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# A Replication/Extension of the Presence of Others on Judgments of Desirability

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# A REPLICATION/EXTENSION OF THE PRESENCE OF OTHERS ON JUDGMENTS OF DESIRABILITY

A Master's Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Psychology

By

John Ervin Scofield

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**A REPLICATION/EXTENSION OF THE PRESENCE OF OTHERS ON JUDGMENTS OF DESIRABILITY**

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**ABSTRACT**

Mate-choice copying is a mating strategy where females rely on contextual information to assist in securing accurate assessments of potential mates. Mate-choice copying has been extensively studied in non-human species, and has begun to be examined in humans as well. The desirability enhancement effect occurs when women judge men surrounded by opposite-sex females as more attractive than those same men alone or with same-sex males. The desirability diminution effect occurs when men judge women surrounded by opposite-sex males as less desirable than those same women alone or with same-sex females. The current project replicated previous findings concerning the desirability enhancement and diminution effect, and extended these findings to investigate homosexual participants. Homosexual men exhibited the desirability enhancement effect, as do heterosexual women, and homosexual women exhibited the desirability enhancement effect, as do heterosexual men, revealing differences across sexual orientation in human mate-choice copying.

**KEYWORDS**: desirability judgments, attractiveness ratings, mate-choice copying, sexual orientation, evolutionary psychology

This abstract is approved as to form and content

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# INTRODUCTION

Evolution by natural selection posits that if beneficial genes help individuals survive and reproduce, they are, on average, more successfully passed on to future generations within a gene pool than deleterious genes (Darwin, 1859). These advantageous genes, and their phenotypic traits, are passed on more reliably to the next generation. Genes that aid in the survival of organisms are an important aspect of evolution by natural selection. However, an equally important aspect regarding evolution lies not just with the survival of organisms, but reproduction as well. The evolution of traits emerges not merely from conferring a survival advantage, but also the result of a reproductive advantage, referred to as sexual selection theory (Darwin, 1871). Trivers (1972) discussed parental investment theory to describe sex differences in organisms. Typically, the higher initial investing sex (most often the female in mammals, due to internal fertilization) will become more selective in mate selection. This is due to the higher initial investing sex having to not only protect for themselves, but for offspring as well. Parental investment theory also predicts that males (the lower investing sex) will therefore engage in fiercer same-sex competition, resulting from more conservative mate selection by the female.

Competition from sexual selection is bifurcated into same-sex competition and intersexual mate choice. Same-sex competition is the result of same-sex individuals competing against another with the goal of gaining access to a potential mate. Intersexual mate choice, in contrast, refers to phenotypic qualities one possesses that is deemed preferential by the opposite-sex (Campbell, 2004). For instance, peacocks compete

intersexually for mates by displaying an ostentatiously colored tail, or plumage. Peahens choose their mates based on the extraordinary plumage males must display. A peacock's tail also signals, or cues, immune health and parasitic resistance (Petrie, Tim, & Carolyn, 1991). Plumage can be viewed as conferring a reproductive advantage because, while ostentatious displays place males at risk to predation, the overall net gain of access to mates makes this an evolutionarily desirable trait. Aspects of the human mind have been suggested to serve a similar ultimate function, like the plumage of peacocks (Miller, 2011). Competition is a battle for access to mates, but can also be a fight for the acquisition of resources, which may indirectly attract mates.

Males and females have faced different adaptive problems in our ancestral past, and thus have evolved differing mating strategies aimed at solving these adaptive problems. The evolution of different mating strategies was based on a plethora of factors, including culture, social interactions, personal mate value, and especially parental investments (Buss, 2009). Men are faced with the adaptive challenges of finding quality mates who aid in successfully passing on his genes towards the next generation, while women face the adaptive challenge of finding quality mates who will protect her from predation in addition to providing resources to ensure the protection of both her and the offspring. The resulting challenge, therefore, is accurately selecting a valuable mate to solve these sex-specific adaptive challenges. Men place higher premiums on characteristics such as youth, health, and attractiveness (cues of fertility), which increase the chance that male's genes will be passed on to his offspring. Women, on the other hand, have evolved more sensitive preferences for higher social status, slightly older

men, and possession of economic resources to ensure the survival of both herself and any offspring (Buss, 1988, 2009; Buss & Barnes, 1986; Symons, 1980).

Aspects of mating psychology do not just differ between sexes. Differences have been noted within same-sex individuals, especially in regards to sexual orientation. Kenrick, Keefe, Bryan, Barr, and Brown (1995) examined mating preferences across sexes and sexual orientation. Considering males, few differences were found between homosexual and heterosexual responses. Mostly, homosexual and heterosexual preferences lined up in terms of preferring younger partners, lifespan changes in age preferences, and minimum age standards imposed on potential partners. Differences between homosexual and heterosexual women were more apparent. Homosexual women exhibited preferences in partner age similar to men, preferring younger partners than heterosexual women (Kenrick et al., 1995). Kenrick et al. suggested that homosexual mating preferences are more complex than simple role reversals, elucidating the dynamics of mating decisions in a broader population.

Bailey, Gaulin, Agyei, and Gladue (1994) had participants respond to a survey measuring a variety of characteristics including interest in uncommitted sex, interest in visual sexual stimuli, concern with partner's status, age preferences, and importance of partner's physical attractiveness. Participants also responded to a sexual and emotional jealousy question (see Buss, Larsen, Westen, & Semmelroth, 1992). Bailey et al. examined whether previously discovered sex differences extended from heterosexual participants to homosexual participants. Identifying homosexual preferences can help shed insight regarding the underlying heterosexual preference mechanisms (Kenrick et al., 1995). Typical sex differences were found that could be predicted by sexual selection

theory. For instance, males had greater preferences for younger partners, exhibited higher levels of sexual jealousy, and valued the importance of physical attractiveness more than women. Women, on the other hand, exhibited greater preferences for aspects like social status than men. An important conclusion from Bailey et al. was that biological sex differences (regardless of sexual orientation) were much stronger predictors of preferences than sexual orientation.

Homosexual participants gave responses that were very similar to their same-sex heterosexual counterparts. This suggested that mating preferences across sexual orientation rested at a "default setting" for each sex (Bailey et al., 1994; Bailey & Zucker, 1995; Kenrick et al., 1995). There were, however, a few atypical sex differences in sexual orientation. For instance, heterosexual women had lower levels of interest in visual sexual stimuli than homosexual women, and reported higher levels of concern with their partner's status. Homosexual men reported lower levels of sexual jealousy than homosexual men, and had lower preferences for younger partners. Scofield and Kostic (2016) surveyed subjects online, following similar procedures of Bailey et al. and replicated their overall findings on most aspects. Some sexual orientation differences noticed were that homosexual men were more interested in long-term mates and social status than heterosexual men. However, these sexual orientation differences found in males did not appear within women as they did in Bailey et al. These discrepant findings could possibly be due to differing sampling or methodological techniques.

Bailey, Kim, Hills and Linsenmeier (1997) examined differences in descriptions of personal advertisements of homosexual men and women. Homosexual men were found to value masculine traits and homosexual women valued feminine traits,

suggesting that homosexual men and women tend to seek out partners whose physical characteristics are like their own (Bailey et al., 1997). Jankowiak, Hill, and Donovan (1992) also investigated homosexual mating preferences, and found that males of all sexual orientations preferred younger partners. However, females exhibited higher variation in responses, with homosexual participants preferring slightly younger partners than their heterosexual counterparts. Silverthorne and Quinsey (2000) also found that both homosexual and heterosexual males preferred younger partners than homosexual and heterosexual women. Gobrogge et al. (2007), on the other hand, did not show effects of sexual orientation considering age preferences for potential mates.

