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ORIGINAL PAPER

The Direct Reproductive Cost of Same-Sex Attraction: Evidence from Two Nationally Representative U.S. Samples

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Abstract
Same-sex attraction is associated with a direct reproductive cost, i.e., a reduced number of biological children. The current study aimed to assess this cost for different forms of sexual attraction (i.e., only attracted to opposite sex, mostly attracted to opposite sex, equally attracted to both sexes, mostly attracted to same-sex, only attracted to same-sex), using two large nationally representative datasets ($N = 15{,}208$) from the USA. The results indicated that same-sex attraction was associated with substantial loss in direct reproductive output. More specifically, significant differences between the different types of same-sex attraction were found: Exclusive and mostly homosexual orientation identities were associated with the highest direct reproductive cost, while mostly attracted to opposite sex orientation and bisexuality identities were associated with lower direct reproductive costs. In addition, bisexual women did not differ significantly from exclusively heterosexual women in terms of their reproductive output. The implications of these findings for the evolutionary origins of same-sex attraction are further discussed.

Keywords Same-sex attraction · Direct reproductive cost · Homosexuality · Bisexuality · Lesbianism · Sexual orientation

Introduction

Same-sex attraction motivates people to divert their mating effort toward same-sex outlets from which children cannot be born. Accordingly, it is expected that individuals who experience same-sex attraction would have fewer biological children than those who do not (Vasey et al., 2014). Yet, the research identifying the reproductive losses associated with same-sex attraction is limited, and the current study aims to add to the existing literature by examining how direct reproductive output (i.e., number of biological children) varies across the different types of sexual attraction (i.e., only attracted to opposite sex, mostly attracted to opposite sex, equally attracted to both sexes, mostly attracted to same-sex, only attracted to same-sex). Such endeavor is important, especially for evolutionary theorizing.

More specifically, same-sex attraction appears to be an evolutionary paradox as it impairs reproductive success by directing mating effort to same-sex outlets from which children cannot be born. Same-sex attraction appears to have also a genetic basis (Burri et al., 2011; Ganna et al., 2019), which means that there are alleles which predispose for it, and were somehow allowed by selection forces in the genepool. On this basis, most evolutionary theories in the area proposed benefits which could potentially balance the reproductive costs, allowing for this trait to exist in the population (see Discussion for a review of some of these theories).

Yet, the direct reproductive cost may not be as high as these theories assumed. For instance, people who experience same-sex attractions may have a strong preference to have children (see Gates et al., 2007), which motivates them to have heterosexual relationships in order to do so. Similarly, many people who experience same-sex attractions are heterosexuals (Apostolou, 2020; LeVay, 2016), and presumably direct most of their mating effort to opposite-sex outlets. Accordingly, it could be the case that same-sex attraction, when found in heterosexual individuals, has little impact on the direct reproductive output. Therefore, the endeavor of identifying the direct reproductive cost associated with different types of same-sex attraction is key in evolutionary theorizing in the area.

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Number of Children and Same-Sex Attraction

There are a number of studies on the reproductive costs of same-sex attraction, which make the case that, at least exclusive same-sex attraction, is associated with high direct reproductive costs. To begin with, Saghir and Robins (1973), in a U.S. sample of married participants, reported that 44% of homosexual men had one child less than their heterosexual counterparts. Similarly, also in a U.S. sample, Bell and Weinberg (1978) reported that married homosexual men had significantly fewer children in their first marriage compared to their heterosexual counterparts. Other studies have estimated that homosexual men reproduce at about 1/5–1/10 the rate of heterosexual men (Moran, 1972; Yankelovich Partners, 1994; Ven et al., 1997).

King et al. (2005), asked 1061 consecutive male attenders to two central London clinics for sexually transmitted infections (STI) to complete anonymous questionnaires about their attractions and their family's size. They found that homosexual men had on average 0.002 (SD = 0.43) children, and heterosexual men had on average 0.360 (SD = 0.83) children (Cohen's $d = 0.54$). Iemmola and Ciani (2009), recruited 250 Italian male participants (98 heterosexual and 152 homosexual), and they found that the heterosexuals had an average of 0.58 children (SD = 0.91) and the homosexuals had an average of 0.12 children (SD = 0.49) (Cohen's $d = 0.63$). Similarly, Schwartz et al. (2010) recruited 1694 men of different age groups in the USA and Canada at Gay Pride and general community festivals. They found that homosexual men had a mean of 0.17 ($SD = 0.6$) children, while heterosexual men had a mean of 0.60 ($SD = 1.1$) children (Cohen's $d = 0.46$). In the same vein, Vasey et al. (2014) examined 235 transgender males who were exclusively attracted to men, and 447 males who were exclusively attracted to women. They found that, males in the former category had no children, while males in the latter category had on average 1.21 (SD = 2.01) children (Cohen's $d = 0.85$).

