

Sexual Arousal and Mental Health in Bisexual Men

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Abstract

There is variation in the extent to which bisexual men get sexually aroused to both sexes. A different line of research suggests that they also vary in how vulnerable they are to mental health problems, compared to gay and straight men. The present study sought to investigate whether variation in bisexual men's mental health related to their physiological sexual arousal patterns. Based on the literature one of our hypotheses was that bisexual men with bisexual arousal patterns report more mental health problems than other bisexual men, straight men, and gay men. However, an alternative hypothesis was that bisexual men who resemble gay or straight men in physiological arousal would report more mental health problems than those bisexual men who show bisexual arousal, straight men, and gay men. As part of an ongoing project, 125 men watched sexually explicit videos of women and men while their genital arousal and pupil dilation were recorded. 56 of these men also completed a survey of their mental health problems. Bisexual genital arousal was most common in men who identified as bisexual-leaning-straight. Mental health problems did not systematically vary across reported sexual orientations. Moreover, prevalence of mental health problems did not relate to differences in genital arousal patterns in bisexual men. The majority of these patterns were confirmed with pupil dilation as the measure of sexual arousal, although findings with pupil dilation were more complex than those with genital arousal.

Introduction

Some self-identified bisexual men show bisexual physiological arousal patterns whereas others show sexual arousal to one sex only, similar to straight or gay men (Rieger, Chivers, & Bailey, 2005; Rosenthal, Sylva, Safron, & Bailey, 2011; 2012; Rieger, Rosenthal, Cash, Linsenmeier, Bailey, & Savin-Williams, 2013). This indicates that there are different groups of self-identified bisexual men in terms of sexual arousal. A different line of research suggests that bisexual men, as a group, are more vulnerable to mental health problems than gay and straight men (Bostwick, Boyd, Hughes, & McCabe, 2010), but substantial variability in their mental health problems indicates that there are considerable differences in mental health within this group. The present study sought to investigate whether mental health differences in bisexual men could point to different groups of bisexual-identified men with respect to their physiological sexual arousal.

Genital Arousal in Bisexual Men

Physiological sexual arousal to erotic stimuli can be assessed in laboratory settings as an indicator of sexual orientation. This method was introduced by Freund (1963) who measured penile circumference in men while they were exposed to visual sexual stimuli. Gay and straight-oriented men typically show bimodal sexual arousal patterns, with most straight men being exclusively aroused to women and most gay men being exclusively aroused to men (Bailey, 2009; Sylvia, Rosenthal, Reber, Parrish, & Bailey, 2013; Freund, 1963; Freund, Watson, & Rienzo, 1989).

Men who identify as bisexual have been a topic for controversy in this regard, as they can show inconsistent sexual arousal patterns across studies. Some research suggests that bisexual men show arousal to only one sex. For example, Freund stated that after hundreds of

male sexual arousal assessments, no evidence for the existence of bisexual arousal patterns in men had occurred (1974, p.39). Rather, bisexual identified men typically showed arousal patterns that resembled those of gay men. Freund's observations inspired several studies to investigate the concordance between bisexual men's self-reported and physiological indices of sexual attraction.

The first study to investigate arousal patterns in bisexual men measured genital arousal in 10 straight, 10 bisexual, and 10 gay men while exposing them to male and female sexual stimuli (Tollison, Adams, & Tollison, 1979). The findings suggested that men who identified as bisexual exhibited arousal patterns resembling those of gay men. Another study replicated this finding in a larger sample that consisted of 30 straight, 33 bisexual, and 38 gay men (Rieger, Chivers, & Bailey, 2005). Most bisexual-identified men showed arousal patterns resembling homosexual men, although a smaller proportion showed heterosexual arousal. However, on average, no bisexual arousal patterns were found for bisexual-identified men. The findings from Tollison et al. (1979) and Rieger et al. (2005) suggest that bisexual-identified men show either homosexual or heterosexual arousal patterns, thus, monosexual arousal, but no substantial bisexual arousal.

Another study presented stimuli depicting sexual interactions between two women (lesbian stimulus), two men (gay stimulus), or one man with one other man and a woman (bisexual stimulus). These stimuli were shown to 27 straight, 19 gay, and 13 bisexual men, while assessing their genital responses (Cerny & Janssen, 2011). Bisexual men were more aroused by the bisexual stimuli than gay and straight men. However, no difference was reported between bisexual and gay men with regards to reactions to gay and straight stimuli – both groups were substantially more aroused to gay stimuli than straight stimuli, and were in this respect equally distinguishable from straight men. According to Cerny and Janssen (2011), their findings indicated that bisexuality in men is associated with a unique and

specific pattern of sexual arousal. However, this was criticised by Bailey, Rieger and Rosenthal (2011) who argued that Cerny and Janssen's (2011) conclusion about bisexual arousal in men was misleading. Bailey et al. (2011) argued that Cerny and Janssen (2011) failed to demonstrate that their bisexual sample had distinct genital sexual arousal to both male stimuli, and, independently, to female stimuli (rather than a combination of these two stimuli), and thus did not provide evidence for bisexual arousal in men. Perhaps, Cerny and Janssen's (2011) men have shown increased arousal to bisexual stimuli due to lack of aversive feeling towards either sex, rather than actual arousal to both sexes (Bailey et al., 2011).

One study investigated genital arousal to sexual stimuli in 20 men with paraphilic (paedophilic, exhibitionistic, fetishist) sexual preferences (McConaghy, & Blaszczynski, 1991). Men who identified as bisexual exhibited bisexual arousal patterns. However, this finding was problematic in two ways: First, their sample was heterogeneous in terms of paraphilic sexual preferences and may therefore not represent most men who identify as bisexual. Second, statistical analyses did not appropriately test for and distinguish potential bisexual arousal from heterosexual or homosexual arousal. Thus, this is not sufficient evidence for existence of bisexual arousal patterns in men.

The first study to obtain compelling evidence for substantial bisexual arousal in men used more stringent recruitment criteria for bisexual men than that of preceding studies, such as having had past sexual and romantic relationships with partners of both sexes (Rosenthal et al., 2011). On average, these bisexual-identified men showed substantial arousal to both gay and straight stimuli, but as these men were recruited with more stringent criteria than in past research that failed to demonstrate bisexual arousal of bisexual men, this may *not be* the most common arousal pattern in this group. In this study, bisexual men were also found to show more sexual arousal to bisexual stimuli (a man having sexual activities with both a man

and a woman) than both straight and gay men (Rosenthal, et al., 2012), similar to a previous study (Cerny & Janssen, 2011).

The mixed findings of the literature indicate that there are at least three groups of bisexual men in terms of their genital arousal. These are: bisexual men with bisexual genital arousal, bisexual men with homosexual genital arousal, and bisexual men with heterosexual genital arousal. Little research has investigated potential differences between these groups. The exception is one study that examined differences in certain sexual personality traits (Rieger et al., 2013). Findings showed that bisexual men, as a group, were higher on trait sexual curiosity when compared to gay and straight men. This means that bisexual men have an elevated interest in certain unconventional sexual acts, such as; watching their partner having sex with someone else, or participating in an orgy. However, sexual curiosity was most elevated in bisexual men who also showed bisexual arousal patterns, whereas those bisexual men who had low sexual curiosity did not show bisexual arousal, but instead, arousal similar to gay men. Although the present research did not investigate sexual curiosity, the finding from that study emphasizes that bisexual men's sexual arousal patterns may, as a group, look different from one study to another or from one analysis to another. *Hypothesis 1 states that self-identified bisexual men, will show, on average, bisexual arousal patterns. However, given past variable results, they could, as a group, also show arousal patterns resembling gay or straight men.*

Pupil dilation in Bisexual Men

Another measure of sexual arousal employed in the present research is pupil dilation to sexual stimuli. Pupil dilation is an indicator of autonomic nervous system activation and can reflect emotional arousal (Bradley, Miccoli, Escrig, & Lang, 2008). The autonomic nervous system is associated with several automatic physiological processes such as

perspiration, blood pressure, heart rate, breathing, and genital response (Donkelaar, Němcová, Lammens, Overeem, & Keyser, 2011). Furthermore, pupil dilation is an automatic response, which is difficult to control and cannot be suppressed (Heaver & Hutton, 2011; Loewenfeld, 1993). This makes pupil dilation a useful measure for assessing automatic responses, such as sexual interest towards stimuli (Goldinger & Papesch, 2012; Laeng, Sirois, & Gredebäck, 2012). In fact, pupil dilation to sexually preferred stimuli appears to be the strongest pupillary response elicited by stimuli (Laeng et al., 2012).