**Non-Independent Mate Choice: Mate-Choice Copying**

Individuals rely on cognitive heuristics to help guide decision making, and utilize contextual information when judgments or situations are uncertain. Examples of different cognitive heuristics include the representativeness and availability heuristic, bounded and ecological rationality, and how thoughts or ideas can be modified to accommodate new or updating information (Gigerenzer & Todd, 1999; Tversky & Kahneman, 1974). Heuristics are often accurate and powerful, albeit occasionally lead to illogical conclusions. The use of contextual information can additionally shed insight on sex differences in mating psychology, namely with female mate choice.

Theoretical models of sexual selection have been suggested and applied towards female mate choice (Fisher, 1958; Heisler, 1984; Kirkpatrick, 1982; Lande, 1981; O'Donald, 1967). These models, however, carry an important assumption of independence of mating decisions. Other research has suggested, and subsequently

modeled, the effects of non-independent female mate choice (Andersson, 1994; Dugatkin & Högland, 1995; Losey, Stanton, Telecky, & Tyler, 1986; Stöhr, 1998). Pruett-Jones (1992) described nonindependent mate choice as a change in the probability of a mate being selected, varying as a function of the actions of others. Wade and Pruett-Jones (1990) reported that mating success depended on different factors including population size and operational sex ratios within populations. Non-independent mating strategies implemented by females were found to result in higher variance of mating success, with few males asymmetrically receiving a higher number of mates, leaving most males with relatively few, or zero mates at all (Wade & Pruett-Jones, 1990). Westneat, Walters, McCarthy, Hatch, and Hein (2000) suggested that aspects of the environment, especially social interactions and observations between individuals, can explain the asymmetric variance seen in mating success, from adopting these forms of nonindependent mating strategies.

Mate-choice copying, a form of non-independent mate choice, is a mating strategy where females rely on contextual information to help secure an accurate assessment of a mate. Mate-choice copying is an insightful and sometimes underappreciated phenomenon in regards to mating research. Females observe and adopt mate choices of conspecific females, leading them to accept or reject a potential male based on his previous mating success with different females (Dugatkin, 1996; Wade & Pruett-Jones, 1990). Females incorporate social information as an indication of mate quality, which can save evolutionarily costly resources, time, and energy during exhaustive mate searches (Briggs, Godin, & Dugatkin, 1996). Mate-choice copying may serve as a particularly useful strategy when mate quality is uncertain or increasingly

difficult to discern between two or more males. Therefore, mate-choice copying offers a shortcut towards making an accurate assessment via a male's previous associations with females.

Mate-choice copying occurs across an exceedingly wide array of non-human taxa, including birds (e.g. Japanese quail, Zebra finches), mammals (Norway rats), insects (fruit flies), fish (guppies, mollies), as well as other species (Galef, Lim, & Gilbert, 2008; Hill & Ryan, 2006; Mery et al., 2009; Swaddle, Cathey, Correll, & Hodkinson, 2005; White & Galef, 1998). As an example, Hill and Ryan examined mate-choice copying in sailfin mollies. When male fish were compartmentalized in an aquarium, females would preferentially spend more time with males that they had previously observed being around other females. The vast range of species that engage in these same behaviors provides important insights: weighing social information in mate assessments can be extremely advantageous, and likely a cardinal aspect of mating systems across different species.

Kundera (1978) initially proposed that humans should be included in the wide array of species eliciting copying behaviors. However, it was not until much more recently that the topic came under experimental scrutiny. Dugatkin (2000) also suggested that mate-choice copying could play an integral role in terms of mating decisions. However, research focusing on whether copying behaviors exist in humans have yielded mixed and inconsistent results. Uller and Johansson (2003) tested the "wedding ring effect", where women should prefer men who were married, or engaged to be married. Results revealed that the presence of wedding rings on male participants did not have any effect on attractiveness or willingness to engage in short- or long-term relationships with

those men, compared to men without wedding rings. Uller and Johansson concluded that their results conflicted with the idea of mate-choice copying existing in humans, and that mating preferences could be more complicated than effects evident in different species. Waynforth (2007) investigated whether female perceptions of male attractiveness varied when males were presented with an attractive (or unattractive) female date compared to when alone. Copying behaviors were influenced by whether female dates were attractive. Evidence for mate-choice copying was only evident when presented with attractive females. Other studies have also shown that women prefer targets when associated with attractive partners (Sigall & Landy, 1973), with some research indicating that men prefer targets with attractive pairings as well (Yorzinski & Platt, 2010).

Jones, DeBruine, Little, Burriss, and Feinberg (2007) examined whether facial expressions of other women played a role in women's preferences for male faces. Women rated pictures of males either alone, or with adjacent pictures of females portraying either negative or positive expressions. Jones et al. found evidence for mate-choice copying, where female preferences for males with adjacent smiling women were augmented. Observing men with adjacent females with negative expressions decreased preferences for male faces. Little, Burriss, Jones, DeBruine, and Caldwell (2008) paired target faces together with both attractive and unattractive faces and asked participants to rate the attractiveness of opposite-sex faces. For both males and females, being paired with attractive partners increased attractiveness levels for opposite-sex faces. This paradigm showed that to a certain extent, humans utilize the choices of other people to help form their judgments. Little et al. found evidence for these effects for long-term

relationship decisions, but still lacked evidence for any copying behaviors in short-term mating decisions.

Parker and Burkley (2009) incorporated relationship status and its effects on evaluations of single and attached targets. Female and male participants were exposed to information about opposite-sex individuals. Half of participants were informed that the target was single, with the other half told targets were in relationships. Single female participants were found to have higher interest in pursuing targets in relationships compared to single targets. This effect was not present, however, in participants who were currently in a relationship. Bressan and Stranieri (2008) had women rate the attractiveness of men who were depicted as being either single or in a relationship. Contrary to Parker and Burkley, women who were in a relationship showed higher levels of attraction towards attached rather than single men, whereas single women did not share that same pattern. Bressan and Stranieri also showed that these results were sensitive and varied, dependent on menstrual cycles. Deng and Zheng (2015) implemented similar methodological procedures and paired images of target men with women, with different expressions indicating interest or rejections of target males. Deng and Zheng found that female participants, both single and in relationships, exhibited mate-choice copying effects. Women were more likely to select males chosen by other woman, regardless of whether those participants were single or in a relationship.

Evidence for attractiveness ratings paired with positive or negative descriptions of target individuals also appear to be mixed. Graziano, Jensen-Campbell, Shebilske, and Lundgren (1993) presented photographs to participants, and subsequently asked participants to rate those photographs on physical attraction and favorability. Before

ratings were given, participants were provided with fabricated descriptions about the target stimuli, elicited as either being negative or positive. Women consistently were influenced by negative social influences and gave lower ratings when shown negative ratings beforehand. Positive information did not have any effect on ratings from females. No evidence was found that negative or positive social influence influenced ratings for male participants either. Sensitivity in women, especially to negative information, could be due to negative qualities appearing as “costlier” than positive qualities about a mate (Feingold, 1992; Trivers, 1972). However, Dunn and Doria (2010) found opposite effects. Photographs of both male and female targets were presented with opposite-sex individuals surrounding target individuals or when presented alone. Females in this study were shown to be influenced by positive, not negative, information regarding attractiveness ratings. When presented with visual information depicting positive attractions, attractiveness ratings increased.

