a questionnaire with demographic information, sexual orientation, and masculinity-femininity and were paid ($50 or $100, depending on the dataset). Procedures took approximately 120 minutes.

Genital arousal data were averaged within stimuli and for each participant and, based on previous recommendations, z-scored within participants (Harris, Rice, Quinsey, Chaplin, & Earls, 1992). In each dataset, such standardization within participants was conducted across responses to all presented stimuli. In one dataset (Chivers et al., 2004), participants' average responses to the second neutral stimulus (which they viewed after return to baseline) were subtracted from their average responses to sexual stimuli. In the

other dataset (Rieger et al., 2015), average genital response to the 10 seconds preceding a sexual stimulus (i.e., at the end of a neutral stimulus and at which time they had returned to baseline) was subtracted from the average response to this stimulus. We then computed, for each participant, two average values reflecting genital response to same-sex stimuli and other-sex stimuli.

Results and Discussion

Hypotheses 1. We predicted that lesbians would be more genitally aroused than straight women to the same sex than the other sex. We first investigated arousal patterns across all women. One-sample *t*-tests indicated that women of all sexual orientations responded on average more to same-sex stimuli, as compared to neutral (a score of 0), $p < .0001$, $d = 2.00$ [1.89, 2.12], and to other-sex stimuli, as compared to neutral, $p < .0001$, $d = 2.03$ [1.93, 2.15].

We then regressed women's genital arousal to the same sex and to the other sex onto their sexual orientation. Because it was possible that responses to the same sex than to the other sex were particularly pronounced in exclusively lesbians (that is, for those with Kinsey scores of 6), we included a test for a curvilinear effect in these analyses (Rieger & Savin-Williams, 2012a). Unless otherwise noted, however, these curvilinear effects were not significant, and the following results refer to a linear effect.

Lesbians (Kinsey scores 5-6) responded non-significantly more to same-sex stimuli as compared to straight women (Kinsey scores 0-1), $p = .13$, $\beta = .12$ [-.04, .28] (Figure 1 A) and significantly less to other-sex stimuli, $p = .05$, $\beta = -.16$ [-.32, -.01] (Figure 1 B). We then calculated a difference score of genital response to same-sex versus other-sex stimuli. For this difference, straight women responded similarly to the sexes (a score of 0),

whereas lesbians responded stronger to the same sex than the other sex, $p = .01$, $\beta = .20$ [.04, .35] (Figure 1 C).

Hypothesis 2. We regressed reported adulthood masculinity-femininity onto women's sexual orientation. Consistent with the hypothesis, lesbians were more masculine than feminine, compared to straight women, $p < .0001$, $\beta = .42$, [.25, .56]. In Figure 2, the 95% confidence intervals of the regression coefficient show that straight women were below the midpoint of possible masculinity-femininity scores (a score of 4) whereas lesbians were just above.

Across women of all sexual orientations there was visible variation in masculinity-femininity scores (Figure 2). It was possible, though, that lesbians vary more strongly than other women (Lippa, 2005b). However, a Levene test for unequal variance (which compares the magnitude of absolute residuals across sexual orientations) did not support this, $p = .14$, $\beta = -.13$ [-.31, .06]. Hence, the variation of masculinity-femininity was similar across sexual orientations.

Hypotheses 3. We hypothesized if lesbians are more male-typical than straight women in their sexual arousal and nonsexual behaviors, then the relationship of female sexual orientation with sexual arousal would be mediated by nonsexual masculine behaviors. We conducted multiple regression analyses predicting genital arousal to the same sex, other sex, and their difference score. Independent variables were sexual orientation and self-reported adulthood masculinity-femininity. If male-typical sexual arousal patterns of lesbians were linked to their nonsexual masculinity, then the inclusion of self-reported masculinity-femininity as an independent variable should decrease the relation of sexual orientation with sexual arousal patterns.

Table 2 summarizes the results of the analyses that included both independent variables. The main effects of sexual orientation remained similar in magnitude before and after including masculinity-femininity as a covariate (see Figure 1 and Table 2). In fact, a comparison among only those women who reported their masculinity-femininity suggested that the effect of sexual orientation on sexual arousal to the same or other sex increased after including masculinity-femininity as a covariate, $p = .03$, $\beta = .20$ [.02, .37], and $p = .003$, $\beta = .30$ [.08, .52], respectively.

We then tested systematically whether masculinity-femininity mediated the relation of sexual orientation with sexual arousal by computing mediation analyses on the basis of 1000 bootstrapped samples (Preacher & Hayes, 2008). Given the distribution of its confidence intervals, the indirect effect of sexual orientation on sexual arousal to the same sex (i.e., the portion of this effect that is influenced by masculinity-femininity) differed significantly from zero, $\beta = -.14$ [-.24, -.06]. From the comparison of effect sizes in the last paragraph, this meant that controlling for masculinity-femininity significantly increased this effect of sexual orientation. This suggests "suppression" rather than mediation; i.e., the predictive power of sexual orientation on arousal is weakened in the absence of masculinity-femininity (MacKinnon, Krull, & Lockwood, 2000).

Notably, higher degrees of adulthood masculinity predicted *less* genital arousal to the same sex, regardless of sexual orientation (Table 2). This was not an artifact due to collinearity because of the correlation of masculinity-femininity with sexual orientation. The simple relationship of genital response to the same sex with adulthood masculinity-femininity was also negative, $p = .02$, $\beta = -.23$ [-.39, -.04]. We had no specific hypothesis about this pattern, and it is unclear whether it is meaningful.

Based on further mediation analyses with bootstrapping, the effect of sexual orientation on sexual arousal to the other sex was not significantly mediated by masculinity-femininity, β = -.02 [-.08, .07]. Similar the above analyses, the difference in sexual arousal to the same sex and other sex was significantly enhanced in the presence of masculinity-femininity, β = -.09 [-.21, -.02].

Hypotheses 4. Alternatively to Hypothesis 3, we hypothesized that masculinity-femininity would moderate the relationship of sexual orientation with sexual arousal. The most masculine-behaving lesbians would be most genitally aroused to the same sex than the other sex, in comparison to both straight women and less masculine lesbians. We conducted three multiple regression analyses predicting genital arousal to the same sex, other sex, and their difference score. Independent variables were sexual orientation, masculinity-femininity, and their interaction. If masculinity-femininity differentiates the genital response patterns of lesbians more so than it does of straight women, then this interaction between sexual orientation and masculinity-femininity will be significant.

Results of these analyses are summarized in Table 3. For genital response to the same sex, other sex, or their difference, there were no significant interactions between sexual orientation and masculinity-femininity. Thus, the most masculine lesbians did not have stronger responses to the same sex than the other sex, as compared to other women. As for the previous analyses, the main effects of sexual orientation remained similar, if not stronger, in magnitude after including masculinity-femininity as a moderator (see Figure 1 and Table 3).

Missing data. Information of self-reported masculinity-femininity was missing for 37 women. We examined whether these women differed from women from whom such

data were available. Multiple linear regression analyses indicated no significant differences between these groups. For example, the relationship of sexual orientation with genital arousal to the same sex or other sex (Figure 1C) was similar before and after controlling for a variable that specified available or missing information on masculinity-femininity, $p = .01$, $\beta = .20$ [.04, .35], and $p = .02$, $\beta = .24$ [.05, .47], respectively. Furthermore, this relationship was not significantly moderated by whether information on masculinity-femininity was missing, $p = .78$, $\beta = .03$ [-.18, -.24].