Intercorrelations between a set of measures of sexual interest; reaction time, viewing time, and pupil dilation to adult sexual stimuli suggests that these measures are measuring the same underlying construct and therefore show convergent validity (Ó Ciardha, Attard-Johnson, & Bindemann, 2018). Reaction time, viewing time, and pupil dilation are also highly predictive of self-reported sexual interests and therefore also show concurrent validity (Ó Ciardha et al., 2018).

The first studies to investigate pupil dilation to sexual stimuli showed male and female participants semi-nude photographs depicting men and women. Changes in pupil size were measured by obtaining exposures of the participant's eye (Hess, & Polt, 1960). Findings indicated that in both men and women, pupils dilate more to the participant's preferred sex than to the less preferred sex. Another study found that pupil dilation patterns in homosexual males reflected a preference for male sexual stimuli (Hess, Seltzer, & Shlien, 1965). Thus, pupil dilation patterns reflect sexual orientation in heterosexual and homosexual men. It is debatable, though, how valid these early findings are, as several of the participants also worked in the lab (and were possibly aware of hypotheses) and pupil dilation was measured from photographs of the eye and by hand, which could have increased measurement error.

More recent studies have used an infrared gaze tracker device to record pupil changes during viewing of visual stimuli. Rieger and Savin-Williams (2012) examined the

correspondence between pupil dilation, viewing time and sexual orientation in a sample of 325 men and women. For male participants, pupil dilation to male or female sexual stimuli corresponded with self-reported sexual orientation. Furthermore, Rieger and Savin-Williams (2012) found that bisexual men showed more pupil dilation to both sexes than homosexual and heterosexual men. The latter finding indicates that bisexual men have a bisexual pupil dilation pattern. Both of these findings are similar to those found in some (but not all) studies on genital arousal patterns in men of different sexual orientations (Rosenthal et al., 2011; 2012; Rieger et al., 2013; 2015).

One study investigated the correspondence between sexual orientation, pupil dilation and genital arousal to sexual stimuli in 76 men and 72 women (Rieger, Cash, Merrill, Jones-Rounds, Dharmavaram, & Savin-Williams, 2015). Findings indicated that pupil dilation is consistent with genital arousal to sexual stimuli. Furthermore, responses to the same or the other sex, both in terms of pupil dilation and genital responses, related stronger to sexual orientation in men than in women; a sex difference that has been previously described with other measures.

Recent research has investigated whether pupil dilation can be used to measure more specific sexual interests. Attard-Johnson, Bindemann and Ciardha (2016) sought to investigate whether pupil dilation to stimuli could reveal age-specific sexual interests. They recorded the pupil dilation of 22 male and 22 female participants who watched stimuli depicting men, women and children of different ages in swim or leisure wear. Men showed strongest pupil dilation to female stimuli when compared to male and child stimuli, and the women's pupils dilated to both male and female stimuli but not to child stimuli. Thus, replicating past findings for pupil dilation to same or other sex in heterosexual men and women (Rieger & Savin-Williams, 2012), and demonstrating that pupil dilation can be used to assess age-specific sexual interest.

Another study investigated whether pupil dilation to stimuli could reveal age specific sexual interests in a sample of 100 men of different sexual orientations (Attard-Johnson, Bindemann, & Ó Ciardha, 2017). Pupil dilation to stimuli depicting adults in swim or leisure wear reflected sexual orientation, and this dilation was stronger than to stimuli depicting younger age groups. Thus, pupil dilation to stimuli can reveal age-specific sexual interest in men of different sexual orientations.

The above studies on pupil dilation to sexual stimuli have used naked or semi-naked models in their stimuli. One study addressed the question of whether the extent to which the stimuli are sexually explicit affects pupil dilation responses (Attard-Johnson & Bindemann, 2017). This was investigated by measuring the pupil dilation responses of 28 female and 24 male heterosexual participants who were exposed to stimuli with varying levels of sexual explicitness. Findings indicated that pupillary responses were consistent with self-reported sexual attraction, and that the extent to which stimuli were sexually explicit did not affect pupillary responses. This finding conflicts with a related study, which suggests that stimuli's level of sexual explicitness does affect pupil dilation (Watts et al., 2016). However, because Attard-Johnson and Bindemann employed more sophisticated methodologies than Watts et al., it is possible that the former findings are more accurate.

The present study will apply pupil dilation and genital measures simultaneously. Based on the above findings from studies on genital arousal and pupil dilation, we expect that the two measurements will show a similar overall pattern in which sexual interests are reflected in both pupil dilation and genital arousal patterns.

Mental health in bisexual men

Another aspect of the present research is mental health. Lesbian, gay and bisexual (LGB) individuals, in comparison to straight individuals, are more likely to experience

mental health problems, including elevated levels of depressive and anxious symptoms, suicide ideation and suicide attempts, and substance use problems (Mustanski, Garofalo & Emerson, 2010; Plöderl & Tremblay, 2015; Semlyen, King, Varney, & Hagger-Johnson, 2016). For example, one US national study found that LGB-individuals are at least one and a half times more likely than heterosexuals to report lifetime mood and anxiety disorders (Bostwick, Boyd, Hughes, & McCabe, 2010).

One occurring theme in the majority of aforementioned studies is that bisexuals experience higher levels of mental health problems than both gay and straight individuals (see review by Plöderl & Tremblay, 2015). One study investigated differences in prevalence of anxiety, depression, suicidality, alcohol misuse, and positive and negative affect in a community sample of 4824 adults in which 78 identified as gay, 71 identified as bisexual, and the remainder was straight (Jorm, Korten, Rodgers, Jacomb, & Christensen, 2002). Findings indicated that bisexuals, on average, reported higher prevalence of anxiety, depression and negative affect than straight individuals, with gay individuals falling somewhere in between.

A large-scale population study assessed the mental health status of 536 gay, 300 bisexual, and 49,065 straight men who had taken part in a Canadian community health survey (Brennan, Ross, Dobinson, Veldhuizen, & Steele, 2010). Gay men, and even more so bisexual men, reported higher prevalence of mood and anxiety disorders, and lifetime suicidality than straight men. More specifically, when compared to straight men, gay men were four times more likely to have seriously considered suicide, and bisexual men were six times more likely to have seriously considered suicide.

Bostwick et al. (2010) conducted one of the most thorough studies on sexual orientation and mental health, with a sample consisting of 34,653 National Epidemiologic Survey on Alcohol and Related Conditions respondents. Bostwick et al. (2010) distinguished

between different indicators of sexual orientation (identity, attraction and behaviour) in their analyses and mental health was measured with DSM-IV diagnostic questionnaires. The prevalence of mental health problems was found to be highest in bisexuals regardless of how sexual orientation was defined.

The above findings highlight the most commonly identified differences in prevalence of mental health problems between gay, straight and bisexual individuals. *Based on the above literature, Hypothesis 2 states that Self-identified bisexual men will report higher prevalence of mental health problems than both straight men and gay men.*

Despite the strength of the above findings, few studies have acknowledged the increased variability in mental health for bisexual men when compared to straight or gay men (Table 4 in Bostwick et al., 2010; Table 2 in Brennan et al., 2010). Possibly due to this increased variability, mixed results between and within studies exist with regards to which sexual minority group it is that suffers the most. The following paragraphs will outline some past findings which to some extent contrast with the literature described above.

A review of nine school-based surveys from different regions in the US explored the prevalence, disparity, and cohort trends in suicidality amongst bisexual teens compared to straight and gay/lesbian peers (Saewyc, Poon, Homma, & Skay, 2008). Mixed findings indicated that the difference in prevalence of suicidality in bisexual youth compared to gay youth may vary across regions, gender and time.