Despite mixed research findings described above, positive results have also emerged with mate-choice copying in humans. Eva and Woods (2006) presented photographs of male targets along with descriptions of the targets. Targets were split into two groups so that half of the descriptions included a “married” relationship status, with the other half being described as “single”. Males were rated as being more attractive as a partner if they were labelled as married, compared to being single. This suggested that the female participants in this study were especially sensitive towards the mating decisions of others, and incorporated that social information in their mate assessment (Eva & Woods, 2006). Place, Todd, Penke, and Asendorpf (2010) assessed mate-choice copying via a different paradigm, speed dating. Subjects first rated the attractiveness of a target

individual, and then viewed video clips of that individual in speed dating encounters with potential mates. Subjects were asked to comment on the success of the encounter by asking whether the couple in question was interested in each other or not. Subjects finally rated the same picture of the target individual after viewing the speed dating video. Place et al. found that both sexes exhibited copying effects, with interest in potential targets increasing after viewing targets in a successful speed dating encounter.

Bowers, Place, Todd, Penke, and Asendorpf (2011) used a speed-dating paradigm as well, and found evidence for copying behaviors. Milonoff, Nummi, Nummi, and Pienmunne (2007) looked at the effects of male friendships on attractiveness levels, and presented participants with photographs with targets surrounded by male and female company. Attraction of target men increased while in the company of same-sex males. However, when target males were surrounded by opposite-sex females, no typical evidence for female mate-choice copying occurred.

**Presence of Others: Opposing Sex Differences in Mate-Choice Copying**

Finally, in a study that formed the basis for the current project, Hill and Buss (2008) examined desirability ratings on target stimuli in the presence of other people. Hill and Buss sought to investigate whether males utilize contextual information, in this case the presence of other people, when assessing the desirability of people. Subjects were asked to rate a series of pictures depicting a target person either alone, with same-sex others, or with opposite-sex others. Ratings were provided for questions including “How attractive do you find this person,” “How desirable is this person to you as a prospective sexual partner,” “How desirable is this person to you as a prospective long-term romantic

partner," "If this person were to ask you on a date, what is the likelihood that you would say yes," and "In general, how desirable do you find this person." Three predictions were proposed by Hill and Buss, including the desirability enhancement effect, the desirability diminution effect, and the rival assessment effect. The desirability enhancement effect is described as when females take into consideration the presence of same-sex rivals into their assessments of males, resulting in men surrounded with other women being perceived as more attractive or desirable.

The desirability diminution effect occurs in an opposite fashion for men, where women surrounded by opposite-sex males are perceived as less desirable as a partner. Contextual information may aide males in quick judgments, based not on the mating success from other rivals, but on a probability of successfully gaining access to that mate (Hill & Buss, 2008). When a male sees a female in the presence of other males, it could be that the perceived probability of gaining access is lower than if that female was alone. The third hypothesis was the rival assessment effect. This phenomenon is where individuals' judgments of their own same-sex competitors are congruent to those of the opposite-sex, utilizing the two preceding assessment heuristics. In the first of two experiments, participants rated opposite-sex targets to test the first two hypotheses. Both hypotheses were supported, as women rated men more desirable in the presence of opposite-sex individuals than any other condition. These effects occurred even when controlling for differing attractiveness of peripheral individuals. Men also rated women less desirable in the presence of opposite-sex individuals than any other condition. These differences were the result of being surrounded by the members of the opposite-sex, not simply the result of a target generally being in the presence of people.

The second experiment tested the same-sex rival hypothesis. Participants in this experiment rated target persons of the same-sex as to how desirable they would seem to the opposite-sex. Results from this second experiment supported the same-sex rival hypothesis, with judgments from men and women of same-sex rivals akin to those made by the opposite-sex. An unforeseen finding from this second experiment revealed that judgments from both men and women when viewing targets depicted with same-sex others were viewed as less desirable to members of the opposite-sex compared to those same targets alone (Hill & Buss, 2008). Men who judged women's desirability ratings of men seem to contradict what the desirability enhancement effect proposes, specifically for same-sex ratings. However, this could result from merely indirect ratings from men, which might not accurately translate into desirability judgments of actual women. Another possible explanation comes from Schwartz (2004), indicating that desirability judgments, when target individuals are alone, might be more favorable if the target is the only available mate, compared to when the target person is surrounded by same-sex others. This could indicate a decrease in desirability of the target because there are more options for the rater to choose from.

**Current Project**

The purpose of the current project was to attempt a replication and extension of the findings from Hill and Buss (2008) Experiment 1, in which they found support for two assessment heuristics: the desirability enhancement effect and the desirability diminution effect. Replications in mate-choice copying are important for several reasons. First, mate-choice copying occurs across a diverse assortment of species, indicating that

copying behaviors serve as a crucial aspect of mating behaviors in general. Considerably less research applies mate-choice copying towards human behavior, with extant research leading to inconsistent and mixed conclusions. While this points towards positive evidence of mate-choice copying in humans, more research is needed to address the reliability of this effect in the case of humans. Second, a good portion of copying research in humans only examines women. Naturally, this is to be the case, as mate-choice copying was originally hypothesized to exist in females, not necessarily men. Copying behaviors benefit females (typically the more selective sex) by granting the opportunity to avoid risky time, resources, and energy to assess potential mates (Andersson, 1994; Deng & Zheng, 2015; Wade & Pruett-Jones, 1990), an adaptive problem which is not as relevant toward males (typically the less selective sex). Less research has focused on these effects using male human participants. Third, most research involving humans has looked at differences or changes in attractiveness ratings towards target individuals. Hill and Buss used desirability judgments as a romantic partner instead, an avenue less explored.

Important comparisons include opposite-sex peripheral individuals versus target individuals alone, or include the use of positive versus negative emotions/interactions from the opposite-sex. Fewer experiments have included the use of same-sex peripheral individuals (not just opposite-sex peripheral individuals), making this comparison an interesting addition to re-examine (Hill and Buss, 2008; Milonoff et al., 2007). Furthermore, we noticed concerns regarding stimuli from Hill and Buss, including possible differences in the sexual tension levels between target and peripheral individuals in the photographs. Especially, it was possible that female peripheral individuals

surrounding male targets appeared to be more sexually interested (and engaged in more physical contact) in the male target than females surrounding other females, men surrounding females, or men surrounding other males (see Figure 1 & 2). Controlling for potential differences in sexual tension between targets and peripheral individuals could further address the reliability of these effects.

An important facet from Hill and Buss (2008) is that participants included in the experiment were strictly heterosexual. No homosexual participants were included in the sample. Interestingly, it appears that the role of sexual orientation has (to the best of our knowledge) yet to be explored in the avenue of human mate-choice copying. This provides an impetus for the current project to extend Hill and Buss by considering different sexual orientations (heterosexual and homosexual) to investigate if mate-choice copying strategies used by heterosexual participants are similarly adopted by homosexual participants. Regan, Medina, and Joshi (2001) discuss further that homosexual populations have often been excluded from experimental investigation, even when homosexual mating preferences can lead to critical insights into universal mating dynamics.

**Predictions**

The current project will use the same stimuli and Hill and Buss and will closely follow the same procedures. Participants will be asked to rate a series of pictures on five characteristics pertaining to desirability as a romantic partner. A list of the five characteristics are listed in the Appendix. Because sexual tension between peripheral and target individuals in the scene from the original stimuli could be potentially confounding

(as noted earlier), an additional question asked participants to rate the amount of sexual tension between people overall in the scene.