Because sexual orientation was a predictor of masculinity-femininity (Figure 2), we computed multiple imputations (Little & Rubin, 2002) to estimate missing values of masculinity-femininity from its covariance with sexual orientation. Across 5 imputations, the pooled effect of sexual orientation with self-reported masculinity-femininity was similar to the effect with list-wise exclusions of missing data, $p < .0001$, $\beta = .39$ [.20, .60], and $p < .0001$, $\beta = .42$ [.25, .56], respectively. Moreover, effects on sexual arousal were comparable for analyses with list-wise excluded data and imputed data. For example, the relation of sexual orientation with genital arousal to the same sex or other sex (with masculinity-femininity as a covariate) was small to modest in effect with excluded data, $p = .003$, $\beta = .30$ [.08, .52] (Table 3), and with imputed data, $p = .003$, $\beta = .28$ [.10, .46]. Similar to the above analyses (Table 3), with imputed data masculinity-femininity acted neither as mediator, nor as moderator ($.65 < p$'s $< .85$, $-.04 < \beta$'s $< .04$, $-.20 <$ CI's $< .15$). In total, analyses with imputed data resembled analyses described above.

Covariates. Lesbians were on average older and more educated than other women (Table 1). Although sexual orientations did not significantly differ by the proportion of being Caucasian, it was possible that this variable, too, had an effect on the dependent

measurers. We conducted regression analyses similar to those described above (Table 3), but included age, education level (scored continuously), and ethnicity (Caucasian or other ethnicity) as covariates. The main effects of sexual orientation on genital arousal patterns were comparable in magnitude before and after controlling for these variables. For example, the main effect of sexual orientation on the difference in arousal to the same sex and other sex remained similar, $p = .003$, $\beta = .30$ [.08, .52] (Table 3), and $p = .002$, $\beta = .34$ [.12, .58], respectively. These main effects (or their interactions with masculinity-femininity) were not significantly moderated by age, ethnicity, or education ($.11 < p's < .99$, $-.09 < \beta's < .17$, $-.23 <$ CI's $< .31$). Thus, assessed demographic variables had little effect on the link of sexual orientation with masculinity-femininity and sexual arousal.

Alternative Analyses. Because Hypotheses 3 and 4 were not confirmed, we investigated whether alternative analyses would give more informative results. One way of analyzing data is to predict women's sexual orientation identities (Table 1) by their genital responses to males and females, as it is the case with discriminant analyses (rather than vice versa, as for the reported regression analyses). When discriminant analyses were conducted, the sexual orientations of the majority of women (82%) were not successfully discriminated based on their genital responses. However, correct classification was significantly stronger for lesbians than for other women (Table 4). A logistic regression analysis confirmed that correct classifications were significantly more common for lesbians than other women, $B = 1.63$ [1.00, 2.41], $p < .0001$, $OD = 26.10$ [7.32, 124.37]. These findings complement the reported results for Hypothesis 1, with lesbians being more strongly arousal to the same sex, whereas other women had less distinct arousal to either sex (Figure 1). Yet, similar to the aforementioned analyses,

sexual orientation differences in correct classifications, based on arousal, were neither mediated nor moderated by their masculinity-femininity.

In sum, lesbians were somewhat more aroused to the same sex than the other sex, consistent with previous research (Chivers et al., 2007), and reported more adulthood masculinity than straight women, also consistent with previous work (Lippa, 2008b). However, present data did not support the hypotheses that masculinity-femininity mediated or moderated the link of female sexual orientation with sexual arousal. It is possible that Study 1 did not employ the most effective measures to elicit the predicted effects. The relationship of female sexual orientation with sexual response can be stronger if measured by pupil dilation rather than genital arousal (Rieger & Savin-Williams, 2012a). Perhaps, pupil dilation is also the more precise measure for assessing any effects of sexual orientation and masculinity-femininity on female sexual response. Furthermore, the relationship of masculinity-femininity with sexual orientation can be stronger if masculinity-femininity is measured with self-reports about childhood or with observations from adulthood behaviors, rather than with self-reports about adulthood characteristics (Rieger et al., 2008; Rieger et al., 2010; Rieger & Savin-Williams, 2012b). Perhaps, too, these measures are superior for assessing effects of sexual orientation and masculinity-femininity on sexual arousal. Study 2 investigated these possibilities with a sample larger than for Study 1, thereby increasing its power for detecting potential effects.

Study 2

Study 2 combined two datasets (Rieger et al., 2015; Rieger & Savin-Williams, 2012a) with unpublished data to examine women's dilation patterns to sexual stimuli. These datasets differed somewhat in their methodologies, as described below.

Differences did not statistically affect the relationships of sexual orientation with pupil dilation or measures of masculinity-femininity.

Method

Participants. Advertisements were placed on websites in an area close to a Northeast university. The 345 recruited women self-identified as "straight" (n = 68), "mostly straight" (n = 63), "bisexual leaning straight" (n = 34), "bisexual" (n = 31), "bisexual leaning lesbian" (n = 43), "mostly lesbian" (n = 66), and "lesbian" (n = 40). The average age (*SD*) was 23.03 (5.47) years. The most common ethnicity was Caucasian (65%), followed by mixed ethnicities (11%), Black (7%), and Hispanic (6%). Education was coded as 1 (no high school), 2 (some high school), 3 (high school diploma), 4 (some college), 5 (college graduate), and 6 (postgraduate student or degree). The average education (*SD*) was 4.57 (.84); the median was 4.00. Most common was "some college" with 57%; all of these participants were currently in college. Table 5 shows that lesbians were significantly older than other sexual orientation groups, $p = .0002$, $R^2 = .07$, had more education, $p = .01$, $R^2 = .05$, and higher proportion of being Caucasian, $\chi^2(6) = 20.1$, $p = .003$. These differences did not significantly affect analyses, as we report below.

Measures.

Sexual orientation. Participants reported their sexual orientation identities, attractions, and fantasies in adulthood on Kinsey-type scales (Kinsey et al., 1953). Measures were highly correlated (p's < .0001, .82 < r's < .94, .78 < 95% CI's < .95), and averaged within participants. For this composite, a score of 0 represented exclusively straight and a score of 6 exclusively lesbian.

Masculinity-femininity. Reported childhood masculinity-femininity was assessed in 186 women (Rieger et al., 2015; unpublished data) with the Childhood Gender Identity Scale (Rieger et al., 2008). Statements included "I was a masculine girl," and "As a child I preferred playing with boys rather than girls," and were endorsed with 7-point scales. Reported adulthood masculinity-femininity was measured in all 345 women with the Continuous Gender Identity Scale (Rieger et al., 2008) described in Study 1. Cronbach's α exceeded .85 for each scale. Two averages were computed for each participant, one each for self-reported childhood and adulthood masculinity-femininity.

Across two datasets (Rieger & Savin-Williams, 2012a; unpublished data) adulthood masculinity-femininity of 273 participants was assessed with observer-ratings. Eighty undergraduate students (20 straight and gay men and women) viewed, in random order, 10-second videos of participants discussing the weather. Raters can reliably assess masculine and feminine behaviors and appearance from such brief videos (Rieger et al., 2010). In one dataset (Rieger & Savin-Williams, 2012a), raters used a 7-point scale for their assessments, ranging from 1 (very feminine) to 4 (average) to 7 (very masculine). In the unpublished data, raters used three scales asking how masculine, feminine, and how masculine versus feminine participants were. These scales ranged from 1 (not at all) to 4 (average) to 7 (very much).

