

Possible evolutionary origins of human female sexual fluidity

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ABSTRACT

I propose an evolutionary theory of human female sexual fluidity and argue that women may have been evolutionarily designed to be sexually fluid in order to allow them to have sex with their cowives in polygynous marriage and thus reduce conflict and tension inherent in such marriage. In addition to providing an extensive definition and operationalization of the concept of sexual fluidity and specifying its ultimate function for women, the proposed theory can potentially solve several theoretical and empirical puzzles in evolutionary psychology and sex research. Analyses of the National Longitudinal Study of Adolescent Health (Add Health) confirm the theory's predictions that: (i) women (but not men) who experience increased levels of sexual fluidity have a larger number of children (suggesting that female sexual fluidity, if heritable, may be evolutionarily selected); (ii) women (but not men) who experience marriage or parenthood early in adult life subsequently experience increased levels of sexual fluidity; and (iii) sexual fluidity is significantly positively correlated with known markers of unrestricted sexual orientation among women whereas it is significantly negatively correlated with such markers among men.

Key words: human female sexual fluidity, homosexuality, pornography, category specificity, menstrual synchrony.

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“If we insist that women have sexual orientations and that *sexual orientation* must have the same mechanism for both sexes, this leads us to the odd conclusion that most women with heterosexual identities and preferences have a bisexual orientation.”

J. Michael Bailey (2009, p. 59)

“What is sexual orientation and do women have one?”

“Interestingly, this was true of some of the women in my heterosexual comparison group. None of the women had any childhood or adolescence experiences of same-sex desire, but the strength of their current emotional attachments to women made them open to the idea of same-sex relationships.”

Lisa M. Diamond (2008, p. 132)

Sexual Fluidity: Understanding Women's Love and Desire

I. INTRODUCTION

It has long been known that women's sexuality is more plastic and malleable than men's (Goode & Haber, 1977; Rich, 1980; Baumeister, 2000; Kinnish, Strassberg & Turner, 2005). Most recently, in her award-winning book *Sexual Fluidity: Understanding Women's Love and Desire*, Diamond (2008) chronicles the sexual experiences and identities of 100 women over the course of 10 years. Most of the women in Diamond's study, which consists of a main sample of young non-heterosexual women and a comparison group of young heterosexual women, change their sexual identities from 'lesbian', to 'bisexual', to 'heterosexual' and back again, many of them often opting not to label their sexual identity at all. Their sexuality is so fluid that no one label quite fits them.

While there appears little doubt that women's sexuality is far more fluid than men's, it remains unclear why. Why is women's sexuality more fluid than men's? Diamond herself

(2007) offers an explicitly evolutionary explanation of female sexual fluidity. She first makes a distinction between two types of sexual desire: *proceptivity* and *arousability*. Proceptivity is the motivation to initiate and pursue sexual contact, otherwise known as 'lust' or 'libido'. Arousability, on the other hand, is the capacity to become sexually aroused to sexual stimuli. Diamond (2007) argues that sexual orientation, to whom sexual desire is directed, is coded only in proceptivity, while arousability is more flexible.

Because proceptivity represents a strong motivation to initiate sexual behavior, it would be important (evolutionarily speaking) for this response to be targeted *only* toward potentially reproductive partners and, therefore, it is reasonable to expect that this form of sexual desire is innately coded for "sex of partner." Yet, the same would not be true for arousability. As long as urges to initiate mating were reliably targeted toward reproductive partners in the EEA [environment of evolutionary adaptedness], there would be little or no selection pressure to code "sex of partner" into arousability

(Diamond, 2007, p. 256).

Because men can reproduce at all time, their proceptivity dominates arousability in their sexual desire. As a result, they constantly pursue sexual contact with desired partners. So heterosexual men consistently pursue sex with women, and homosexual men consistently pursue sex with men. In sharp contrast, women are reproductive only for a few days of the month during ovulation. Proceptivity dominates women's sexual desire during ovulation, but for the rest of the time the more flexible arousability dominates. As a result, women are capable of being aroused by either men or women during the time when their arousability dominates their proceptivity (Diamond, 2007).

This is an elegant and coherent theory of the evolution of female sexual fluidity. Even if it is entirely correct, however,

it only provides *proximate* mechanisms for female sexual fluidity, not an ultimate explanation, as Diamond (2007, p. 248) herself explicitly recognizes. Diamond's proposed explanation only answers the 'how' question of proximate mechanisms, not the 'why' question of ultimate functions.

In this review, I propose an alternative explanation for female sexual fluidity, by suggesting its possible reproductive benefits and thus ultimate evolutionary functions. I argue that women may have been evolutionarily selected to be sexually fluid in order to allow them to have sex with their cowives in polygynous marriage. Even though humans have been mildly polygynous throughout evolutionary history, polygynous marriages are often characterized by conflict and tension among cowives. I propose that occasional sex among cowives may have reduced such conflict and tension, and increased their reproductive success. Female sexual fluidity may have evolved as an adaptation to facilitate it.

It is important to state explicitly what the theory does *not* propose. It proposes *neither* that sexual fluidity is the only evolved mechanism to reduce conflict and tension among cowives in polygynous marriage *nor* that conflict reduction is the only function of female sexual fluidity. The theory merely proposes that female sexual fluidity may be *one* of the evolved mechanisms to reduce conflict and tension among cowives in polygynous marriage, and that such conflict reduction may be *one* of (potentially many) evolved functions of female sexual fluidity. The theory is therefore entirely compatible with other potential mechanisms to reduce tension and conflict among cowives in polygynous marriage (such as separate residences in separate groups/locations) and with other potential functions of female sexual fluidity, such as alloparenting (Kuhle & Radtke, 2013). In addition to providing an ultimate, functional explanation for female sexual fluidity, the proposed theory can potentially provide possible solutions to eight separate and seemingly unrelated theoretical and empirical puzzles in evolutionary psychology and sex research.

II. WHAT IS SEXUAL FLUIDITY?

Diamond (2008, p. 3) defines sexual fluidity as "situation-dependent flexibility in women's sexual responsiveness." Before I present an evolutionary psychological theory of the origin of female sexual fluidity, I aim in this section to extend and operationalize this definition.

Sex researchers enumerate four different measures of sexual orientation (Mustanski, Chivers & Bailey, 2002, pp. 122–127; Wilson & Rahman, 2005, pp. 13–16):

- 1 Self-identified labels ('homosexual', 'bisexual', 'heterosexual')
- 2 Actual sexual behaviour (with whom individuals have sex)
- 3 Self-reported sexual feelings (fantasies and desires)
- 4 Genital or brain responses (physiologically measured arousal to male or female images).

Wilson & Rahman (2005, pp. 15–16) argue that:

physiological measures may be the best means of all of assessing sexual orientation. By observing genital responses (e.g. a penis volume measure for men or vaginal blood flow for women) to erotic stimuli (pictures of nude men and women and depictions of heterosexual and homosexual activity), or brain responses (by EEG or functional MRI scans), we obtain objective information regarding an individual's erotic preferences and arousal patterns. When self-reported desires and physiological responses agree there is no problem; when they provide conflicting information, the latter are perhaps more telling because they are less susceptible to social pressures or conscious impression management.

I follow Wilson & Rahman (2005) and treat genital and brain responses as the most objective and accurate measures of sexual orientation, although not necessarily of other aspects of sexuality or sexual preferences (Chivers & Bailey, 2005; Suschinsky & Lalumière, 2011; Chivers *et al.*, 2014).

I suggest that sexual fluidity can operate on any and all of these definitions of sexual orientation. I further suggest that sexual fluidity has three different facets: nonexclusivity; change; and variance.

Nonexclusivity. A person is sexually fluid to the extent that she is nonexclusive in her sexual orientation by any of the four definitions above. By this definition, bisexual individuals are sexually more fluid than mostly heterosexual and mostly homosexual individuals, who in turn are sexually more fluid than strictly heterosexual and strictly homosexual individuals. The degree of nonexclusivity can be measured by self-identified labels, actual sexual behaviour, self-reported sexual feelings, or genital or brain responses.

Change. A person is sexually fluid to the extent that her sexual orientation by any of the four definitions above changes over time or across situations. By this definition, a person is more sexually fluid if she changes her sexual orientation more frequently over time or in different situations. The frequency of change can be measured by self-identified labels, actual sexual behaviour, self-reported sexual feelings, or genital or brain responses.

Variance. A person is sexually more fluid to the extent that her sexual orientation by one of the above definitions is at variance with that by another definition. By this definition, a woman is sexually fluid if, for example, she identifies as strictly heterosexual by self-identified label (Definition 1 above) but has sexual fantasies and desires about women (Definition 3) or has sex with a woman (Definition 2).

One potential problem with the definition of sexual fluidity outlined above is that it could be internally inconsistent. For example, someone who goes from 'mostly heterosexual' to 'strictly heterosexual' back and forth frequently over time will be more sexually fluid than someone who is consistently 'bisexual' over time by the *change* facet of sexual fluidity, but less sexually fluid by the *nonexclusivity* facet. In order to avoid such internal inconsistency, we can assign differential weights

to the three facets of sexual fluidity to produce a single 'sexual fluidity score' for each person. So, for example, if nonexclusivity is deemed more important than change, then the consistently bisexual person would be more sexually fluid than the person who fluctuates between strictly heterosexual and mostly heterosexual. By contrast, if change is deemed more important, then the person who fluctuates between strictly heterosexual and mostly heterosexual would be more sexually fluid than the consistently bisexual person.

It is beyond the scope of this review to assign such weights to the three proposed facets of sexual fluidity. I merely want to propose these three facets of sexual fluidity and suggest that they can operate on all four definitions of sexual orientation.

III. THEORETICAL AND EMPIRICAL PUZZLES

This section discusses eight theoretical and empirical puzzles that remain unsolved in evolutionary psychology and sex research. While these eight puzzles may appear completely unrelated, the proposed evolutionary psychological theory of female sexual fluidity (presented in Section IV) can potentially shed light on all eight puzzles (see Section VII).

(1) What about homosexuality?

Homosexuality presents perhaps the greatest challenge to evolutionary psychology (Confer *et al.*, 2010), whose theoretical 'bottom line' is reproductive success. One of the first questions that I receive as soon as I tell people – both fellow academics and civilians – that I am an evolutionary psychologist is "What about homosexuality?" A series of popular introductions to the field have asked, and failed to answer, why homosexuality exists (Wright, 1994, pp. 384–386; Miller, 2000, pp. 217–219; Miller & Kanazawa, 2007, pp. 180–182).

There are some potential explanations for male homosexuality, however. A leading explanation is the balancing selection hypothesis (Schwartz *et al.*, 2010), originally proposed by evolutionary biologists Robert L. Trivers and William R. Rice (Hamer & Copeland, 1994, pp. 183–184). It suggests that genes for male homosexuality may be carried by their sisters, who compensate for the lower reproductive success of their homosexual brothers by having more offspring than sisters of heterosexual men. The evidence for this explanation for male homosexuality has been mixed; some studies support it (Camperio-Ciani, Corna & Capiluppi, 2004; Iemmola & Camperio Ciani, 2009; Rieger *et al.*, 2012) while others do not (Schwartz *et al.*, 2010; Blanchard, 2012). A related possibility is that 'genes for' homosexuality may be linked to 'genes for' other, reproductively advantageous traits, such as intelligence or lower levels of intragroup aggression, and may thus piggyback on them during selection (Wilson & Rahman, 2005).

Another explanation is the kin-selection hypothesis (Wilson, 1978, pp. 142–147). It suggests that gay men

increase their inclusive fitness by investing in their close kin and increasing *their* reproductive success, thereby ensuring the survival of the genes that the gay men share with their close relatives. Unfortunately, there does not appear to be any empirical support for this explanation (Bobrow & Bailey, 2001; Rahman & Hull, 2005; Vasey & VanderLaan, 2012), except in Samoa (Vasey, Pocock & VanderLaan, 2007; Vasey & VanderLaan, 2009).

Perhaps the most likely, as well as the simplest, explanation is that male homosexuality has survived to this day because, throughout most of recorded history, gay men were forced to hide their sexuality by the threat of social and legal sanctions, and so got married and had children like straight men (Hamer & Copeland, 1994, pp. 182–183; Miller, 2000, pp. 217–219). If so, then the liberation of homosexuals, which allows them to come out of the closet freely and not pretend to be straight, may ironically contribute to the end of homosexuality (Miller & Kanazawa, 2007, p. 181).

