

# Not Straight and Not Straightforward: the Relationships Between Sexual Orientation, Sociosexuality, and Dark Triad Traits in Women

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Published online: 19 June 2017  
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**Abstract** Two studies examined the connection between women's sexual orientation, their sociosexuality (i.e. willingness, attitudes, and desires associated with uncommitted sexual behaviour), and Dark Triad traits (Machiavellianism, narcissism, and psychopathy). Both studies found that moderately bisexual women reported less-restricted sociosexuality, as well as higher levels of Dark Triad traits—particularly psychopathy. In both studies, sexual orientation differences in Dark Triad traits were mediated by sociosexuality. Study 2 confirmed that the relationship between women's sexual orientation and sociosexuality is curvilinear, with moderately bisexual women (i.e. Kinsey 1–2) reporting heightened sociosexuality compared to other groups. These results are consistent with the conclusion that moderate levels of female bisexuality may be a by-product of selection for traits that result in less restricted sociosexuality. At either end of the orientation continuum, women who report exclusive or near-exclusive homosexuality or heterosexuality report more restricted sociosexuality and lower Dark Triad scores, compared to women nearer to the middle of the continuum. As such, the aetiology of moderate bisexuality in women may be distinct from the aetiology of exclusive or near-exclusive homosexuality in women.

**Keywords** Female sexual orientation · Sociosexuality · Dark triad · Bisexuality · Female gynephilia

Women, on average, employ long-term sexual strategies, seeking more commitment from sexual partners, whereas men are more willing to engage in short-term sexual strategies, preferring relatively higher levels of casual sex with lower commitment (e.g. Buss 2006; Schmitt 2005; Trivers 1972). While true, this broad generalization misses important nuance in variation among women with respect to how they approach sexual interactions. For example, women's *sociosexuality*—the distinct but overlapping aspects of a person's willingness, attitudes, and desires pertaining to uncommitted sexual behaviour (Penke and Asendorpf 2008)—shows considerable variability (e.g. Bailey et al. 1994; Wlodarski et al. 2015). Some of the ways that women's unrestricted sociosexuality manifests is through heightened willingness to engage in sexual activity outside of a committed relationship, as well as more permissive attitudes regarding such behaviour in both oneself and others (Simpson and Gangestad 1991).

Sociosexuality has been shown to be substantially heritable ( $A^2 = .49$ ), with non-shared environmental influences accounting for most of the remaining trait variance ( $E^2 = .47$ ) (Bailey et al. 2000). The tendency for women to engage in infidelity, another cue of unrestricted sociosexuality, is also heritable and to a similar degree (Cherkas et al. 2004; Zietsch et al. 2015). Even single item measures of sociosexuality, such as lifetime sexual partners, indicate that variation in this behavioural measure is significantly heritable (Burri et al. 2015; Cherkas et al. 2004). This is not to say that environmental factors do not heavily influence the development of women's sociosexuality (Del Giudice 2009; Fernandes et al. 2016). Indeed, local-environmental (Barber 2000; Campbell 2013; de Jong et al. 2012; Moss and Maner 2016; Weir et al.

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2011), life history (Del Giudice 2009; Fernandes et al. 2016), and personality factors (e.g. Jonason et al. 2009; Mikach and Bailey 1999; Schmitt and Buss 2000) are known to moderate women's sexual strategies.

Sexual orientation also influences women's sociosexuality, particularly as it pertains to bisexuality. There is considerable variability in women's relative degree of androphilia (i.e. sexual attraction to adult men) and gynephilia (i.e. sexual attraction to adult women) (e.g. Gates 2011; Laumann et al. 1994; Mosher et al. 2005). Most women (~90%) report exclusive androphilia (i.e. heterosexuality), but a significant proportion of women identify as mostly heterosexual (7–10%; Savin-Williams and Vrangalova 2013), fewer identify as bisexual (0.8–2.8%), and still fewer as exclusively homosexual (0.9–1.3%; Gates 2011; Laumann et al. 1994; Mosher, et al. 2005). Thus, the distribution of women's sexual orientation is positively skewed, in stark contrast to the more bimodal distribution that typically characterizes men's sexual orientation (Bailey et al. 2016).

Previous research has found that exclusively androphilic and exclusively gynephilic women do not differ in their cautiousness towards uncommitted sex (i.e. sociosexuality) (Bailey et al. 1994; Eisenberg et al. 2009; Lyons et al. 2014). Schmitt (2007) found that bisexual women reported heightened sociosexuality compared to heterosexual or lesbian women (who did not differ) (but see Howard and Perilloux 2016). This same pattern has also been found for women's self-reported sex drive, an important facet of sociosexuality, which is higher in bisexual women than it is in either heterosexual or homosexual women (Lippa 2006, 2007).<sup>1</sup> These psychological differences in sociosexuality manifest behaviourally, with many bisexual women reporting that the majority of their sexual partners are male, and more lifetime male (and female) sexual partners than their heterosexual counterparts (e.g. Fethers et al. 2000).

Such differences speak to the fact that bisexuality and homosexuality in females may have somewhat distinct bio-developmental foundations, with the former arising from women's general tendency to be "sexually fluid", and the latter arising from neurohormonal influences that direct some women's sexual interests exclusively towards female targets (Diamond 2013). Lippa (2006, 2007) suggested that that higher sex drive among women is associated with heightened sexual interest in both men and women. Taken together, the existing evidence suggests that the relationship between

women's sexual orientation and sociosexuality is curvilinear, with bisexual women representing the "peak" of the curve (Lippa 2006, 2007; Schmitt 2007). While these studies are informative, their trichotomous measurement of sexual orientation (e.g. heterosexual, bisexual, homosexual) does not capture important variation in the *degree* of bisexuality reported by many women (e.g. Savin-Williams and Vrangalova 2013; Vrangalova and Savin-Williams 2014). As such, it is unclear *which* bisexual women are responsible for this group difference.

Women's sexual orientation has also been linked to variation in numerous personality traits. Lesbian and bisexual women tend to evaluate themselves as being more masculine than heterosexual women, as well as show more interest in male-typical occupations (Lippa 2005; Lippa 2008), a pattern that holds cross-culturally (Zheng et al. 2011). Lippa (2005, 2008) notes that heterosexual women consistently outscore lesbians on measures of neuroticism and that lesbians have a greater tendency towards instrumentality (the tendency to be aggressive, competitive, decisive, independent, etc.) than heterosexual women. Furthermore, bisexual women score higher than both heterosexual and lesbian women in neuroticism, disagreeableness, and disagreeable assertiveness (Lippa 2008). In addition to these personality differences, lesbian and bisexual women show greater gender-atypicality in childhood than heterosexual women, as shown in both self-referent recall measures and independent ratings of childhood home videos (Rieger et al. 2008). Observers used many of these gender-atypical traits to reliably distinguish the sexual orientation of unfamiliar individuals, even with only brief exposure (Rieger et al. 2010). The subtle differences in personality and comportment displayed by bisexual and lesbian women are relatively more male-typical when compared to heterosexual women, which parallels the male-typical shift—at least among bisexual women—in sociosexuality.