In each dataset and for each rater group, ratings on the same scale were reliable (all Cronbach's α*'s* $\geq$ .94). Ratings of the four groups were highly correlated (*p's* < .0001, .80 < *r's* < .97, .71 < 95% CI's < .98); therefore, their ratings were combined for further analyses. In one dataset (Rieger & Savin-Williams, 2012a), ratings were averaged within participant to obtain an overall score with higher numbers indicating more observer-rated

masculinity than femininity. In the unpublished data, the reverse of participants' average femininity scores correlated strongly with their average masculinity scores and their masculinity-femininity scores, p's < .0001, .97 < r's < .99, .95 < 95% CI's < .99. Thus, these three scores were further averaged to compute an overall score with higher numbers indicating more observer-rated masculinity than femininity.

Across available data, the three measures of masculinity-femininity (self-report from childhood and adulthood, and observer-ratings from adulthood) were modestly correlated (p's < .0001, .44 < r's < .54, .28 < CI's < .64). However, one dataset did not include information on self-reported childhood masculinity-femininity (Rieger & Savin-Williams, 2012a), whereas one other did not have data on observer-rated adulthood masculinity-femininity (Rieger et al., 2015). This was the case because these projects have been independently designed with different emphasizes given to these measures. Below we report analyses that investigated whether missing data affected the relationships of sexual orientation, masculinity-femininity, and pupil dilation.

Stimuli. In one dataset (Rieger & Savin-Williams, 2012a) and the unpublished data, 30-second videos of 12 male stimuli and 12 female stimuli showed either a naked male or female model masturbating. Thirty-second videos of nature scenes (landscapes or animations of clouds) were used as neutral stimuli. In the other dataset (Rieger et al., 2015), 3-minute videos of 3 male stimuli and 3 female stimuli were used as sexual stimuli and 2-minute videos of cloud animations for neutral stimuli. This difference in stimulus length (30 seconds versus several minutes) did not affect results. All stimuli were of similar luminance; furthermore, luminance was set to equal upper and lower thresholds

across stimuli by using the programs MPEG Streamclip and Final Cut Pro. Videos had a resolution of 768 by 536 pixels and were presented full screen.

Pupil data. Pupil dilation to sexual stimuli reflects sex and sexual orientation differences in genital arousal, suggesting it is a valid indicator of sexual response (Hess, Seltzer, & Shlien, 1965; Rieger et al., 2015; Rieger & Savin-Williams, 2012a). A SR Research Remote infrared gaze tracker recorded pupil data every 2 milliseconds with a 16 mm lens (Rieger & Savin-Williams, 2012a) or every millisecond with a 35 mm lens (Rieger et al., 2015; unpublished data). Lenses were focused on participants' preferred eye. The program EyeLink computed pupil area as the number of the tracker's camera pixels occluded by the infrared light reflected by the pupil. If pupils dilated while viewing stimuli, more pixels were occluded. Because raw pupil area data included "0's" for missing values, for example from blinks or head movements, these values were removed prior to analyses.

Procedure. Participants provided written informed consent and were seated in a dimly lit room facing a screen with resolution of 1024 by 768 pixels. Participants' heads rested on a mount 500 mm from the eye tracker's lens. For calibration of pupil data, participants fixated and re-fixated their gaze on 9 points that defined the outline of the screen. Participants were instructed to watch all videos carefully, regardless of whether they liked the content. First, participants watched one of the neutral stimuli (landscapes or cloud animations), followed, in random order, by presentations of sexual stimuli, alternating with questions about the videos (Rieger & Savin-Williams, 2012a) or a combination of questions and nature scenes (Rieger et al., 2015; unpublished data). The last video was the final neutral stimulus.

After watching stimuli privately, 273 participants were videotaped, seated in a chair and discussing winters in the Northeast USA (Rieger & Savin-Williams, 2012; unpublished data). The first full sentence given as an answer within the first 10 seconds was used for subsequent observer-ratings of participant's adulthood masculinity-femininity. Finally, participants completed questionnaires about demographics, sexual orientation, and masculinity-femininity and received payment ($30 or $100, depending on the dataset). The procedure took 45 to 120 minutes, depending on the dataset.

There is no consensus as to the most appropriate technique of analyzing pupil size data (Otero, Weekes, & Hutton, 2011). We decided on procedures identical to those recommended for analyzing genital arousal responses (Harris et al., 1992). Pupil data were averaged within stimuli and for each participant. Because pupils vary in size and degree of dilation, these averages were, equivalent to the genial arousal data, z-scored within participants. Average dilation to neutral stimuli was subtracted from the average dilation to each sexual stimulus. We then computed, for each participant, two average values reflecting pupil dilation to same-sex and other-sex stimuli.

Results and Discussion

Hypothesis 1. Lesbians were hypothesized to dilate more strongly to the same sex than to the other sex. One-sample *t*-tests indicated that women of all sexual orientations dilated more to same-sex stimuli, as compared to neutral, $p < .0001$, $d = 0.61$ [0.54, 0.69], and more to other-sex stimuli, as compared to neutral, $p < .0001$, $d = 0.67$ [0.60, 0.75]. However, lesbians dilated more strongly to same-sex stimuli than straight women, $p < .0001$, $\beta = .23$ [.14, .34]. This linear effect was qualified by a curvilinear effect, suggesting that dilation to the same sex was particularly pronounced for exclusively

lesbians (i.e., women with a Kinsey 6 score), $p = .002$, $\beta = .17$ [.05, .31] (Figure 3 A). Lesbians responded less strongly to the other sex, $p < .0001$, $\beta = -.25$ [-.34, -.15]; this result was not qualified by a curvilinear effect, $p = .20$, $\beta = -.07$ [-.21, .07] (Figure 3 B). Finally, lesbians dilated more strongly to the same sex than the other sex, compared to straight women, $p < .0001$, $\beta = .27$ [.17, .38], and this effect was most pronounced among exclusively lesbians, $p = .01$, $\beta = .13$ [.01, .27] (Figure 3 C).

Hypothesis 2. Consistent with the hypothesis, lesbians reported more masculinity than femininity during their childhood and adulthood, and were evaluated by observers to be more masculine than feminine in adulthood, compared to straight women, $p < .0001$, $\beta = .29$ [.15, .43], $p < .0001$, $\beta = .42$ [.33, .51], and, $p < .0001$, $\beta = .56$ [.46, .66] respectively (Figure 4 A-C). For self-reported childhood masculinity-femininity (but not for other measures) this effect was curvilinear, $p = .05$, $\beta = .14$ [.00, .31]. The linear effect of sexual orientation was stronger for observer-rated than self-reported adulthood masculinity-femininity, similar to previous reports, but the effect was also stronger with self-reports from adulthood than from childhood, which varies from previous research (Rieger et al., 2008; 2010). Given that across past and present studies effects for each measure were still similar, these differences might be random. Still, these variations left the possibility that one of these measures would more effectively reveal influences of masculinity-femininity on the relationship of sexual orientation with sexual arousal.

Figure 4 shows that across measures, the 95% confidence intervals of the regression coefficients indicated that straight women were below the midpoint of possible masculinity-femininity scores, whereas lesbians were just above. Furthermore, even though there was noticeable variation in masculinity-femininity, in general, lesbians and

bisexual women varied more strongly than straight women with respect to observer-ratings. A Levine test for unequal variance confirmed this finding, $p < .0001$, $\beta = .34$ [.23, .44]. To a small degree this was also found for their self-reported childhood masculinity-femininity, $p = .05$, $\beta = .14$ [.01, .29], but not for their self-reported adulthood masculinity-femininity, $p = .61$, $\beta = .03$ [-.08, .14].