(2) What about female homosexuality (lesbianism)?

There is an additional mystery about homosexuality. Female homosexuality (lesbianism) appears to be completely different from male homosexuality.

Male homosexuality appears to be heritable; its heritability has been estimated to be between 0.26 (Kirk *et al.*, 2000) and 0.60 (Bailey & Pillard, 1991). The remaining variance in male sexual orientation, however, appears to be accounted for by prenatal exposure to androgens in the womb (Ellis & Ames, 1987; Blanchard & Bogaert, 1996; Blanchard, 2004; VanderLaan & Vasey, 2011). There is by now strong evidence for a fraternal birth-order effect on male homosexuality – men who have more older brothers are more likely to be homosexual (Blanchard & Bogaert, 1996; Bogaert, 2003). Each additional brother increases the odds that a man becomes homosexual by 33–38%. Many sex researchers believe that, between genes and prenatal hormones, men's sexual orientation may be largely determined before birth (Mustanski *et al.*, 2002; Wilson & Rahman, 2005; LeVay, 2010; Bailey, 2012). Bem's (1996, 2000) "Exotic Becomes Erotic" theory specifies one potential developmental path from genes and prenatal hormones to sexual orientation *via* childhood gender nonconformity (although the theory is purported to apply to both sexes).

None of this holds for lesbians. While geneticists may have located the genes for male homosexuality in the locus Xq28 (Hamer *et al.*, 1993), they have not located comparable genes for female homosexuality, although some studies have found evidence of concordance for homosexuality among female monozygotic twins (Whitam, Diamond & Martin, 1993; Bailey, Dunne & Martin, 2000). Men are usually strictly heterosexual or strictly homosexual in their sexual orientation (Tollison, Adams & Tollison, 1979; Rieger, Chivers & Bailey, 2005), although some recent studies suggest that some men may be genuinely bisexual (Cerny & Janssen, 2011; Rosenthal *et al.*, 2012; Lippa, 2013). In sharp contrast, many women are somewhere in between, which leads to their

Table 1. Fluidity in adult sexual identity (Add Health Waves III and IV)

Wave III	100% straight	Mostly straight	Bisexual	Mostly gay	100% gay	Asexual	Total
<i>Women</i>							
				Wave IV			
100% straight	5274 (75.7%)	628 (9.0%)	60 (0.9%)	18 (0.3%)	10 (0.1%)	23 (0.3%)	6013 (86.3%)
Mostly straight	280 (4.0%)	376 (5.4%)	41 (0.6%)	7 (0.1%)	6 (0.1%)	2 (0.0%)	712 (10.2%)
Bisexual	30 (0.4%)	70 (1.0%)	48 (0.7%)	17 (0.2%)	10 (0.1%)	1 (0.0%)	176 (2.5%)
Mostly gay	6 (0.1%)	3 (0.0%)	6 (0.1%)	7 (0.1%)	13 (0.2%)	0 (0.0%)	35 (0.5%)
100% gay	3 (0.0%)	2 (0.0%)	0 (0.0%)	6 (0.1%)	22 (0.3%)	0 (0.0%)	33 (0.5%)
Total	5593 (80.3%)	1079 (15.5%)	155 (2.2%)	55 (0.8%)	61 (0.9%)	26 (0.4%)	6969 (100.0%)
<i>Men</i>							
				Wave IV			
100% straight	5371 (91.3%)	115 (2.0%)	11 (0.2%)	9 (0.2%)	18 (0.3%)	11 (0.2%)	5535 (94.1%)
Mostly straight	86 (1.5%)	75 (1.3%)	7 (0.1%)	8 (0.1%)	8 (0.1%)	3 (0.1%)	187 (3.2%)
Bisexual	7 (0.1%)	8 (0.1%)	15 (0.3%)	8 (0.1%)	5 (0.1%)	0 (0.0%)	43 (0.7%)
Mostly gay	5 (0.1%)	0 (0.0%)	0 (0.0%)	18 (0.3%)	19 (0.3%)	0 (0.0%)	42 (0.7%)
100% gay	3 (0.1%)	0 (0.0%)	2 (0.0%)	10 (0.2%)	60 (1.0%)	0 (0.0%)	75 (1.3%)
Total	5472 (93.0%)	198 (3.4%)	35 (0.6%)	53 (0.9%)	110 (1.9%)	14 (0.2%)	5882 (100.0%)

sexual fluidity (Diamond, 2008) as discussed below. In fact, some sex researchers question whether women have sexual orientations in the same sense that men do, as indicated by the Bailey quote at the beginning of this review. Why female homosexuality (and female sexuality) differ so much from male homosexuality (and male sexuality) remains a mystery in sex research.

(3) Why is female sexuality (unlike male sexuality) so fluid?

While many studies of sexual fluidity, like Diamond's (2008), are based on small convenience samples (often of college women), data from nationally representative samples of both men and women confirm their observations. For example, the National Longitudinal Study of Adolescent Health (Add Health) is a prospectively longitudinal study of a nationally representative sample of American youths, initially sampled when they were in junior high and high school in 1994–1995 (Wave I), and subsequently reinterviewed in 1996 (Wave II), 2000–2002 (Wave III), and 2007–2008 (Wave IV). For further details of the sampling and study design, see <http://www.cpc.unc.edu/projects/addhealth/design>.

Add Health measures respondents' sexual orientation by self-identified labels (Definition 1 in Section II) and self-reported sexual feelings (Definition 3 in Section II). In Wave III, when the respondents were between 18 and 28, and again in Wave IV, when they were between 25 and 34, Add Health asked its respondents to describe their sexual identity. At Wave III, the respondents could choose from five labels (100% straight, mostly straight, bisexual, mostly gay, 100% gay). At Wave IV, Add Health added the option 'asexual'. This is a measure of *adult sexual identity*.

Both at Waves III and IV, Add Health asked two questions about the respondents' romantic attraction to men and women. In Wave III, it asked "Have you ever had a

romantic attraction to men?" and "Have you ever had a romantic attraction to women?" In Wave IV, it asked slightly different questions "Are you romantically attracted to men?" and "Are you romantically attracted to women?" Note that these are independent questions to which the respondents can give independent answers. While most respondents say "yes" to one and "no" to the other in each wave, some say "yes" to both, and others say "no" to both. From these questions, I can construct binary measures of homosexual and heterosexual romantic attractions. These are measures of *adult sexual attraction*.

Table 1 presents the joint distribution of Add Health respondents by their adult sexual identity at Waves III and IV, shown separately by sex. Table 2 similarly presents the joint distribution of their adult homosexual and heterosexual attractions at Waves III and IV, shown separately by sex. Table 3 presents the association between adult sexual identity and adult homosexual and heterosexual attractions, for Waves III and IV, shown separately by sex. Close inspection of these data shows that women are significantly more sexually fluid than men in all three facets of sexual fluidity discussed in Section II.

(a) *Nonexclusivity*

Table 1 shows that women are far more likely to identify themselves with sexually nonexclusive labels such as 'mostly straight', 'bisexual', and 'mostly gay' than men are, both at Wave III (13.24% *versus* 4.46%, $t(14953) = 18.889$, $P < 0.001$) and at Wave IV (18.72% *versus* 4.87%, $t(15559) = 26.904$, $P < 0.001$). (Note that all statistical results presented in the text throughout come from the analyses of raw data, not from the tables. The analyses of Wave III data, for example, include all cases with non-missing data in Wave III, whereas the cases presented in Table 1 have non-missing data in *both* Waves III and IV.) Further, women are significantly more likely to identify themselves

Table 2. Fluidity in adult sexual attraction (Add Health Waves III and IV)

Wave III	No	Yes	Total
Homosexual attraction			
<i>Women</i>			
		Wave IV	
No	5877 (83.2%)	303 (4.3%)	6180 (87.5%)
Yes	543 (7.7%)	342 (4.8%)	885 (12.5%)
Total	6420 (90.9%)	645 (9.1%)	7065 (100.0%)
<i>Men</i>			
	No	Wave IV Yes	Total
No	5482 (92.3%)	112 (1.9%)	5594 (94.2%)
Yes	179 (3.0%)	164 (2.8%)	343 (5.8%)
Total	5661 (95.4%)	276 (4.6%)	5937 (100.0%)
Heterosexual attraction			
<i>Women</i>			
		Wave IV	
No	47 (0.7%)	220 (3.1%)	267 (3.8%)
Yes	146 (2.1%)	6655 (94.2%)	6801 (96.2%)
Total	193 (2.7%)	6875 (97.3%)	7068 (100.0%)
<i>Men</i>			
		Wave IV	
No	78 (1.3%)	184 (3.1%)	262 (4.4%)
Yes	132 (2.2%)	5541 (93.4%)	5673 (95.6%)
Total	210 (3.5%)	5725 (96.5%)	5935 (100.0%)

as 'bisexual' both at Wave III (2.50% *versus* 0.68%, $t(14953) = 8.808$, $P < 0.001$) and at Wave IV (2.36% *versus* 0.73%, $t(15559) = 8.108$, $P < 0.001$). As discussed in Section III.2 above, and consistent with past research (Tollison *et al.*, 1979; Rieger, Chivers & Bailey, 2005), very few men (less than 1% at each Wave) identify themselves as bisexual.

Women are also more likely to be nonexclusive in their adult sexual attraction (Table 2). They are significantly more likely than men to state that they have ever been romantically attracted to both men and women at Wave III (11.92% *versus* 4.45%, $t(15168) = 16.707$, $P < 0.001$) and to state that they are romantically attracted to both men and women at Wave IV (7.68% *versus* 2.24%, $t(15643) = 15.508$, $P < 0.001$). Add Health data therefore suggest that women are far more sexually fluid than men in the nonexclusivity facet, measured both by adult sexual identity and adult sexual attraction.

(b) Change

Table 1 also shows that women are far more likely to change their sexual orientation over time, by choosing different self-identified labels at Waves III and IV (17.83% *versus* 5.82%, $t(12849) = 20.971$, $P < 0.001$) (Savin-Williams, Joyner & Rieger, 2012). Women are also more likely to change their joint pattern of adult sexual attraction to men or women between Waves III and IV (16.29% *versus* 9.32%, $t(12996) = 11.784$, $P < 0.001$). Whether measured

by adult sexual identity or adult sexual attraction, women are significantly more likely to be sexually fluid in the change facet.

(c) Variance

Finally, Table 3 shows that women are mostly, although not entirely, more sexually fluid in the variance facet, measured by the concordance between their adult sexual identity and adult sexual attraction. If individuals' sexual orientation by self-identified labels (Definition 1) and self-reported sexual feelings (Definition 3) are more concordant and at less variance with each other, signifying less sexual fluidity, then adult sexual identity (from 1 = 100% straight to 5 = 100% gay) should be correlated positively with the likelihood of adult homosexual attraction and negatively with the likelihood of adult heterosexual attraction. I test these predictions by regressing adult sexual identity on adult sexual attraction (homosexual and heterosexual), sex, and the interaction term between adult sexual attraction and sex, and then testing for the significance of the interaction term.

At Wave III, the correlation between adult sexual identity and adult homosexual attraction is actually slightly and statistically significantly *smaller* among men than among women ($r = 0.681$ *versus* 0.656, $t(1) = 17.495$, $P < 0.001$), suggesting that men may be more sexually fluid in the variance facet than women. However, by all other measures of sexual fluidity in the variance facet, women are significantly more sexually fluid than men. The negative correlation between adult sexual identity and adult heterosexual attraction is larger among men than among women ($r = -0.124$ *versus* -0.333 , $t(1) = -11.317$, $P < 0.001$). Further, at Wave IV, the correlation between adult sexual identity and adult homosexual attraction is significantly larger among men than women ($r = 0.697$ *versus* 0.810, $t(1) = 32.957$, $P < 0.001$) and the negative correlation between adult sexual identity and adult heterosexual attraction is significantly larger among men than among women ($r = -0.461$ *versus* -0.730 , $t(1) = -15.008$, $P < 0.001$). The Add Health data thus generally show (with one exception) that women are significantly more sexually fluid than men in the variance facet. The results presented in Tables 1–3 confirm similar findings by Ott *et al.* (2011) with Add Health.