One prediction was to successfully replicate Hill and Buss (2008), Experiment 1 (both the desirability enhancement effect in females and the desirability diminution effect in males) when the only covariate included in the analysis is the attractiveness differential. Another prediction was that we would fail to replicate Hill and Buss, Experiment 1 when also controlling for possible differences in sexual tension of the scene overall across stimuli. If this second prediction receives support, then a new stimulus set would be generated and the first prediction would be re-tested using new stimuli. Given previous research regarding homosexual mating preferences, while differences in sexual orientation exist, a large portion of male and female homosexual preferences tend to line up with their respective same-sex heterosexual counterparts. By extending Hill and Buss to include homosexual participants, we therefore also predicted that homosexual males would exhibit desirability diminution effects (similar to heterosexual males) when viewing male target individuals surrounded by opposite-sex (female) competitors. Homosexual females were also predicted to exhibit desirability enhancement effects (like heterosexual females) when rating female target individuals surrounded by opposite-sex (male) competitors. The experimental investigation of homosexual preferences in the presence of same-sex or opposite-sex others serves to elucidate homosexual mating preferences, adding to the knowledge of mating dynamics in a broader human population. Also, given that research on mate-choice copying in humans has yielded inconsistent and mixed results, research investigating homosexual populations can show if different

subgroups of the human mating system favor mate-choice copying, or if this complicated mating tactic strictly exists in heterosexual populations (Milonoff et al., 2007).

# METHOD

## Participants

Prior approval for this project was obtained from the Missouri State University Institutional Review Board (IRB) (November 28, 2016; approval: IRB-FY2017-101). Participants were recruited from Amazon Mechanical Turk (MTurk). MTurk participants are typically more diverse than college samples, and has been suggested to be as reliable as traditional data collection methods to receive high-quality data (Buhrmester, Kwang, & Gosling, 2011; Paolacci, Chandler, & Ipeirotis, 2010; Shapiro, Chandler, & Mueller, 2013). Age can be an important consideration for mate-choice copying effects (Bowers et al., 2011), and Dugatkin and Godin (1993) indicate that younger, more inexperienced females would rely on copying behaviors more than older individuals. Since typical MTurk samples vary more than typical college samples and tend to be multi-cultural, an initial thought would be to control for this to match samples used in Hill and Buss (2008). But given some unsettled research in regards to forms of mate-choice copying, and potential developmental time constraints, Bowers et al. (2011) calls for further research. Research should consider not only larger populations, but broader populations, including other age ranges and cultures to indicate more robust findings. For that reason, responses from MTurk were not subject to constraints in terms of age or culture. An (*a-priori*) power analysis was performed using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). Using the interaction effect size from Hill and Buss (2008) experiment 1, the analysis was specified using an $f$ effect size of .56, $\alpha$ of .05, $\beta$ of .80, numerator $df$ of 2, 6 groups, and 1 covariate. This *a-priori* power analysis suggested a total sample size of 35

participants. While the effect size from Hill and Buss revealed a large effect size, we expect to find a medium to large effect. Using a medium *f* effect size of .25, the suggested total sample size was 158 participants per group (heterosexual and homosexual). We biased our sample size towards the latter power analysis to increase the likelihood of achieving sufficient statistical power. Forty-four heterosexual females (Age: $M = 34.82$, $SD = 11.33$), 78 heterosexual males (Age: $M = 32.19$, $SD = 8.54$), 32 homosexual females (Age: $M = 31.88$, $SD = 9.21$), and 74 homosexual males (Age: $M = 29.51$, $SD = 6.22$) were included in the current project. Participants were recruited online and completed a questionnaire. The entire procedure, including obtaining consent and debriefing did not last more than 30 minutes. Subjects through MTurk were compensated $1.00 for their participation. A separate sample of 45 undergraduates from Missouri State University provided ratings of attractiveness as pilot data for all peripheral individuals for later use as an attractiveness differential covariate. Individual faces were shown, one at a time, to participants, and were asked to rate on a scale of 1 (not very) to 7 (very) how attractive they thought each face was. Average attractiveness ratings for males were $M = 4.18$, $SD = 0.96$, and for females were $M = 5.20$, $SD = 1.02$.

**Materials**

Demographic questions included basic questions such as gender, age, ethnicity, sexual orientation, and relationship history. A total of 30 stimulus photographs were presented out of a set of 60 total stimuli (either 30 females or 30 males depending on participant sex and sexual orientation). There were 10 stimuli for each of the three conditions. Stimuli were selected so that each individual chosen (male and female

targets) was the same target person in the other conditions as well. The stimuli that were used in the current study were the same stimuli used from Hill and Buss (2008). The ages of target stimuli individuals were between 18 and 22 (men: $M = 19.40$ women: $M = 18.90$). All pictures were taken in a university courtyard. In the alone condition, each target individual is pictured sitting alone at a table. In the same-sex others condition, each target is sitting with 4 members of the same-sex. In the opposite-sex others condition, each target individual is sitting with 4 members of the opposite-sex. Hill and Buss controlled for clothing, hair styles, and lighting for all targets across conditions by taking all stimulus photographs within 30 minutes of each other. Each target person that the participants rated was marked with a yellow arrow for easy identification.

Figure 1 and 2 show example stimuli, and the entire stimuli collection is available at https://osf.io/r5ygk/. A possible confound, noted in Hill and Buss (2008) could include the attractiveness of the peripheral non-target individuals and the effect they may have on desirability ratings of the target individuals. To deal with this possible confound, an attractiveness differential between the target and peripheral individuals served as a covariate in statistical analyses. Analyses also controlled for the possible confound of differing levels of sexual tension between people overall in stimulus photographs.

**Design and Procedure**

The purpose and nature of the study was partially explained in the online postings. We offered to answer any questions in a private message or email. If participants agreed to continue, they received an online informed consent form. The form clearly stated that no potentially identifying information was to be collected, so all data were completely

anonymous. Participants first entered in simple demographic information, described above in the materials section. In the first group, heterosexual participants viewed the series of 30 stimulus photographs of opposite-sex targets in three conditions: alone, with same-sex others, and with opposite-sex others. Homosexual participants were not included for analysis in this first group. In the second group, homosexual participants viewed 30 stimulus photographs of same-sex targets in those same three conditions. Heterosexual participants were not included for analysis in this second group. The remainder of the procedures were the same for both groups. Participants rated each picture on five characteristics pertaining to desirability as a romantic partner. One question additionally addressed how much sexual tension was present in the scene overall. The scale ranged from 1 (not at all attractive, desirable, likely) to 10 (very attractive, desirable, likely) for ratings of attractiveness and desirability, and from 1 (no sexual tension at all) to 10 (A lot of sexual tension) for ratings of sexual tension. A copy of the five characteristics are listed in the appendix. Participants were free to skip any questions they wished and could stop the survey at any time. After the experiment ended, the participants were debriefed, and received contact information for the experimenters in case they had additional questions.

The design for both groups used a 2 (participant sex: male, female) x 3 (stimulus condition: alone, same-sex others, opposite-sex others) mixed design with repeated measures on the last factor. The dependent measure of interest was a desirability judgment composite score. The results from these two groups were analyzed separately. A composite score was calculated from the four desirability questions on the scale. This score was calculated by taking the mean of the four desirability questions for each

stimulus photograph. These were then averaged again across conditions to yield one desirability composite score per participant per condition. To control for possible attractiveness differences in peripheral non-target individuals, an attractiveness differential was used. To calculate the attractiveness differential, the averaged peripheral non-target ratings given by a separate sample was subtracted from the attractiveness ratings given to each target individual to control for potential differences in attraction. For ratings provided in the alone condition, where no peripheral individuals were present surrounding a target individual, a differential of zero was used, as there were no peripheral individuals to compare ratings to.