Hypotheses 3. We hypothesized that the relationship of sexual orientation with sexual arousal was mediated by nonsexual masculinity-femininity. We conducted a series of multiple regression analyses. The dependent variables were either pupil dilation to the same sex, or other sex, or their difference score. Independent variables were sexual orientation and, because the relationship of sexual orientation with pupil dilation patters was partially curvilinear (Figure 3), the quadratic function of sexual orientation. Finally, we included one measure of masculinity-femininity as a mediator variable (self-reported childhood, self-reported adulthood, or observer-rated adulthood).

Tables 6 to 8 summarize the results of these analyses. The linear and curvilinear effects of sexual orientation remained similar in magnitude before and after including measures of masculinity-femininity as covariates (compare Figure 3 with Tables 6-8). Mediation analyses on the basis of 1000 bootstrapped samples (Preacher & Hayes, 2008) did not support that any measure of masculinity-femininity significantly mediated the linear or curvilinear relationship of sexual orientation with pupil dilation to the same sex, other sex, or their difference. Indirect effects were neither significant in the presence of self-reported childhood masculinity-femininity ($-.02 < \beta's < .02$, $-.06 <$ CI's $< .07$), nor self-reported adulthood masculinity-femininity ($-.01 < \beta's < .02$, $-.07 <$ CI's $< .08$), nor observer-rated adulthood masculinity femininity ($-.02 < \beta's < .04$, $-.09 <$ CI's $< .13$).

Hypotheses 4. It was hypothesized that the most masculine lesbians would dilate more strongly to the same sex than the other sex, compared to both straight women and less masculine lesbians. We conducted a series of multiple regression analyses, similar to those summarized in Tables 6-8. In addition, the interactions of sexual orientation with the given measure of masculinity-femininity were included in these analyses. Because the relationship of sexual orientation with pupil dilation patterns was partially curvilinear (Figure 3), we also included the curvilinear effect of sexual orientation and its interaction with masculinity-femininity as independent variables. These interactions tested whether lesbians, and especially exclusively lesbians, dilated more strongly than other women to the same sex than the other sex, depending on their degree of masculinity-femininity.

There were no significant interactions of the linear or curvilinear effect of sexual orientation with any measure of masculinity-femininity. This was neither the case if the moderator was self-reported childhood masculinity-femininity ($.13 < p\text{'s} < .39$, $-.18 < \beta\text{'s} < .15$, $-.42 <$ CI's $< .39$), nor self-reported adulthood masculinity-femininity ($.19 < p\text{'s} < .79$, $-.09 < \beta\text{'s} < .07$, $-.24 <$ CI's $< .18$), nor observer-rated adulthood masculinity-femininity ($.35 < p\text{'s} < .96$, $-.12 < \beta\text{'s} < .04$, $-.25 <$ CI's $< .17$). Thus, there was no support that the most masculine lesbians dilated most strongly to the same sex than the other sex, compared to other women. The linear and curvilinear effects of sexual orientation remained highly similar in size to those effects summarized in Tables 6 to 8.

Missing data. Self-reported childhood masculinity-femininity was not included in one dataset (Rieger & Savin-Williams, 2012a); observer-rated adulthood masculinity-femininity was not included in another (Rieger et al., 2015). Multiple linear regression analyses indicated no significant differences between participants with available or

missing data. The linear and curvilinear relationships of sexual orientation with pupil dilation to the same sex or other sex (Figure 3C) were not moderated by whether self-reported childhood masculinity-femininity was available, $p = .20$, $\beta = -.06$ [-.16, .04], and $p = .82$, $\beta = .02$ [-.12, .15], respectively. Likewise, these relationships were not moderated by whether observer-rated adulthood masculinity-femininity was available, $p = .80$, $\beta = -.01$ [-.14, .11], and $p = .99$, $\beta = .00$ [-.17, .17], respectively.

We computed multiple imputations (Little & Rubin, 2002) to estimate missing values of self-reported childhood and observer-rated adulthood behaviors from their covariance with sexual orientation and self-reported adulthood masculinity-femininity. From five imputations, the pooled effects of sexual orientation on these measures were almost identical to those calculated with missing data (Figure 4). The effects of sexual orientation on pupil dilation patterns also remained equivalent. For instance, with missing data, the effect of sexual orientation on pupil dilation to the same sex or other sex in the presence of observer-rated masculinity-femininity as covariate (Table 8), compared to the pooled effect with imputed data, $p < .0001$, $\beta = .35$ [.24, .47], and $p < .0001$, $\beta = .32$ [.17, .45], respectively. No analyses with imputed data indicated mediations by masculinity-femininity; nor were there moderations ($.10 < p$'s $< .89$, $-.15 < \beta$'s $< .03$, $-.35 <$ CI's $< .14$). Thus, imputed data yielded results comparable to the above.

Covariates. Lesbian were on average older, more educated, and more likely to be Caucasian than other women (Table 5). We conducted regression analyses similar to the above, but included age, education, and ethnicity as covariates. The main effects and curvilinear effects of sexual orientation on pupil dilation patterns (and their interactions with masculinity-femininity) remained identical in size before and after controlling for

demographic variables. For example, for analyses that included self-reported adulthood masculinity-femininity as a mediator (Table 7), the main effect on pupil dilation to the same sex or other sex remained similar, $p < .0001$, $\beta = .30$ [.19, .40], and $p < .0001$, $\beta = .31$ [.18, .43], respectively. Effects of sexual orientation were not moderated by age, ethnicity, or education ($.13 < p's < .99$, $-.10 < \beta's < .18$, $-.31 <$ CI's $< .37$). Thus, demographic information did not systematically affect the above results.

Alternative Analyses. Similar to Study 1, we further analyzed data with discriminant analyses, predicting women's sexual orientation identities (Table 5) by their pupil dilation to the same sex and other sex. Pupil dilation patterns generally misclassified women's sexual orientation identities (78%), but Table 9 shows that correct classifications were significantly more common for lesbians than other women, $B = 0.82$ [0.48, 1.68], $p < .0001$, $OD = 5.16$ [2.60, 10.33]. This finding was neither mediated nor moderated by measures of masculinity-femininity.

Overall, Study 2 suggested that lesbians were more masculine in their self-reported and observer-rated behaviors than were straight women. Thus, it was possible that these behavioral differences mediated sexual orientation differences in sexual arousal. In addition, variation in observer-ratings (and to some degree for reported childhood behaviors) of masculinity-femininity was stronger in lesbians than straight women, similar to previous reports (Lippa, 2005b; Lippa, 2008b; Rieger et al., 2008; Rieger et al., 2010). Hence, it was possible that especially the most masculine-behaving lesbians had the most male-typical sexual responses. However, as in Study 1, masculinity-femininity neither mediated nor moderated the effect of sexual orientation on sexual arousal.

General Discussion

Consistent with Hypotheses 1 and 2, results from Studies 1 and 2 suggest that lesbians were, on average, more male-typical than straight women in both their sexual arousal and nonsexual behaviors. However, Hypothesis 3, which states that behavioral masculinity-femininity accounts for general sexual orientation differences in sexual arousal was not confirmed. Neither was there confirmation that the most masculine-behaving lesbians had the most male-typical sexual arousal (Hypothesis 4).

The finding that lesbians were, on average, more male-typical than straight women in their sexual responses and nonsexual behaviors is consistent with previous research (Chivers et al., 2007; Lippa, 2008b). Furthermore, similar to previous findings for sexual arousal (Rieger et al., 2015; Rieger & Savin-Williams, 2012a) and masculinity-femininity (Rieger et al., 2008; Rieger et al., 2010), the present data indicated visible variation in either trait. Thus, contrarily to the general trends, some straight women responded more strongly to males or females, whereas some lesbians responded similarly to both (Figures 1 & 2). Likewise, some straight women were more masculine than feminine, and some lesbians were more feminine than masculine (Figures 2 & 4). These figures highlight our previous notion that any differences can only be interpreted in aggregate.