However, past studies show, assuming that physiological measures of sexual orientation are more objective and accurate than self-report measures (Wilson & Rahman, 2005), that women may not always be aware of their own sexual responses and thus sexual orientation (Chivers, Seto & Blanchard, 2007; Diamond, 2008). Self-report measures of their sexual orientation may therefore *underestimate* the true extent of sexual fluidity among women. Self-identified heterosexual women who report never having had romantic attractions to women may nonetheless show brain or genital responses to audio narratives of female–female sexual encounters (Chivers & Timmers, 2012) or equal appraisal of male and female

Table 3. Association between adult sexual identity and adult sexual attraction (Add Health Waves III and IV)

	Adult sexual attraction					
	Homosexual			Heterosexual		
	No	Yes	Total	No	Yes	Total
Wave III						
<i>Women</i>						
100% straight	5827 (96.6%)	206 (3.4%)	6033 (100.0%)	181 (3.0%)	5852 (97.0%)	6033 (100.0%)
Mostly straight	267 (37.5%)	445 (62.5%)	712 (100.0%)	19 (2.7%)	693 (97.3%)	712 (100.0%)
Bisexual	7 (4.0%)	169 (96.0%)	176 (100.0%)	5 (2.8%)	171 (97.2%)	176 (100.0%)
Mostly gay	0 (0.0%)	35 (100.0%)	35 (100.0%)	7 (20.0%)	28 (80.0%)	35 (100.0%)
100% gay	1 (3.0%)	32 (97.0%)	33 (100.0%)	17 (51.5%)	16 (48.5%)	33 (100.0%)
Total	6102 (87.3%)	887 (12.7%)	6989 (100.0%)	229 (3.3%)	6760 (96.7%)	6989 (100.0%)
<i>Men</i>						
100% straight	5429 (97.9%)	119 (2.1%)	5548 (100.0%)	159 (2.9%)	5389 (97.1%)	5548 (100.0%)
Mostly straight	125 (66.5%)	63 (33.5%)	188 (100.0%)	17 (9.0%)	171 (91.0%)	188 (100.0%)
Bisexual	6 (13.3%)	39 (86.7%)	45 (100.0%)	3 (6.7%)	42 (93.3%)	45 (100.0%)
Mostly gay	2 (4.8%)	40 (95.2%)	42 (100.0%)	4 (9.5%)	38 (90.5%)	42 (100.0%)
100% gay	1 (1.3%)	75 (98.7%)	76 (100.0%)	56 (73.7%)	20 (26.3%)	76 (100.0%)
Total	5563 (94.3%)	336 (5.7%)	5899 (100.0%)	239 (4.1%)	5660 (95.9%)	5899 (100.0%)
Wave IV						
<i>Women</i>						
100% straight	6605 (99.3%)	45 (0.7%)	6650 (100.0%)	75 (1.1%)	6571 (98.9%)	6646 (100.0%)
Mostly straight	886 (69.5%)	388 (30.5%)	1274 (100.0%)	13 (1.0%)	1269 (99.0%)	1282 (100.0%)
Bisexual	12 (6.2%)	183 (93.8%)	195 (100.0%)	8 (4.1%)	187 (95.9%)	195 (100.0%)
Mostly gay	3 (4.1%)	70 (95.9%)	73 (100.0%)	38 (52.1%)	35 (47.9%)	73 (100.0%)
100% gay	2 (2.6%)	75 (97.4%)	77 (100.0%)	73 (94.8%)	4 (5.2%)	77 (100.0%)
Asexual	38 (90.5%)	4 (9.5%)	42 (100.0%)	19 (45.2%)	23 (54.8%)	42 (100.0%)
Total	7546 (90.8%)	765 (9.2%)	8311 (100.0%)	226 (2.7%)	8089 (97.3%)	8315 (100.0%)
<i>Men</i>						
100% straight	6735 (99.2%)	57 (0.8%)	6792 (100.0%)	65 (1.0%)	6722 (99.0%)	6787 (100.0%)
Mostly straight	204 (83.6%)	40 (16.4%)	244 (100.0%)	3 (1.2%)	241 (98.8%)	244 (100.0%)
Bisexual	11 (21.2%)	41 (78.8%)	52 (100.0%)	2 (3.8%)	50 (96.2%)	52 (100.0%)
Mostly gay	0 (0.0%)	58 (100.0%)	58 (100.0%)	37 (63.8%)	21 (36.2%)	58 (100.0%)
100% gay	0 (0.0%)	132 (100.0%)	132 (100.0%)	128 (97.0%)	4 (3.0%)	132 (100.0%)
Asexual	26 (89.7%)	3 (10.3%)	29 (100.0%)	10 (34.5%)	19 (65.5%)	29 (100.0%)
Total	6976 (95.5%)	331 (4.5%)	7307 (100.0%)	245 (3.4%)	7057 (96.6%)	7302 (100.0%)

sexual stimuli in Implicit Association Tests (Snowden & Gray, 2013).

That women's sexuality appears much more fluid than men's is abundantly clear both from a large number of past studies and from inspection of representative data from Add Health; what is not clear is *why*. Why is women's sexuality so much more fluid than men's?

(4) Why do heterosexual men find lesbian sex arousing?

It is well known that heterosexual men find visual images of lesbian sex sexually arousing. In fact, heterosexual men respond so reliably to visual images of lesbian sex that sex researchers discovered a long time ago that the best way to distinguish between heterosexual and homosexual men by means of physiological measures (penile enlargement) is to show them images of sex between two women and sex between two men. Heterosexual men respond with significantly greater arousal to visual images of lesbian sex

while homosexual men respond with significantly greater arousal to visual images of gay male sex (Mavissakalian *et al.*, 1975; Sakheim *et al.*, 1985). Visual images of heterosexual sex do not distinguish heterosexual and homosexual men as effectively, because each can find what they like in such images.

Another line of evidence for heterosexual men's sexual arousal to lesbian sex is pornography. Most consumers of pornography worldwide are men (Symons, 1979, pp. 170–184), and most men are heterosexual. So most consumers of pornography worldwide are heterosexual men. Yet images and depictions of sex between two women are very common in pornography for heterosexual male consumption.

A recent content analysis of 304 scenes from the 50 most popular pornographic videos for the heterosexual male audience in the USA in 2004–2005 reveals that “same-sex activities appeared only between women, with female-to-female oral sex taking place in 22.7% ($n = 69$)

of the scenes” (Sun *et al.*, 2010, p. 343). A separate content analysis by the same team of researches of 122 scenes from 44 best-selling adult videos for 2004 and 2005 shows that 27.9% ($n = 34$) of the scenes similarly contain “woman-to-woman oral” sex acts (Sun *et al.*, 2008, p. 318, Table 2). A content analysis of the 50 top-selling pornographic videos in Australia shows that these videos devote nearly three hours (2 hours 54 minutes 03 seconds) to “oral sex on woman by woman.” It is the 11th most common sex act of the 74 different sex acts coded in these videos, more common than “nipple stimulation” (1 hour 50 minutes 50 seconds), “breast rubbing” (1 hour 13 minutes 37 seconds), or “vaginal penetration, by man, with penis, missionary position” (1 hour 5 minutes 49 seconds) (McKee, 2005, p. 284, Table 1).

Further, in these ‘girl-on-girl’ scenes in pornography aimed at the heterosexual male audience, women who engage in homosexual acts usually are not typical (exclusive or predominant) lesbians who usually prefer women to men as sexual partners. They are instead typical heterosexual women who enjoy (perhaps to an unrealistic degree in the fantasy world of pornography) sex with men, yet engage in sex with other women in some scenes in a seemingly gratuitous manner.

Pornography is a visual and auditory means to elicit sexual arousal. Male viewers are sexually aroused when they view pornography because they implicitly and unconsciously imagine themselves to be in the situations in pornography and to be having the depicted sexual acts with the actresses in them (Miller & Kanazawa, 2007, pp. 69–71). A fundamental assumption in evolutionary psychology is that the human brain has difficulty comprehending and dealing with entities and situations that did not exist in the ancestral environment (Kanazawa, 2004). For example, there is considerable evidence that human brains cannot truly comprehend television and implicitly respond to characters regularly seen on TV as their own friends (Kanazawa, 2002; Gardner & Knowles, 2008; Derrick, Gabriel & Hugenberg, 2009). This is why actresses in pornographic films usually embody physical characteristics desired by men in their female sexual partners in real life.

Why then would men find sexual acts between two women sexually arousing? Why would heterosexual men prefer to watch sexual desires of women directed, not to men like themselves (or how they imagine themselves to be), but to other women? Why are ‘girl-on-girl’ scenes so popular in pornography aimed at the heterosexual male audience (McKee, 2005; Sun *et al.*, 2008, 2010)? Why are these women usually depicted as (perhaps hypersexual) *heterosexual* women who enjoy having sex with men but nonetheless occasionally have sex with other women?

(5) Why do heterosexual men in relationships often encourage their mates to engage in lesbian relationships whereas they would react in the opposite way for heterosexual affairs?

Many heterosexual men in committed relationships often fantasize about threesomes involving their current sexual partner and another woman. A survey of common sexual

fantasies of university students in the 1980s found that an equal number of men ($N = 58$, 42.0% of the sample) fantasized about “several sex partners at the same time” and “current sex partner” (Davidson, 1985, p. 28, Table 2). A large survey of readers of a British newspaper also found that 34% of men (out of a sample of 1862) have actually experienced “sex with two other people (a threesome)” and a further 19% of men have experienced “group sex (more than three people present),” although it is not clear whether these experiences involved their current regular sex partners (Wilson, 1987, p. 126, Table 1). Men overwhelmingly prefer threesomes with two women rather than with a man and a woman (Hughes, Harrison & Gallup, 2004, p. 9, Figure 3). Men’s desire for sexual experiences that include their current sexual partner and another woman is so strong and widespread that there have been popular books, written by women for male readers, such as *Getting Your Wife or Girlfriend to Have a Threesome* (Taylor, 2011) and *How to Get Her to Watch Porn, Have Anal Sex, and Call Her Best Friend for a Threesome* (St. James, 2008). An in-depth study of married, strictly heterosexual women over 30 who engage in swinging finds that many of them begin their bisexual activities at the specific suggestions of their husbands (Dixon, 1984).

Men’s desire for their mate to have sex with another woman also manifests itself in their starkly different reactions to their mate having an affair with another man or another woman. Men find the prospect of their mate having an affair with a woman to be much less distressing than the prospect of her having an affair with a man (Wiederman & LaMar, 1998; Hughes *et al.*, 2004). As a result, men are much more likely to continue their relationship with their current mate after her homosexual affair than after her heterosexual affair (Confer & Cloud, 2011).

Evolutionary psychologists explain men’s varied reactions to their mate’s homosexual and heterosexual affairs in terms of the threat of cuckoldry (Wiederman & LaMar, 1998; Hughes *et al.*, 2004; Confer & Cloud, 2011). If a man’s mate has an affair with another man, it might potentially result in pregnancy and the possibility of cuckoldry, where the man unwittingly invests his valuable resources in raising the genetic offspring of the interloper. His mate’s affair with another woman does not raise the same possibilities. Similarly, evolutionary psychologists explain men’s strong desire for threesomes involving two women in terms of their desire for multiple sexual partners (Wilson, 1997; Hughes *et al.*, 2004). A threesome with two women doubles the chances of conception, and group sex with four women quadruples them.

These unconscious reproductive motives are no doubt a large part of men’s varied responses to their mate’s homosexual and heterosexual affairs, and their strong desire for threesomes with their mate and another woman. But could there also be another reason? Even if men are not as disturbed by their mate’s homosexual affairs as by her heterosexual affairs because of the absence of the threat of cuckoldry, why do some men *encourage* and *desire* their mate to have sex with another woman? If the increased chance

of conception is the reason behind men's strong desire for threesomes, why do they have to have sex with multiple women *simultaneously* (as in threesomes or group sex)? Given that a man requires a refractory period after each orgasm, he can maximize his chances of multiple conceptions if he has sex with multiple women *on separate occasions*, not simultaneously as in threesomes or group sex. Why then do men have such a strong desire for sex with multiple women *simultaneously*?

(6) Why is male sexuality 'category specific' while female sexuality is not – why is there a positive correlation between the number of heterosexual and homosexual sex partners for women but a negative correlation for men?

Sex researchers largely concur that male sexual desire is far more 'category specific' than female sexual desire (Chivers *et al.*, 2004; Chivers, 2005; Lippa, 2006, 2007; Lippa, Patterson & Marelich, 2010). Typically, men are either sexually attracted to men or sexually attracted to women, whereas women tend to be sexually attracted to both.