One study provided evidence on differences in pregnancy rates between heterosexual, bisexual and homosexual women. More specifically, Hodson et al. (2017) conducted a systematic review of papers published between 2000 and 2015, and found that, for the general population, the chances to be pregnant was ninefold lower among lesbian and over twofold lower among bisexual women in comparison to heterosexual women. This study was limited however, because it focused on pregnancy rates and not on live births. Another study employed a non-probability sample of 1458 Italian female participants (mean age 31 years), and found that, heterosexual women had a mean of 0.33 children ($SD = 0.85$), bisexual women had a mean of 0.08 children (SD = 0.38; Cohen's $d = 0.38$) and homosexual women had a mean of 0.09 children (SD = 0.44; Cohen's $d = 0.35$) (Camperio Ciani et al., 2018).

The existing literature makes the case that homosexuality is associated with a high reproductive cost, with the effect sizes indicating considerable differences in reproductive output between heterosexual and homosexual men. The current evidence suggests also that there is a substantial difference in the reproductive output between heterosexual and lesbian women. Nonetheless, same-sex attraction is not confined only to bisexuality and homosexuality, with several people being attracted predominantly to the opposite sex but occasionally to the same sex. The latter i.e., heterosexual orientation with same-sex attractions identity, is actually the most prevalent type of same-sex attraction, found in 14–15% of women and 3–8% of men (Calzo et al., 2016; Dickson et al., 2003; Savin-Williams et al., 2012; Yougov Report, 2015). Nevertheless, to our knowledge, there has not been any study which has attempted to examine differences in direct reproductive output between heterosexual with same-sex attractions and exclusively heterosexual men and women. In the same vein, there is no study which has attempted to examine differences in direct reproductive output between bisexual and exclusively heterosexual men.

The present study, aimed to address this gap in the literature by estimating the differences in the number of biological children between exclusively heterosexual people and people who experience varying degrees of same-sex attraction. Furthermore, previous studies employed non-probability samples, so the estimates of the direct reproductive cost may not accurately reflect the actual reproductive costs. To address this limitation, the current study employed data on reproductive output from probability samples.

As people's attractions shift toward exclusive homosexual orientation, they will direct more of their mating effort toward same-sex outlets, and less toward opposite-sex outlets. For instance, heterosexual people who experience same-sex attractions, would spend more time in heterosexual relationships than people who are homosexuals. On this basis, we predict that the direct reproductive output will decrease as we shift toward exclusive same-sex attraction. Note that, one can experience primarily same-sex attractions, but engage primarily in heterosexual behaviors. This is especially likely to be the case in cultural settings which stigmatize homosexuality. Our main goal was to investigate the connection between attractions and reproductive output, so the current study focused on attractions and not on behaviors.

Study 1

Method

Participants

For the purposes of our study, we employed data from the National Longitudinal Study of Adolescent to Adult Health

(Add Health) 1994–2008, which is a longitudinal study of a nationally representative sample of U.S. adolescents in Grades 7 through 12 during the 1994–1995 school year (Harris et al., 2009).

Measures and Procedure

The Add Health cohort was followed into young adulthood with four in-home interviews, the most recent conducted in 2008 when the sample was aged 24–32. In the present study, we employed data from the 2008 wave; participants in earlier waves were too young to have children, so data from these waves were not used. This dataset was chosen because it recorded participants' sexual orientation and number of children. More specifically, sexual orientation identity was measured in the following scale: "100% heterosexual," "Mostly heterosexual, but somewhat attracted to same sex," "Bisexual, that is, attracted to men and women equally," "Mostly homosexual, but somewhat attracted to opposite sex," "100% homosexual," and "Not sexually attracted to either males or females." Participants were also asked to indicate the number of living children they had.