Unlike Hypotheses 1 and 2, Hypotheses 3 and 4, which regarded influences of masculinity-femininity on sexual responses, were not confirmed. Null findings must be interpreted with care and it needs to be considered whether the present research employed correct measurements or analyses. For one, we might not have utilized accurate measures of masculinity and femininity. Other research suggests that psychological gender differences are multi-dimensional and do not fall onto a single differentiation of male versus female (Carothers & Reis, 2012). The same could be true within the sexes. In fact,

present findings that male-typical sexual arousal is independent of male-typical behaviors in women support the theory of several gendered dimensions within sex. Similarly, our conceptualization of a one-dimensional index of masculinity-femininity might have been too simplistic. Yet, many people perceive masculine and feminine as opposite ends of one dimension (Pedhazur & Tetenbaum, 1979) and a one-dimensional approach with respect to self-concepts, interests, and behaviors yields predicted and strong sex and sexual orientation differences (Lippa, 2005b; Rieger et al., 2010). In the current studies, these one-dimensional measures were also linked to sexual orientation in the predicted directions (Figures 2 & 4), and are, in this sense, valid. Hence, even if used measures of masculinity-femininity did not fully capture all dimensions of gender between and within the sexes, they are strongly related to sexual orientation, and could allow detecting sexual orientation differences in sexual arousal, if such differences existed.

It is also possible that hypothesized patterns would have been detected with a different measure of sexual arousal. One common measure is women's subjective arousal to sexual stimuli. The current research included such measure (not reported in the Results) and, similar to physiological arousal, there was no sign that masculinity-femininity mediated or moderated the relation of sexual orientation with subjective arousal. However, we do not consider subjective arousal a superior measure for investigating these patterns. Unlike women's physiological sexual arousal, which is usually weakly linked to sexual orientation, women's subjective sexual responses vary in how strongly they relate to their sexual orientation (Bossio et al., 2014; Rieger et al., 2015; Spape, Timmers, Yoon, Ponseti, & Chivers, 2014) and are prone to social desirability biases (Huberman, Suschinsky, Lalumière, & Chivers, 2013). Because

subjective responses are more under participants' control than their physiological arousal (Janssen et al., 2007), they are less effective in reflecting automatic sexual responses unique for each sex or sexual orientation. Hence, we considered that specific patterns of arousal, depending on masculinity-femininity, would be more telling with respect to women's physiological than their subjective sexual responses.

It is also possible that alternative analyses would give more informative results. For this reason we have also reported discriminant analyses (Tables 4 & 9), which, similar to the conducted regression analyses (Figures 1 & 3), suggest that sexual responses to the same sex and other sex are more strongly linked to a lesbian identity than other sexual orientation identities. Thus, these alternative analyses further supported Hypothesis 1; yet these differences in correctly classifying sexual orientations did not relate to women's masculinity-femininity, neither confirming Hypothesis 3 nor 4.

Because of the null findings for some of our hypotheses, it is difficult to speculate about broader mechanisms behind present results. However, if one assumes that present results are accurate, then the finding that some lesbians show male-typical sexual arousal is unrelated to their male-typical nonsexual characteristics and vice versa. Their sexual and nonsexual traits could therefore be affected by different factors. For example, hormonal exposure at different timeframes during early development might be responsible for their independent expressions. This hypothesis is indirectly supported by research on non-human primates. Female rhesus macaques exposed to unusually high levels of androgen early in their gestation mounted other macaques (a sexual behavior typically seen in males) more than untreated females did. The same females did not display more of a nonsexual male-typical behavior, rough-and-tumble play. Contrarily,

females who were exposed to high levels of androgens later in their prenatal development showed higher indices of rough-and-tumble play but not of mounting behaviors (Goy, Bercovitch, & McBrair, 1988; Wallen, 2005). An extension to humans may be premature, but it is possible that androgen influences at different timeframes explain why some women show male-typical sexual arousal and others show male-typical behaviors, but that these are apparently not linked.

In addition, influences of the social environment could explain in part the present findings. Although there is no strong evidence that social factors determine the origins of sexual orientation (Rahman & Wilson, 2003a; Wilson & Rahman, 2005), social expectations throughout the lifespan reinforce gender-typed behaviors, self-concepts, cognition, and emotions, and the manifestation of gender roles in women and men (Eagly & Wood, 2013; Eagly, Wood, & Diekman, 2000; Hines, 2010). Social expectations may also contribute to variations of gender behaviors within sexual orientation groups. Lippa (2005b) proposed that predominant pressures towards typical gender roles cause some lesbians and gay men to behave in gender-typical ways, but counteractive influences against stereotypical gender behaviors within the gay and lesbian community compel others to behave in a gender-atypical manner. Women's genital arousal and pupil dilation patterns are likely less obvious to other people than their behavioral masculinity-femininity. Thus, these physiological responses might be less affected by social expectations. The different impact of social forces on women's sexual responses and nonsexual behaviors could lead to independent connections of their sexual orientation with either trait.

Our discussion this far has focused on differences between straight women (Kinsey scores 0-1) and lesbians (Kinsey scores 5-6). Bisexual women (Kinsey scores 2-4) were intermediate in many of their sexual arousal and masculinity-femininity patterns (Figures1-4). For masculinity-femininity, their intermediate state was, on average, distinct from straight women and lesbians (i.e., the upper confidence interval at a Kinsey score 2 was below or close to the lower confidence interval at a Kinsey score 4). Intermediate masculinity-femininity of bisexual women, different from other groups, was previously reported (Lippa, 2005b; Lippa, 2008b). Yet, Figures 1 to 4 also suggest that variations in masculinity-femininity were not that distinguishable between most adjacent groups (e.g., the upper confidence interval at Kinsey 1 overlapped with the lower confidence interval at Kinsey 2) and can therefore be interpreted as a continuous change along sexual orientations. Similarly, most changes in sexual response were on a gradient between adjacent groups. Hence, our interpretation of lesbian's unique male-typical sexual arousal or behaviors is most applicable by comparing women who are exclusively sexually orientated towards the same sex or the other sex.

Limitations

Present findings need to be understood within the framework of broader limitations. Samples in Study 1 and 2 were mostly Caucasian, and the largest proportion was college educated (Tables 1 & 5). Moreover, samples were drawn from US locations where the population tends to have liberal political views. Hence, present samples likely are what has been described as Western, Educated, Industrialized, Rich, and Democratic (WEIRD). Such samples do not represent most people and can yield biased results. This general issue in the social sciences affects research programs such as perception, cognition,

reasoning, self-concepts, and cooperation (Henrich, Heine, & Norenzayan, 2010). Although differences in age, ethnicity, and education did not influence the associations between sexual orientation, sexual arousal, and masculinity-femininity in the present data, we cannot rule out that reported findings are limited to the WEIRD demographic.

In addition, many people are unwilling to participate in studies on genital arousal (Strassberg & Lowe, 1995), which could lead to biased findings. Women who participate are more liberal in their sexual attitudes than those who are not willing to participate. Yet, the same variables that differentiate these groups do not systematically differentiate genital responses within those women who do participate (Chivers et al., 2004). Research with less invasive measures of sexual response such as pupil dilation, reaction time, and viewing time arguably draw more diverse samples than a study on genital arousal. Findings with these measures mirror general sex differences and sexual orientation differences in genital arousal (Lippa, 2013; Rieger & Savin-Williams, 2012a; Wright & Adams, 1999). Hence, at least for participants in sexuality research, female genital arousal patterns appear to resemble an overall pattern of female sexual response.