The best empirical demonstration of the clear sex differences in category specificity of sexual desire is the sexually dimorphic effect of sex drive on sexual desire for men and women. Among men, higher sex drive increases sexual attraction either only to women (for heterosexuals) or only to men (for homosexuals). In sharp contrast, higher sex drive increases sexual attraction simultaneously to both men and women among women (Lippa, 2006, 2007).

While all past studies of sex differences in category specificity of sexual desire use convenience samples, even when they are large and cross-cultural (as in Lippa, 2007), data from nationally representative samples confirm their conclusion as well. Wave IV of Add Health asked its respondents how many homosexual and heterosexual sex partners they had in the last 12 months. The correlation between the number of homosexual sex partners and the number of heterosexual sex partners was significantly positive among women ($r = 0.146$, $P < 0.001$, $N = 8235$) but significantly negative among men ($r = -0.051$, $P < 0.001$, $N = 7238$).

A similar correlation between the number of homosexual and heterosexual sex partners that Add Health respondents have ever had in their lives is significantly positive both among women ($r = 0.229$, $P < 0.001$, $N = 8113$) and men ($r = 0.040$, $P < 0.001$, $N = 7142$). However, this is due to a small number of outliers among men who have had (or claim to have had) hundreds of sexual partners of both sexes in their lives. If I limit the sample to those with 100 or fewer sex partners of either sex, the correlation is then significantly positive among women ($r = 0.151$, $P < 0.001$, $N = 8066$) and significantly negative among men ($r = -0.041$, $P < 0.001$, $N = 7037$). Similarly, the correlation between the number of homosexual and heterosexual sex partners that Add Health respondents had before Age 18 is significantly positive both among women ($r = 0.264$, $P < 0.001$, $N = 8091$) and men ($r = 0.030$, $P < 0.05$, $N = 7123$) due to outliers. If I limit the sample to those with 10 or fewer sex partners of either

sex before Age 18, the correlation is again significantly positive among women ($r = 0.120$, $P < .001$, $N = 7782$) and is negative and approaches significance among men ($r = -0.023$, $P = 0.058$, $N = 6653$).

Nor is this pattern, where the correlation between the number of homosexual and heterosexual sex partners is positive among women but negative among men, limited to Add Health. In the General Social Surveys, conducted over the last 40 years, among respondents who have had 100 or fewer sex partners of either sex since Age 18, the correlation is significantly positive among women ($r = 0.044$, $P < 0.001$, $N = 11782$) and is negative and approaches significance among men ($r = -0.019$, $P = 0.075$, $N = 8952$).

While the lower category specificity of female sexual desire obviously relates to greater female sexual fluidity as discussed in Section III.3, sex researchers do not yet know *why* men's sexual desire is more category specific than women's. Nor do they know why men with higher sex drive have more sex only with men or only with women, while women with higher sex drive have sex with both men and women. These questions remain among the mysteries in sex research.

(7) Do women synchronize their menstruation, and, if so, why?

McClintock (1971) was the first to document the phenomenon of menstrual synchrony. Over the course of an academic year from October to April, 135 close friends and roommates in a dormitory gradually synchronized their menstrual onsets. In the last 40 years, since McClintock's groundbreaking study, a large number of studies have independently confirmed menstrual synchrony among women who live or socialize together (Skandhan *et al.*, 1979; Graham & McGrew, 1980, 1992; Russell, Switz & Thompson, 1980; Quadagno *et al.*, 1981; Preti *et al.*, 1986; Goldman & Schneider, 1987; Matteo, 1987; Little *et al.*, 1989; Graham, 1991; Weller & Weller, 1992, 1993a,b, 1997; Weller, Weller & Avinir, 1995; Stern & McClintock, 1998; Weller *et al.*, 1999a; Weller, Weller & Roizman, 1999b). However, an equally large number of studies have failed to find menstrual synchrony under similar circumstances (Wilson, Kiefhaber & Gravel, 1991; Trevathan, Burleson & Gregory, 1993; Weller & Weller, 1995a,b, 1998; Cepicky *et al.*, 1996; Strassmann, 1997; Yang & Schank, 2006; Ziolkiewicz, 2006). Whether menstrual synchrony is real is a hotly debated and currently unsettled issue.

Another problem with menstrual synchrony is that, even if it exists, we do not know why or what its adaptive function is (Barash & Lipton, 2009, pp. 41–46). Several scholars have proposed evolutionary explanations of menstrual synchrony (Burley, 1979; Knowlton, 1979; Turke, 1984). All of these evolutionary explanations, however, equate *menstrual* synchrony with *ovulatory* synchrony; they explain menstrual synchrony by proposing evolutionary functions for ovulatory synchrony. However, it has not been demonstrated that menstrual synchrony equals ovulatory synchrony (Kiltie, 1982; Strassmann, 1999). To my knowledge, no one has ever proposed an evolutionary explanation of *menstrual* synchrony

as opposed to *ovulatory* synchrony. Why menstrual synchrony exists (if it does) and what its evolutionary functions are thus remains a mystery.

(8) Why do women exhibit greater erotic plasticity than men?

Baumeister (2000) maintains that women exhibit greater *erotic plasticity* than men. His notion of erotic plasticity is related to but more inclusive than Diamond's (2007, 2008) notion of sexual fluidity, and includes three facets. (i) *Intraindividual variability*. Women experience greater changes over time and across situations, not only in the sex of their preferred sexual partners (sexual fluidity), but also other aspects of their sexual desires, attitudes and behaviour such as the frequency of sexual activities. (ii) *Sociocultural factors*. Social and cultural factors such as religion and education affect women's sexual desires, attitudes and behaviour to a much greater extent than they do men's. For example, more-educated women are more different from less-educated women than more-educated men are from less-educated men. (iii) *Attitude-behaviour consistency*. Women exhibit lower attitude-behaviour consistency in the area of sex than men do. For example, a larger proportion of women who disapprove of premarital sex nevertheless have it themselves. In general, Baumeister (2000) argues that social, cultural, and situational factors play a larger role in determining women's sexuality, whereas biological factors (genes and hormones) play a larger role in determining men's.

Why do women exhibit greater erotic plasticity than men do? Baumeister (2000) offers three potential explanations. First, men are physically stronger and socially and politically more powerful than women so they are often able to impose their desires on women and women must engage in behaviour not necessarily consistent with their desires and attitudes. Second, women's change of mind – from no to yes – is inherent in the sexual script because a man and a woman can have sex for the first time only when the woman changes her mind. Third, women may have weaker sex drive and may thus care about and insist on what they want less than men do. In the end, however, Baumeister (2000) concedes that, while it is clear from the evidence he has gathered that women are indeed more plastic in their sexual desires, attitudes and behaviour, the reason for their greater erotic plasticity remains unclear.

IV. AN EVOLUTIONARY PSYCHOLOGICAL THEORY OF FEMALE SEXUAL FLUIDITY

The evolutionary psychological theory of female sexual fluidity begins with the human evolutionary history of polygyny. The species-typical degree of polygyny, both among primate and nonprimate species, correlates highly positively with the degree of sexual dimorphism in size (Leutenegger & Kelly, 1977; Alexander *et al.*, 1979). The more polygynous the species, the greater the size disparity

between the sexes. So, for example, among the completely monogamous gibbons, there is no sexual dimorphism in size; both by height and by weight males are about the same size as females. By contrast, among the highly polygynous gorillas, males are 1.3 times as large by height and twice as large by weight as females (Alexander *et al.*, 1979, pp. 428–30, Table 15-3).

On this scale, humans are somewhere in the middle. Typically, men are 1.1 times as large by height and 1.2 times as large by weight as women (Eveleth & Tanner, 1976, 1990). This suggests that, throughout evolutionary history, humans have been *mildly* polygynous, not as polygynous as gorillas but not strictly monogamous like gibbons either. Further, given that polygynous men have many more offspring than monogamous or mateless men, the evolution of human nature has been much more influenced by the human evolutionary history of polygyny than the incidence of polygyny in any given society at any given time appears to suggest. Most of us are descended from highly polygynous men with great reproductive success, not from monogamous men with a few offspring or mateless men with none.

While it has been a consistent feature of human evolutionary history, polygyny often engenders conflict among cowives married to the same men. Even though most women benefit from the institution of polygyny (Becker, 1974; Grossbard, 1978, 1980; Kanazawa & Still, 1999), it is seldom in the existing wife's reproductive interest for her husband to acquire another wife. The senior wife who is already married to the man usually suffers from the addition of each new wife to the household, because each additional wife takes away the husband's resources otherwise available to her and her children. The conflict among cowives in polygynous marriages is therefore ubiquitous (Jankowiak, Sudakov & Wilreker, 2005).

One means of reducing such conflict and tension among cowives in a polygynous marriage is the institution of sororal polygyny, where a set of sisters marry the same man. When the cowives are sisters, they should not object so strongly to the diversion of the husband's resources to the new wife and her children, because the senior wife is genetically related to both (Chisholm & Burbank, 1991; Jankowiak *et al.*, 2005). In the Standard Cross-Cultural Sample, about a third (41 out of 137) of polygynous societies largely or exclusively practice sororal polygyny (White, 1988, p. 540). From this perspective, it is probably not coincidental that Mormons refer to cowives in their polygynous marriages as 'sister wives', whether they are indeed sisters or not, which they often are, as seen below in Section V.3.

But what if sororal polygyny is not possible? What if a set of sisters cannot be married to the same man, either because the wife does not have any sisters or because her sisters are already married to other men? What if the polygynous man wants to acquire an additional wife who is not related to any of his existing wives? How can cowives in a polygynous marriage avoid conflict and tension inherent in such marriages when they are not genetically related?

I propose that sexual relations among cowives may have evolved as one possible alternative means to reduce conflict and tension in polygynous marriages and strengthen bonds among cowives. If polygynous marriages with reduced conflict and tension among cowives are more successful in raising all the children of the cowives, because of increased coordination, cooperation, and collaboration among the cowives and the efficient division of labour and economies of scale that result from them, then any genetic tendency for women to want to have sex with their cowives and increase solidarity with them will be evolutionarily selected, because their children are more likely to survive to sexual maturity than children of cowives who constantly fight. And because wives in any marriage (polygynous or otherwise) would have to be predominantly heterosexual, these women would have to be sexually fluid – not exclusively or predominantly homosexual – in order to maintain a successful polygynous marriage with little or no conflict among cowives because they occasionally have sex with each other.

In addition to reducing conflict and tension with cowives in polygynous marriage, female sexual fluidity may have had additional functions in the ancestral environment. For example, the available molecular genetic evidence suggests that our ancestors likely practiced female exogamy (Seielstad, Minch & Cavalli-Sforza, 1998). When girls reached puberty, they left their natal groups to marry into neighbouring groups, in order to avoid inbreeding, while boys stayed in their natal groups their entire lives. So all men in a hunter–gatherer band were genetically related to each other, whereas women were not (Geary *et al.*, 2003). Women spent their entire adult lives among genetically unrelated strangers (Hrdy, 2009). Women's sexual fluidity, and their desire occasionally to have sex with other women, may have helped them make friends and establish key alliances quickly in their new group initially surrounded by strangers. Since friendships and alliances can have reproductive benefits, sexual fluidity that facilitates such friendships and alliances among women is expected to be evolutionarily selected.

The observation that nonhuman primates (both male and female) engage in homosexual behaviour in order to reduce tension, facilitate reconciliation, and build alliances is widespread among primatologists (Vasey, 1995, pp. 192–194; de Waal, 1995). For example, primatologists (Kuroda, 1980; de Waal, 1987; White & Thompson-Handler, 1989) argue that female bonobos engage in genitogenital (G-G) rubbing in order to reduce tension and conflict; in fact, Furuichi (1989, pp. 186–190) specifically suggests that bonobos, like humans, practice female exogamy, and young juvenile females who migrate into new groups use G-G rubbing to establish new alliances with senior females in the new group. The current theory is an application of these ideas to humans in the specific context of polygynous marriage and relationships among cowives in the ancestral environment.