Evidence has also been presented linking many gender-atypical traits expressed by bisexual and lesbian women with less-restricted sociosexuality. Mikach and Bailey (1999) reported that women's lifetime number of sexual partners correlated with more masculinity in both childhood and adulthood. Follow-up research has replicated the link between recalled masculine traits in childhood, unrestricted sociosexuality, and a greater number of lifetime partners (Ostovich and Sabini 2004). Additionally, recent research has shown that both adult masculinity and femininity (as assessed by the Bem Sex-Role Inventory) partially mediate sex differences in sociosexual attitudes and behaviour (Rammsayer et al. 2017). An Australian twin study reported that adult gender-atypicality (i.e. more masculinity) in heterosexual females was associated with increased mating success, as measured by the number of lifetime opposite-sex sexual partners (Zietsch et al. 2008), a pattern recently replicated in a British sample of female twins (Burri et al. 2015).

<sup>1</sup> Unlike women, sociosexuality does not differ across men's sexual orientation groups (e.g. Schmitt 2007; Howard and Perilloux 2016). Considering sex differences in the distribution of sexual orientations and the lack of male sexual orientation differences in sociosexuality, it is theoretically inappropriate to assume that the bio-developmental foundations of bisexuality or homosexuality are the same in men and women (e.g. Diamond 2013; Bailey 2009; Bailey et al. 2016; LeVay, 2016). For these reasons, the focus of the present study is women.

Interestingly, Burri et al. (2015) proposed that gender non-conformity among women might be associated with traits such as “sensation seeking and dominance that increase sexual behavior and mating success” (p. 1010). Put another way, when women carry genes associated with gynephilia, but are not exclusively gynephilic, they may enjoy more mating success than women who do not carry these same genes. As such, natural selection may tolerate the relative frequency of moderate bisexuality among women so long as it manifests in increased sexual behaviour with women *and* men. Non-conformity in the domain of gender expression may relate to other forms of social non-conformity, such as less restricted sociosexuality (Baumeister and Twenge 2002).

Research indicates that a particular cluster of socially non-conformist traits, the Dark Triad (DT), are positively correlated with sociosexuality and masculinity (Brewer and Abell 2015; Brewer et al. 2015; Carter et al. 2014; Jonason et al. 2009, 2015, 2011; Kastner and Sellbom 2012; McDonald et al. 2012). The DT—composed of Machiavellianism, sub-clinical narcissism, and subclinical psychopathy—is a constellation of agentic, antisocial traits that show moderate to high levels of intercorrelation (Paulhus and Williams 2002; Paulhus 2014). Machiavellian individuals tend to be calculated and manipulative (Christie and Geis 1970); narcissistic individuals seem entitled, with a grandiose sense of superiority (Raskin and Terry 1988); and psychopathic individuals often display antisocial tendencies, superficial charm, and low levels of empathy or remorse (Mealey 1995). When sex differences are found in the DT, men have higher average scores than do women (Furnham et al. 2013; Jonason and Webster 2010; Paulhus and Williams 2002; Paulhus 2014). A recent meta-analysis reports moderate sex differences in all DT traits, with the largest differences found in psychopathy (Muris et al. 2017). Additionally, cross-cultural research indicates that largest sex differences in DT traits are found in more gender egalitarian nations (Schmitt et al. 2016).

Although the short-term mating strategies employed by DT individuals have been characterized as being male-typical (Jonason et al. 2009), researchers are increasingly noting that the sex differences in DT traits have been somewhat overstated and that the Dark Triad facilitates effective mating strategies in women (Carter et al. 2014). Increased attention is being paid to manifestations of DT traits in women, and how they facilitate resource acquisition and desirable mating opportunities (for review, see Honey 2017). Dark personality traits may enhance an individual’s fitness, by helping them garner not only more mates but also more genetically desirable mates (Buss and Schmitt 1993; Jonason and Buss 2012). While no study has evaluated the relationship between sexual orientation and the Dark Triad, DT traits partially mediate sex differences in sociosexuality (Jonason et al. 2009), indicating that within-sex variation in DT traits may provide valuable insights into variation in women’s sociosexuality.

Furthermore, recent research has shown that not only that low honesty/humility underlies the common core of the DT (Book et al. 2015; Lee et al. 2013) but also that bisexual women score lower on this trait relative to other female sexual orientation groups (Bogaert et al. 2017). The same pattern has been reported for conscientiousness (Greaves et al. 2017). These patterns are somewhat akin—and likely connected—to the differences already noted in women’s sociosexuality.

The findings highlighted above show that male-shifted patterns of certain traits (increased gynephilia, heightened DT traits, etc.) are associated with concurrent shifts in sociosexuality. As such, the first aim of the present study is to test whether increased gynephilia in women is related to both sociosexuality and the DT. Because it is unclear why bisexual women show increased sociosexuality while homosexual women do not (Lippa 2006, 2007; Schmitt 2007), it is also of interest to understand whether gynephilia is related to sociosexuality and the DT in a linear or a curvilinear fashion. The former relationship would indicate that the gynephilia of bisexual and homosexual women is underpinned by similar factors, as stepwise increases in gynephilia result in similar shifts in other traits. The latter (curvilinear) relationship, however, would indicate that the two groups differ somewhat in the bio-developmental roots of these traits, as suggested by Diamond (2013). Given that previous research shows that bisexual women report greater sociosexuality (Lippa 2006, 2007; Schmitt 2007) and lower honesty/humility (Bogaert et al. 2017) than both heterosexual and homosexual women, we predict that both sociosexuality and DT traits will have a curvilinear relationship with sexual orientation among women. Second, we predict that sociosexuality in women will not be independent of DT traits, and the hypothesized sexual orientation differences in DT traits will be mediated by sociosexuality.

## Study 1 Method

### Participants and Procedure

A total of 446 female students at a Midwestern Canadian University completed a questionnaire for course credit in their introductory psychology course. Three participants were excluded due to missing data, leaving 443 for analysis. The average age of the participants was 20.81 years ( $SD_{age} = 5.03$ ;  $Range = 16–57$ ). Each questionnaire was completed online from a unique IP address, and took approximately 20 min to complete. Upon completion, participants were thanked and debriefed via a statement from the authors. All research was conducted with institutional ethical approval consistent with the Canadian Tri-Council Policy Statement (TCPS 2) and the Declaration of Helsinki.

## Measures

Participants answered a series of demographic questions, including their current age, and age of first intercourse. Sexual orientation was assessed on a five-point scale (1 = *exclusively heterosexual*, 2 = *mostly heterosexual*, 3 = *bisexual*, 4 = *mostly homosexual*, and 5 = *exclusively homosexual*). There were 308 self-identified exclusively heterosexual individuals, 108 mostly heterosexual, 20 as bisexual, 3 mostly homosexual, and 0 exclusively homosexual participants. Four participants declined to answer.