The sample we analyzed included 5,114 participants (2761 women and 2353 men). The mean age of women was 28.9 years (SD = 1.8), and the mean age of men was 29.1 years (SD = 1.8). In addition, 79.2% ($n = 2177$) of the female participants indicated that they were 100% heterosexual, 16.0% ($n = 439$) mostly heterosexual, but somewhat attracted to same sex, 2.4% ($n = 67$) bisexual, 0.7% ($n = 20$) mostly homosexual, but somewhat attracted to opposite sex, 1% ($n = 28$) that they were 100% homosexual, and 0.7% ($n = 18$) that they were not sexually attracted to either males or females. In addition, there were 12 cases for which sexual orientation was not recorded. Moreover, 93.5% ($n = 2186$) of the male participants indicated that they were 100% heterosexual, 3.0% ($n = 70$) mostly heterosexual, but somewhat attracted to same sex, 0.8% ($n = 19$) bisexual, 0.9% ($n = 20$) mostly homosexual, but somewhat attracted to opposite sex, 1.5% ($n = 34$) that they were 100% homosexual, and 0.3% ($n = 8$) that they were not sexually attracted to either males or females. Finally, there were 16 cases for which sexual orientation was not recorded.

Results

For the purpose of our analysis, we dropped the "Not sexually attracted to either males or females" category ($n = 26$) as it was not related to the goals of our study. We estimated the mean number of children for the remaining categories of sexual orientation identity. As we can see from Table 1, participants who were exclusively heterosexual tended to have more children than participants who experienced same-sex attractions. There was one exception however, namely bisexual women, who tended to have more children than female participants in other categories.

In order to examine whether the differences above were significant, we run an ANCOVA where the number of children was entered as the dependent variable and participants' sexual orientation identity was entered as the independent variable. Participants' age was also entered as a covariate. Post hoc analysis using Bonferroni was used in order to identify significant differences between the groups. The analysis was performed separately for each sex.

Starting with women, there was a significant main effect of sexual orientation [$F(4, 2634) = 5.21$, $p < 0.001$, $\eta_p^2 = 0.008$]. As we can see from Table 2, exclusive heterosexual orientation identity was significantly different only from homosexual orientation with same-sex attractions. Furthermore, there was a significant main effect of age [$F(1, 2634) = 78.55$, $p < 0.001$, $\eta_p^2 = 0.029$], with a positive coefficient ($b = 0.116$), indicating that the number of children increased with participants' age. Note that, running the analysis without including age as a covariate, did not change the patterns of the post hoc results i.e., differences that were significant remained significant, and differences which were not significant remained insignificant.

Moving on to men, there was also a significant main effect of sexual orientation identity [$F(4, 2230) = 9.39$, $p < 0.001$, $\eta_p^2 = 0.017$]. In addition, there was a significant main effect of age [$F(1, 2634) = 56.04$, $p < 0.001$, $\eta_p^2 = 0.025$], with a positive coefficient ($b = 0.094$). From Table 2 we can see that, exclusive heterosexual orientation was significantly different from homosexual with opposite-sex attractions and from exclusively homosexual groups. In order to obtain a measure

Table 1 The mean number of children across different categories of sexual orientation

Attractions	Study 1		Study 2	
	Women	Men	Women	Men
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Exclusively heterosexual	1.18 (1.19)	0.82 (1.09)	1.35 (1.41)	0.87 (1.28)
Heterosexual with same-sex attractions	1.01 (1.17)	0.48 (0.88)	0.90 (1.22)	0.52 (1.12)
Bisexual	1.31 (1.48)	0.26 (0.73)	0.75 (1.11)	0.41 (0.97)
Homosexual with opposite-sex attractions	0.35 (0.81)	0 (0)	0.29 (0.81)	0.11 (0.42)
Exclusively homosexual	0.61 (0.99)	0 (0)	0.38 (0.91)	0.06 (0.38)

Table 2 Post hoc analysis difference between exclusively heterosexual orientation and the other categories of sexual orientation