I concur with Bailey (2009), in the quote at the beginning of this review, that sexual orientation, as it is usually

conceptualized, may only apply to men, and most women may not have sexual orientations in the same sense as men do. While most men may be either homosexual or heterosexual, being strictly category specific in their sexual arousal patterns, many women appear to be somewhere in the middle, being somewhat fluid sexually. The theory proposes that, while sexual orientations (heterosexual *versus* homosexual) characterize men, degrees of *sociosexual orientation* (Simpson & Gangestad, 1991) characterize women. From this perspective, greater sexual fluidity among some women may be a consequence of less-restricted sociosexual orientation. Lippa's (2006, 2007) finding that women, but not men, with less-restricted sociosexual orientation exhibit greater sexual arousal to both men and women is consistent with this perspective.

Recently, Kuhle & Radtke (2013) independently proposed that female sexual fluidity may have evolved to facilitate alloparenting among ancestral women. My proposed theory is entirely consistent with Kuhle & Radtke's (2013) alloparenting hypothesis, but has two differences. First, I focus on the human evolutionary history of mild polygyny, and conflict and tension inherent in polygyny, as the origin of female sexual fluidity. Second, my theory is more comprehensive than that of Kuhle & Radtke (2013) in that I propose that female sexual fluidity may have evolved not only to facilitate alloparenting but to solve all other problems inherent in polygynous marriages. Parenting may be one such problem, which alloparenting could partially resolve, but I suggest that polygynous marriages involving unrelated women may produce other problems which female sexual fluidity could potentially have solved, by reducing conflict and tension and fostering more harmonious relations among such cowives in general.

I propose that female sexual fluidity may have evolved as a means to allow cowives in polygynous marriages occasionally to have sex with each other in order to reduce conflict and tension among themselves and increase their bonds and solidarity. The theory proposes that women may have been *evolutionarily designed* to be more or less sexually fluid, in order to allow them simultaneously to reproduce sexually through heterosexual intercourse with their husband and strengthen their bonds with cowives in polygynous marriages by occasionally having sex with them throughout human evolutionary history. If this is the case, then there should be evidence that, throughout history and throughout the world, cowives in polygynous marriages who are predominantly heterosexual have engaged in sex with each other. In the next section, I survey such evidence, before testing the theory more rigorously with quantitative empirical data.

V. ETHNOGRAPHIC EVIDENCE

By the very nature of the phenomenon, it is difficult to obtain systematic, quantitative evidence on the prevalence and frequency of sexual relationships among cowives

in polygynous marriages throughout the world. There is, however, some scattered ethnographic evidence from Africa, China, and the USA. There is also some evidence that sexual relations between females in a polygynous reproductive unit happens in some avian species. Studies of sororal polygyny suggest that harmonious and collaborative relationships among cowives, such as may also be achieved by unrelated cowives having sex with each other in nonsororal polygynous marriages, may lead to higher reproductive success and thus female sexual fluidity may be evolutionarily selected.

Evidence from tribal societies in sub-Saharan Africa is of particular importance to evolutionary psychological theory because it is the site of human evolution and hunter–gatherer societies in Africa and elsewhere are the best (albeit imperfect) analog of the ancestral life that we have to examine today. For any proposed evolved psychological mechanism, it is also very important to obtain cross-cultural evidence to show that it is species-typical and not limited to any particular group or region in the world (Buss, 1989). Comparative data for analogous mechanisms from other species are also very useful in evaluating evolutionary theories. When it comes to forms of marriage and family, data from avian species are often more important than those from more closely related species such as nonhuman great apes, because many avian species have pair-bonds and biparental care which are rarely observed elsewhere in nature (Emlen, 1995).

However, I present the ethnographic and comparative evidence below as merely suggestive of and consistent with the proposed theory. I will present more direct, quantitative evidence for the theory in the next section.

(1) Africa

Evans-Pritchard (1970) notes that lesbian sex among cowives in a polygynous marriage was common (albeit disapproved) among the Azande of Sudan.

So far something has been said about male homosexuality. What about lesbianism? That also must be regarded as a product, like male homosexuality, of polygamy on a large scale; for if this precluded young men from normal sex, so in large polygamous homes it prevented the wives, or some of them, from receiving the amount of sexual attention they wished for from their common husband, who, moreover, might well have been elderly and not at the height of his sexual vigor. Though men have slightly different habits, it can be said generally that a woman who is one of three wives would not sleep with her husband more than some ten nights a month, one of six wives more than five nights, and so on. One of the many wives of a prince or of an important commoner in the past might not have shared her husband's bed for a month or two, whereas some of the dozens, even hundreds, of wives of a king must have been almost totally deprived of the sex life normal in smaller homes. Adulterous intercourse was very difficult for a wife in such large polygamous families, for the wives were kept in seclusion and carefully watched; death on discovery, or even

on suspicion, would have been the penalty for both the wife and her lover.

It was in such polygamous families, Azande say, that lesbianism was practiced. Obviously I had no opportunity of knowing anything about it by observation, so that I can only tell what I was told (by males only, though women admitted that some women practiced it). Wives would cut a sweet potato or manioc root in the shape of the male organ, or use a banana for the purpose. Two of them would shut themselves in a hut and one would lie on the bed and play the female role while the other, with the artificial organ tied round her stomach, played the male role. They then reversed roles (pp. 1431–1432).

In his comprehensive review of all forms of homosexuality in all recorded human history, Murray (2000, p. 253) provides an example of sex among cowives of polygynous marriages from central Africa.

Gustave Hulstaert wrote the following about relationships between Nkundó women (in what was then the Belgian Congo): “Nkundó girls play at ‘husband and wife’ and even adult married women engage in this vice. According to my informants, the causes are as follows: first, an intense and very intimate love between two women, second and above all, the fact that wives of polygamists find it difficult to satisfy their passions in a natural way. Often they engage in this practice with co-wives of the same man.” He further noted that “in establishments where girls are too securely kept away from the opposite sex, there has been an increase” in sexual relationships between girls. The latter often engage in sex with co-wives.

(2) China

Murray's (2000) encyclopedic survey of homosexuality contains a section called “Chinese wives sharing concubines with their husbands” (pp. 238–241). This was apparently a common practice, and there appear to be many recorded examples of lesbian relationships between a wife and a concubine or between concubines in imperial China.

Dui shi (literally, eating facing each other) as a label for a relationship suggests that mutual oral sex was the practice of women in ancient Han courts. . . . In a chronicle . . . of the Han emperor Cheng, who ruled from 32 BC to 7 BC . . . , his wife and a Kung, a female student clerk who taught her poetry, had a *dui shi* relationship. The emperor also favored Kung by deigning to impregnate her, so that de facto she was a concubine to the emperor as well as to the empress (p. 238).

A well-known example of a female's love for another female is the focus of the 1645 play *Lian xiangban* (Loving/Pitying the Fragrant Companion) by Li Yu. In it, Cui Jian-Yun, a masculine young married woman . . . loves a young, talented fifteen-year-old girl, Cao Yu-Hua. To ensure that they will be together, Cui arranges for Yu-Hua to become her husband's concubine, and the three live happily, without jealousy (pp. 238–239).

The practice of a married woman convincing her husband to take on a concubine or marry her polygynously so that the two women could continue their sexual relationship is a common theme, not only in ancient China, but, as we see below, also in the contemporary USA among polygynous Mormons.

In ancient China keeping concubines was a privilege of the emperors or the wealthy. A man's wealth was measured by the number of concubines he kept. "A duke can take nine concubines at one time, an emperor can take twelve concubines at one time," is a passage found in the *K'ung-yang T'suen*. The *Li-Chi (The Book of Rites)* states that until the age of 50 a husband should enter the pleasure pavilion of his wife once every third day, of his concubines every fifth day. But the number of concubines made this prescription a physical impossibility. The lack of sexual outlet, the social isolation, and the close proximity of women made the harem a fertile ground for the development of lesbian relationships.

Lesbian practice was also encouraged by the husband in order to help him conserve his sexual energy

(Lieh-Mak, O'Hoy & Luk, 1983, p. 22).

Sexual frustration among concubines, because of their large number and the inability of the man to satisfy all of them at all times, is a common reason evoked for occasional sexual relationships among the concubines themselves, not only in China but also elsewhere in Asia. "In the Surakata court [in Java] during the early 1820s, one of the ruler's concubines "acted the male role" with "frustrated royal concubines"" (Carey & Houben, 1987, p. 20; quoted in Murray, 2000, p. 234).

(3) USA

Mainstream Mormons officially renounced polygyny in 1890, partly as a condition for Utah to be admitted into the Union. However, a large number of fundamentalist Mormons have continued to practice polygyny to this day (Bennion, 2012).

Homosexuality for both men and women is very strongly condemned in the official Mormon doctrine, as "the abominable and detestable crime against nature" (O'Donovan, 1994), so it is very difficult to find evidence of homosexual behaviour among Mormons. However, in her extensive ethnographic study of polygyny among fundamentalist Mormons, Bennion (2012) nonetheless notes that lesbian relationships among cowives ('sister wives') in Mormon polygynous marriages occasionally happen.

"Tina," of the Allred Group, represents many experiences of convert women who find solace in sister wife relationships. Tina experienced a period of alienation from her husband. During this trying time, she was warmed by the friendship she had forged with her co-wife, Joyce, a friendship that developed into physical love . . .

Tina found that her best friend in the world and the only person who understood her needs was her sister wife

Joyce . . . The two wives were several years younger than the other wives and found that they were much happier living and working with each other than with the larger family. Their husband did not spend much time with them because they were removed from the other wives, who were higher ranked, and so they spent most of their time with each other, letting their children play and sleep together as if they were full brothers and sisters. Tina and Joyce coped with economic and emotional hardship in each other's love and devotion. "Joyce and I grew to love each other. We shared a mutual contempt for our husband and for his lack of attention and help. We often held each other in our suffering to comfort each other. We would lie naked and a fire ignited and we loved each other. We continued to love, comfort and nourish each other" (author's field notes, 1994). Tina said that for a long time their husband did not visit, nor did they expect him; that no longer mattered. They considered the intimate, sexual relationship they shared to be the action of "two desperate souls" hungering for a sense of love and acceptance. This was their special sisterhood (pp. 101–102).

Bennion (2012) also describes a typical manner in which an already-married man acquires a new wife; it is often initiated and coordinated by existing wives, in a manner reminiscent of the descriptions of Chinese polygynous marriages (and lesbian relationships between wives and concubines) discussed above.

The procedure for the bride-to-be, however, is much quicker and more efficient from the point of view of many of the women with whom I spoke. One simply gets to know another man's wife extremely well, in the process finding some commonality or bond. The wife then strongly recommends to her husband and the priesthood council that the girl or woman whom she has been "courting" be sealed to her husband for "all eternity." In this way, the bonds between women are often stronger than the bonds between a wife and her husband . . . In the sample of women and men with whom I spoke, women often seem to form more effective bonds with each other than they do with their male spouses (p. 119).

In other sects and among independents, it is the first or second wife who will court a new wife for her husband. I experienced this brand of courtship myself in three separate instances. In Colonia LeBaron, one of Verlan's sons asked me to consider marriage, but it was his second wife, Elizabeth, who wrote me "love letters." In Pinesdale, a woman took me to a restaurant in Hamilton to determine whether I was wifely material. She said she was attracted to the fact that I was college-educated, which meant that I could earn a good salary. It also helped that I was related to George Q. Cannon and that I was personable and a good listener. In the third instance, a polygamist I had known for years confessed that his third wife had always wanted me as their fourth wife because we had struck up a good rapport and were close in age. We would both have been converts from the Mormon Church, which is what she desperately needed in a co-wife; she was surrounded with born-in women every day (p. 121)

Note that Bennion (2012) says that the polygynist's third wife wanted her as *their* fourth wife, not as *his* (her husband's) fourth wife.

Another example of co-wife courtship is found in the "Mason" family of Pinesdale, Montana. When a bright Brigham Young University graduate, "Bill" Mason, began to ask questions about the "mysteries," he was referred to a friend of a friend in his AUB group. He and his wife "Jill" began attending cottage meetings and soon converted to the group. Jill then told her best friend, a BYU student, about the "Work" and sought to convert her. She promised her that her husband would love her forever and that they could bear and raise their children together as lifelong companions, eventually growing old together. After "Yvonne's" conversion and the subsequent endowment ceremony where Jill gripped Yvonne's hand in the sacred way and then placed it in her husband's hand, Jill knew she would be tied to her BYU girlfriend for eternity, as friend, sister, and wife. She told me, "Yvonne and I were roommates at BYU. When she wrote me about the lack of good men down in Provo, I told her to come on up to Montana and I'd hook her up to my husband." Although Jill and Yvonne both live in Pinesdale, Bill spends his time traveling between Montana and Utah to visit his other wives and to take care of priesthood business as one of the ten AUB councilors. In all, Jill and Yvonne see their husband only six months of the year, an arrangement that has fostered a strong emotional and economic bond between the two women (pp. 121–122).