The *Dirty Dozen* scale (Jonason and Webster 2010) was used to measure Dark Triad traits. This scale asks participants how much they agree (1 = *not at all*; 9 = *very much*) with 12 self-referent statements including “I tend to be callous or insensitive”, and “I have used deceit or lied to get my way”. Internal consistency was appreciable for the subscales and a composite of the three subscales: Machiavellianism ( $\alpha = 0.83$ ), psychopathy ( $\alpha = 0.66$ ), narcissism ( $\alpha = 0.84$ ), composite ( $\alpha = 0.85$ ). Machiavellianism was correlated with psychopathy ( $r(443) = 0.49, p < .01$ ) and narcissism ( $r(443) = 0.46, p < .01$ ). Psychopathy was correlated with narcissism ( $r(443) = 0.29, p < .01$ ). These intercorrelations, as well as averages on the scales, are very similar to those observed by other researchers using the *Dirty Dozen* (e.g. Carter et al. 2014; Jonason and Webster 2010). All scores were standardized to facilitate comparisons between scales with different variances and to make the direction of sexual orientation differences obvious (Jackson 2011).

Consistent with Schmitt (2007), sociosexuality was assessed using the *Sociosexual Orientation Inventory* (SOI) (Simpson and Gangestad 1991), which assesses individual's behaviour and attitudes pertaining to uncommitted sexual relationships. The SOI contains open response questions such as “with how many different partners have you had sex (sexual intercourse) within the past year?” as well as scaled items to which participants indicate the extent to which they disagree (1) or agree (9) with statements such as “sex without love is okay”. The SOI showed appreciable reliability as a whole ( $\alpha = 0.82$ ), as well as for both the behavioural ( $\alpha = 0.66$ ) and the attitude ( $\alpha = 0.80$ ) subscales. The *Sex Drive Questionnaire* (SDQ) (Ostovich and Sabini 2004) was administered to assess participant's desire for sex independent of their behaviour. Four questions such as “How often do you experience sexual desire?” and “How often do you masturbate?” were measured on a seven-point scale (1 = *never*; 4 = *several times a week*; 7 = *several times a day*), and showed appreciable reliability ( $\alpha = 0.80$ ). Higher scores on all of these measures indicate less restricted sociosexuality, and all were included in order to more fully capture the multi-faceted nature of the underlying construct (Penke and Asendorpf 2008). Participant scores on these measures were transformed into *z*-scores in order to make comparisons across measures with

different scales. A composite SOI score was also calculated by averaging participant *z*-scores on the SDQ and the SOI attitude and behaviour subscales.

## Results

There were numerous significant correlations among measures, all in expected directions (Table 1). It is noteworthy that SOI composite was positively correlated with all of the DT measures, but most significantly with Machiavellianism ( $r(443) = 0.33, p < .001$ ). These correlations lend further support to the hypothesized relationship between Dark Triad traits and a short-term mating strategy (Carter et al. 2014; Jonason et al. 2009).

In order to more fully understand possible differences among sexual orientation categories, analysis of variance (ANOVA) was used,<sup>2</sup> with critical alpha = 0.01 to control the type 1 error rate across multiple comparisons (Nakagawa 2004). Because only three participants identified as mostly homosexual, they were dropped from the analysis, as were the four individuals who declined to answer the question, leaving 436 cases available for analysis. Exclusively heterosexual participants ( $n = 308$ ) were compared to mostly heterosexual ( $n = 108$ ) and bisexual women ( $n = 20$ ). Although age was correlated with lifetime number of partners ( $r(443) = .32, p < .001$ ), this was not controlled for because groups did not differ significantly for this variable ( $F(2, 433) = .61, p = .54$ ). Age of sexual debut (overall  $M \pm SD = 16.58$  years old  $\pm 1.64$ ) did not differ between sexual orientation groups,  $F(2, 433) = 1.75, p = .18$ .

The most striking sexual orientation differences are in SOI attitude, total SOI score, SDQ, and Dark Triad total (driven in large part by differences in scores on Machiavellianism) (Table 2). Taken as a whole, these group differences indicate that mostly heterosexual women score higher on Machiavellianism and Psychopathy—and hence the Dark Triad composite—than do strictly heterosexual women. Bisexual women also score more highly on the DT composite than heterosexual women, a difference seemingly driven by bisexual women's higher Machiavellianism. Additionally, mostly heterosexual and bisexual women in our sample have a less restricted sociosexuality, as indicated by their attitudes, desire, and behaviour, as well as their lifetime number of sexual partners. All of these shifts show agreement regarding the hypothesized gender-atypicality of these traits and behaviours in women who are not exclusively heterosexual. Additionally, the general pattern is for heterosexual women to differ from

<sup>2</sup> While ANOVA is robust to differences in group size, we have reported the more conservative Brown-Forsythe statistic for omnibus comparisons throughout the manuscript when Levene's test revealed violations of the assumption of homogeneity of variance (Field 2013).

**Table 1** Correlations between measures of sociosexuality and the dark triad in study 1

Item	1	2	3	4	5	6	7	8	9
1. SOI—attitude	–								
2. SOI—behaviour	0.56**	–							
3. SDQ	0.45**	0.36**	–						
4. SOI—composite	0.84**	0.80**	0.76**	–					
5. Lifetime sex partners	0.45**	0.62**	0.31**	0.57**	–				
6. Machiavellianism	0.32**	0.24**	0.23**	0.33**	0.15*	–			
7. Psychopathy	0.24**	0.14*	0.08	0.19**	0.12	0.49**	–		
8. Narcissism	0.15*	0.11	0.12	0.16*	0.01	0.46**	0.28**	–	
9. Dark Triad composite	0.31**	0.21**	0.19**	0.30**	0.12	0.84**	0.74**	0.75**	–

\* $p < .01$ ; \*\* $p < .001$ 

both mostly heterosexual and bisexual women, but for bisexual women and mostly heterosexual women to not differ from one another, perhaps due to smaller sample size and thus

lower statistical power. When looking at aggregate sociosexuality, there is some preliminary evidence that greater gynephilia is associated with less restricted sociosexuality

**Table 2** Differences between heterosexual, mostly heterosexual, and bisexual women in study 1

	Heterosexual <i>Mean (SD)</i> $n = 308$	Mostly heterosexual <i>Mean (SD)</i> $n = 108$	Bisexual <i>Mean (SD)</i> $n = 20$	<i>F</i> -statistic	Cohen's <i>d</i>
SOI—behaviour	−0.14 (0.76)a	0.23 (1.22)c	0.61 (1.34)c	$F(2, 54.1)^a = 6.35$ , $p = .003$	0.41, 0.93, 0.31
SOI—attitude	−0.24 (0.88)a	0.46 (1.03)b	0.99 (1.00)b	$F(2, 72.3)^b = 30.42$ , $p < .001$	0.76, 1.37, 0.50
SDQ	−0.15 (0.97)a	0.19 (0.93)b	0.95 (0.84)c	$F(2, 433) = 15.76$ , $p < .001$	0.35, 1.14, 0.84
SOI—composite	−0.18 (.68)a	0.30 (.85)b	0.85 (.83)c	$F(2, 69.2)^c = 24.94$ , $p < .001$	0.66, 1.49, 0.65
Age of first Intercourse	16.71 (1.42)a	16.40 (1.53)a	16.64 (1.97)a	$F(2, 432)^d = 1.75$ , $p = .175$	0.21, 0.05, 0.15
Machiavellianism	−0.13 (0.99)a	0.31 (0.96)b	0.29 (0.89)a,b	$F(2, 433) = 8.75$ , $p < .001$	0.44, 0.42, 0.02
Psychopathy	−0.09 (0.97)a	0.25 (1.07)b	0.04 (0.98)a,b	$F(2, 433) = 4.72$ , $p = .009$	0.34, 0.14, 0.20
Narcissism	−0.05 (0.97)a	0.15 (1.01)a	0.11 (1.27)a	$F(2, 433) = 1.73$ , $p = .178$	0.20, 0.16, 0.04
Dark Triad composite	−0.12 (.99)a	0.30 (0.94)b	0.19 (1.10)a,b	$F(2, 433) = 7.60$ , $p = .001$	0.43, 0.31, 0.11