	Women				Men			
	Heterosexual with same-sex attractions	Bisexual	Homosexual with opposite-sex attractions	Exclusively homosexual	Heterosexual with same-sex attractions	Bisexual	Homosexual with opposite-sex attractions	Exclusively homosexual
Study 1								
Exclusively heterosexual	.357	1	.047	.134	.178	.387	.012	< .001
Study 2								
Exclusively heterosexual	< .001	.170	< .001	< .001	.073	.003	< .001	< .001

of the direct reproductive cost of each category of same-sex attraction, we estimated the effect size (Cohen's *d*) for the difference in the means of exclusive heterosexual orientation with each category of same-sex attraction. Furthermore, there was a significant main effect of age [$F(1, 2230) = 56.04$, $p < 0.001$, $\eta_p^2 = 0.025$], with a positive coefficient ($b = 0.116$). As before, running the analysis without including age as a covariate did not change the patterns of the post hoc results. The effect sizes (Cohen's $d = \text{Mean}_1 - \text{Mean}_2/\text{SD}_{\text{pooled}}$) are plotted in Fig. 1, where we can observe a substantial increase as we move toward homosexuality.

Study 2

Method

Participants

For the current study, we employed data from the National Survey of Family Growth (NSFG) study. The study was initially designed to be nationally representative of women 15–44 years of age in the civilian, noninstitutionalized population of the United States. Beginning in September 2015, NSFG expanded its age range for both men and women from 15–44 to 15–49, but its content and scope remained largely the same.

Measures and Procedure

The NSFG was conducted through in-person interviews, with a portion of the more sensitive questions answered privately by self-administration. Sexual orientation identity was measured in the following scale: "Only attracted to opposite sex," "mostly attracted to opposite sex," "equally attracted to both sexes," "mostly attracted to same-sex," "only attracted to same-sex," and "not sure." Female participants were also asked to report the total number of live-born babies they ever had, while male participants had to report the number of children they had ever fathered.

The sample we analyzed included 10,094 participants (5554 women and 4540 men). The mean age of women was

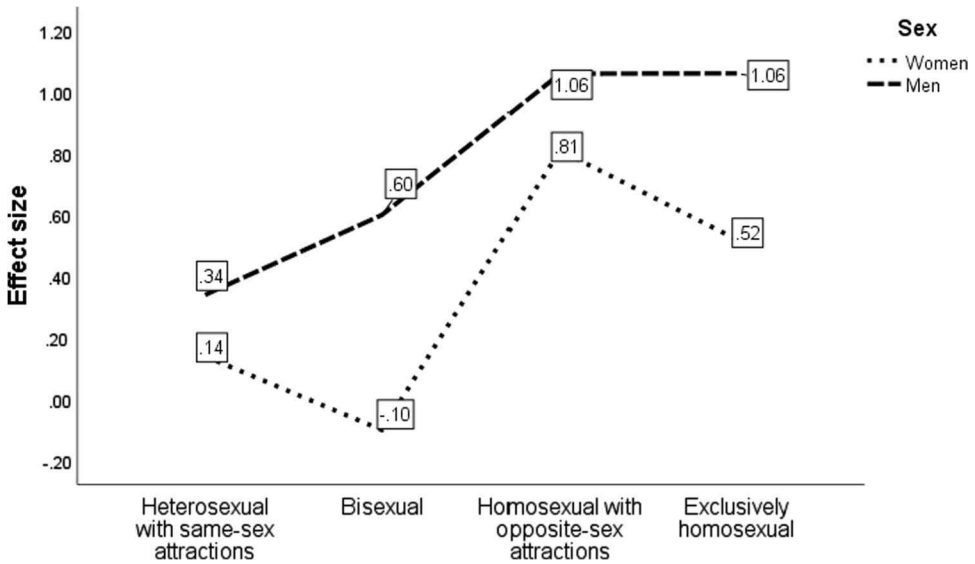

Fig. 1 Effect sizes estimated for the differences between exclusively heterosexual orientation and the rest of the categories of sexual orientation for women and men in Study 1

31.0 years (SD = 9.9) and the mean age of men was 30.5 (SD = 10.2). Also, 76.7% ($n = 4212$) of the female participants indicated that they were only attracted to opposite sex, 13.5% ($n = 739$) mostly attracted to opposite sex, 4.8% ($n = 263$) equally attracted to both sexes, 1.7% ($n = 91$) mostly attracted to same-sex, 1.5% ($n = 85$) only attracted to same-sex, and 1.8% ($n = 99$) were not sure. In addition, there were 65 cases for which sexual orientation was not recorded. Moreover, 90.0% ($n = 4046$) of the male participants indicated that they were only attracted to opposite sex, 4.4% ($n = 196$) mostly attracted to opposite sex, 1.4% ($n = 61$) equally attracted to both sexes, 1.2% ($n = 55$) mostly attracted to same-sex, 2.1% ($n = 93$) only attracted to same-sex, and 1.0% ($n = 47$) were not sure. Finally, there were 42 cases for which the sexual orientation was not recorded.