Another study assessed differences in prevalence of mental health disorders in people of different sexual orientations, races/ethnicities, and genders in 246 youths (Mustanski, Garofalo, & Emerson, 2010). Mental health disorders were assessed according to DSM-IV diagnostics by employing the Diagnostic Interview Schedule for Children (DISC). Contrary to the above reviewed large scale studies (Bostwick et al., 2010; Brennan et al., 2010), one of

Mustanski et al's (2010) findings indicated that bisexual men and women had lower prevalence of every diagnosis when compared to gay individuals.

The two latter studies show that although large scale averages indicate a higher prevalence of mental health problems in bisexual men than in gay men, some variation may occur between and within these groups across populations and time. As it has been mentioned already, one explanation for these mixed findings could be that there is greater variation in the prevalence of mental health problems within the bisexual population than within the gay population.

Standard deviations and confidence intervals for prevalence of mental health problems are typically larger for bisexuals than for others. For example, Figure 4 in Bostwick et al's (2010) study shows that the standard deviation for prevalence of lifetime mood disorders in bisexual-identified men is 6.4, compared to 4.5 for gay men and 0.5 for straight men, when prevalence was assessed in terms of the percentage of participants who met criteria for a diagnosis. Moreover, in Table 2 in Brennan et al's (2010) study the 95% confidence interval for life-time suicidality in bisexual men is 13.6 – 56.0, compared to 14.6 – 35.8 in gay men and 6.8 – 7.9 in straight men, when prevalence was assessed in terms of the percentage of participants who met criteria for a diagnosis. A similar pattern was present for most of the examined disorders. Thus, some bisexual men seem to have far better mental health and others far worse mental health than the mean implies. *Based on the above literature, Hypothesis 3 states that there will be more variation in the mental health of bisexual men than in the mental health of gay and straight men.*

Sexual arousal and mental health in bisexual men

The aforementioned literature indicates that for bisexual men, there is variation in mental health problems and sexual arousal patterns. It is possible that in bisexual men,

variation in one of these variables relates to variation in the other. This could present itself in two ways. First, bisexual men who exhibit bisexual arousal could report higher prevalence of mental health problems. Alternatively, bisexual men whose arousal patterns are monosexual (i.e. to one sex only) could report higher prevalence of mental health problems. The following paragraphs outline an argument for each of these possible outcomes.

Although some studies have found that male bisexual arousal is most common in men who identify as bisexual, such an arousal pattern is possibly uncommon. Studies that have found bisexual arousal patterns in bisexual-identified men have typically been selective of their sample, for the specific purpose of increasing the likelihood of recruiting men who get aroused to both sexes (Rosenthal et al., 2011; 2012). That is, before Rosenthal et al.'s (2011) study, no conclusive evidence of bisexual arousal patterns in men had been found. However, stringent criteria (a history of sexual and romantic relationships with partners of both sexes) and place of recruitment (website where men seek sex with both members of straight couples), resulted in the finding of some men with bisexual arousal patterns. The authors were sceptical that their finding was representative of the general population of bisexual-identified men.

Some of the following studies applied similar recruitment methods to those of Rosenthal et al (2011). Rieger and Savin Williams (2012), Rieger et al. (2013) and Rieger et al. (2015) recruited at least part of their sample from websites where men sought both men and women for sexual reasons. Due to the selective nature of this recruitment method, and the fact that other studies, who used less stringent criteria, showed monosexual arousal patterns of bisexual men (Tollison et al., 1979; Rieger et al., 2005), it could be argued that those bisexual-identified men who also show bisexual arousal consist of a minority within the bisexual population.

As noted above, LGB-groups typically suffer from more mental health problems than others. One explanation for this is the increased experience of minority stress in LGB groups compared to other groups (Meyer, 1995; 2003). Minority stress includes experiences of prejudice events, expectations of rejection, hiding and concealing, internalized homophobia, and ameliorative coping processes in LGB-individuals. Thus, the minority stress model can be used as a framework for understanding why sexual minority groups suffer from more mental health problems than others.

One study investigated differences in experienced minority stress between gay/lesbians and bisexuals (Lewis, Derlega, Brown, Rose, & Henson, 2009). Findings showed that bisexuals reported more conflict regarding their sexual orientation and were less open about their sexual orientation than gay/lesbian participants. Thus, different groups within the LGB may have different experiences of minority stress, and this may lead to differences in their mental health.

It has been further suggested that bisexual individuals suffer from an additional form of minority stress, so-called bi-negativity (Bucholski, 2014). Bi-negativity is broadly explained as double-sided marginalization, questioning of whether bisexuality is a valid identity, and accusations of heterosexual privilege. That is, the bisexual population may suffer from minority stress caused by attitudes held by other members of the LGB as well as heterosexuals, which may be another cause for the elevated prevalence of mental health problems in bisexuals. As bisexual men with bisexual arousal patterns likely are a minority within the bisexual population, these men could suffer more minority stress.

If bisexual men with bisexual arousal patterns consist of a minority within the bisexual population, this could cause this group to suffer from increased minority stress, and thus more mental health problems. *Based on this logic, Hypothesis 4 states that bisexual men*

with bisexual arousal patterns will report more mental health problems than other bisexual men, and straight and gay men.

An alternative assumption is that bisexual-identified men who have monosexual arousal are most distressed. Bisexual men whose arousal patterns resemble gay or straight arousal could report higher prevalence of mental health problems due to issues relating to discrepancy in their sexual identity. As sexual orientation is a critical aspect of one's sexual self-concept (Hensel, Fortenberry, O'Sullivan, & Orr, 2011), discrepancies between different aspects of sexual orientation and arousal could cause distress. In fact, discrepancy in several aspects of the self can cause psychological distress, and symptoms of depression (Boyle and Omoto 2014; Gonnerman et al. 2000).

Lourie and Needham (2017) investigated the relationship between discordance in people's sexual orientation and their perceived stress and depressive symptoms. Sexual orientation discordance, in this case, means dissonance between dimensions of a person's sexual orientation, including attraction, behaviour, and identity. One finding showed that discordance in one's sexual orientation related to depressive symptoms in men who identified as mostly straight. However, Lourie and Needham (2017) only assessed discrepancy between self-reported aspects of sexual orientation. It could be the case that discordance between a person's self-reported sexual orientation and his sexual arousal patterns also cause distress in some men. *Based on this logic, Hypothesis 5 states that bisexual-identified men who show monosexual arousal will report a higher prevalence of mental health problems when compared to others.*

Hypotheses

In total, the following hypotheses were tested in this research:

Hypothesis 1. Self-identified bisexual men, will show, as a group, bisexual arousal patterns. However, given past variable results, they could, as a group, also show arousal patterns resembling gay or straight men.

Hypothesis 2. Self-identified bisexual men will report higher prevalence of mental health problems than both straight men and gay men.

Hypothesis 3. There will be more variation in the mental health of bisexual men than in the mental health of gay and straight men.

Hypothesis 4. Because bisexual men who are bisexually aroused likely are a minority, even among bisexual men, they might experience more minority stress. This will result in bisexual men with bisexual arousal patterns to report more mental health problems than other bisexual men, and straight and gay men.

Hypothesis 5. Alternatively, bisexual men who resemble gay or straight men in physiological arousal might be most distressed due to discrepancy between their identity and their sexual arousal. Thus, these bisexual men will report more mental health problems than bisexual men with bisexual arousal, and straight and gay men.

Method

Participants

Participants were recruited from Pride events at the University of Essex, LGBT-oriented Facebook groups, and the “casual encounters” section of Craigslist.org. The latter recruitment method has been used successfully to recruit bisexual men with bisexual arousal patterns (Rosenthal et al., 2012).

The present study was part of an ongoing research project investigating sexual arousal. Because of this, sexual arousal data from 69 participants had already been collected prior to the addition of 56 who also completed the mental health measures that were specifically intended for the present study. Hence, this approach resulted in more available data on sexual arousal (125 data sets) than on mental health (56 data sets). 28 men were excluded from analyses which regarded genital arousal, due to problems with apparatus or lack of sufficient arousal to stimuli. That is, participants were excluded if they failed to exhibit at least 0.5 SD genital arousal to a sexual stimulus, as compared to baseline, or 2mm increase in penile circumference, as compared to baseline, and this to at least one sexual video. All men indicated their sexual orientation on 7-point Kinsey scales (Kinsey, 1948), ranging from “exclusively straight” to “bisexual” to “exclusively gay”. The final number of participants for data related to genital arousal, after exclusion, within each sexual orientation is presented in Table 1. For pupil data, no men were excluded (Table 2).