**Data Analyses**

All analyses were performed using Excel, JASP, and *R* (R Core Team, 2013). Data were screened for accuracy, missing data, outliers, and normal assumptions. Confirmatory analyses consisted of an analysis of covariance (ANCOVA), multilevel modeling (MLM), and Bayes factors. From a statistical point of interest, the current project also compared results considering these different analyses. A 2x3 mixed design ANCOVA was tested using desirability judgment composite scores as the dependent measure. Benefits of using ANCOVA include eliminating potential confounds and reducing within-group error variance (Field, Miles, & Field, 2012). The attractiveness differentials served as the covariate. Post-hoc comparisons were made with the appropriate Bonferroni correction for individual significant main and interaction effects. To examine the second hypothesis, a second 2x3 ANCOVA was tested, using the same dependent measure and attractiveness differential covariate. However, this second

analysis also included a second covariate of sexual tension. The second covariate controlled for any influencing effects that the sexual tension between people overall in the scene might have had on desirability judgments. Effect sizes ($\eta_p^2$, *d*), confidence intervals, and graphs are displayed for all statistical analyses as well (Cortina & Nouri, 2000).

The use of ANCOVA for mixed or repeated measures designs, however, has received some criticism within the social sciences. Repeated measures designs have been stated to violate the independence assumption, as well as having decreased statistical power from using aggregate data (Field et al., 2012; Miller & Chapman, 2001). The previous study and analysis use doubly aggregated data by averaging over both the desirability ratings and stimuli, thus, losing valuable information about both factors. Therefore, in addition to the intended ANCOVA analyses, a MLM analysis was used in tandem to every ANCOVA analysis. MLM is used when data in nature is hierarchical or has a clustered structure (Hox, 1998). Repeated measures data is considered hierarchical data where multiple data points can be nested within individual participants (Peugh, 2010). The advantage of using MLM over repeated measures ANCOVA includes controlling for correlated error, random effects of participants and/or items, and has shown to have more sensitivity and power to detect possible effects, especially because the data are not aggregated (Gelman, 2006; Hayes, 2006). Another benefit of using MLM is that missing data are not as problematic as with traditional null hypothesis testing.

Null hypothesis significance testing (NHST), in general, has received criticism in regards to questionable research practices, including how *p*-values are typically selected, reported, and sometimes misinterpreted (Wagenmakers, 2007). Bayesian inference makes

possible to test the probability of a hypothesis, given an observed set of data. Advantages of implementing Bayesian statistics also include the possibility of stating evidence for and against (invariance of an effect) both the null and research hypotheses (Rouder, Speckman, Sun, Morey, & Iverson, 2009). Therefore, in addition to the above analyses, Bayes factors were calculated and reported using the *BayesFactor* package and *JASP* (Rouder, Morey, Speckman, & Province, 2012) with default priors and a joint multinomial sampling plan. Bayes factors were interpreted through guidelines set forth by Kass and Raftery (1995). Bayes factors between 1-3 are considered negligible evidence, 3-20 being positive evidence, 20-150 being strong evidence, and anything above 150 considered very strong evidence. By comparing the results from traditional NHST, MLM, and the use of Bayes factors, the robustness of desirability enhancement and diminution effects can be examined with multiple options from the statistician's toolbox.

**Replication and Pre-Registration**

The Open Science Collaboration (2015) conducted large scale replications on several psychological effects that were published across a variety of academic psychological journals. Across replication attempts, the Open Science Collaboration found that 36% of replications reported significant effects, compared to a remarkable 97% significance rate from original studies. Interestingly, effect sizes from replication attempts were halved compared to their original counterparts. In turn, more awareness has fixated on the reliability of psychological effects. With this recent replication crisis in mind, many previously assumed effects are now failing to replicate (Klein et al., 2014). With direct replications being less common in practice, more emphasis is put on

conceptual replications or extensions. Extensions or conceptual replications can be more appealing to competitive academic journals and shed light on different conditions or contexts in which an effect may occur, instead of testing the reliability of the effect itself. Frank and Saxe (2012) provided an interesting alternative for teaching replications, referring to this as the gold standard for reliability of scientific literature. This procedure entails students replicating studies as course credit for their experimental methods classes. These replications can incentivize and/or promote reliability testing of effects broadly. However, little incentive remains for publishable replications. Recently, progress in this replication crisis has emerged. The *Journal of Experimental Psychology: General* and *Psychological Science* acknowledges the importance of replication and takes effort to publish replications. Chambers (2013) discussed the benefits of replication studies including, but not limited to, the elimination of publication bias. In registered replications, manuscript decisions on acceptance are made before any data are collected. Essentially, this practice can assure that an experiment that has initially been accepted will be published, independent of the statistical result. Registration may also prevent common unethical research practices such as *p*-hacking, hypothesizing after results are known (HARKing), and selective reporting (Chambers, 2013; Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012).

An important role of replications are the pre-registration of the study design and analysis plan themselves. By sharing pre-registrations, stimuli, materials, and data on an online platform such as the Center for Open Science (https://www.osf.io), it expedites the idea of developing standards for open practices in the scientific community (Nosek et al., 2015). Registered reports also make the important distinction between exploratory and

confirmatory analyses. While exploratory analyses are an integral part of research which can lead to the development of new hypotheses and ideas, the acknowledgment of pre-registered confirmatory analyses is even more important for the integrity of open science (Wagenmakers et al., 2012). It is important to note that with all studies (original or replications), there cannot be totally confirming or denying evidence of an effect. Rather, replications work to probabilistically enhance or diminish the reliability of an effect. Replications are an important step in the research process, as it indicates where there is a need for further research (Open Science Collaboration, 2015). The current project was pre-registered before any data were collected. No statistical analyses were computed until all data collection was completed. All materials, stimuli, data, and a pre-registered hypothesis and analysis plan is available at https://osf.io/r5ygk.

## RESULTS

Before any analyses were performed, data were first screened for assumptions. Across all participants, (homosexual and heterosexual), 50 participants were initially excluded for the following reasons: Either selecting sexual orientation as bisexual or preferring not to say (the current project only examined heterosexual and homosexual participants), indicating that participants did not wish to have their data included in any analyses, choosing two different sexual orientations when subsequently asked later on in the survey, or duplicate IP addresses, indicating a participant may have taken the survey more than once. Three multivariate outliers (using Mahalanobis distance scores) were present among heterosexual participants and four were identified among homosexual participants, and were subsequently removed before final analyses. Linearity, homogeneity (and sphericity for repeated measures factors), homoscedasticity, and normality were all met.

### Replication: Hill and Buss (2008), Experiment 1

A 3x2 mixed ANCOVA was performed to analyze the interaction between participant sex and stimulus condition on desirability judgments, after controlling for the attractiveness of peripheral individuals (attractiveness differential). The attractiveness differential was a significant adjustor of desirability judgments, $F(2, 353) = 21.44$, $p < .001$, $\eta_p^2 = .11$, and was also positively correlated with desirability judgments ($t(358) = 16.80$, $p < .001$, $r = .66$). This indicated that as the difference between attractiveness levels between the target individual and peripheral individuals increased, desirability

judgments of target individuals increased as well. After controlling for attractiveness differentials, the main effect of stimulus condition was not significant, $F(2, 353) = 0.23$, $p = .76$, showing no significant differences between desirability ratings in the opposite-sex ($M_{adj} = 4.74$, $SD = 2.07$), same-sex ($M_{adj} = 5.07$, $SD = 2.08$), or alone conditions ($M_{adj} = 5.34$, $SD = 2.06$). There was a significant main effect of participant sex, $F(1, 353) = 304.80$, $p < .001$, $\eta_p^2 = .46$. Male participants rated female targets ($M_{adj} = 5.57$, $SD = 1.60$) as being significantly more desirable than female participants rated male targets ($M_{adj} = 4.18$, $SD = 1.85$).