Results

In our analysis, we did not include the "not sure" category of sexual orientation as it was not informative for the purposes of our study. We estimated the mean number of children for the rest of the categories. As we can see from Table 1, exclusively heterosexual participants had more children than participants who experienced same-sex attractions. In order to examine whether these differences were significant, we run an ANCOVA where the number of children was entered as the dependent variable, and the participants' sexual orientation identity was entered as the independent variable. Participants' age was also entered as a covariate. Post hoc analysis using Bonferroni was used in order to identify significant differences between the groups. The analysis was performed separately for each sex.

With respect to women, there was a significant main effect of sexual orientation identity [$F(4, 5384) = 25.02$, $p < 0.001$, $\eta_p^2 = 0.018$]. From Table 2 we can see the exclusive heterosexual group was significantly different from all other groups, with the exception of the bisexual group. In addition, there was a significant main effect of age [$F(1, 5384) = 1449.75$, $p < 0.001$, $\eta_p^2 = 0.212$], with a positive coefficient ($b = 0.064$), indicating that as age increased so did the number of children. Note that, running the analysis without including age as a covariate did not change the patterns of the post hoc results.

With respect to men, there was also a significant main effect of sexual orientation identity [$F(4, 4444) = 29.66$, $p < 0.001$, $\eta_p^2 = 0.026$]. From Table 2, we can see the exclusive heterosexual group was significantly different from all other groups, with the exception of the heterosexual with same-sex attractions group, where the p value approached but did not pass the significance level. In addition, there was a significant main effect of age [$F(1, 4444) = 1467.25$, $p < 0.001$, $\eta_p^2 = 0.248$], with a positive coefficient ($b = 0.062$), indicating that as age increased so did the number of children. Note that, running the analysis without including age as a covariate did not change the patterns of the post hoc results. The only notable difference was in the comparisons between "only attracted to opposite sex" and "mostly attracted to opposite sex" categories, where the p value was reduced from 0.073 to 0.001. Finally, from Fig. 2 we can see that, for both sexes, the effect sizes tend to increase as same-sex attractions strengthened, with the largest differences found at the homosexual with opposite-sex attraction and the exclusive homosexual groups.

Discussion

Evidence from two independent studies indicated that same-sex attraction was associated with substantial loss in direct reproductive output. In particular, significant differences

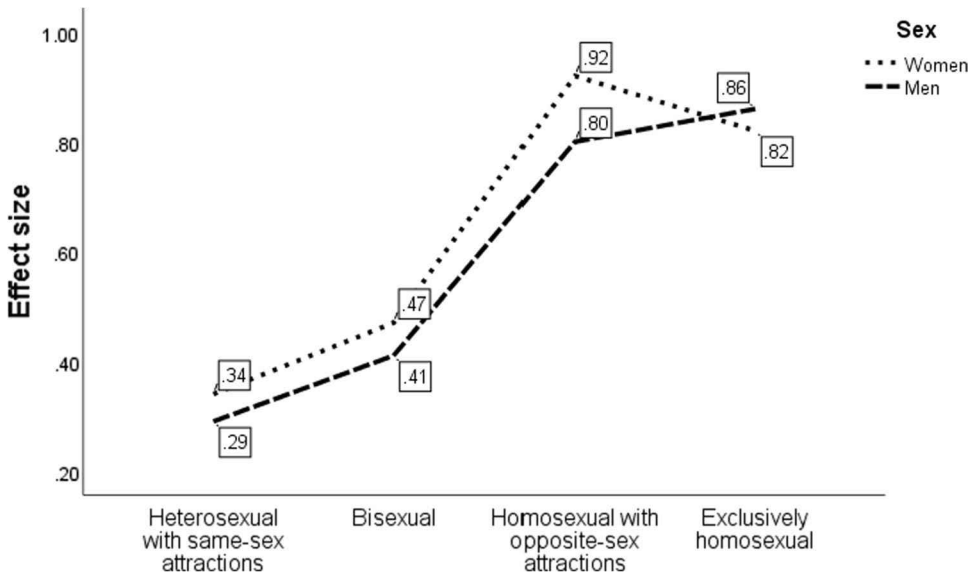

Fig. 2 Effect sizes estimated for the differences between exclusively heterosexual orientation and the rest of the categories of sexual orientation for women and men in Study 2