	Sexual orientation						
	Straight	Mostly straight	Bisexual leaning straight	Bisexual	Bisexual	Mostly leaning gay	Gay
N Genital	29	11	8	8	3	14	24
Arousal:							
N Mental	11	8	8	5	1	9	8
Health:							

Table 1. *For analyses regarding genital arousal: Distribution of sexual orientation identities as indicated on the Kinsey scale. 97 men took part in the genital arousal experiment, 50 of whom also completed the mental health measure.*

	Sexual orientation						
	Straight	Mostly straight	Bisexual leaning straight	Bisexual	Bisexual	Mostly leaning gay	Gay
N Pupil	40	11	13	8	4	15	34
Dilation:							
N Mental	15	8	10	5	1	9	8
Health:							

Table 2. *For analyses regarding pupil dilation: Distribution of sexual orientation identities as indicated on the Kinsey scale. 125 men took part in the pupil dilation experiment, 56 of whom also completed the mental health measure.*

Measures

Sexual Orientation

Participants indicated their sexual orientation identities (Table 1 and Table 2) and sexual attractions toward men and women on 7-point Kinsey-type scales (Kinsey et al., 1948). Measures of sexual orientation and attraction were averaged within participants because they were strongly correlated ($p < .001$, $r = .96$). For this composite, a score of 0 indicated exclusively straight orientation, a score of 3 indicated bisexual orientation, and a score of 6 indicated exclusively gay orientation.

Mental health

The 23-item scale from the DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure – Adult (American Psychiatric Association, 2013) was used to measure prevalence of psychiatric disorder symptoms. This measure was designed to provide an overview of mental health domains across psychiatric diagnoses experienced by the respondent. The items are designed to indicate the degree to which an interviewee suffers from the following symptoms: Depression, anger, mania, anxiety, somatic symptoms, suicidal ideation, psychosis, sleep problems, memory problems, repetitive thoughts and behaviours, dissociation, personality functioning problems, and substance use. Each of these symptoms were related to 1-3 questionnaire items, and the total number of items was 23. The original 5-point likert scale was adjusted to a 7-point scale where participants reported the extent to which they had been affected by each item. Although items measured symptoms of different diagnoses, they were somewhat related in the present research. Correlations between individual symptoms ranged from $r = .0002$ to $r = .70$. Albeit variable in strength, the median r was modest (.37), the majority of these correlations were significant. The overall Cronbach's α across all items was = .87. Moreover, results were similar across subscales.

Hence, for simplicity, the overall measure was used. The items of this measure are listed in Appendix 1.

Genital Arousal

Genital arousal data were recorded by a BIOPAC MP100 data acquisition unit and the program AcqKnowledge, which recorded penile circumference each 5 milliseconds while participants were viewing stimuli. The signal was sampled at 200 Hz, low-pass filtered to 10 Hz and digitized with 16 bits resolution. The measuring device for penile circumference in men is an indium/gallium strain gauge (plethysmograph) which is placed around the participant's penis. The gauges were calibrated on a cone for two circumferences (80 and 110mm) before each session.

Pupil dilation

Participants' pupil dilation was measured by a SR Remote Infrared gaze tracker device every millisecond through a 35mm lens, which includes an infrared illuminator. The software EyeLink registered the number of eye tracker camera pixels occluded by the light reflected by the pupil. Changes in pupil dilation (number of occluded pixels) was recorded while participants were watching sexual and neutral stimuli.

Stimuli

The stimuli in the present study consisted of 6 sexual videos and 6 nature documentary videos, each lasting for 3 minutes and 2 minutes, respectively. Three of the sexual videos portrayed women and three portrayed men, and all videos featured a masturbating person in a bedroom setting. Both sexual and nature videos were presented in random order, although a sexual video was always followed by a nature video throughout.

The sexual videos were selected in previous research to be the most attractive male and female models from a large pool of videos (Rieger et al., 2015).

Neutral stimuli consisted of six 2-minute nature documentary videos that were used to assess participants' baseline genital responses. The contents of these videos were engaging but non-sexual to help participants return to an unaroused baseline. However, because the nature videos could provoke interest of a non-sexual nature, these stimuli could potentially cause pupillary responses. Therefore, 2-minute animations of clouds were presented at the start and at the end of the stimuli presentation to assess the baseline for pupil data. The luminance levels were similar for all videos, and kept equal in terms of upper and lower thresholds across stimuli by using the programs MPEG Streamclip and Final Cut Pro. All videos had 768 by 536 pixels resolution, presented in full screen.

Design

The present study used both an experimental design (i.e., the manipulation of arousal within each man by stimulus sex) and correlational design (the correspondences of arousal with sexual orientation and with mental health across men). That is, we measured changes in each man's sexual arousal to each type of stimuli (sexual and neutral), and computed how these changes related to individual differences in sexual orientation and mental health. Multiple regression analyses were used to test hypotheses.

Procedure

Upon arrival in the laboratory, participants provided written informed consent. Participants then completed a computer-based survey, which included the following measures: Basic demographics (such as; gender, age and ethnicity), Kinsey scales for sexual orientation and attraction (Kinsey, 1948), and the DSM-5 Self-Rated Level 1 Cross-Cutting

Symptom Measure – Adult (American Psychiatric Association, 2013) questionnaire. After completion of the survey, participants were placed in a booth where they were instructed to take a seat in a chair facing a screen with their heads resting in the same position. The gaze tracker device was placed approximately 60cm in front of the participant and fixated on one of the participant's eyes, and calibrated to eye movements. The calibration process consisted of fixation and re-fixation by the participants on nine points, presented in a sequence, outlining the square and centre of the screen. The participants were instructed on how to place the penile gauge around their penis. They did this in privacy and informed the experimenter through an intercom when they were ready to proceed. Hence, stimuli were presented while pupil dilation and genital arousal was measured to each stimulus.

For each participant, both genital data and pupil data were standardized and averaged within each stimulus. For genital data, standardized responses to the 10 seconds preceding a sexual stimulus (at the end of a neutral stimulus and at which time they had returned to baseline) were subtracted from the standardized response to this stimulus. For pupil data, standardized responses to neutral stimuli (the animated clouds) were subtracted from standardized responses to all other stimuli. We next computed, for each participant, average values across stimuli of the same type, reflecting his overall genital response and pupil response, respectively, to same-sex stimuli and other-sex stimuli. Finally, for each participant, we computed contrast scores representing responses to the same sex or the other sex.

Results

Hypothesis 1

The first hypothesis predicted that among self-identified bisexual men, some will, on average, show bisexual arousal patterns. However, given the variable results in the literature, they could, on average, still show arousal patterns resembling gay or straight men. This was tested in three steps.

The first step tested whether, as a group, bisexual men were more aroused to men or to women. A male-female contrast variable was computed for both genital arousal and pupil dilation data by subtracting arousal to female stimuli from arousal to male stimuli for each participant. A multiple regression analysis was conducted, predicting the genital arousal contrast (male versus female stimuli) by sexual orientation. Because this relationship does not need to be linear, we tested for a curvilinear effect of sexual orientation, in addition to the linear effect. The linear term of sexual orientation predicting male-female contrast was significant, $p < .0001$, $\beta = .85$. This means that on average, straight men were most aroused to the other sex, gay men were most aroused to the same sex, and bisexual men fell, on average, in the middle. This relationship was further qualified by the curvilinear term; that is, a negative quadratic relationship, $p < .01$, $\beta = -.14$ (Figure 1 A). This indicates that bisexual men were, on average, more similar to gay men than straight men in their genital arousal contrast to men or women.