It is evident from Bennion's ethnographic accounts that the friendship or the 'courtship' between women happens first, and the polygynous marriage of a new wife to the man happens *as a consequence of the relationship between the women*.

In Mormon polygamy, the emotional bonds between the dyad (one man and one woman) are reduced so that the husband is free to devote his energies to religion, politics, and economics. This means that women must build strong friendships with their co-wives and children and learn to avoid emotional or financial dependence on a man.... It can also give wives an incentive to have affairs or to strike up a relationship with another wife, behavior that does not cohere with Mormon values but may be seen as a viable option when the husband is absent for a long time (p. 125).

Bennion (2012, p. 132) also notes that sexual relationships among cowives in Mormon polygynous marriages "were written about in early church magazines, were discussed in public, and were often encouraged by nineteenth- and early twentieth-century church officials."

Other Mormon scholars echo Bennion's observations and note emotional and sexual relationships between Mormon women, *which then* leads to a polygynous marriage.

Indeed at least one Mormon woman went so far as to request that her husband marry polygamously after she fell in love with another woman, so that the two women could openly live together. Sarah Louisa (Louie, the masculinized name she preferred) Bouton married Joseph Felt in 1866 as his first

wife, but according to a 1919 biography, around 1874 she met and "fell in love with" a young Mormon woman in her local LDS congregation named Alma Elizabeth (Lizzie) Mineer. After discovering her intense passion for Lizzie, a childless Louie encouraged Joseph to marry the young woman as a plural wife, explaining "that some day they would be privileged to share their happiness with some little ones." Joseph conceded in 1876. But Lizzie's new responsibilities of bearing and raising children evidently proved too great a strain for her and Louie's relationship. Five years later Louie fell in love with "another beautiful Latter-day Saint girl" named Lizzie Liddell, and again Joseph obligingly married her. Thus Louie "opened her home and shared her love" with this second Lizzie

(O'Donovan, 1994, p. 127).

(4) Comparative data

Some oystercatchers (*Haematopus ostralegus*) form polygynous threesomes (one male, two females) where the two females engage in copulation (Heg & van Treuren, 1996). These 'cooperative' threesomes raise their young together, much like human polygynous marriages. However, the behaviour probably has not yet reached fixation among oystercatchers because cooperative threesomes do not necessarily have higher reproductive success than 'aggressive' threesomes (where the two females do not copulate with each other) or monogamous pairs. This may be an avian equivalent of female sexual fluidity.

(5) Evidence for evolutionary selection

For female sexual fluidity to evolve as a capacity to allow cowives in polygynous marriages occasionally to have sex with each other in order to increase their solidarity and bonds, it must necessarily be the case that polygynous marriages in which cowives have sex with each other have greater average reproductive success than otherwise comparable polygynous marriages in which cowives do not have sex with each other. In addition to the prediction that cowives in polygynous marriages occasionally have sex with each other, for which I provide sketchy ethnographic evidence above, the theory logically entails that polygynous marriages in which cowives occasionally have sex with each other have greater average reproductive success than, and are thus evolutionarily selected over, polygynous marriages in which cowives do not have sex with each other.

I present quantitative evidence that female sexual fluidity may be evolutionarily selected in Section VI.3. To my knowledge, no studies have ever compared the reproductive success of polygynous marriages where cowives occasionally have sex with each other and those where they do not; there is scant enough evidence that cowives occasionally have sex with each other at all. However, there is some evidence that sororal polygynous marriages may have higher reproductive success than nonsororal polygynous marriages.

As I note above, polygynous marriages are often characterized by conflict and competition between and among cowives, and sororal polygyny emerged as an institution to reduce such conflict and competition. Jankowiak *et al.* (2005, p. 95) note:

The presence of an alternative sexual and emotional outlet may also account for the marked decrease in co-wife conflict reportedly present in sororal polygynous marriages. Sisters who have established strong bonds of intimacy prior to marriage are less focused on dominating access to their common husband. For them, the husband is a secondary player in the enhancement of their well-being. Why the need to form a pair bond is more muted in sororal polygyny is beyond the scope of our data. Perhaps biological sisters find greater emotional satisfaction with one another and thus have no need to form an exclusive attachment with their common husband.

It may be reasonable to posit that cowives who occasionally have sex with each other may be more altruistic towards each other, by genuinely caring about each other's welfare and that of their children, than cowives who do not. In this sense, cowives who occasionally have sex with each other may act more like genetic sisters (cowives in sororal polygynous marriages) than total strangers (cowives in nonsororal polygynous marriages). Then, if sororal polygynous marriages have greater reproductive success than nonsororal polygynous marriages, it may be reasonable to infer that polygynous marriages in which cowives occasionally have sex with each other may similarly have greater reproductive success than polygynous marriages in which they do not.

In the only published study to date that compares the reproductive success of sororal and nonsororal polygynous marriages, Chisholm & Burbank (1991) show that sororal polygynous marriages have significantly longer interbirth intervals than nonsororal polygynous marriages (85.14 months *versus* 37.52 months, $P = 0.014$). The interbirth interval is an indicator of parental investment; children born with longer interbirth intervals are expected to receive greater parental investment and are thus expected to have higher probabilities of survival, especially in resource-poor environments. Accordingly, Chisholm & Burbank's (1991) data show that sororal polygynous marriages have a non-significant trend towards a greater percentage of children surviving five years compared to nonsororal polygynous marriages (89.07% *versus* 76.71%, $P = 0.118$). Sororal polygynous marriages also have a tendency towards a larger number of pregnancies and live births per wife (both 4.80 *versus* 4.56) and a larger number of children surviving five years (3.86 *versus* 3.38) than nonsororal polygynous marriages. However, none of these differences are statistically significant, possibly due to the very small sample size (14 sororal and 16 nonsororal polygynous marriages).

If Chisholm & Burbank's (1991) findings from the Australian Aboriginal community in Southeast Arnhem Land generalize to sororal polygynous marriages in general,

and if polygynous marriages in which cowives occasionally have sex with each other enjoy greater reproductive success than polygynous marriages in which they do not, because they have lower levels of conflict, competition, and tension, then women's heritable tendency to be sexually fluid will be evolutionarily selected. A larger study of sororal and nonsororal polygynous marriages and their relative reproductive success may shed some light on this proposition. However, a direct test of the evolutionary hypothesis will require a comparison of reproductive success between polygynous marriages in which cowives occasionally have sex with each other and those in which they do not.

VI. QUANTITATIVE EMPIRICAL EVIDENCE

The theory presented in Section IV proposes that female sexual fluidity might reduce tension and conflict among genetically unrelated cowives in polygynous marriages. The proposition is difficult to test empirically in modern western societies (such as the USA) because few women are involved in (simultaneous) polygynous marriage. However, other implications of the proposed theory can be tested with quantitative data from contemporary western societies.

In particular, first, taking sexual fluidity as an independent variable, the theory predicts that women (but not men) who experience increased levels of sexual fluidity will have a larger number of offspring. This prediction is crucial if female sexual fluidity is to be evolutionarily selected. Second, taking sexual fluidity as a dependent variable, the theory predicts that women (but not men) who experience marriage or parenthood earlier in life will experience increased levels of sexual fluidity. Third, taking sexual fluidity as a correlate or indicator, the theory predicts that sexual fluidity correlates significantly with other known indicators of unrestricted sociosexual orientation among women but not among men.

(1) Data

I used Waves III and IV data from Add Health. Respondents were on average 22 years old in Wave III (in 2001–2002; $N = 15197$) and 29 years old in Wave IV (in 2007–2008; $N = 15701$).

(2) Measures of sexual fluidity

I tentatively used the non-exclusivity and change facets of sexual fluidity in this empirical analysis (see Section II). As noted above in Section III.3, Add Health measures respondents' adult sexual identity on a five-point Likert scale: 1 = 100% straight, 2 = mostly straight, 3 = bisexual, 4 = mostly gay, 5 = 100% gay. I deleted a small number ($N = 71$) of Wave IV respondents who stated they were asexual. (There are 71 respondents in Wave IV who identify

as 'asexual'; however, 31 of these respondents have missing data on adult sexual identity in Wave III, most likely because Wave III did not include an option for 'asexual'. These respondents are excluded from Table 1.)

For the *nonexclusivity* facet, I assigned a sexual fluidity score of 0 if the respondents indicated they were either 100% straight (= 1) or 100% gay (= 5), 1 if the respondents indicated they were either mostly straight (= 2) or mostly gay (= 4), and 2 if the respondents indicated they were bisexual. In addition, I constructed a measure of *change* in sexual fluidity from Ages 22 to 29, by subtracting the Wave III sexual fluidity score from Wave IV score; the sexual fluidity change score therefore varies discretely from -2 (becoming less sexually fluid from Ages 22 to 29) to +2 (becoming more sexually fluid from Ages 22 to 29).

(3) Sexual fluidity as an independent variable

The number of biological offspring for both women and men is a count measure with overdispersion (women: $M = 1.12$, variance = 1.47; men: $M = 0.78$, variance = 1.21), so the appropriate statistical technique for its analysis is negative binomial regression (Hilbe, 2007). Consistent with the prediction, a negative binomial regression analysis showed that, net of age and current marital status, women (but not men) who experience increased levels of sexual fluidity from Ages 22 to 29 have more biological children at Age 29 (women: $b = 0.104$, S.E. = 0.037, $P < 0.01$, $N = 6929$; men: $b = 0.033$, S.E. = 0.090, ns, $N = 5839$). Greater reproductive success of women who experience increased levels of sexual fluidity in adulthood suggests that sexual fluidity, if heritable, may be evolutionarily selected. Although caution is necessary because individuals at Age 29 have not yet completed their lifetime reproduction, the pattern during their early reproductive careers is consistent with the prediction of the theory.

(4) Sexual fluidity as a dependent variable

Consistent with the prediction, an ordinal regression analysis showed that, net of age and current marital status, women (but not men) who married before Age 22 had increased levels of sexual fluidity from Ages 22 to 29 (women: $b = 0.184$, S.E. = 0.081, $P < 0.05$, $N = 6933$; men: $b = 0.220$, S.E. = 0.175, ns, $N = 5858$). Similarly, net of age and current marital status, women (but not men) who have children before Age 22 have increased levels of sexual fluidity from Ages 22 to 29 (women: $b = 0.315$, S.E. = 0.073, $P < 0.001$, $N = 6941$; men: $b = 0.087$, S.E. = 0.180, ns, $N = 5863$). Even though virtually all married women in the USA are involved in monogamous (not simultaneously polygynous) marriage, the experience of marriage itself and in particular that of parenthood in early adulthood appear to increase women's sexual fluidity subsequently. This is consistent with the theory's contention that women are evolutionarily selected to be sexually fluid in order to facilitate their marriage and childrearing, possibly by alloparenting (Kuhle & Radtke, 2013).

(5) Sexual fluidity as a correlate and indicator of sociosexual orientation

Finally, one of the theory's contentions is that women do not have sexual orientations in the same sense that men do; instead women have sociosexual orientations. From the theory's perspective, female sexual fluidity is a consequence of women's less-restricted sociosexual orientation. Consistent with this suggestion, Add Health data show that women who are more sexually fluid also exhibit other markers of less-restricted sociosexual orientation. For example, among women, sexual fluidity at Age 22 is significantly negatively associated with age at first vaginal intercourse ($r = -0.108$, $P < 0.001$, $N = 7793$), and significantly positively associated with frequency of vaginal intercourse in the last 12 months ($r = 0.078$, $P < 0.001$, $N = 6365$), number of vaginal intercourse partners in the last 12 months ($r = 0.122$, $P < 0.001$, $N = 7763$), and lifetime number of vaginal intercourse partners ($r = 0.205$, $P < 0.001$, $N = 7730$). Similarly, at Age 29, women's sexual fluidity is significantly negatively associated with age at first vaginal intercourse ($r = -0.139$, $P < 0.001$, $N = 7835$), and significantly positively associated with lifetime number of vaginal intercourse partners ($r = 0.195$, $P < 0.001$, $N = 7879$), number of vaginal intercourse partners in the last 12 months ($r = 0.103$, $P < 0.001$, $N = 8194$), and lifetime number of heterosexual sex partners of all sexual activities ($r = 0.239$, $P < 0.001$, $N = 8073$).