Another limitation is that discussed findings are drawn from experiments in which participants passively view relatively short sexual stimuli with restricted intensity. Recent research, however, suggests that longer (10-minute) sexual stimuli do not affect sex differences in the specificity of genital response, and neither does the apparatus used to assesse genital vasocongestion (Huberman & Chivers, 2015). Other research indicates that the nonspecific sexual responses of straight women are unaffected by variation in stimulus length and modality (Chivers et al., 2014; Chivers & Timmers, 2012; Rieger et al., 2015; Rieger & Savin-Williams, 2012a). In addition, when data from straight women

and lesbians are compared, the intensity of stimuli does not strongly affect the correlation of women's sexual orientation with their genital responses to the same sex or other sex (Chivers et al., 2007; Table 1). With respect to sexual arousal studies conducted in the lab, we therefore believe that present findings are valid, regardless of stimulus length and intensity. However, we cannot rule out that longer and intense sexual stimulations, such as intercourse in a private setting, results in very different arousal patterns than those observed in the lab.

Conclusion

In conclusion, there were no indications that lesbians are, on average, more male-typical that straight women in their sexual arousal because such a pattern is linked to their male-typical nonsexual behaviors. Perhaps the hypothesized connections between female sexual orientation, sexual arousal, and behavioral masculinity-femininity will become apparent with the advent of other measures of sexual arousal such as thermography (Huberman & Chivers, 2015) or neurological activity while watching sexual stimuli (Prause, Staley, & Roberts, 2014). It is also possible that women's sexual arousal to their preferred sex can be enhanced by the unobstructed depiction of prepotent sexual features, that is, sexually aroused genital (Spape et al., 2014), and that sexual stimuli depicted these sexual cues will yield the predicted patterns. Based on present data, however, the most parsimonious interpretation is that any masculinization of women's sexual response systems is independent of a masculinization of their nonsexual behaviors and attitudes.

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Table 1.

Distribution of Sexual Orientation Identities across Ages, Ethnicities, and Education in Study 1.

Women (N = 152)	Straight	Mostly Straight	Bisexual Leaning Straight	Bisexual	Bisexual Leaning Lesbian	Mostly Lesbian	Lesbian
Number	31	41	14	10	18	19	19
Average Age	22.81	23.08	24.20	22.89	26.24	26.78	27.21
	[21.18, 24.44]	[21.49, 24.67]	[21.78, 26.62]	[19.60, 26.18]	[23.28, 29.19]	[23.76, 29.81]	[23.92, 30.51]
Percentage Caucasian	67	63	40	67	52	78	64
	[50, 80]	[47, 77]	[20, 64]	[35, 88]	[31, 74]	[58, 90]	[39, 84]
Average Education[1]	4.19	4.35	4.60	4.11	4.71	5.00	4.29
	[4.02, 4.37]	[4.08,4.63]	[4.19, 5.01]	[2.99, 5.23]	[4.27, 5.14]	[4.69, 5.40]	[3.71, 4.86]

Note. Numbers in brackets represent 95% confidence intervals. [1]Education was coded as 1 (no high school), 2 (some high school), 3 (high school diploma), 4 (some college), 5 (college graduate), 6 (postgraduate student or degree). One participant indicated "other education."

Table 2.

Multiple Regression Analyses for Sexual Orientation and Self-Reported Adulthood Masculinity-Femininity Predicting Genital Arousal to the Same Sex, Other Sex, and their Difference Score across 115 Women.

	Response to Same Sex	Response to Other Sex	Response to Same or Other Sex
Variables	β	β	β
Sexual Orientation (SO)[1]	.28 [.14, .43]*	-.16 [-.31, .01]	.30 [.09, .53]*
Self-Reported Adulthood Masculinity-Femininity (M-F)[2]	-.34, [-.46, -.22]*	-.03 [-.14, .09]	-.23 [-.40, .00]*

Note. R^2*'s* for the three models are .12, .03, and .08, respectively. Numbers in brackets represent 95% confidence intervals of the standardized regression coefficient, β. [1]Higher scores indicate stronger orientation to the same sex and less to the other sex. [2]Higher scores indicate more masculinity and less femininity. *$p < .05$.

Table 3.

Multiple Regression Analyses for Sexual Orientation and Self-Reported Adulthood Masculinity-Femininity Predicting Genital Arousal to the Same Sex, Other Sex, and their Difference Score across 115 Women.

	Response to Same Sex	Response to Other Sex	Response to Same or Other Sex
Variables	β	β	β
Sexual Orientation (SO)[1]	.28 [.12, .43]*	-.17 [-.33, .02]	.30 [.08, .52]*
Self-Reported Adulthood Masculinity-Femininity (M-F)[2]	-.34, [-.46, -.21]*	-.02 [-.14, .10]	-.23 [-.41, .00]*
SO X M-F	-.00 [-.13, .10]	.04 [-.08, .15]	-.03 [-.20, .15]

Note. R^2*'s* for the three models are .12, .03, and .08, respectively. Numbers in brackets represent 95% confidence intervals of the standardized regression coefficient, β. [1]Higher scores indicate stronger orientation to the same sex and less to the other sex. [2]Higher scores indicate more masculinity and less femininity. *$p < .05$.

Table 4.

Distribution of Correctly and Incorrectly Classified Sexual Orientation Identities Based on Women's Genital Responses to the Same Sex and the Other Sex.

Women (N = 152)	Straight	Mostly Straight	Bisexual Leaning Straight	Bisexual	Bisexual Leaning Lesbian	Mostly Lesbian	Lesbian
Correct	8 (26)	2 (05)	2 (14)	1 (10)	2 (11)	1 (05)	15 (78)
Incorrect	23 (74)	39 (95)	12 (86)	9 (90)	16 (89)	18 (95)	4 (22)

Note. Numbers in brackets are percentage scores.

Table 5.

Distribution of Sexual Orientation Identities across Ages, Ethnicities, and Education in Study 2.

Women (N = 345)	Straight	Mostly Straight	Bisexual Leaning Straight	Bisexual	Bisexual Leaning Lesbian	Mostly Lesbian	Lesbian
Number	68	63	34	31	43	66	40
Average Age	21.62	21.57	22.97	24.16	21.86	24.88	25.08
	[20.36, 22.87]	[20.70, 22.44]	[21.75, 24.19]	[21.70, 26.62]	[21.01, 22.71]	[22.97, 26.79]	[23.46, 26.69]
Percentage Caucasian	59	68	47	68	63	82	83
	[47, 70]	[56, 78]	[31, 63]	[50, 81]	[48, 76]	[71, 89]	[68, 91]
Average Education[1]	4.13	4.46	4.53	4.61	4.37	4.65	4.60
	[3.94, 4.32]	[4.26, 4.66]	[4.25, 4.80]	[4.20, 5.02]	[4.12, 4.62]	[4.46, 4.84]	[4.33, 4.87]

Note. Numbers in brackets represent 95% confidence intervals. [1]Education was coded as 1 (no high school), 2 (some high school), 3 (high school diploma), 4 (some college), 5 (college graduate), 6 (postgraduate student or degree).

Table 6.

Multiple Regression Analyses for Sexual Orientation and Self-Reported Childhood Masculinity-Femininity Predicting Pupil Dilation to the Same Sex, Other Sex, and their Difference Score across 186 Women.