Standardized scores are reported for SOI and DT variables. Means ( $\pm SD$ ) with same lowercase letters do not differ from each other (using Tukey's post-hoc comparisons,  $p < .01$ ). All effect sizes listed compare heterosexual to mostly heterosexual; heterosexual to bisexual; and mostly heterosexual to bisexual. Effect sizes contrasting bisexual women with other groups should be interpreted with caution due to low sample size and limited statistical power. Given 80% power, and  $\alpha = 0.05$ , the present sample had sensitivity to detect effects of  $d \geq 0.31$  when comparing heterosexual to mostly heterosexual women,  $d \geq 0.64$  when comparing heterosexual to bisexual women, and  $d \geq 0.68$  when comparing mostly heterosexual to bisexual women (calculated with G\*Power; see Faul et al. 2007).

<sup>a</sup> Degrees of freedom adjusted based on a significant Levene's test,  $F = 12.24$ ,  $p < .001$

<sup>b</sup> Degrees of freedom adjusted based on a significant Levene's test,  $F = 4.21$ ,  $p = .016$

<sup>c</sup> Degrees of freedom adjusted based on a significant Levene's test,  $F = 5.90$ ,  $p = .003$

<sup>d</sup> One mostly heterosexual participant did not respond to this question

( $r(436) = 0.354, p < .001$ ), although the pattern for mostly homosexual and exclusively homosexual women cannot be evaluated in these data.

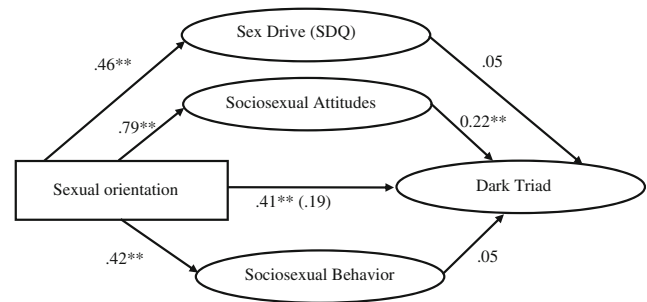
Because Dark Triad traits have repeatedly been associated with sociosexuality (Jonason et al. 2009; Lee et al. 2013; Kastner and Sellbom 2012), it was of interest to evaluate whether sexual orientation differences in Dark Triad traits were mediated by differences in sociosexuality.<sup>3</sup> Because mostly heterosexual and bisexual women did not tend to differ on traits related to sociosexuality or the Dark Triad (Table 2), they were combined in mediation analysis as one group ( $n = 128$ ). Bootstrap mediation analyses (Preacher and Hayes 2008), using 10,000 bias corrected samples, revealed that sexual orientation differences in composite Dark Triad scores were not independent of scores on sociosexuality<sup>4</sup> (z-scores of each component of sociosexuality were included in the model in order to isolate the specific factors driving the effect). Consistent with Hypothesis 2, sociosexual attitudes fully mediate the effect of sexual orientation on the Dark Triad, because the impact of sexual orientation on Dark Triad traits is non-significant (95% CI [-0.02, 0.40]) when accounting for the mediating effects of sociosexuality (Fig. 1).

## Study 1 Discussion

Study 1 provides preliminary evidence that women's sexual orientation is associated in a meaningful way with reported sociosexuality and DT traits, with mostly heterosexual and bisexual women scoring higher than exclusively heterosexual women in attitudes, behaviour, and sex drive, as well as both Machiavellianism and psychopathy. The difference between mostly heterosexual and exclusively heterosexual women in sociosexuality is associated with moderate to large effect sizes, while the differences in DT traits are more modest. Although these group differences are informative, there are two obvious limitations. First, study 1 used a five-point sexual orientation *identity* scale, rather than the more commonly accepted seven-point Kinsey scale (Kinsey et al. 1948) assessing sexual *attractions*. There were also insufficient numbers of mostly homosexual female participants, and none who identified as exclusively homosexual. Additionally, the brief measure of the DT that was employed has been criticized as being inadequate, sacrificing validity for concision (e.g. Carter et al. 2015; Maples et al. 2014). The Short Dark Triad (SD3) (Jones

<sup>3</sup> Jonason et al. (2009) evaluated the mediating role of DT traits on sex differences in sociosexuality. We would argue that sociosexuality should be tested as the true mediator, given that it is a more general omnibus indicator of sexual strategy, of which DT traits are only one component.

<sup>4</sup> Although only scores on the composite Dark Triad are reported here for the sake of brevity, an identical pattern of results were found when mediation models instead tested for total psychopathy or Machiavellianism score (groups did not differ on narcissism).



**Fig. 1** Sociosexual attitudes mediate sexual orientation difference in overall Dark Triad score. Values in *parentheses* represent the direct effect of sexual orientation on Dark Triad, after mediating effects are accounted for. The values to the *left of those parentheses* represent the total effect of sexual orientation on Dark Triad. Sexual orientation coded as Heterosexual = 1 and Non-heterosexual = 2

and Paulhus 2014) offers improved psychometric validity that better represents each facet of the DT (Muris et al. 2017). In light of these concerns, study 2 sought to replicate the findings of study 1 using a more detailed measure of sexual preference, a more robust measure of the DT traits (SD3), and a larger and more varied sample of women from across the sexual orientation spectrum.

## Study 2 Methods

### Participants and Procedure

A total of 647 female students at a Midwestern Canadian University completed a questionnaire for course credit in their introductory psychology course. Forty-seven were excluded for incomplete measures, or implausible responding (e.g. lifetime sexual partners reported as >7000), leaving 600 cases for analysis. The average age of participants was 20.40 years ( $SD_{age} = 2.92$ ;  $Range = 18-45$ ). Each questionnaire was completed online from a unique IP address, and took approximately 25 min to complete. Upon completion, participants were thanked and debriefed via a statement from the authors. All research was conducted with institutional ethical approval consistent with the Canadian Tri-Council Policy Statement (TCPS 2) and the Declaration of Helsinki.