Very importantly, the pattern of correlations is *exactly opposite* among men. Sexually more fluid men are *more* sexually restricted with respect to vaginal intercourse (Wave III: age at first vaginal intercourse: $r = 0.086$, $P < 0.001$, $N = 6994$; frequency of vaginal intercourse in the last 12 months: $r = -0.027$, $P < 0.05$, $N = 5940$; number of vaginal intercourse partners in the last 12 months: $r = -0.027$, $P < 0.05$, $N = 6951$; lifetime number of vaginal intercourse partners: $r = -0.052$, $P < 0.001$, $N = 6929$; Wave IV: age at first vaginal intercourse: $r = 0.024$, $P = 0.053$, $N = 6681$; lifetime number of vaginal intercourse partners: $r = -0.012$, ns, $N = 6820$; number of vaginal intercourse partners in the last 12 months: $r = -0.029$, $P < 0.05$, $N = 7216$; lifetime number of heterosexual sex partners of all sexual activities: $r = -0.030$, $P < 0.05$, $N = 7136$).

Finally, it is known that sexually less restricted parents are more likely to have sons than sexually more restricted parents (Gangestad & Simpson, 1990; Kanazawa & Apari, 2009). Consistent with this phenomenon, women (but not men) who have a son as their first child have a significantly higher level of sexual fluidity at Age 29 (women: 0.2105 *versus* 0.1805, $t(4617) = -2.257$, $P < 0.05$; men: 0.0282 *versus* 0.0300, $t(3025) = 0.268$, ns). These findings – where sexually more fluid women have less restricted sociosexual orientations whereas sexually more fluid men have more restricted sociosexual orientations, at least with respect to vaginal intercourse – make perfect sense in light of the theory's contention that men have sexual orientations and are either straight or gay, whereas women have more or less restricted sociosexual orientations and greater sexual fluidity

is a consequence of less restricted sociosexual orientations. From this perspective, more ‘sexually fluid’ men are simply more homosexual than less ‘sexually fluid’ men, and have less frequent vaginal intercourse with fewer women.

It seems difficult for an alternative theory *simultaneously* to explain why women (but not men) who experience increased levels of sexual fluidity have a larger number of biological offspring, why women (but not men) who experience marriage or parenthood early in adulthood would subsequently experience increased levels of sexual fluidity, and why sexual fluidity is positively associated with known markers of unrestricted sociosexual orientation among women when it is negatively associated with them among men. While the empirical evidence presented above is far from conclusive, it at the very least calls for further investigation and more rigorous testing of the proposed theory of the evolutionary origins of female sexual fluidity.

VII. HOW THE THEORY SOLVES THE THEORETICAL AND EMPIRICAL PUZZLES

(1) Male homosexuality, female homosexuality, and female sexual fluidity

The proposed theory has nothing at all to say about the mystery of male homosexuality; it cannot explain why it exists or why it has not been selected out. However, the theory has a lot to say about at least some forms of female homosexuality, and why it appears so different from male homosexuality, including its apparent lack of genetic basis.

The theory concurs with Bailey’s (2009) contention that women may not have sexual orientations in the same sense that men do. It instead suggests that women may be characterized by more or less restricted sociosexual orientation, and that some forms of homosexual behaviour among women may be the consequence of less restricted sociosexual orientation and greater sexual fluidity. Both Lippa’s (2006, 2007) data and the analyses of Add Health data presented in Section VI.5 are consistent with the contention that women who experience greater sexual fluidity (and are hence more likely to engage in homosexual behaviour) have less restricted sociosexual orientations.

The proposed theory does not deny, nor is it inconsistent with, the existence of exclusive lesbians. However, most women are not exclusive lesbians, and the theory can explain why many women appear to be sexually fluid, neither exclusively homosexual nor exclusively heterosexual. The proposed theory cannot explain the small number of exclusive lesbians, which, according to Table 1, may comprise about 0.3% of American women.

(2) Male arousal to lesbian sex, and male desire for their wives and girlfriends to have sex with another woman

The proposed theory can explain why men find sex between women sexually arousing and why men may encourage their

wives and girlfriends to have sex with another woman. The theory suggests that the male desire for threesomes or group sex involving multiple women is not (or at least not entirely) due to their desire for multiple simultaneous sex partners. Because of their need for a refractory period after each ejaculation, men should seek multiple sexual opportunities sequentially, not *simultaneously*, if their goal is to copulate with and impregnate multiple women. The theory suggests an entirely different evolutionary reason for men’s arousal to lesbian sex and their desire to see their wives and girlfriends have sex with another woman.

If women are evolutionarily designed to be sexually fluid in order to allow them to have sex with their cowives to strengthen their bonds with them and build more stable polygynous marriage, then men should simultaneously be evolutionarily designed to encourage their cowives to have sex with each other for the same purpose of more stable and harmonious marriage. Our male ancestors who discouraged or prohibited their cowives from having sex with each other would have been expected to have less-stable marriages with greater levels of conflict and tension. Their marriages would therefore be less likely to last and their children would be expected to receive less-consistent parental investment.

As a result, any genetic tendency to discourage or prohibit sex among cowives would be selected out, and the opposite tendency to encourage and be aroused by it would be evolutionarily selected. Children of our male ancestors who found sex among their cowives sexually arousing and encourage them to have sex with each other would on average be more likely to survive to sexual maturity. Contemporary men’s preference for ‘girl-on-girl’ scenes in pornography and their desire for their wives and girlfriends to have sex with another woman may be evolutionary byproducts of such genetic tendencies to be aroused by and encourage sex among cowives in the evolutionarily novel context of socially imposed monogamy.

(3) Category unspecificity of female sexual desire

The greater category specificity of male sexual desire than female sexual desire – where most men are either sexually attracted to women or sexually attracted to men whereas most women, whether consciously or unconsciously (Chivers *et al.*, 2007; Chivers & Timmers, 2012), are sexually attracted to both – begins to make sense in light of female sexual fluidity documented by Diamond (2008). The theory suggests that women may be *evolutionarily designed* to be sexually fluid, thus the category unspecificity of female sexual desire may be part of the evolutionary design of female sexuality.

The theory can further explain why there may be a positive correlation between the number of heterosexual and homosexual sex partners that women have had whereas, in sharp contrast, there is a negative correlation for men. Although we do not know exactly why, men are born either heterosexual or homosexual (Mustanski *et al.*, 2002; Wilson & Rahman, 2005; LeVay, 2010), by a combination of genetic (Hamer *et al.*, 1993) and prenatal hormonal factors (Ellis & Ames, 1987; Blanchard & Bogaert, 1996; Blanchard, 2004;

VanderLaan & Vasey, 2011). Men therefore either seek women as sexual partners if they are heterosexual or seek men as sexual partners if they are homosexual. By contrast, the theory suggests that women may be evolutionarily designed to seek both men and women as sexual partners simultaneously, in the same context of polygynous marriage. It is part of the same evolutionary design, with the same evolutionary goal of increasing reproductive success, that they sometimes seek to have sex with men (their husband, for the purpose of reproduction) and sometimes seek to have sex with women (their cowives, for the purpose of building bonds and solidarity with them in order that their polygynous marriage will be more harmonious and successful in raising all of their children together to sexual maturity, so that the children themselves can have children). From the perspective of the proposed theory, women's desire to have sex with men and their desire to have sex with women have the same reproductive goal of raising as many genetic children to sexual maturity as possible.

It therefore is not unreasonable to expect that any factor – such as higher sex drive – that inclines women to seek more male sexual partners will simultaneously incline them to seek more female sexual partners. The theory can therefore explain why women who have higher sex drive simultaneously have more male and female sex partners, whereas men who have higher sex drive have either more female sex partners or more male sex partners (Lippa, 2006, 2007). It can also explain why, in the general population, the correlation between the number of heterosexual and homosexual partners that women have had is positive, while the same correlation is negative for men.

(4) Menstrual synchrony

The proposed theory also suggests a possible evolutionary function of *menstrual* synchrony, as opposed to *ovulatory* synchrony, and can therefore explain why women may have been evolutionarily selected to experience menstrual synchrony. First, if we assume that women are less likely to have sex (either with a man or a woman) during menstruation, then menstrual synchrony among coresident cowives of a polygynous marriage maximizes the number of days in a month that they can have sex with each other, while not affecting the number of days that the husband can have sex with any of his wives. Second, a survey of women about their subjective experiences and feelings about menstrual synchrony shows that, while most women are neutral about it, nearly six times more women view menstrual synchrony as a positive experience than as a negative experience (Arden, Dye & Walker, 1999). These women state that they feel close to other women when their menstrual cycles synchronize with theirs. Thus, by maximizing the number of days that they can have sex with each other and allowing them to feel closer to each other, menstrual synchrony among cowives may further increase their solidarity. However, one distinct disadvantage of menstrual synchrony in a polygynous marriage is that it might encourage the husband to seek extra-pair copulations, as it means that there are days when he cannot have

sex with *any* of the wives (M. A. Harrison, personal communication).

From this perspective, it is interesting to note that Weller & Weller (1992) found that lesbian couples synchronize their menstrual cycles. However, a similar study by Trevathan *et al.* (1993) found no evidence of menstrual synchrony among lesbian couples. Strassmann's (1997) finding that women in a natural-fertility population (the Dogon of Mali) do not synchronize their menstruation also goes against this suggestion, as such a population more closely resembles the ancestral environment than a modern industrial society where virtually all studies of menstrual synchrony have been conducted. But Weller & Weller (1997) did find strong evidence of menstrual synchrony in another non-Western population (the Bedouin of Israel). Just as evidence for menstrual synchrony itself, the evidence for the suggested evolutionary function of menstrual synchrony is also quite mixed.

(5) Female erotic plasticity

Finally, the theory suggests an intricate relationship between Baumeister's (2000) notion of female erotic plasticity and Diamond's (2008) notion of female sexual fluidity. I believe that female sexual fluidity is phenomenologically a part of the larger female erotic plasticity that Baumeister (2000) documents while the evolutionary function of female sexual fluidity that the theory proposes is the cause of female erotic plasticity in all of its facets.

Baumeister (2000) notes that male sexuality is much less plastic than female sexuality because it is largely determined by biological factors (genes and hormones) whereas female sexuality is largely determined by sociocultural and situational factors. From the perspective of the theory, this is probably because men use sex primarily for the ultimate biological purpose of reproduction whereas women use it both for the biological purpose of reproduction and social function of conflict reduction and alliance formation.

This is true even for homosexual men. Even though they seek to have sex with members of the “wrong” sex reproductively, they still have largely the same mate-selection criteria as heterosexual men; for example, both prefer young and physically attractive mates (Bailey *et al.*, 1994; Russock, 2011). So even homosexual men are evolutionarily designed to use sex for the ultimate (if unconscious) biological purpose of reproduction as heterosexual men do, albeit with members of the same sex.

If men are evolutionarily designed to use sex primarily for the biological function of reproduction while women are evolutionarily designed to use sex for both the biological function of reproduction and social function of conflict reduction and alliance formation, it makes sense that male sexuality is largely determined by biological factors of genes and hormones (and is hence mostly inflexible) while female sexuality is largely determined by sociocultural and situational factors (and is hence mostly plastic). All the manifestations of greater female erotic plasticity that Baumeister (2000) documents can be the varied consequences of the fact that female sexuality is

not determined by biological factors and women use sex sometimes for social and political functions.

VIII. POTENTIAL OBJECTIONS TO THE THEORY

One potential objection to the evolutionary psychological theory of female sexual fluidity is its relatively low observed frequency. If women are evolutionarily designed to be sexually fluid, why are most women *not* sexually fluid? The Add Health data presented in Tables 1 and 2 show that, while women are significantly more sexually fluid than men, most women are nevertheless not sexually fluid. Three-quarters (75.7%) of women are consistently '100% straight' by adult sexual identity (Table 1) and 83.2% of women consistently state that they are not and have never been sexually attracted to women (Table 2). If sexual fluidity is part of evolved female human nature, why are most women *not* sexually fluid?