The interaction between participant sex and stimulus condition was significant, $F(2, 353) = 21.44$, $p < .001$, $\eta_p^2 = .11$. Adjusted interaction means for participant sex and stimulus condition on desirability judgments, controlling for attractiveness differentials can be seen in Figure 3. Paired samples *t*-tests using a Tukey correction were used to examine adjusted means between stimulus conditions, split by participant sex. For male participants, males rated target females as being less desirable when surrounded by opposite-sex males ($M_{adj} = 4.74$, $SD = 1.56$) than both when those same target females were surrounded by same-sex females ($M_{adj} = 5.77$, $SD = 1.60$, $t(353) = 5.79$, $p < .001$, $d_{avg} = 0.65$, 95% CI[0.45, 0.85]) and when target females were alone ($M_{adj} = 6.21$, $SD = 1.65$, $t(353) = 7.59$, $p < .001$, $d_{avg} = 0.92$, 95% CI [0.71, 1.13]). Males also rated target females as less desirable when surrounded by same-sex females than targets alone, $t(353) = 2.71$, $p = .02$, $d_{avg} = 0.27$, 95% CI [0.09, 0.46]. Turning to female participants, females rated male targets as being more desirable when surrounded by opposite-sex females ($M_{adj} = 4.75$, $SD = 1.88$) than when target males were with same-sex males ($M_{adj} = 3.87$, $SD = 1.82$, $t(353) = 2.36$, $p = .05$, $d_{avg} = 0.47$, 95% CI [0.28, 0.66]) and when those males

were alone ($M_{adj}$ = 3.90, *SD* = 1.88, *t*(353) = 2.21, *p* = .07, $d_{avg}$ = 0.45, 95% CI [0.26, 0.64]). However, differences were only marginally significant. No differences were found between females rating males alone versus males surrounded by same-sex males, *p* = .99.

A second 2x3 mixed ANCOVA was then run adding the second covariate of sexual tension. The sexual tension covariate was a significant adjustor of desirability judgments, *F*(1, 352) = 14.59, $p < .001$, $\eta_p^2$ = .04, with a positive correlation to the dependent measure of desirability judgments (*t*(358) = 5.77, $p < .001$, *r* = .29). This indicated that as sexual tension ratings between the target individual and peripheral individuals increased, desirability judgments of target individuals slightly increased as well. After controlling for both attractiveness differentials and sexual tension ratings, the main effect of stimulus condition remained non-significant, *F*(2, 352) = 0.28, *p* = .76, revealing no significant differences between desirability ratings in opposite-sex ($M_{adj}$ = 4.68, *SD* = 2.07), same-sex ($M_{adj}$ = 5.26, *SD* = 2.08), or alone conditions ($M_{adj}$ = 5.24, *SD* = 2.06). The main effect of participant sex remained significant, *F*(1, 352) = 310.56, $p < .001$, $\eta_p^2$ = .46. Male participants still rated female targets ($M_{adj}$ = 5.58, *SD* = 1.60) as more desirable than female participants rating male targets ($M_{adj}$ = 4.16, *SD* = 1.85).

The interaction between participant sex and stimulus condition also remained significant after controlling for both attractiveness differentials and sexual tension ratings, *F*(2, 352) = 18.38, $p < .001$, $\eta_p^2$ = .09. Adjusted interaction means for participant sex and stimulus condition including both covariates can be seen in Figure 4. Paired samples *t*-tests with a Tukey correction were performed between stimulus conditions, split by participant sex. Considering male participants, males rated target females as being less desirable when surrounded by opposite-sex males ($M_{adj}$ = 4.73, *SD* = 1.56)

than when target females were with same-sex females ($M_{adj}$ = 5.93, *SD* = 1.60, $t(352)$ = 5.87, $p < .001$, $d_{avg}$ = 0.76, 95% CI [0.56, 0.96]) and when target females alone ($M_{adj}$ = 6.09, *SD* = 1.65, $t(352)$ = 7.02, $p < .001$, $d_{avg}$ = 0.84, 95% CI [0.63, 1.05]). However, after controlling for sexual tension, no differences found between male participants rating females alone versus target females surrounded by same-sex females, $p$ = .21. Considering female participants, females judged male targets to be more desirable when surrounded by opposite-sex females ($M_{adj}$ = 4.61, *SD* = 1.88) than when those same males were alone ($M_{adj}$ = 3.77, *SD* = 1.88, $t(252)$ = 2.52, $p$ = .06, $d_{avg}$ = 0.45, 95% CI [0.26, 0.63]). However, after controlling for sexual tension ratings, the difference between females rating target men higher when surrounded by opposite-sex females compared to same-sex males ($M_{adj}$ = 4.11, *SD* = 1.82) disappeared, $p$ = .92. Differences between female participants rating male targets alone versus being surrounded by same-sex males remained non-significant, $p$ = .31.

As using ANCOVA with repeated measures factors has been criticized by some, a MLM approach was also implemented. MLM was used to examine the relationship between participant sex, stimulus condition, and desirability judgments controlling for attractiveness differentials. Analyses were conducted with the *nlme* package in *R* (Pinheiro, Bates, DebRoy, & Sarkar, 2014). Table 1 shows statistical values for all model comparisons. A random intercept model was first compared to an intercept only model, which was significantly better, suggesting that nesting data by participant is important. All subsequent models used a random intercept. The covariate of attractiveness differentials was then controlled for, which was a significant model. As attractiveness differentials increased, desirability judgments increased as well. Variables were then

added to the model in step-wise fashion. Both main effects of sex and condition improved the model significantly. An interaction term between sex and condition was added, using condition as a random slope, which significantly improved the model as well. Table 2 shows regression values for all predictors during the step they were added into the model.

The interaction between sex and condition was then broken down by running separate multilevel models split by participant sex. Model specifications were the same as the previous model, albeit the exclusion of the interaction and the main effect of participant sex. Mirroring the ANCOVA results, male participants rated females surrounded by opposite-sex males less desirable than when surrounded by same-sex females, $b = 0.99$, $t(2259) = 14.47$, $p < .001$ , and when target females were alone, $b = 1.36$, $t(2259) = 9.30$, $p < .001$. Target females surrounded by same-sex females were also rated less desirable than those same females in the alone condition, $b = 0.37$, $t(2259) = 2.55$, $p = .01$. Turning to female participants, male targets were rated as more desirable when surrounded by opposite-sex females than when surrounded by same-sex males, $b = -0.60$, $t(1273) = -7.21$, $p < .001$, and also when those same male targets were alone, $b = -0.53$, $t(1273) = -3.19$, $p < .01$. No differences were found between same-sex peripheral individuals and target males alone ($p = .64$).

The MLM analysis was also recomputed adding in the second covariate of sexual tension ratings. Table 3 shows statistical values for all model comparisons after controlling for sexual tension ratings. All equations similarly used a random intercept. Factors were entered step-wise, starting with adding both covariates simultaneously into the model. Adding attractiveness differentials and sexual tension ratings significantly improved the model. Participant sex and stimulus condition were then entered one at a

time, both leading to significant improvements in model fit. The interaction between participant sex and stimulus condition after controlling for both attractiveness differentials and sexual tension ratings remained significant. Table 4 also shows regression values for predictors at the step they were entered into the model (with both covariates).

The interaction again was broken down by performing separate multilevel models separated by participant sex. Model specifications were again the same as previous models, however excluding the interaction term and main effect of participant sex. Results, for the most part, were like the first MLM analysis. Male participants still rated females surrounded by opposite-sex males less desirable than when surrounded by same-sex females, $b = 1.13$, $t(2258) = 15.75$, $p < .001$, as well as when target females were alone, $b = 1.29$, $t(2258) = 8.42$, $p < .001$. However, the effect between target females with same-sex others versus females alone disappeared, indicating no differences between those two groups, $b = 0.16$, $t(2258) = 1.01$, $p = .31$. Considering female participants, male targets surrounded by opposite-sex females were more desirable than both male targets with same-sex males, $b = -0.36$, $t(1272) = -3.40$, $p < .001$, and alone, $b = -0.53$, $t(1272) = -3.20$, $p < .01$. There remained no significant differences between target males with same-sex males or alone, $b = -0.18$, $t(1272) = -0.98$, $p = .33$.