### Measures

Participants answered a series of demographic questions, including their current age, age of first intercourse, and number of male and female sexual partners across their lifetime (the two were combined to create a “lifetime partners” variable). Sexual orientation was assessed using a seven-point Kinsey scale (Kinsey et al. 1948). Participants' response options ranged from “sexual feelings only towards males” (Kinsey rating = 0) to “sexual feelings only towards females” (Kinsey rating = 6). Among all respondents, 340

(56.6%) responded as Kinsey 0, 160 (26.6%) as Kinsey 1, 42 (7.0%) as Kinsey 2, 15 (2.5%) as Kinsey 3, 19 (3.2%) as Kinsey 4, 11 (1.8%) as Kinsey 5, and 13 (2.2%) as Kinsey 6. These percentages illustrate the positively skewed distribution of women's sexual orientation, although they differ from population prevalence estimates of Kinsey score in women (e.g. Gates 2011; Laumann et al. 1994; Mosher et al. 2005), probably because the recruitment script for the online study specifically invited non-heterosexual women to participate. To create large enough groups for comparison, certain Kinsey scores were clustered together (for similar groupings see Dawson et al. 2016; Savin-Williams and Vrangalova 2013; Vrangalova and Savin-Williams 2014). Women identifying as Kinsey 0–2 were treated as independent groups, and are referred to as androphilic (Kinsey 0), mostly androphilic (Kinsey 1), and somewhat ambiphilic (Kinsey 2), respectively. Additionally, women reporting Kinsey scores from 3 to 4 were combined into an ambiphilic group ( $n = 34$ ), and those with Kinsey scores of 5 or 6 ( $n = 24$ ) formed a predominantly/exclusively gynephilic group.

Dark Triad traits were assessed using the Short Dark Triad (SD3) (Jones and Paulhus 2014). This scale asks participants how much they agree (1 = *strongly disagree*; 5 = *strongly agree*) with 27 self-referent statements (9 for each DT trait) including “You should wait for the right time to get back at people”, and “I insist on getting the respect I deserve”. Sociosexuality was evaluated using identical scales employed in study 1 (i.e. SOI and SDQ). Internal consistency was appreciable for measures of DT traits: Machiavellianism ( $\alpha = 0.73$ ), psychopathy ( $\alpha = 0.72$ ), narcissism ( $\alpha = 0.66$ ), and composite ( $\alpha = 0.80$ ). Machiavellianism was correlated with psychopathy ( $r(600) = .49, p < .001$ ) and narcissism ( $r(600) = .20, p < .001$ ). Psychopathy was correlated with narcissism ( $r(600) = .23, p < .001$ ). The total SOI scale showed appreciable reliability ( $\alpha = 0.75$ ), as well as for both the behavioural ( $\alpha = 0.69$ ) and the attitude ( $\alpha = 0.82$ ) subscales. Likewise, the SDQ showed appreciable reliability in this sample ( $\alpha = 0.77$ ). In line with study 1, a composite SOI score was created from the average  $z$ -scores on the SOI behavioural and attitude scales, as well as the SDQ (the reliability of questions from these combined scales was  $\alpha = 0.75$ ). Additionally, the SD3 measures were standardized to allow for comparison across instruments using different scales.

## Results

One-way analysis of variance (ANOVA) compared the five sexual orientation groups on bio-demographic variables, as well as traits related to sociosexuality and the Dark Triad

(Table 3), with critical alpha adjusted to 0.01 for both omnibus and follow-up comparisons to control the type 1 error rate (Nakagawa 2004). ANOVA results are reported in Table 4. Correlations were also calculated between Dark Triad traits and sociosexuality variables (Table 5), showing a similar pattern to study 1. Ambiphilic women were significantly younger than mostly androphilic ( $d = -0.83$ ) and predominantly/exclusively gynephilic women ( $d = -0.72$ ). Age was also modestly correlated with lifetime sexual partners ( $r(600) = 0.28, p < .001$ ), which is a significant contributor to the behavioural aspect of SOI. However, the reported omnibus comparisons do not control for age because the pattern of results did not differ when using ANCOVAs; as such, the simpler ANOVAs are reported here.<sup>5</sup>

As Kinsey scores move towards greater levels of gynephilia, women tended to report a greater number of female partners, and a lower ratio of male sex partners (proportion of lifetime partners that are male). When comparing composite SOI scores, somewhat-ambiphilic (Kinsey 2) women were higher in sociosexuality than both exclusively androphilic (Kinsey 0) and ambiphilic women (Kinsey 3 and 4).<sup>6</sup> The sociosexuality of mostly androphilic women (Kinsey 1) was only significantly different from exclusively androphilic women (i.e. they did not differ from other sexual orientation groups). Because of these group differences (displayed in Fig. 2), and their similarity to previous data (Lippa 2006, 2007; Schmitt 2007), we examined the possible curvilinear relationship between Kinsey score and SOI.

A polynomial regression was conducted, with block one predicting composite SOI from sexual orientation group (coded 1–5), and block two predicting composite SOI from both sexual orientation group (i.e. block one) and its squared product. The first block of the regression was significant,  $F(1, 598) = 20.33, p < .001$ , accounting for 3.1% of the variance. Block two was also significant,  $F(2, 597) = 26.97, p < .001$ , accounting for 8.0% of the variance. The  $R^2$  change was significant between blocks 1 and 2,  $F = 32.53, p < .001$ , indicating a significant curvilinear relationship between sexual orientation group and composite SOI.

Regarding Dark Triad traits, group differences emerged only for psychopathy, with somewhat-ambiphilic women (Kinsey 2) scoring higher on the trait than exclusively androphilic (Kinsey 0;  $d = 0.56, [0.22, 0.87]$ ) and mostly androphilic (Kinsey 1;  $d = 0.60, [0.26, 0.95]$ ) women, but not differing from ambiphilic (Kinsey 3) or predominantly/exclusively gynephilic women (Kinsey 5 and 6). A regression

<sup>5</sup> For specific group comparisons using ANOVA vs. ANCOVA, please contact the corresponding author.

<sup>6</sup> Somewhat-ambiphilic women (Kinsey 2) differed from predominantly/exclusively homosexual women (Kinsey 5 and 6) in composite SOI at  $p = .047$  in the follow-up comparison. Given the modest sample size in both groups, this difference and associated effect size (reported in Fig. 2) should be interpreted cautiously.