	Response to Same Sex	Response to Other Sex	Response to Same or Other Sex
Variables	β	β	β
Sexual Orientation (SO)[1]	.19 [.01, .37]*	-.20 [-.39, -.01]*	.22 [.04, .40]*
SO X SO	.19 [.02, .42]*	-.06 [-.29, .18]	.15 [.01, .37]*
Self-Reported Childhood Masculinity-Femininity (M-F)[2]	.07 [-.19, .33]	.02 [-.25, .28]	.03 [-.23, .28]

Note. R^2*'s* for the three models are .06, .03, and .06, respectively. Numbers in brackets represent 95% confidence intervals of the standardized regression coefficient, β. [1]Higher scores indicate stronger orientation to the same sex and less to the other sex. [2]Higher scores indicate more masculinity and less femininity. *$p < .05$.

Table 7.

Multiple Regression Analyses for Sexual Orientation and Self-Reported Adulthood Masculinity-Femininity Predicting Pupil Dilation to the Same Sex, Other Sex, and their Difference Score across 345 Women.

	Response to Same Sex	Response to Other Sex	Response to Same or Other Sex
Variables	β	β	β
Sexual Orientation (SO)[1]	.25 [.14, .35]***	-.29 [-.40, -.17]***	.30 [.19, .40]***
SO X SO	.16 [.03, .30]*	-.07 [-.22, .03]	.13 [.00, .27]*
Self-Reported Adulthood Masculinity-Femininity (M-F)[2]	.01 [-.10, .12]	.06 [-.06, .18]	-.03 [-.14, .09]

Note. R^2*'s* for the three models are .09, .08, and .11, respectively. Numbers in brackets represent 95% confidence intervals of the standardized regression coefficient, β. [1]Higher scores indicate stronger orientation to the same sex and less to the other sex. [2]Higher scores indicate more masculinity and less femininity. *$p < .05$. ***$p < .0001$.

Table 8.

Multiple Regression Analyses for Sexual Orientation and Observer-Rated Adulthood Masculinity-Femininity Predicting Pupil Dilation to the Same Sex, Other Sex, and their Difference Score across 273 Women.

	Response to Same Sex	Response to Other Sex	Response to Same or Other Sex
Variables	β	β	β
Sexual Orientation (SO)[1]	.31 [.21, .40]***	-.37 [-.49, -.26]***	.35 [.24, .47]***
SO X SO	.16 [.04, .28]*	-.13 [-.26, .00]*	.15 [.02, .29]*
Observer-Rated Adulthood Masculinity-Femininity (M-F)[2]	.02 [-.08, .13]	.07 [-.04, .18]	-.03 [-.15, .08]

Note. R^2*'s* for the three models are .12, .13, and .13, respectively. Numbers in brackets represent 95% confidence intervals of the standardized regression coefficient, β. [1]Higher scores indicate stronger orientation to the same sex and less to the other sex. [2]Higher scores indicate more masculinity and less femininity. *$p < .05$. ***$p < .0001$.

Table 9.

Distribution of Correctly and Incorrectly Classified Sexual Orientation Identities Based on Women's Pupil Dilation to the Same Sex and the Other Sex.

Women (N = 345)	Straight	Mostly Straight	Bisexual Leaning Straight	Bisexual	Bisexual Leaning Lesbian	Mostly Lesbian	Lesbian
Correct	21 (31)	11 (17)	2 (06)	9 (29)	4 (09)	7 (11)	23 (58)
Incorrect	47 (69)	52 (83)	32 (94)	22 (71)	39 (91)	59 (89)	17 (42)

Note. Numbers in brackets are percentage scores.

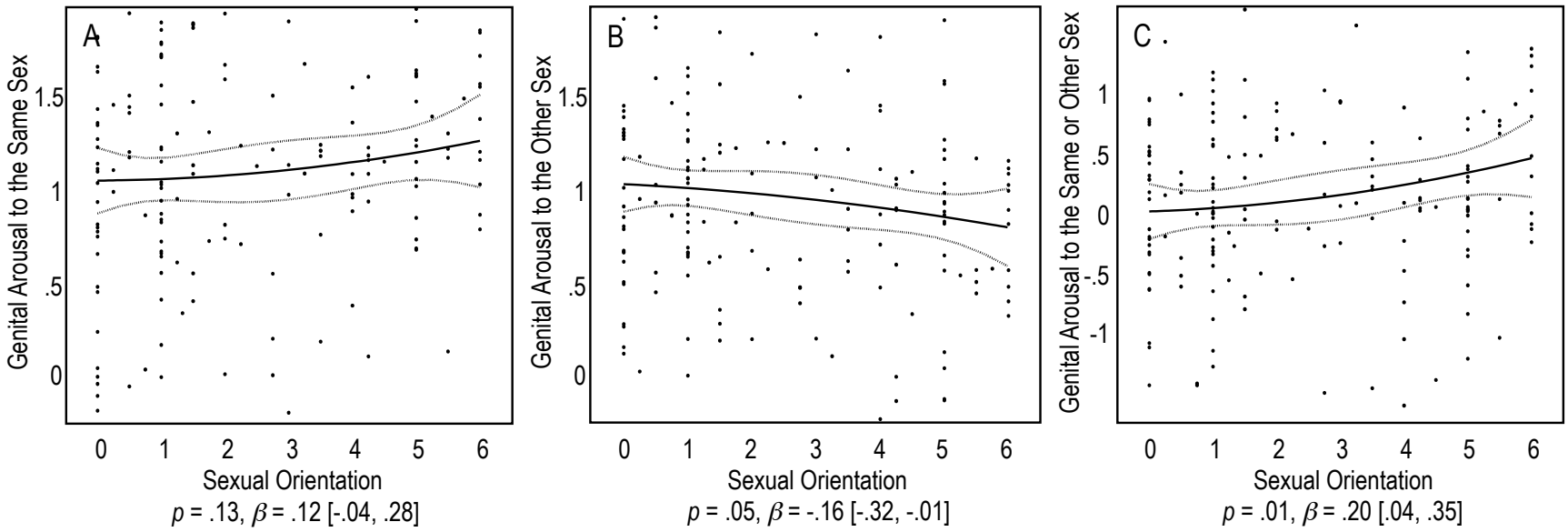

Figure 1. Women's responses to sexual stimuli. Reported sexual orientation of 152 women in relation to genital arousal to the same sex (A), other sex (B), and their difference (C). On the Y axes, genital arousal scores reflect changes compared to baseline, *z*-scored within participants. On the X axes, 0 represents exclusively straight, 3 bisexual, and 6 exclusively lesbian. Lines represent regression coefficients with 95% confidence intervals. Dots represent participants' average scores. Statistics represent linear effects.

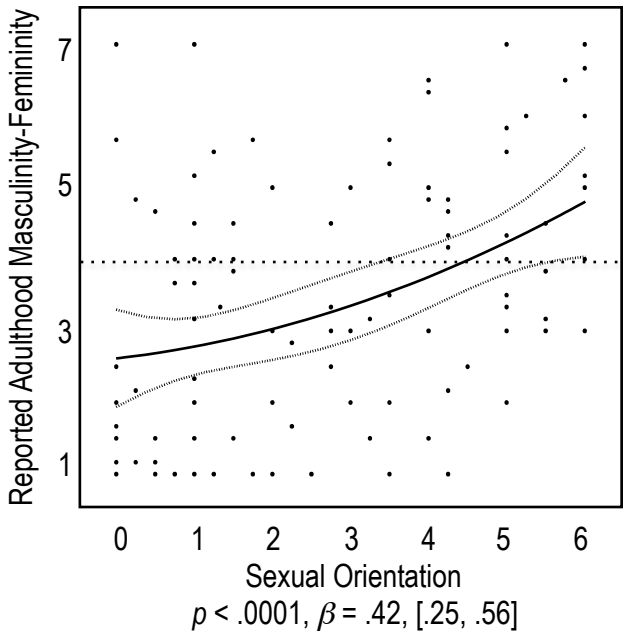

Figure 2. Women's degree in masculinity and femininity. Reported sexual orientation of 115 women in relation to their self-reported adulthood masculinity-femininity. On the Y axis, a score of 7 indicates the most masculine score, the middle line an average score of 4, and a score of 1 the most feminine score. On the X axes, 0 represents exclusively straight, 3 bisexual, and 6 exclusively lesbian. Lines represent regression coefficients with 95% confidence intervals. Dots represent participants' average scores. Statistics represent a linear effect.