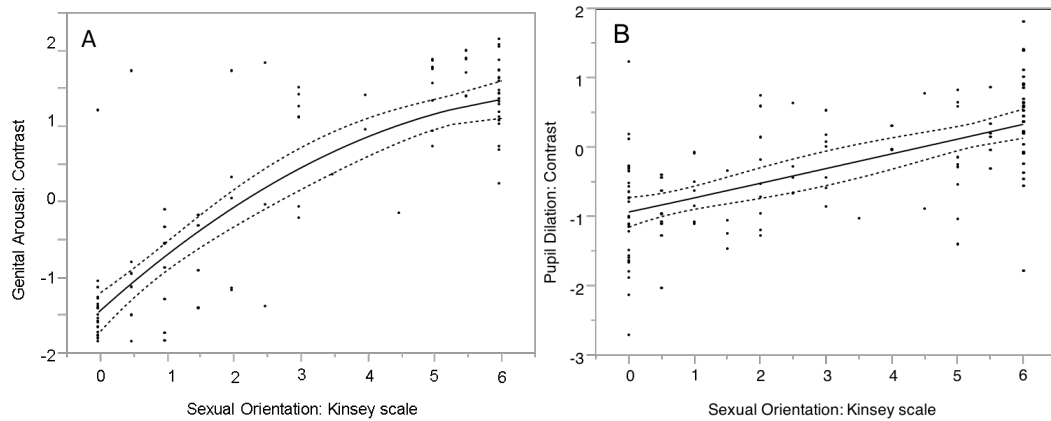


Figure 1. *Sexual orientation predicting male-female arousal contrast (arousal to females subtracted from arousal to males). Figure A and B show the quadratic regression lines for genital circumference and pupil dilation indicated arousal, respectively. Dashed lines represent 95% confidence. The dots represent individual scores. The different scaling of these figures is used to make the effect as visible as possible in each panel.*

Corresponding analyses were conducted for pupil dilation. The linear effect was significant for sexual orientation predicting the pupil dilation contrast to males or females, $p < .0001$, $\beta = .62$. This means that on average, straight men's pupils dilated more to the other sex, gay men's pupils dilated more to the same sex, and bisexual men fell, on average, in the middle. This linear effect was not further qualified by a quadratic effect, $p = .97$, $\beta .002$ (Figure 1 B), which indicates that bisexual men were no more similar to gay men than straight men in their pupil dilation contrast to male or female stimuli.

The next step tested whether self-identified bisexual men, as a group, showed more bisexual arousal than gay and straight men. A variable for arousal to the less arousing sex was computed by comparing the average arousal to female stimuli to the average arousal to male stimuli and then excluding the higher score (either to men or women, whichever sex it

was). This resulted in a score of arousal to their less arousing sex. Bisexual men do not need to have equal arousal to both sexes. Rather, the average arousal to both males and females should be substantially higher than for straight or gay men. That is, their arousal to male stimuli should exceed that of straight men, and their arousal to female stimuli should exceed that of gay men. Thus, bisexual men’s substantial arousal to the less arousing sex (as compared to straight or gay men) would indicate their bisexual arousal pattern.

A multiple regression analysis with the curvilinear term of sexual orientation predicting arousal to the less arousing sex was conducted. When sexual arousal was measured as genital arousal, a negative quadratic relation was found, $p < .001$, $\beta = -.34$. This indicates that bisexual men, as a group, showed more arousal to the less arousing sex (and thus, in total, bisexual arousal) than gay and straight men. However, this pattern was further qualified by a cubic effect. Even though this effect was on the edge of significance, it was strong in magnitude, $p = .05$, $\beta = .76$. Figure 2A. shows that bisexual arousal was more common in men who identified as “bisexual leaning straight” (Kinsey 1 and 2) than in other men.

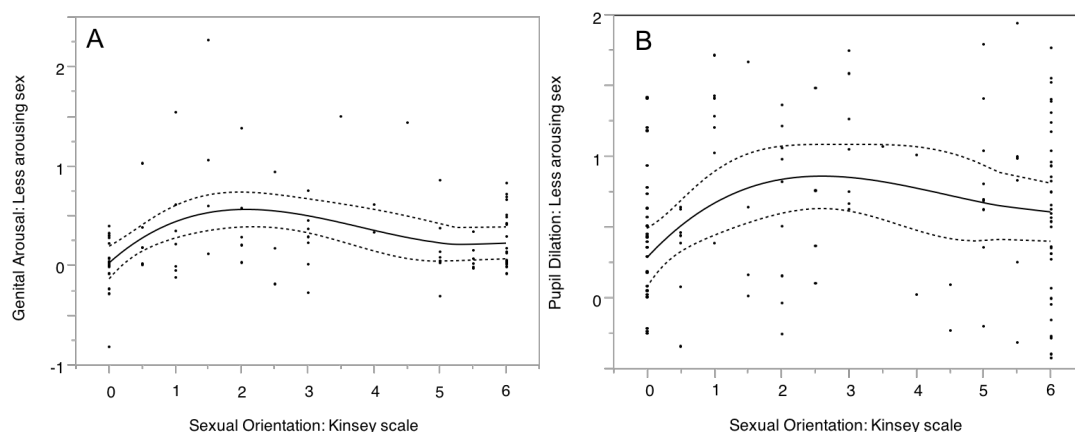


Figure 2. *Sexual orientation predicting arousal to the least arousing sex (comparing arousal to men and to women, and excluding the highest score). A represents the cubic*

regression line for sexual orientation predicting genital arousal. B represents the quadratic regression line for sexual orientation predicting pupil dilation. Dashed lines represent 95% confidence intervals. The dots represent individual scores. The different scaling of these figures is used to make the effect as visible as possible in each panel.

Regarding pupil dilation to the less arousing sex, the quadratic effect of sexual orientation was significant, $p < .01$, $\beta = -.25$. In this sense, pupil data showed a similar pattern to genital data. However, for pupil data, this quadratic effect was not further specified by a cubic relation, $p = .38$, $\beta = .33$ (Figure 2B). This indicated that bisexual arousal, as defined by pupil dilation, was most common in men who identify as bisexual, regardless of whether they were leaning straight or gay in their identity.

The final analysis tested whether there was more variation in sexual arousal patterns among bisexual men than among gay and straight men. Figure 1 shows that at least in their genital arousal, bisexual men showed, as a group, more arousal to male than female stimuli. However, they also appeared to have more variability in their arousal contrast scores than heterosexual and homosexual men: some bisexual men being particularly more aroused to men than women, and other bisexual men being more aroused to women than men. To investigate this variability systematically, a variable was computed for absolute residuals from the curvilinear regression line for the male-female arousal contrast (Figure 1). If bisexual men had more variability in their sexual arousal patterns than straight and gay men, then their absolute residual values should be larger, on average, than for straight or gay men.

A multiple regression analysis was conducted, with the quadratic term of sexual orientation predicting absolute residuals of genital arousal and pupil dilation. A negative quadratic relation showed that residuals of genital arousal were larger for bisexual men than

gay and straight men, $p < .01$, $\beta = -.32$ (Figure 3A). In total, these results for genital arousal (Figures 1A, 2A, & 3A) suggest that although bisexual men, as a group, show bisexual arousal patterns, but also, that there is considerable variability in their genital arousal. Some bisexual men showed bisexual arousal, others showed similar arousal to gay men, and yet others showed arousal similar to straight men.

A corresponding analysis for residual scores from Figure 1 was conducted for pupil dilation. The curvilinear effect of sexual orientation did not significantly relate to absolute residual pupil dilation scores, $p = .78$ $\beta = .02$ (Figure 3B). In total findings for pupil dilation (Figure 1B, 2B, & 3B) indicate that on average, bisexual men showed bisexual arousal but there was no more variability in the bisexual men's arousal to male and female stimuli when compared to gay and straight men.