**Table 3** Bio-demographic, sociosexuality, and Dark Triad data from study 2

	Androphilic <i>n</i> = 340 <i>M</i> ( <i>SD</i> )	Mostly androphilic <i>n</i> = 160 <i>M</i> ( <i>SD</i> )	Somewhat- ambiphilic <i>n</i> = 42 <i>M</i> ( <i>SD</i> )	Ambiphilic <i>n</i> = 34 <i>M</i> ( <i>SD</i> )	Predominantly or exclusively gynephilic <i>n</i> = 24 <i>M</i> ( <i>SD</i> )
Age	20.27 (1.79)	20.75 (2.75)d	20.45 (2.97)	18.93 (1.37)be	21.83 (5.52)d
Male sexual partners	4.19 (4.42)b	6.60 (6.22)ade	5.63 (5.37)e	2.55 (2.17)b	1.43 (1.90)b c
Female sexual partners	0.02 (0.12)cde	0.22 (0.55)ce	1.41 (2.26)abe	0.83 (0.86)ae	2.61 (2.94)abcd
Ratio of male to female sexual partners	0.997 (0.033)cde	0.962 (0.109)cde	0.856 (0.196)abde	0.697 (0.352)abce	0.351 (0.390)abcd
Lifetime partners	4.19 (4.53)b	6.51 (6.48)a	6.16 (5.77)	3.00 (2.47)	4.09 (3.36)
Age of first intercourse	16.95 (1.68)b	16.35 (1.50)a	16.23 (1.97)	17.19 (1.36)	17.43 (2.02)
SOI—behaviour	-0.133 (.90)bc	0.242 (1.11)a	0.473 (1.30)ad	-0.307 (0.76)c	-0.112 (0.60)
SOI—attitude	-0.219 (.99)bc	0.228 (0.882)a	0.650 (0.95)a	0.295 (1.06)	0.031 (1.04)
SDQ	-0.194 (.99)bc	0.227 (0.865)a	0.556 (0.96)a	0.025 (1.12)	0.219 (1.11)
SOI—composite	-0.182 (.73)bc	0.232 (0.72)a	0.560 (0.75)ad	0.005 (0.76)c	0.046 (0.61)
Machiavellianism	-0.03 (.97)	-0.03 (0.96)	0.23 (1.01)	0.23 (1.27)	-0.05 (1.18)
Narcissism	0.07 (1.04)	-0.10 (0.96)	-0.02 (0.95)	-0.02 (0.94)	-0.33 (0.78)
Psychopathy	-0.07 (1.02)c	-0.08 (0.93)c	0.48 (0.90)ab	0.35 (1.01)	0.26 (1.07)
Dark Triad composite	-0.02 (1.02)	-0.10 (0.95)	0.32 (0.96)	0.26 (1.04)	-0.05 (0.98)

Lowercase letter denotes that a significant difference was found between that group and comparison group as follows: androphilic = a; mostly androphilic = b; somewhat-ambiphilic = c, ambiphilic = d, and predominantly/exclusively gynephilic = e. All tests completed with Tukey’s follow-up comparisons,  $p < .01$ . Standardized scores are reported for SOI and DT variables. Sexual partner numbers, as well as ratio of male to female partners, exclude participants who reported no lifetime sexual partners (72 androphilic, 23 mostly androphilic, 6 biflexible, 13 ambiphilic, and 1 lesbian woman). Ambisexual individuals were more likely to report being virgins ( $\chi^2$ ,  $df = 4$  and 15.37,  $p = .004$ ) with follow-up tests revealing that there were significantly more ambiphilic virgins compared to mostly androphilic and predominantly/exclusively gynephilic groups. Additionally, age of first intercourse excludes virgins and an additional of seven participants who did not respond to the question (five androphilic, one mostly androphilic, and one somewhat-ambiphilic).

model predicting psychopathy from sexual orientation group alone was significant,  $F(1, 598) = 11.32$ ,  $p = .001$ , but accounted for an extremely modest proportion of variance ( $R^2 = 0.017$ ). This relationship was not curvilinear, as adding

the squared product of sexual orientation group to the model did not significantly increase  $R^2$  ( $p = .89$ ).

However, because exclusively androphilic (Kinsey 0), mostly androphilic (Kinsey 1), and somewhat ambiphilic

**Table 4** Results of one-way ANOVAs comparing sexual orientation groups in study 2

Variable	Levene’s test	<i>F</i> -statistic
Age	$F = 4.12, p = .003$	$F(4, 59.1) = 3.07, p = .023$
Male sexual partners	$F = 8.34, p < .001$	$F(4, 181.8) = 13.16, p < .001$
Female sexual partners	$F = 97.06, p < .001$	$F(4, 51.5) = 14.06, p < .001$
Ratio of male to female sexual partners	$F = 128.86, p < .001$	$F(4, 54.7) = 33.17, p < .001$
Lifetime partners	$F = 7.68, p < .001$	$F(4, 167.0) = 7.20, p < .001$
Age of first intercourse	$F = 2.34, p = .054$	$F(4, 473) = 5.17, p < .001$
SOI—behaviour	$F = 5.43, p < .001$	$F(4, 173.0) = 7.58, p < .001$
SOI—attitude	$F = 1.35, p = .251$	$F(4, 595) = 12.21, p < .001$
SDQ	$F = 2.16, p = .072$	$F(4, 595) = 9.29, p < .001$
SOI—composite	$F = 0.31, p = .873$	$F(4, 595) = 15.63, p < .001$
Machiavellianism	$F = 3.17, p = .014$	$F(4, 138.3) = 0.96, p = .434$
Narcissism	$F = 0.77, p = .547$	$F(4, 595) = 1.52, p = .195$
Psychopathy	$F = 0.86, p = .488$	$F(4, 595) = 4.71, p = .001$
Dark Triad composite	$F = 0.49, p = .742$	$F(4, 595) = 2.03, p = .203$

Brown-Forsythe reported when assumption of homogeneity of variance is violated

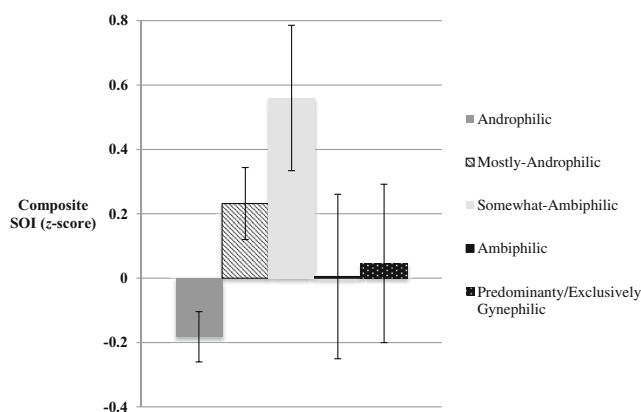


**Table 5** Correlations between measures of sociosexuality and the Dark Triad in study 2

Item	1	2	3	4	5	6	7	8	9
1. SOI—attitude	–								
2. SOI—behaviour	0.55**	–							
3. SDQ	0.29**	0.29**	–						
4. SOI—composite	0.80**	0.80**	0.69**	–					
5. Lifetime sex partners	0.46**	0.91**	0.30**	0.73**	–				
6. Machiavellianism	0.05	–0.05	0.02	0.00	–0.08	–			
7. Psychopathy	0.24**	0.13*	0.15**	0.23**	0.10	0.49**	–		
8. Narcissism	0.04	0.07	0.12*	0.10	0.07	0.20**	0.23**	–	
9. Dark Triad composite	0.15**	0.06	0.13*	0.15**	0.04	0.78**	0.78**	0.64**	–

\* $p < .01$ ; \*\* $p < .001$ 

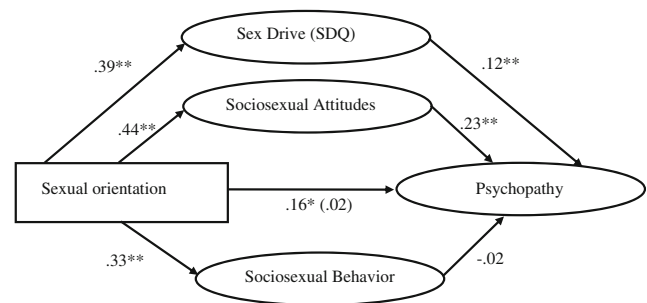
(Kinsey 2) women showed differences in sociosexuality, and because sociosexuality has been repeatedly linked to Dark Triad traits (see above), we once again sought to test whether sexual orientation differences in psychopathy between women identifying as Kinsey 0, 1, and 2 were mediated by differences in sociosexuality. Bootstrap mediation analyses (Preacher and Hayes 2008), using 10,000 bias corrected samples, revealed that sexual orientation differences in psychopathy scores were not independent of scores on sociosexuality ( $z$ -scores of each component of sociosexuality were used in order to isolate the specific factors driving the effect). As illustrated in Fig. 3, sociosexual attitudes and SDQ score fully mediate the effect of sexual orientation on psychopathy because the impact of sexual orientation on psychopathy is non-significant (95% CI [–0.12, 0.15]) when accounting for the mediating effects of these facets of sociosexuality.