between the different forms of same-sex attraction were found: Exclusive and nearly exclusive homosexual orientation identities were associated with the highest direct reproductive cost, while mostly heterosexual orientation with same-sex attractions and bisexuality identities were associated with lower costs. Furthermore, in Study 1 it was found that bisexual women had on average more children than exclusively heterosexual women, while in Study 2 that they had fewer children. However, in both studies, these differences were not significant, suggesting that the direct reproductive output of bisexual women was similar to the direct reproductive output of exclusive heterosexual women.

These findings have important implications for understanding the evolutionary origins of same-sex attraction. More specifically, there have been several theories which have attempted to investigate the evolution of same-sex attraction (for a comprehensive review see Apostolou, 2020; Bailey et al., 2016; LeVay, 2016). To begin with, it has been proposed that homosexuality has evolved through kin selection (Wilson, 1975). In particular, homosexual people suffer considerable reproductive costs, but these costs are compensated by diverting resources to their genetic relatives (Nila et al., 2018; Vasey & VanderLaan, 2014; Wilson, 1975). Another hypothesis is that, alleles that predispose for same-sex attraction predispose also for other traits, which are under positive selection. The positive selection on these other traits compensates for the negative selection on same-sex attraction (Hutchinson, 1959). One possibility is that, such alleles code for mechanisms which increase fecundity in genetic relatives (Camperio Ciani et al., 2008, 2015).

Kuhle and Radtke (2013) proposed that women who experienced same-sex attractions suffered reproductive costs which were compensated by their increased capacity to secure alloparental help for their children. In the same vein, Kanazawa (2017) argued that such costs could be balanced by reduced conflict in polygynous marriages. Another study provided evidence that men find same-sex attractions in women attractive, and on this basis, it was argued that the costs associated with such attraction were compensated by better relationships with partners (Apostolou, et al., 2017). Last but not least, another hypothesis is that factors such as arranged marriage that were prevalent in ancestral human societies, reduced the reproductive costs of same-sex attraction, allowing this predisposition to remain in the population (Apostolou, 2016).

There is no shortage of theories on the evolutionary origins of same-sex attraction, all of which share the assumption that this trait is associated with reduced direct reproductive output. The current study has provided evidence that this assumption is sound: Same-sex attraction is associated with reduced direct reproductive output. The current study has also offered evidence that the reproductive cost of same-sex attraction is relatively low for people who are mostly heterosexual, but increases considerably for people who are mostly or exclusively homosexual. This finding has also important implications for evolutionary theorizing, as it indicates that same-sex attraction may not require considerable benefits in order to remain in the population.

In more detail, Miller (2000) argued that there are many alleles predisposing for same-sex attraction, each having a small effect, with the more individuals carry, the stronger their same-sex attractions are. Accordingly, when an allele predisposing for same-sex attraction arises, most likely through mutation, it will affect individuals who carry it to experience same-sex attractions although they are predominantly attracted to the opposite-sex. As they are predominantly heterosexual, their reproductive output is not going to be affected considerably, indicating that negative selection forces on these alleles would be relatively weak. Such weak selection forces would translate into several generations passing prior to selection forces removing from the gene pool these mutant alleles, while at the same time, positive mutation rate would keep introducing alleles predisposing for same-sex attraction in the gene pool (see Apostolou, 2018, 2020).