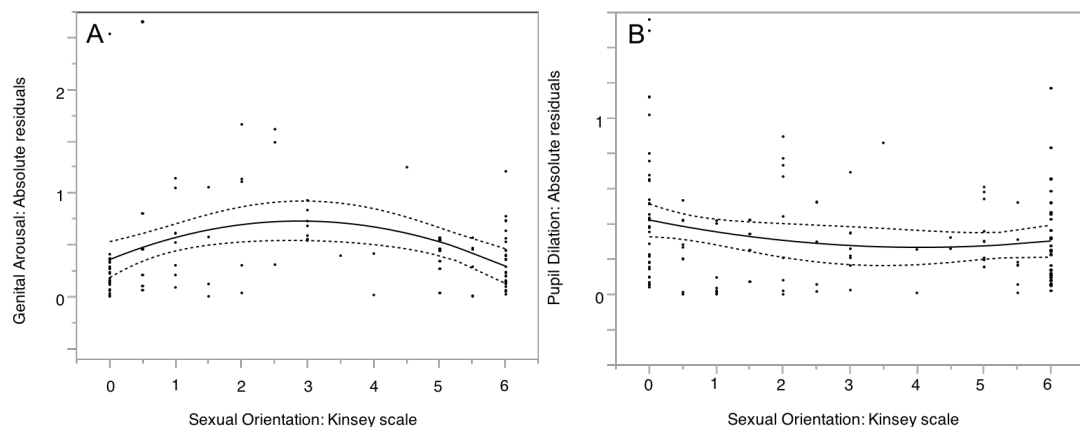


Figure 3. *Sexual orientation predicting absolute residuals (distance between individual scores and the curvilinear regression line) from Figure 1. A and B represents the regression line for absolute residuals of genital arousal and pupil dilation, respectively. Dashed lines represent 95% confidence intervals. The dots represent individual scores. The different scaling of these figures is used to make the effect as visible as possible in each panel.*

Hypothesis 2

The second hypothesis predicted that, on average, bisexual men will report higher prevalence of mental health difficulties than gay and straight men. This was tested by computing a regression analysis with the curvilinear term of sexual orientation predicting the overall score of mental health problems. A negative quadratic relationship would in this case indicate that bisexual men, on average, have elevated prevalence of mental health problems. Results did not confirm this hypothesis for the quadratic effect; $p = .52$, $\beta = -.09$.

Because bisexual genital arousal was best explained by a cubic effect, with highest scores of bisexual arousal amongst bi-leaning-straight men (Figure 2A), we also investigated if a similar relationship of a sexual orientation with health was best explained with a cubic effect. However, there was no significant cubic effect; $p = .50$, $\beta = -.31$ (Figure 4). In total, there was no significant relationship between sexual orientation and overall score on the DSM-5 Cross-Cutting Symptom Measure. This indicated that bisexual men, as a group, do not suffer more from mental health problems than other men.

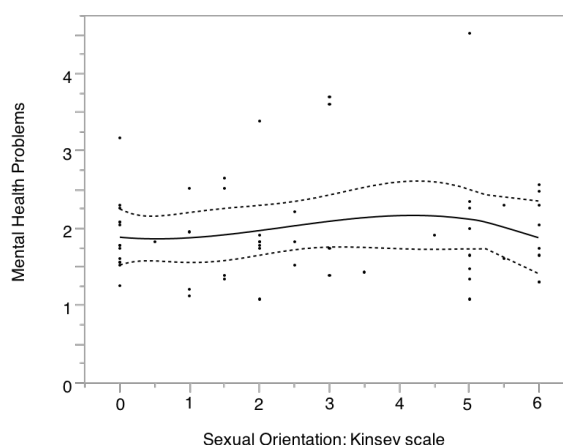


Figure 4. *The cubic regression line for sexual orientation predicting mental health problems. Dashed lines represent 95% confidence intervals. The dots represent individual scores.*

Hypothesis 3

The third hypothesis predicted more variation in the mental health of bisexual men than the mental health of gay and straight men. To investigate this variability systematically, a variable was computed for absolute residuals from the regression line for mental health problems (Figure 4). If bisexual men had more variability in their mental health problems than straight and gay men, then their absolute residual values should be larger, on average, than for the other groups.

A multiple regression analysis with the curvilinear term of sexual orientation predicting absolute residuals from the regression line in Figure 4 was conducted. A negative quadratic relation showed that residuals of genital arousal were larger for bisexual men than gay and straight men, $p = .08$, $\beta = -.23$ (Figure 5). Although not significant, this indicated that there is more variation in the mental health of bisexual men than gay and straight men.

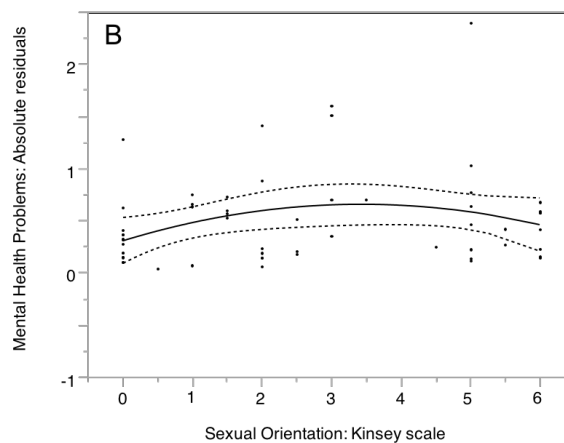


Figure 5. *Sexual orientation predicting absolute residuals (distance between individual scores and the regression line) from Figure 4. Dashed lines represent 95% confidence intervals. The dots represent individual scores.*

Hypothesis 4 and 5

Hypothesis 4 states that bisexual men with bisexual arousal patterns will report more mental health problems than bisexual men with monosexual arousal patterns, and gay and straight men. Alternatively, Hypothesis 5 states that bisexual men who resemble gay or straight men in their sexual arousal will report more mental health problems than bisexual men with bisexual arousal patterns, and gay and straight men. These hypotheses were tested simultaneously by conducting multiple regression analyses for the interaction of the curvilinear term of sexual orientation with mental health problems predicting bisexual arousal pattern (degree of arousal to the less arousing sex). Hypothesis 4 would be supported if bisexual sexual arousal was most common amongst bisexual-identified men, if they also scored high on mental health issues (and as compared to those bisexual men who don't have mental health issues and straight and gay men). Hypothesis 5 would be supported if bisexual arousal is less common (and monosexual arousal more common) amongst bisexual-identified men if they score high on mental health problems. Both of these hypotheses would be confirmed by a significant interaction of the curvilinear effect of sexual orientation and mental health predicting arousal. However, the direction and meaning of this interaction would be different, depending on the hypothesis.

As a cubic trend was found for genital arousal to the less arousing sex, with bisexual arousal most common in bi-leaning-straight men, (Figure 2A), we further tested for a similar interaction between the cubic term of sexual orientation and mental health problems predicting

sexual arousal. Similar analyses were run for both genital arousal and pupil dilation to the less arousing sex.

Contrary to both Hypotheses 4 and 5, mental health did not interact with the quadratic term of sexual orientation in predicting genital arousal or pupil dilation to the less arousing sex, $p = .19$, $\beta = .28$ and $p = .58$, $\beta = .12$, respectively. This indicates that bisexual men's genital arousal and pupil dilation patterns are not significantly affected by their mental health.

Mental health did not interact with the cubic curvilinear term of sexual orientation predicting genital arousal to the less arousing sex, $p = .89$, $\beta = -.05$. This indicates that neither bisexual-leaning-straight men's nor bisexual-leaning-gay men's genital arousal patterns are significantly affected by their mental health.

In partial support of both Hypotheses 4 and 5, mental health did interact with the cubic curvilinear term of sexual orientation predicting pupil dilation to the less arousing sex, $p < .05$, $\beta = -.97$ (Figure 6). A break-down of this interaction indicated, if men scored lower on mental health problems, bisexual-leaning-straight (Kinsey 1 and 2) men showed most bisexual arousal, whereas bisexual-leaning-gay men showed less bisexual arousal. Conversely, if men scored higher on mental health problems, bisexual-leaning-gay (Kinsey 4 and 5) men showed most bisexual arousal, but those leaning straight showed less bisexual arousal. Thus, Hypotheses 4 and 5 are supported to an extent, but for different groups of self-identified bisexual men.