**Fig. 2** Comparison of composite SOI (average  $z$ -scores) across sexual orientation groups in study 2. Error bars represent 95% confidence intervals. Somewhat-ambiphilic women's composite SOI is greater than androphilic women ( $d = 1.01$ , [0.68, 1.34]), ambiphilic women ( $d = 0.74$ , [0.26, 1.20]), and predominantly/exclusively gynephilic women ( $d = 0.73$ , [0.21, 1.24]). Mostly androphilic women only differed significantly from androphilic women ( $d = 0.57$ , [0.38, 0.76]) (all Cohen's  $d$  reported with 95% CIs). Given 80% power, and  $\alpha = 0.05$ , the present sample had adequate sensitivity to detect all effects reported in Fig. 2 (calculated with G\*Power; see Faul et al. 2007)

## Study 2 Discussion

Study 2 replicated aspects of study 1, employing a more detailed measure of Dark Triad traits, and using a sample that more adequately represented the spectrum of women's sexual orientation. Most strikingly, study 2 found that somewhat-ambiphilic (Kinsey 2) women have higher sociosexuality than most other groups, with moderate to large effect sizes (Fig. 2). The relationship between women's sexual orientation and less restricted sociosexuality was found to be curvilinear, replicating previous studies showing bisexual women to be higher in sociosexuality than heterosexual or homosexual women (Lippa 2006, 2007; Schmitt 2007), but adding granularity regarding sexual orientation groupings. More specifically, mostly androphilic (Kinsey 1) and somewhat ambiphilic (Kinsey 2) women exhibited higher sociosexuality compared to ambiphilic women (Kinsey 3–4), although all of these groups have been characterized as “bisexual” in the literature. In addition, somewhat-ambiphilic women were found to score higher on measures of psychopathy than mostly or exclusively androphilic women. Much like study 1, these group differences were mediated by traits associated with sociosexuality,



**Fig. 3** Sociosexual attitudes and sex drive mediate sexual orientation difference in psychopathy. Values in parentheses represent the direct effect of sexual orientation on psychopathy, after mediating effects are accounted for. The values to the left of those parentheses represent the total effect of sexual orientation on psychopathy. Sexual orientation coded as Androphilic = 0, Mostly Androphilic = 1, and Somewhat-Ambiphilic = 2; \* $p < .05$ ; \*\* $p < .01$

specifically more favourable attitudes towards casual sex, and a higher sex drive. It is noteworthy that study 2 *did not* replicate the findings of study 1 regarding sexual orientation differences in Machiavellianism, and overall Dark Triad traits. This is perhaps owing to the more limited scope of the *Dirty Dozen* questionnaire employed in study 1, and the fact that the SD3 psychopathy subscale captures traits that overlap substantially with Machiavellianism (Table 5; see also Muris et al. 2017).

## General Discussion

The present study sought to understand the associations between women's sexual orientation, their sociosexuality, and self-reported Dark Triad (DT) traits. Consistent with our predictions, sexual orientation had a curvilinear relationship with sociosexuality such that mostly androphilic (Kinsey 1) and somewhat-ambiphilic (Kinsey 2) women scored higher on these traits than other groups (Prediction 1). Furthermore, the sexual orientation differences in DT traits were mediated by sociosexuality (Prediction 2).

Taken together, studies 1 and 2 lead to three tentative conclusions. First, women with moderate levels of bisexuality tend to score higher on measures of sociosexuality than women on other points on the sexual orientation continuum. Second, these same moderately bisexual women also score higher on traits of psychopathy. Third, the differences in psychopathy between exclusively heterosexual and moderately bisexual (Kinsey 1 and 2) women are entirely accounted for by concurrent shifts in the latter's sociosexuality, particularly their attitudes towards uncommitted sexual activity (studies 1 and 2) and their sex drive (study 2).

Given previous research linking women's sexual orientation and sociosexuality (Lippa 2006, 2007; Schmitt 2007), and the links between less restricted sociosexuality and psychopathy (e.g. Jonason et al. 2009, Kastner and Selbom 2012; Lee et al. 2013; McDonald et al. 2012), interpretation and explanation of the present findings are necessarily enmeshed. Moderately bisexual women's higher levels of psychopathy may be the result of their less restricted sociosexuality, given that the two traits are reliably correlated (Jonason et al. 2009, Kastner and Selbom 2012; Lee et al. 2013; McDonald et al. 2012). We reiterate that it is reasonable to treat sociosexuality as a more general omnibus indicator of sexual strategy, with DT traits being one possible facilitator of the strategy. Put another way, both dark personality traits and unrestricted sociosexuality are likely part of a cluster of traits that help facilitate relatively short-term focused sexual strategies in men (Jonason et al. 2009) and women (Carter et al. 2014; Honey 2017). Explaining why women with higher sociosexuality also have higher psychopathy addresses only a portion of the present results. The deeper question is why

women who report moderate bisexuality display higher sociosexuality compared to their counterparts who are either exclusively androphilic (Kinsey 0), or those who report relatively more gynephilia (i.e. Kinsey 3–6), including those that are completely bisexual (Kinsey 3).

Rather than positing that the sexual orientation of moderately bisexual women (Kinsey 1–2) is causing their heightened sociosexuality (as well as the associated psychopathy), it is instead possible that their moderate bisexuality is driven in large part by their elevated interest and willingness to engage in sexual activity, coupled with the impulsivity and non-conformity associated with subclinical psychopathy (Sellbom and Verona 2007) and their ability to become aroused to both male and female erotic stimuli (e.g. Chivers et al. 2007, 2015). It is, therefore, conceivable that moderately bisexual women (Kinsey 1–2) are simply those women who represent the upper end of female sociosexuality scores, and this sexual openness leads to more sexual experience overall (Table 3), some of which occurs with women. This suggests a difference in the bio-developmental roots of these women's moderate gynephilia, as compared to women who experience relatively greater degrees of gynephilia (Kinsey 3–5), but who do not show upwards shifts in their sociosexuality or DT scores.