The last statistical analysis used for the heterosexual group of participants included the use of Bayesian ANCOVA. The main model was analyzed using *JASP* to calculate Bayes Factors, which included the dependent measure of desirability judgments, fixed effects of stimulus condition and participant sex (including the interaction between sex and condition), random effects of participants, and the covariate of attractiveness

differentials. Participants and attractiveness differentials were treated as nuisance variables, so that all models included both participant effects and attractiveness differentials. Table 5 shows model comparisons for this analysis. Default priors from *JASP* were used, including scales of $r_{fixed}$ = .50, $r_{random}$ = 1.00, and $r_{covariate}$ = .35. To draw inferences from the model, the most preferred model (highest Bayes Factor) was used as a reference point (Rouder, Morey, Verhagen, Swagman, & Wagenmakers, 2016). To draw inferences regarding the main effect of condition, we compared the ratio of the full model (most preferred), including both main effects and an interaction effect, to the next most preferred model *without* the main effect of condition, indicating positive evidence for the inclusion of an effect of stimulus condition 4.79 to 1. Comparing the full model to the model without the main effect of condition indicated strong evidence for the inclusion of the main effect of sex $9.8 \times 10^8$ to 1. Positive evidence for the inclusion of the interaction between sex and condition was favored 3.48 to 1 by comparing the full model to the model only containing both main effects of condition and sex.

Interaction effects were analyzed following guidelines from Morey and Wagenmakers (2014). First, data were split by participant sex to analyze effects of stimulus condition on desirability judgments. Order restriction models were then tested on combinations of the stimulus condition levels. Priors for the order restriction models were set simply as the inverse of the number of potential orderings of each factor level combination. Since each post-hoc comparison could only have three orderings (greater than, less than, equal to), the set prior odds were 1/3. To calculate the posterior odds for post-hoc comparisons, we sampled (10,000 iterations) from the posterior distribution of the model for the inclusion of the interaction effect. Next, predicted order constraints

(predictions stemming from results from Hill and Buss [2008]) were set for each pairwise combination of stimulus condition for each sex. The proportion of samples from the main interaction model that were consistent with our predicted order constraints were then calculated. The posterior probability of the observed order constraint was set as the number of matching orders from the main model sample divided by the number of iterations, in this case 10,000. Bayes factors of the order restriction to the full model including the interaction effect were calculated by dividing the posterior order restriction odds by our previously set odds of 1/3. Bayes factors were then multiplied by the main model against the null model to yield Bayes factors for each pairwise comparison against the null model. Results showed that male participants rated female targets surrounded by opposite-sex males less desirable than both when surrounded by same-sex females ($BF_{10} = 3.2 \times 10^9$) and when target females were alone ($BF_{10} = 2.2 \times 10^9$). No differences were found between target females with same-sex females versus those same target females alone, $BF_{01} = 2.2 \times 10^9$. Considering female participants, positive evidence emerged indicating females rated male targets surrounded by opposite-sex females more desirable than both when surrounded by same-sex males ($BF_{10} = 3.19$) and when alone ($BF_{10} = 3.16$). However, the prediction of no differences between male targets with same-sex males versus alone yielded equivocal evidence, $BF_{01} = 0.68$.

A second Bayesian ANCOVA was calculated, using the same priors and methodology as listed above. The only difference being that the second covariate of sexual tension ratings were added (included as a nuisance variable as well). Table 6 shows model comparisons for this second Bayesian analysis, with the inclusion of both covariates. Comparing the full model to the model void of the effect of stimulus

condition indicated positive evidence for the inclusion of the main effect of condition 7.47 to 1. Examining the main effect of sex yielded strong evidence for the inclusion of sex 1.1 x $10^9$ to 1. Positive evidence for the inclusion of the interaction of participant sex and stimulus condition was favored 5.60 to 1 by comparing the full model to the model void of the interaction effect. Post-hoc comparisons were analyzed using the same methodology as above (Morey & Wagenmakers, 2014). The addition of sexual tension ratings as a covariate were predicted to account for the differences found in Hill and Buss (2008), yielding no significant differences. However, male participants rating female targets with opposite-sex males were still rated less desirable than both targets with same-sex females ($BF_{01}$ = 9.3 x$10^{-10}$) and when alone ($BF_{01}$ = 9.27 x $10^{-10}$). Female targets were also found to be less desirable when with same-sex females than when alone ($BF_{01}$ = 9.87 x $10^{-10}$). Considering female participants, although patterns trended similarly to the first Bayesian analysis, equivocal evidence was found for target males with opposite-sex females versus same-sex males ($BF_{01}$ = 0.61), target males with opposite-sex females versus when alone ($BF_{01}$ = 0.42), and target males with same-sex males versus when alone ($BF_{01}$ = 0.44).

**Extension: Homosexual Desirability Judgments**

The second set of analyses included examining homosexual participants. A 3x2 mixed ANCOVA was implemented, investigating the interaction between participant sex and stimulus condition on desirability judgments. After controlling for the attractiveness differentials between peripheral and target individuals, the attractiveness differential was a significant adjustor of desirability judgment means, $F(1, 305) = 393.91$, $p < .001$, $\eta_p^2$ =

.56, which was strongly correlated with the dependent measure of desirability judgments, $t(310) = 17.26$, $p < .001$, $r = .70$. As the difference between target attractiveness and peripheral attractiveness increased, desirability judgments also increased. After controlling for this attractiveness differential covariate, the main effect of stimulus condition was not significant, $F(2, 305) = 0.02$, $p = .98$. There were no significant differences between desirability judgments in opposite-sex, ($M_{adj} = 5.48$, $SD = 1.83$), same-sex ($M_{adj} = 5.12$, $SD = 1.81$), or alone conditions ($M_{adj} = 6.19$, $SD = 1.79$). The main effect of participant sex was significant, $F(1, 305) = 12.03$, $p < .001$, $\eta_p^2 = .04$. Males rated male targets ($M_{adj} = 5.59$, $SD = 1.74$) as being significantly less desirable than women rated female targets ($M_{adj} = 5.62$, $SD = 1.92$).

The interaction between participant sex and stimulus condition was significant, $F(2, 305) = 23.07$, $p < .001$, $\eta_p^2 = .13$. Adjusted interaction means for participant sex and stimulus condition for homosexual participants can be seen in Figure 5. Paired samples *t*-tests were used with a Tukey correction to examine differences of stimulus condition, split by participant sex. Considering male participants, males rated male targets less desirable when surrounded by other males ($M_{adj} = 4.82$, $SD = 1.75$) than when those same target males were surrounded by other females ($M_{adj} = 5.88$, $SD = 1.78$, $t(305) = 5.31$, $p < .001$, $d_{avg} = 0.60$, 95% CI[0.39, 0.81]) and when target males were alone ($M_{adj} = 6.06$, $SD = 1.72$, $t(305) = 6.11$, $p < .001$, $d_{avg} = 0.71$, 95% CI [0.50, 0.93]). There were no significant differences between target males alone and target males surrounded by opposite-sex females, $p = .62$. Turning to female participants, homosexual females rated female targets more desirable when they were alone ($M_{adj} = 6.52$, $SD = 1.95$) than when those same target females were surrounded by opposite-sex males ($M_{adj} = 4.49$, $SD =$

1.94, $t(305) = 6.19$, $p < .001$, $d_{avg} = 1.04$, 95% CI [0.80, 1.28]) and when those females were surrounded by same-sex females ($M_{adj} = 5.85$, $SD = 1.93$, $t(305) = 2.44$, $p = .04$, $d_{avg} = 0.35$, 95% CI [0.16, 0.53]). Target females were also judged to be more desirable when surrounded by same-sex females compared to when surrounded by opposite-sex males, $t(305) = 4.59$, $p < .001$, $d_{avg} = 0.70$, 95% CI [0.49, 0.92].