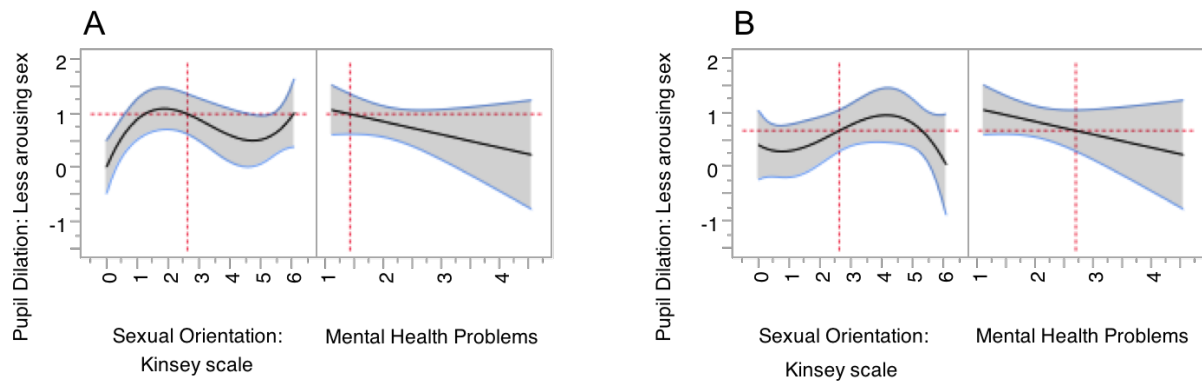


Figure 6. Profiler for the cubic term of sexual orientation interacting with mental health in predicting pupil dilation to the less arousing sex. A shows pupil dilation to the less arousing sex when mental health scores are set 1SD below the mean. B shows pupil dilation to the less arousing sex when mental health scores are set 1SD above the mean. Lines represent regression coefficients with 95% confidence intervals.

Discussion

Findings suggest that on average, bisexual men showed bisexual responses in their genital arousal and pupil dilation. Moreover, there was greater variability in bisexual men's genital arousal patterns and mental health when compared to gay and straight men. However, the variability in mental health did not systematically relate to the variability in genital arousal patterns of bisexual men. Pupil dilation patterns did not vary more in bisexual men than in gay and straight men and did not relate to mental health in a simple manner. Those bisexual men with most mental health problems were a) bisexual-leaning-straight men with less bisexual pupil dilation and b) bisexual-leaning-gay men with more bisexual pupil dilation.

Mental health and genital arousal

Contrary to predictions, variation in mental health did not relate to variation in genital arousal in bisexual men. Hypothesis 4 predicted that bisexual men who show bisexual arousal patterns would have more mental health problems than others. This prediction was based on the assumption that as a minority within the bisexual population, these men would be more prone to experiences of minority stress than others, and thus be more vulnerable to mental health problems (Meyer, 1995; 2003). However, in light of the present findings, this seems not to be the case. Thus, although men who show bisexual genital arousal likely consist of a minority within the bisexual population (Rosenthal et al., 2011; 2012), this does not lead to increased prevalence of mental health problems in this group.

One explanation for this could be that minority stress is experienced because of sexual identity alone. This would make sexual arousal patterns less relevant for relating to factors which might influence bisexual men's experiences of minority stress. That is, factors such as bi-negativity (Bucholski, 2014) could be experienced by any person who adopts a bisexual identity, regardless of their arousal patterns. Thus, no matter of whether a person adopts a bisexual identity because of experienced genital arousal towards both sexes or for other reasons, minority stress might be the same. Hence, this would result in the same amount of mental health problems in all men who identify as bisexual, regardless of their arousal patterns. As discussed below, present data did not indicate more mental health problems of bisexual-identified individuals (Figure 4), although there was somewhat more variability in this group (Figure 5).

Hypothesis 5 predicted that men who identify as bisexual, but have a monosexual arousal pattern would suffer from more mental health problems than others. This prediction was based on the assumption that discrepancy between a person's sexual identity and experienced sexual arousal would cause distress. However, the present research was not able

to confirm a relation between sexual arousal and mental health in these men, at least with respect to genital arousal. Notably, previous research has found that discrepancy in a person's self-reported aspects of sexual orientation can cause distress (Lourie and Needham, 2017). Thus, whichever sexual self-discrepancy may be involved in causing bisexual men to report more mental health problems than others, according to the present findings this does not involve genital arousal patterns. One explanation for this could be that people's sexual self-concept (Hensel et al., 2011) does not relate to experienced genital arousal in men. Perhaps, sexual self-concept is constructed in the mind rather than based on physiological experiences. Thus, in bisexual men with mental health problems, the present findings indicate that discrepancy between self-reported sexual orientation and genital arousal patterns cannot be considered a contributing cause for mental health problems.

Mental health and pupil dilation

Bisexual-leaning-straight men with monosexual pupil dilation and bisexual-leaning-gay men with bisexual pupil dilation had more mental health problems when compared to others. This exact pattern was not expected but showed some consistencies with both Hypotheses 4 and 5. One explanation for the mental health problems of bisexual-leaning-straight men (who did not show bisexual dilation patterns) could thus be that these men experience a discrepancy between their sexual identity (which was bisexual to a degree) and their conflicting pupil dilation (which was not bisexual). This builds on Lourie and Needham's (2017) finding that sexual orientation discrepancy may lead to mental health problems in bisexual-leaning-straight men. That is, rather than only considering discrepancy in self-reported aspects of sexual orientation, the present finding indicates that pupil dilation patterns may be part of the equation. This could further indicate that pupils are more sensitive to subjective states than genital reactions.

With regards to bisexual-leaning-gay men who showed bisexual dilation patterns, mental health problems could be caused by minority stress (Meyer, 1995; 2003). It might be that this group consists of a minority that experiences increased marginalization and questioning of the validity of their sexual orientation. It could be that these men's interest in their less arousing sex (possibly women) is disbelieved by both the gay community and the straight community because they are expected to come out as gay at any moment. In fact, some same-sex attracted men have been shown to adopt a temporary bisexual identity before identifying as exclusively gay (Lever, 1994) and society might incorrectly expect that this is true for all bisexual men who are open to indicate a stronger preference for men than women. Thus, this group of men may be more prone to bi-negativity which hence leads to their elevated mental health problems (Bucholski, 2014).

Although this was a significant finding that should be further investigated, we stress that this particular pattern was not initially expected and should therefore be interpreted with caution.

Mental Health in Bisexual Men: Prevalence and Variability

Despite literature suggesting that mental health problems are elevated, on average, in LGB populations, and highest among those who identify as bisexual (Plöderl & Tremblay, 2015), the present study failed to find this effect. One potential reason for this is that most past research on the mental health of LGB individuals has investigated large-scale, nationally representative samples while the present study investigated mostly university students and men who were seeking casual encounters online. Support from communities and friends has a positive effect on the mental health of sexual minority individuals (Snapp, Watson, Russell, Diaz, & Ryan, 2015; Pacey, 2016). It is thus possible that men in the present study who typically were part of LGB-inclusive societies on campuses and online-communities have

been less exposed to minority stress (Meyer, 1995, 2003) than others in the general population, and as a result reported less mental health problems than that found in past large-scale studies. This builds on past research by showing that the prevalence of mental health problems in LGB individuals differs across sub-populations.

Nevertheless, it needs to be stressed that the null finding in the present study (bisexual men did not differ on average from gay and straight men in their reported mental-health problems) contrasts with the majority of past research, where bisexuals were found to be the most vulnerable subgroup in the LGB-population (Bostwick et al., 2010; Brennan et al., 2010; Plöderl & Tremblay, 2015; Jorm et al., 2002). In the present study, this did not appear to be an issue of power. The magnitude of effect for the association of bisexuality with mental health problems ($p = .52$, $\beta = -.09$) was so minor, that increasing the number of participants would likely not change the results with given sampling strategies and methods. However, this result is partially in line with some of the studies where findings deviated from large-scale studies. For example, when Mustanski, Garofalo and Emerson (2010) investigated a smaller sample of LGBT youths, they found that bisexuals are the least vulnerable group, which contrasts directly with the findings of other studies (Bostwick et al., 2010; Brennan et al., 2010). Although the present study did not find an identical effect to that of Mustanski, Garofalo and Emerson (2010), it is important to acknowledge that both findings differ from those of typical large-scale studies on mental health problems in LGB individuals. Furthermore, the fact that mental health differences between bisexuals and gay individuals varies across populations was previously demonstrated by Saewyc et al. (2008) who investigated high school students across different regions in the US. Thus, although it has typically been reported the mental health differs across sexual orientation, the present and past findings suggest that this is not always the case.