It is not clear why natural selection would tolerate so much variability in women's sexual orientation. Some researchers have forwarded adaptationist arguments, positing that female-female sexual contact would lessen tensions in polygynous marriage arrangements, thus making female bisexuality adaptive in certain contexts (Kuhle and Radtke 2013; Radtke 2013; but see Apostolou 2016a). In contrast, Apostolou (2016b) has suggest that women's sexual orientation has been under "weak selection" throughout the history of our species, as mate choice has historically been regulated by women's parents and reproduction by their partners. Such weak selection is consistent with the skewed distribution of women's sexual orientation, with each step up the Kinsey scale (i.e. more relative gynephilia) becoming increasingly rare at the population level. Explaining moderate gynephilia among women poses far less an evolutionary puzzle than exclusive gynephilia, given research showing that female bisexuality is associated with increased levels of sexual behaviour with both women and men (e.g. Fethers et al. 2000; Kanazawa 2016; Lippa 2006, 2007; Schmitt 2007), a pattern also replicated in study 2. Moderately bisexual women in study 2 (Kinsey 1 and 2) did not report fewer male sexual partners than exclusively androphilic (Kinsey 0) women—if anything they reported *more*, a pattern that finds support elsewhere in the literature (see also Hayes et al. 2011; Lindley et al. 2012). This means that the fitness of moderately bisexual women need not be compromised despite their sexual interest in same-sex targets.

From a reproductive standpoint, the possible benefits of an unrestricted sociosexuality in such women may be tied to mate

quality, given that an interest in casual sex is associated with a greater preoccupation with partner attractiveness (Mikach and Bailey 1999) which, in turn, is one possible indicator of partner quality (for review, see Gildersleeve et al. 2014). There is some evidence to suggest that mothers reporting higher sociosexuality tend to have more sons than daughters (Kanazawa and Apari 2009), a bias that not only ensures offspring have a higher than average sociosexuality (because this trait is heritable), but that this sexual strategy is more often expressed in males where it is likelier to lead to higher reproductive output in absolute terms. As such, it is possible that less restricted sociosexuality in women has been under moderate selection because of the associated benefits in reproduction and inclusive fitness (Hamilton 1964). Evolutionary pressures that select for less restricted sociosexuality may have coincidentally selected for the appreciable amount of moderate bisexuality reported by women at the population level, as well as slightly elevated psychopathy. In this view, the heightened psychopathy of moderately bisexual women would simply be a by-product of selection pressures on less restricted sociosexuality. A slight shift among females towards less restricted sociosexuality may have historically been associated with slightly increased fecundity, which would have offset the fact that these mostly androphilic women did not always seek sexual encounters with men. From an evolutionary perspective, this suggestion is especially viable if the same-sex motivation or behaviour of mostly androphilic women is primarily restricted to non-ovulatory periods of their menstrual cycle (e.g. Diamond and Wallen 2011). Unfortunately, this possibility cannot be evaluated in the current study.

### Limitations

The present cross-sectional study does not inform our understanding of changes in women's sexual preference or behaviour across time (Diamond 2003a, 2009) nor does the convenience sample, comprised primarily of young Canadian university undergraduate women, allow for firm conclusions to be drawn about other groups of women, or women in other cultures. The average age of the sample was also decidedly young, a fact that cannot be overlooked given that many women do not explore same-sex sexuality until somewhat later in their lives (Diamond 2009; Dickson et al. 2013; Kanazawa 2016). Additionally, sociosexuality is an imperfect proxy for fitness—a limitation that could be overcome by measuring actual reproduction in an older sample of women. It is also unclear from our data what motivations (e.g. love, affiliation, sexual desire) factored into participants' decisions to engage in sexual activity with men, women, or both (Diamond 2003b). Furthermore, no data were collected pertaining to early childhood experiences (parents' socioeconomic status, childhood abuse or abandonment, etc.) that would inform their life-history, as these factors have been implicated in the

development of women's attachment styles and sexual strategies (Del Giudice 2009; Fernandes et al. 2016). The role of relationship status (and type) should be evaluated in future research, especially considering evidence that bisexual women are more likely to hold favourable attitudes towards, and have experience with, consensual non-monogamy (CNM) (see Hauptert et al. 2016). Although CNM is an example of less restricted sexual behaviour, it is worth noting that the present sexual orientation differences in DT traits were mediated by attitude and sex drive facets of sociosexuality, not behavioural indices.

Regarding trait measurement, future studies should employ better validated measures of both the DT and sociosexuality. For the DT, the authors of a recent meta-analysis urge researchers to utilize individual measures for Machiavellianism, narcissism, or psychopathy, to adequately capture the multi-faceted nature of each construct (Muris et al. 2017). Given that studies 1 and 2 indicated that women's sexual orientation was most strongly related to psychopathy, future studies should focus on more detailed measures of this trait such as Hare's (1985) SRP-III. Sociosexuality is typically evaluated with the Revised Sociosexual Orientation Inventory (SOI-R) (Penke and Asendorpf 2008), which incorporates measures of sexual behaviour, attitude, and desire in a single scale. Future research should employ the SOI-R rather than the measures used presently (i.e. the original SOI scale, and the SDQ). Further, no measures of socially desirable responding were employed in either study. Self-report data are often subject to social desirability biases (Paulhus 1991) in that individuals want to present themselves in a favourable light, particularly when reporting on socially undesirable behaviour (Crowne and Marlowe 1964). In light of this possibility, behavioural questions were neutrally worded in order to reduce response bias. Additionally, survey anonymity is known to reduce socially desirable responding in users, which is linked to higher rates of self-disclosure overall (Booth-Kewley et al. 2007; Joinson 2007), and online surveys are further associated with reductions in socially desirable responding (Frick et al. 2001; Tourangeau 2004)—both of these features characterize the present study.

Lastly, although efforts were made to gather a large sample of women that represent all sexual orientations, some groups were entirely unrepresented (e.g. mostly or exclusively homosexual women in study 1), or had to be combined for analysis (Kinsey 3–4 and 5–6 in study 2). Future research with sufficient representation of all Kinsey scores will help elucidate (or refute) many of the patterns found in the present study. This is the first study to examine Dark Triad traits across sexual orientation groups in women, and given that numerous personality traits differ between heterosexual and non-heterosexual men (reviewed in Bailey et al. 2016), potential sexual orientation differences in the DT could be investigated in males as well.

## Conclusion

The results of the current investigation build on a growing body of evidence indicating that exclusively androphilic, somewhat-gynephilic, and predominantly/exclusively gynephilic women differ in numerous measurable and identifiable ways. Indeed, the present study, in conjunction with the research reviewed above, suggests that the small degree of gynephilia reported by moderately bisexual women may have an aetiology that is distinct from that of the relatively greater degree of gynephilia reported by women whose bisexualities tend towards more equal preference for males and females, or those whose preference is biased or exclusively towards female sexual partners. Additionally, these data lend credence to the idea that an increased interest in casual sex is associated with Dark Triad traits among women in general (Carter et al. 2014). The current investigation focuses on women who are not entirely “straight”, and illustrates that the interplay between women’s sexual orientation, sociosexuality, and Dark Triad traits is far from straightforward.

**Acknowledgements** Scott W. Semenyina and Charlene F. Belu are funded by Joseph-Armand Bombardier Canada Graduate Scholarships (Doctoral) from the Social Sciences and Humanities Research Council (SSHRC) of Canada.

**Compliance with Ethical Standards** All research was conducted with institutional ethical approval consistent with the Canadian Tri-Council Policy Statement (TCPS 2) and the Declaration of Helsinki.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. An institutional human subject research ethics committee reviewed and approved this research.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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