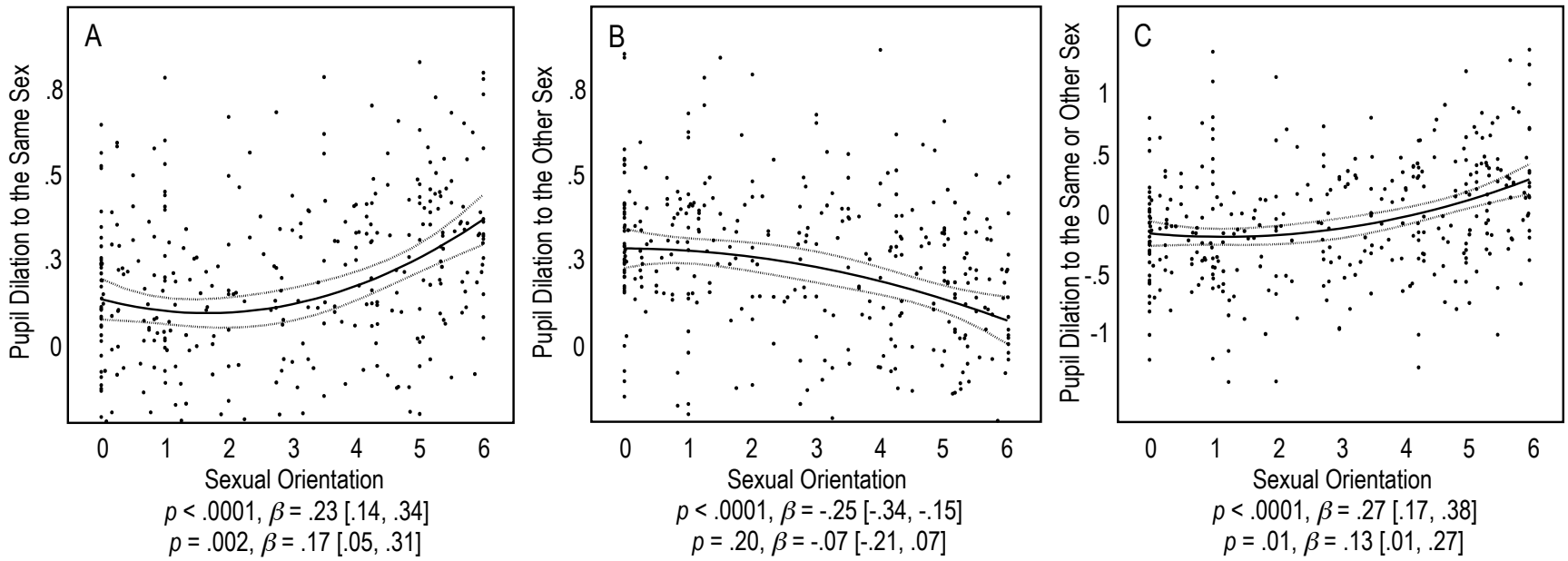

Figure 3. Women's responses to sexual stimuli. Reported sexual orientation of 345 women in relation to pupil dilation to the same sex (A), other sex (B), and their difference (C). On the Y axes, pupil dilation scores reflect changes compared to baseline, *z*-scored within participants. On the X axes, 0 represents exclusively straight, 3 bisexual, and 6 exclusively lesbian. Lines represent regression coefficients with 95% confidence intervals. Dots represent participants' average scores. Statistics represent linear and curvilinear effects.

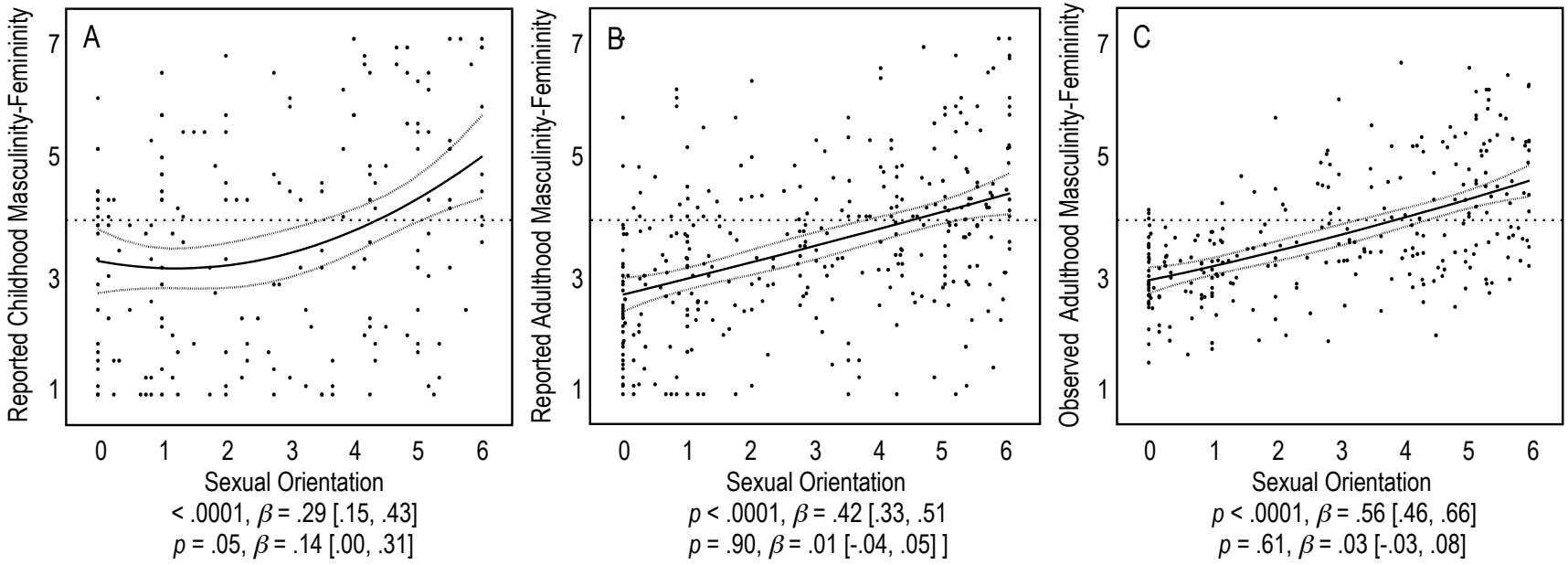

Figure 4. Women's degree of masculinity and femininity. Reported sexual orientation of women in relation to self-reported childhood masculinity-femininity ($N = 186$; A), self-reported adulthood masculinity-femininity ($N = 345$, B), and observer-rated adulthood masculinity-femininity ($N = 273$, C). On the Y axes, a score of 7 indicates the most masculine score, the middle line an average score of 4, and a score of 1 the most feminine score. On the X axes, 0 represents exclusively straight, 3 bisexual, and 6 exclusively lesbian. Lines represent regression coefficients with 95% confidence intervals. Dots represent participants' average scores. Statistics represent linear and curvilinear effects.