Measures of variability (SD and CI) in past studies seem to indicate that the prevalence of mental health problems in bisexuals vary more than in gay and straight men (see Table 2 in Brennan et al., 2010 and Figure 4 in Bostwick et al., 2010). The present study sought to investigate this variability systematically. Although not significant, a trend was found which indicated that the prevalence of mental health problems varied more in bisexual men than both straight and gay men. This means that some bisexual men have far worse and others far better mental health than the mean implies. Moreover, this may partially explain why some studies have reached differing conclusions about the prevalence of mental health in bisexual men compared to gay and straight men.

Sexual Arousal in Bisexual Men: Genital arousal and pupil dilation

In the present study, bisexual arousal was investigated using a variable which indicated arousal to the less arousing sex. In line with past research (Rosenthal et al., 2011; 2012; Rieger et al., 2013), bisexual men, as a group, were more likely to show bisexual arousal than gay and straight men. For genital arousal (but not pupil dilation), this effect was further qualified by a finding which indicated that bisexual arousal is most prevalent in bisexual-leaning-straight men when compared to other men (Figure 2A). This effect has not been reported by any of the studies reviewed in the present paper. Perhaps, social pressures could explain why men who exhibit the clearest pattern of bisexual genital arousal identify as bisexual leaning straight. These men might experience strong attractions towards both sexes, but lean in the straight direction in order to act more in line with social expectations. Thus, because they can get aroused by either sex, they might feel pressured to lean towards a straight identity.

However, similar to findings across past work (Tollison et al., 1979; Rieger et al 2005; Rosenthal et al., 2011; 2012; Rieger et al., 2013), bisexual arousal was found to some

degree but not necessarily for all men. In fact, the present finding indicated that the variability in bisexual men's arousal to male or female stimuli was greater than in gay and straight men. This variability indicates that some bisexual-identified men have arousal patterns similar to gay men, others have arousal patterns similar to straight men, and yet some have bisexual arousal patterns. This could, in part, explain why mixed findings have been reported between past studies.

Pupil dilation measures showed a similar pattern to those of genital arousal in that both measures found sex-specific preferences in gay and straight men and that bisexual men showed bisexual arousal patterns. This finding is mostly consistent with previous findings resulting from using these measures simultaneously (Rieger et al., 2015). However, a difference between these measures occurred when arousal to the less arousing sex was further investigated in terms of a cubic relationship. That is, pupil dilation to the less arousing sex was most common in bisexual men regardless of whether they were leaning straight or gay, whereas for genital arousal, this pattern was distinct.

One explanation for this difference could be that although both pupil dilation and genital responses reflect a sexual interest in the stimuli, pupil dilation has been shown to occur regardless of how sexually explicit a sexual stimulus is (Attard-Johnson & Bindemann, 2017). Genital arousal, however, might be more sensitive to how explicit a stimulus is. Thus, it could be that pupil dilation reflects a sexual interest, which differs from that which triggers a genital response. In some cases, the nature of the stimuli might have been insufficient to trigger genital arousal, while sexual interest in the stimuli still triggers a pupillary response. This discrepancy might also be involved in causing the difference between the measures with respect to the cubic relationship of sexual orientation predicting bisexual arousal.

Contrary to genital arousal, pupil dilation to the less arousing sex did not vary more in bisexual men when compared to gay and straight men. This means that men who identify as

bisexual typically show a bisexual pupil dilation pattern. This highlights another difference between genital and pupil dilation indicated sexual arousal in men. One explanation for this difference could, again, be that the sexual nature of the stimuli is explicit enough to cause pupillary responses but not always genital responses to both sexes.

Limitations

The measurement of mental health problems might not have been sufficiently comprehensive. Although the DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure—Adult (American Psychiatric Association, 2013) provides an overall view of mental health and which symptom domains participants are affected by, it may not provide a comprehensive picture of each symptom domain (Bastiaens & Galus, 2017). It might further be that this measure is asking about issues that are extreme, and thus does not detect smaller differences in mental health.

It is not clear if the present sample was representative of the general population with regards to participants who also took part in the mental health measures. Because we needed participants of different sexual orientations, the sample was not randomly selected. Men of different sexual orientations, as well as men who have previously been found likely to show bisexual arousal patterns (Rosenthal et al., 2012) were selected. Typically, in studies where samples are drawn from large scale surveys, the evidence consistently finds that mental health differs across sexual orientation. The present study used a sample which was smaller than that of most past research on mental health across sexual orientation (Bostwick et al., 2010; Brennan et al., 2010; Mustanski, Garofalo & Emerson, 2010; Plöderl & Tremblay, 2015). As the present results differed from those of past studies, one should be cautious when interpreting the present results.

The circumstances under which the experiment took place might have influenced participants' sexual arousal. For example, some participants may have been nervous under the experimental conditions, which may have inhibited their arousal to stimuli. Others may have experienced arousal due to the proximity of the experimenters while watching stimuli. Thus, although the experimental conditions were the same for each participant, each participant's reactions to the experimental conditions and the consequences of this were not controlled for.

Future Directions and Conclusion

Future research should build on the present study by including measurements of paraphilia. The present study found that bisexual genital arousal is most common in men who identify as mostly-straight and bisexual-leaning-straight. Bisexual men with bisexual arousal patterns have personality traits which may relate to paraphilia (see discussion in Rieger et al., 2013). Other research potentially indicates that bisexual-identified men who also have a paraphilia (that is, unusual sexual interests) exhibit bisexual arousal patterns (McConanhy & Blaszczynski, 1991). Thus, bisexual arousal patterns may in part be a matter of paraphilic interests rather than of sexual orientation in itself, and the cause for bisexual arousal might be sexual compulsions and fantasies that are triggered by erotic stimuli regardless of the sex of the person depicted. It is further possible that any mental health issues are most common in those bisexual-identified men who show paraphilic arousal patterns rather than solely a matter of increased arousal to men or women. Future work should therefore focus on potential associations of mental health with bisexuality and paraphilia.

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Appendix 1.

The questions below are about things that might have bothered you. For each question, indicate what best describes how much, or how often, you have been bothered by each problem during the past TWO (2) WEEKS.

During the past TWO (2) WEEKS, how much (or how often) have you been bothered by the following problems?

Little interest or pleasure in doing things?

Feeling down, depressed, or hopeless?

Feeling more irritated, grouchy, or angry than usual?

Sleeping less than usual, but still have a lot of energy?

Starting lots more projects than usual or doing more risky things than usual?

Feeling nervous, anxious, frightened, worried, or on edge?

Feeling panic or being frightened?

Avoiding situations that make you anxious?

Unexplained aches and pains (e.g., head, back, joints, abdomen, legs)?

Feeling that your illnesses are not being taken seriously enough?

Thoughts of actually hurting yourself?

Hearing things that other people couldn't hear, such as voices even when no one was around?

Feeling that someone could hear your thoughts, or that you could hear what another person was thinking?

Problems with sleep that affected your sleep quality over all?

Problems with memory (e.g., learning new information) or with location (e.g., finding your way home)?

Unpleasant thoughts, urges, or images that repeatedly enter your mind?

Feeling driven to perform certain behaviours or mental acts over and over again?

Feeling detached or distant from yourself, your body, your physical surroundings, or your memories?

Not knowing who you really are or what you want out of life?

Not feeling close to other people or enjoying your relationships with them?

Drinking at least 4 drinks of any kind of alcohol in a single day?

Smoking cigarettes, a cigar, or pipe, or using snuff or chewing tobacco?

Using any of the following medicines ON YOUR OWN, that is, without a doctor's prescription, in greater amounts or longer than prescribed [e.g., painkillers (like Vikodin), stimulants (like Ritalin or Adderall), sedatives or tranquilizers (like sleeping pills or Valium), or drugs like marijuana, cocaine or crack, club drugs (like ecstasy), hallucinogens (like LSD), heroin, inhalants or solvents (like glue), or methamphetamine (like speed)]?