Therefore, if the difference in the direct reproductive output between exclusively heterosexual and mostly heterosexual people is very small, a combination of weak negative selection pressures and positive mutation rate could account for the relatively high prevalence of same-sex attraction in the population. We found here that this difference is small indeed, but probably not small enough for the rate that negative selection forces remove alleles from the gene pool to match the rate that positive selection introduces these alleles in the gene pool. Nevertheless, the estimated reproductive costs were most probably much lower in ancestral human societies due to factors such as regulation of mating and low tolerance of same-sex relationships. In particular, there are reasons to believe that in ancestral human societies marriages were arranged (Apostolou, 2014; Coontz, 2005). Anthropological, historical and phylogenetic evidence indicates that, arranged marriage was the typical pattern of long-term mating in ancestral human societies (Apostolou, 2010, 2012; Walker et al., 2011). In this institution, parents arrange heterosexual marriages for their children irrespectively of the latter's attractions, meaning that same-sex attractions were less relevant in directing mating effort, and thus, were probably associated with lower reproductive costs than they are in a post-industrial context where mate choice is freely exercised.

In addition, especially in agropastoral pre-industrial societies, children are considered a form of wealth as they provide the labor force necessary for cultivating the land and herding the animals. Consequently, even people who experienced strong same-sex attractions, may actually want to have their marriage arranged, in order to be able to have children (Apostolou, 2020). Moreover, throughout human history, long-term

same-sex relationships were not tolerated, and people were expected to enter in heterosexual marriages (Boswell, 1995; Fone, 2000). Thus, social pressures would drive individuals with same-sex attractions to heterosexual marriages reducing the reproductive cost associated with their attractions. Overall, these factors along with positive mutation rate and the relatively low direct reproductive cost, could possibly explain the high prevalence of same-sex attraction in heterosexual individuals, and perhaps the bisexual attraction.

On the other hand, the high direct reproductive cost of homosexuality suggests that this trait is likely to have a separate evolutionary history from other types of attraction (Dixson, 2010). That is, same-sex attraction in heterosexual individuals may have been the product of weak selection pressures, but homosexual attraction may have been selected for conferring fitness benefits which balance its costs. For instance, it has been proposed that an allele that predisposes for male homosexuality could be selected by increasing the fecundity of female relatives of male homosexuals (LeVay, 1996). Consistent with this hypothesis, there is empirical evidence that the female relatives of male homosexuals have more children (Camperio Ciani et al., 2004, 2015; King et al., 2005; VanderLaan & Vasey, 2011). More research is, nevertheless, necessary in order to examine fecundity for other forms of same-sex attraction, and whether they can balance the direct reproductive costs found in the present study.

The current research has several limitations. More specifically, Study 1 was based on relatively young sample, and since parental drive may strengthen later in life, the participants' reproductive output could change in older age (see Farr & Patterson, 2013). Study 2 was based on a large representative sample, which included different age groups. Nevertheless, similar to Study 1, it was based on self-report measures of same-sex attraction. In these measures, participants may be unwilling to indicate their same-sex attractions. In addition, the datasets we employed were based on U.S. samples and thus, our findings may not apply to other cultural settings. More generally, people in Western societies represent only a thin slice of the human population, and Western societies differ with non-Western societies in levels of education, access to health care and maternal health care, family and kin networks sizes, use of birth control and so on, which affect fertility. Accordingly, replication of these findings is necessary in different cultural contexts.

Furthermore, although the samples employed were relatively large, some of the individual group sizes were small (e.g., exclusively homosexual women in Study 1: $n = 34$). Therefore, the study may not have enough power to detect significant group differences in some of the post hoc comparisons. In addition, the instruments used in each study to measure attraction have limitations, including participants might have been confused about the category of sexual orientation they belonged to. For instance, participants may have been uncertain about whether they belonged to the mostly heterosexual or to the bisexual category. Last but not least, the datasets used in the present research included several variables such as education, which are likely to predict fertility. The current study had the specific goal of examining the reproductive cost of the different types of same-sex attraction, and in order not to lose focus, it did not consider other than age variables. Future research needs to examine these variables as well as possible interactions they may have with same-sex attraction.

Despite the different limitations, the present research provided evidence that the different types of same-sex attraction were associated with reduced direct reproductive output. The decrease was considerably lower for heterosexual participants with same-sex attractions than for homosexual participants, a difference which has implications for understanding the evolution of same-sex attraction. Future research needs to replicate these findings in different cultural contexts and assess their evolutionary implications.

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Declarations

Conflict of interest The author declares no conflict of interest.

Data Availability The datasets employed in the current research are available online. The sources are referenced in the methods sections.

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