First, I would point out that evolved psychological mechanisms are not incompatible with individual differences; in fact, most evolved psychological mechanisms exhibit some individual differences in their operation (Tooby & Cosmides, 1990; Kanazawa, 2010, pp. 283–284). Thus the fact that there are some individual differences in the degree of sexual fluidity among women, where some women are more sexually fluid than others, is not in itself evidence against the evolutionary psychological theory of female sexual fluidity which posits that it is an evolved psychological mechanism and women are evolutionarily designed to be sexually fluid.

Second, women may not be consciously aware of the extent of their own sexual fluidity. The Diamond (2008) quote at the beginning of this review may be instructive in this context. She found that even the women in her *strictly heterosexual* control group often expressed openness to same-sex relationships. These women were recruited by Diamond to be in the control group, because they identified themselves to be strictly heterosexual and had no same-sex experiences or attractions prior to their recruitment. These are exactly the type of women who would respond '100% straight' to the Add Health question about their sexual identity, yet Diamond (2008) found that even these women sometimes expressed openness to having same-sex relationships.

Further, if we assume, as I argue above in Section II, following Wilson & Rahman (2005), that physiological measures (brain and genital responses) are the most objective and accurate measures of sexual orientation, then some studies (Chivers *et al.*, 2007; Chivers & Timmers, 2012) suggest that women may often not be consciously aware of their same-sex attractions. Even when self-identified heterosexual women report subjective arousal only to men, the physiological measures (genital responses) indicate arousal to both men and women. Snowden & Gray's (2013) recent study replicates Chivers's (Chivers *et al.*, 2007; Chivers & Timmers, 2012) earlier finding. I therefore believe that, regardless of how they may respond to survey questions

or what sexual identity they may normally hold, most women – a much larger proportion than suggested by survey data presented in Tables 1 and 2 – may actually be sexually fluid and may experience same-sex sexual desires and relationships under some circumstances.

Third, and most important, even though all women may be evolutionarily designed to be capable of sexual fluidity, as the proposed theory contends, the actual experience of sexual attraction to other women may require environmental triggers. For example, as the quantitative empirical evidence presented in Section VI.4 suggests, the experience of marriage and parenthood might trigger women's greater sexual attraction to other women and thus greater sexual fluidity. Given that women in the Add Health sample are relatively young (mean age of 22 in Wave III and 29 in Wave IV), many of them may not yet have experienced the necessary environmental triggers for the actual experience of sexual fluidity.

Another potential objection to the theory is that, rather than increasing bonds and solidarity, homosexual sex among cowives might lead to complications and problems in their (presumably) heterosexual marriage. Would a wife having sex with anyone other than her husband not be considered an instance of infidelity by her husband?

I believe such complications occur only in the modern context of socially imposed monogamy, where a married woman is only expected to have sex with her husband and where all women (and men) are expected to be either heterosexual or homosexual, often leading to the question 'Am I gay or straight?' for many women after the first experience of lesbian sex (Diamond, 2008). I do not believe such complications are likely to occur if women, as cowives in a polygynous marriage, are *expected* to have sex with each other, with the husband's approval and encouragement. It would not lead to problems in their polygynous marriage, nor would it lead women to question their sexuality, if all women are expected to be and are sexually fluid.

IX. SOME COUNTERINTUITIVE IMPLICATIONS

The evolutionary psychological theory of female sexual fluidity proposes that women may have evolved to be sexually fluid in order to maintain successful polygynous marriage during human evolutionary history. Sexual fluidity – the preference and desire to have sex with both men and women under different circumstances – would have allowed our ancestral women to marry and have regular intercourse with a man for the purpose of biological reproduction while at the same time occasionally having sex with their cowives in order to reduce the conflict and tension inherent in nonsororal polygynous marriages.

In addition to providing an ultimate, evolutionary, and functional explanation for female sexual fluidity, the theory can also solve some theoretical and empirical mysteries in evolutionary psychology and sex research, such as: (i) why homosexuality exists at all and has not been selected out by now (at least among women); (ii) why female homosexuality

appears to be so different from male homosexuality; (iii) why women are so much more sexually fluid than men even in representative population samples; (iv) why heterosexual men find sex between women sexually arousing; (v) why men often desire and encourage their wives and girlfriends to have sex with another woman (when they would have an extremely adverse reaction even to the possibility of them having sex with another man); (vi) why male sexual desire is much more category specific than female sexual desire, and why there is a positive correlation between the number of heterosexual and homosexual sex partners that women have had when the same correlation is negative for men; (vii) why menstrual synchrony might exist among coresident women; and (viii) why women exhibit greater erotic plasticity than men.

I present some scattered ethnographic evidence from Africa, imperial China, and the contemporary USA (Mormons) that cowives in polygynous marriages might sometimes have sex with each other. In addition, I present quantitative empirical evidence from Add Health that women (but not men) who experience increased levels of sexual fluidity subsequently have a larger number of children (suggesting that female sexual fluidity, if heritable, may be evolutionarily selected), that women (but not men) who experience marriage or parenthood earlier in their lives experience greater levels of sexual fluidity subsequently, and that known markers of unrestricted sociosexual orientations are positively correlated with women's levels of sexual fluidity while they are negatively correlated among men.

The evidence from Add Health is suggestive but far from conclusive. In order to provide strong support for the theory, much more additional empirical evidence will be necessary, and such evidence would ideally come from societies that practice simultaneous polygyny. I predict that cowives in polygynous marriages would be inclined to, and indeed do, have sex with each other in order to build bonds and solidarity with each other, as juvenile female bonobos do with resident senior females upon migrating into a new group. By contrast, what evidence is available in the contemporary western society with socially imposed monogamy? What would the theory predict about the behaviour of women in such societies?

Because humans are naturally polygynous, "polygyny is a matter of degree" (Daly & Wilson, 1988, pp. 140–142). In other words, *all human societies are polygynous*. In societies with the institution of socially imposed monogamy (such as the USA), where *simultaneous* polygyny – a man married to multiple women at the same time – is prohibited, people nonetheless practice *serial* polygyny, where a man is married to multiple women sequentially, by remarriage a second wife after divorcing the first.

Serial polygyny is not very different from simultaneous polygyny in its biological consequences and implications. In simultaneous polygyny, a man reproduces first with his first wife, then with his second wife, and then with his third wife (although their reproductive careers may partially overlap in time). In serial polygyny, a man reproduces first with his first

wife, then (after divorcing the first wife) with the second wife, and then (after divorcing the second wife) with the third wife; their reproductive careers are typically discrete and do not overlap in time. Both in simultaneous and serial polygyny, the second wife is typically younger than the first wife, and the third wife is typically younger than the second wife. Both in simultaneous and serial polygyny, the first wife may be menopausal and nonreproductive by the time her husband marries his third or fourth wife.

Many divorced women remarry, and thus practice 'serial polyandry'. For several reasons, however, serial polyandry is not as significant a reproductive institution among humans as serial polygyny. First, divorced women are less likely to remarry than divorced men (De Graaf & Kalmijn, 2003; Wu & Schimmele, 2005; Kreider, 2006). Second, among those who eventually remarry, divorced women take slightly longer to do so than divorced men (National Center for Health Statistics, 1989; Kreider, 2006). Third, and most important, as a result of the above, and the natural limitation on women's fertility placed by menopause, remarried women are less likely to have children in their second and subsequent marriages than remarried men are, even though the median age at second marriage for American women in 2009 was only 33.3 (Kreider & Ellis, 2011, p. 17, Table 7).

For example, according to the General Social Surveys, among ever-married Americans 45 years and older (who have likely already completed their lifetime reproduction; $N=18009$), remarried women have significantly *fewer* children than women who have never remarried (2.62 *versus* 2.72, $t=1.988$, $P<0.05$). In sharp contrast, remarried men have significantly *more* children than men who have never remarried (2.85 *versus* 2.56, $t=-5.864$, $P<0.001$). Marriages that do not produce children have no biological and evolutionary consequences. Thus the contemporary USA and other Western nations essentially practice serial polygyny, not serial polyandry.

The theory would therefore predict similar behaviour among 'cowives' in serial polygyny as it does for cowives in simultaneous polygyny. It would predict, among others, that the first (divorced) wife and the second (current) wife of the same man may be inclined to want to have sex with each other. This prediction is highly counterintuitive, because the typical pattern that we observe among ex- and current wives, at least anecdotally and stereotypically, is that they often hate each other. From the perspective of the proposed theory, however, such animosity between ex- and current wives in serially polygynous marriages may reflect the typical conflict and tension present in simultaneously polygynous nonsororal marriage (Chisholm & Burbank, 1991; Jankowiak *et al.*, 2005), which is present because they typically do *not* have sex with each other. Ex- and current wives of a serially polygynous man have the same reproductive goal as the cowives of a simultaneously polygynous marriage; they all aim to raise and invest in their own respective genetic children with the resources from the man they share. The theory would therefore predict that they might be able to reduce their conflict and

tension and benefit reproductively if they occasionally engage in sexual relations.

Additionally, if I am right about the evolutionary function of menstrual (as opposed to ovulatory) synchrony, then the theory might also predict that ex- and current wives of a serially polygynous man may synchronize their menstruation. Virtually all studies of menstrual synchrony since McClintock (1971) have assumed that coresidence is a prerequisite for menstrual synchrony, because pheromones are thought to be the proximate triggers of menstrual synchrony (Russell *et al.*, 1980; Preti *et al.*, 1986; Stern & McClintock, 1998). If menstrual synchrony evolved to facilitate sexual relations among cowives in simultaneous polygyny during the course of human evolution, then coresidence and pheromones would be excellent proximate triggers of menstrual synchrony because such cowives typically either lived together in the same household or in separate households in close proximity. However, many ex- and current wives of a serially polygynous man in the USA and other western industrial societies also live in close proximity to each other, usually to facilitate joint custody of children after the divorce. Thus it would not be unreasonable to expect ex- and current wives to be able to influence each other through pheromones and synchronize their menstruation.

There are other empirical implications of the proposed theory of human female sexual fluidity. If female sexual fluidity and women's sexual attraction to other women evolved to facilitate harmonious relationships among cowives in polygynous marriages, as the theory contends, then it follows that women's sexual fluidity and attraction to other women (cowives) should decrease during ovulation (M. A. Harrison, personal communication). The primary biological and evolutionary function of a marriage (polygynous or otherwise) is heterosexual reproduction, and attraction to other women during ovulation would on average decrease women's reproductive success. Thus the theory would predict that women's sexual fluidity would decrease during ovulation and increase at other times. This prediction is consistent with Diamond's (2008) own evolutionary theory of female sexual fluidity in terms of proceptivity and arousability discussed in Section I.

These and many other counterintuitive implications of the proposed theory await empirical investigation.

X. CONCLUSIONS

(1) It is well established that human female sexuality is much more fluid than human male sexuality, but it is not yet known why.

(2) There are at least eight seemingly unconnected theoretical and empirical puzzles in human sex research.

(3) A new evolutionary psychological theory of human female sexual fluidity explains its evolutionary origin in the human evolutionary history of polygyny. The theory suggests that human female sexual fluidity may have evolved as one

of the mechanisms to reduce conflict and tension among cowives in nonsororal polygynous marriages.

(4) The proposed theory is consistent with a wide array of ethnographic evidence from Africa, China, and the USA.

(5) Three specific hypotheses derived from the proposed theory are supported by quantitative data from the National Longitudinal Study of Adolescent Health (Add Health).

(6) The proposed theory provides potential solutions to the theoretical and empirical puzzles in human sex research.

XI. ACKNOWLEDGEMENTS

I thank Glenn Geher for the original insight behind this paper; Marissa A. Harrison, Gerulf Rieger, Ritch C. Savin-Williams, Sari M. van Anders, and Griet Vandermassen for their comments on earlier drafts; and Martha S. Bradley, Janet Bennion, Kathryn M. Daynes, Gordon G. Gallup, Jr., B. Carmon Hardy, Christine Horne, Valerie M. Hudson, Cardell K. Jacobson, Armand L. Mauss, Rocky O'Donovan, D. Michael Quinn, Catherine A. Salmon, Lawrence A. Young, and Glenn D. Wilson for their assistance. See Add Health acknowledgments at <http://www.cpc.unc.edu/projects/addhealth/faqs/addhealth/index.html#what-acknowledgment-should-be>.

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(Received 13 April 2015; revised 15 March 2016; accepted 17 March 2016)