The final 2x3 mixed ANCOVA analyzed homosexual judgments while adding the second covariate of sexual tension ratings. The sexual tension ratings covariate was a significant adjustor of the dependent variable, $F(1, 304) = 27.25$, $p < .001$, $\eta_p^2 = .08$, and was positively correlated with desirability judgments, $t(310) = 12.48$, $p < .001$, $r = .58$. As sexual tension ratings increased, desirability judgments subsequently increased. After controlling for the effects of attractiveness differentials and sexual tension ratings, the main effect of stimulus condition remained non-significant, $F(2, 304) = 0.02$, $p = .98$. No differences emerged between desirability judgments in opposite-sex ($M_{adj} = 5.43$, $SD = 1.83$), same-sex ($M_{adj} = 5.24$, $SD = 1.81$), or alone conditions ($M_{adj} = 6.12$, $SD = 1.79$). The main effect of participant sex remained significant, $F(1, 304) = 12.43$, $p < .001$, $\eta_p^2 = .04$. Males rated male targets ($M_{adj} = 5.56$, $SD = 1.74$) as being significantly less desirable than women rated female targets ($M_{adj} = 5.68$, $SD = 1.92$).

The sex-condition interaction, after controlling for both covariates, remained significant as well. Adjusted interaction means including both covariates can be seen in Figure 6. Paired samples *t*-tests with a Tukey correction were performed, splitting by participant sex. Male participants rated male targets less desirable when surrounded by same-sex males ($M_{adj} = 4.95$, $SD = 1.75$) than both when those same target males were surrounded by opposite-sex females ($M_{adj} = 5.75$, $SD = 1.78$, $t(304) = 3.57$, $p < .01$, $d_{avg} =$

0.45, 95% CI [0.25, 0.65]) and when target males were alone ($M_{adj}$ = 5.98, $SD$ = 1.72, $t(304) = 4.76$, $p < .001$, $d_{avg}$ = 0.59, 95% CI [0.38, 0.80]). After controlling for sexual tension ratings, there were no differences found between males rating target males alone versus males with opposite-sex females, $p = .43$. With homosexual females, female targets were judged to be more desirable when alone ($M_{adj}$ = 6.44, $SD$ = 1.96) than when with opposite-sex males ($M_{adj}$ = 4.66, $SD$ = 1.94, $t(304) = 5.20$, $p < .001$, $d_{avg}$ = 0.91, 95% CI [0.68, 1.14]). Females also judged target females surrounded by same-sex females ($M_{adj}$ = 5.93, $SD$ = 1.93) more desirable than those same females surrounded by opposite-sex males, $t(304) = 4.29$, $p < .001$, $d_{avg}$ = 0.66, 95% CI [0.44, 0.87]. However, after controlling for sexual tension ratings, the significant difference between females rating target females higher when alone compared to same-sex females disappeared, $p = .14$.

A MLM approach was utilized, as well, considering homosexual participants. Table 7 shows statistical values for all model comparisons. A random intercept model was compared to an intercept only model, which was significantly better, indicating that nesting data by participant is important. Subsequent models all included a random intercept. Attractiveness differentials were first controlled for, which indicated a better model fit. As attractiveness between target and peripheral individuals increased, so did desirability judgments. Fixed effects were then added to the model one at a time. The main effect of participant sex, surprisingly, did not improve model fit, although the main effect of stimulus condition did. The interaction between sex and condition was then added, using condition as a random slope, which significantly improved model fit. Table 8 shows regression values for all predictors during the step they were added.

The interaction between participant sex and stimulus condition was then broken down through separate multilevel models, splitting data by participant sex. Model specifications remained the same as previous models, with the only difference being the lack of the interaction term and participant sex. Male participants judged target males surrounded by opposite-sex females more desirable than when surrounded by same-sex males, $b = -0.76$, $t(2143) = -11.87$, $p < .001$. However, targets surrounded by opposite-sex females were not significantly different from those same targets alone, $b = 0.13$, $t(2143) = 0.86$, $p = .39$. Males also rated target males surrounded by same-sex males less desirable than targets who were alone, $b = 0.89$, $t(2143) = 5.97$, $p < .001$. Considering female participants, female targets were judged less desirable when surrounded by opposite-sex males than when surrounded by same-sex females, $b = 0.90$, $t(925) = 9.21$, $p < .001$, and compared to when targets were alone, $b = 1.41$, $t(925) = 7.46$, $p < .001$. Target females were also judged less desirable when with same-sex females than when alone, $b = 0.51$, $t(925) = 2.74$, $p = .01$.

A second MLM was analyzed with the additional covariate of sexual tension ratings. Table 9 shows statistical values for all model comparisons with the addition of this second covariate. All equations utilized a random intercept. Factors were, again, entered step-wise, beginning with the addition of both covariates into the model. The addition of attractiveness differentials, as well as sexual tension ratings, significantly improved model fit. Like the previous MLM analysis, participant sex did not significantly improve model fit, while the addition of stimulus condition did. The interaction between participant sex and stimulus condition was significant. Table 10 shows regression values for predictors at the step they were entered.

The last interaction for MLM was broken down with separate multilevel models, split by participant sex. Model specifications remained the same as previous interactions. Results mirrored the first MLM, which only included the covariate of attractiveness differentials. Male participants judged target males more desirable when with opposite-sex females compared to when surrounded by same-sex males, $b = -0.61$, $t(2142) = -8.99$, $p < .001$. Differences between target males with opposite-sex females and targets alone remained non-significant, $b = 0.19$, $t(2142) = 1.16$, $p = .25$. Males rated target males with same-sex males less desirable than when those same targets were alone, $b = 0.80$, $t(2142) = 4.92$, $p < .001$. Female participants judged female targets with opposite-sex males less desirable than when with same-sex females, $b = 0.91$, $t(924) = 9.30$, $p < .001$, and when those same targets were alone, $b = 1.36$, $t(924) = 6.70$, $p < .001$. Females rated target females less desirable when with same-sex females compared to when alone, $b = 0.45$, $t(924) = 2.28$, $p = .02$.

The final analysis for homosexual participants included using Bayesian ANCOVA. All aspects of the analysis were the same as before, apart from using the second group of homosexual participants for the analyses. Participants and covariates were, again, treated as nuisance variables, which were included in all models. Default priors were used, including scales of $r_{fixed} = .50$, $r_{random} = 1.00$, and $r_{covariate} = .35$. Table 11 includes model comparisons for the Bayesian ANCOVA with the covariate of attractiveness differentials. The most preferred model, including both main and interaction effects, were compared to the next preferred model absent of stimulus condition, indicating an invariance of stimulus condition, favoring the null hypothesis 2.76 to 1. Ambiguous evidence was found for the main effect of sex ($BF_{10}$ 1.65 to 1),

comparing that to the model lacking the main effect of sex. Positive evidence was found for the inclusion of the interaction effect, 3.34 to 1. Interactions were then analyzed by using restricted order models (as described above), splitting by participant sex. Male participants judged target males more desirable when surrounded by opposite-sex females compared to same-sex males, $BF_{10} = 7.3 \times 10^6$. Target males were judged less desirable when with same-sex males compared to when those same targets were alone, $BF_{10} = 7.3 \times 10^6$. No differences were predicted between targets with opposite-sex females or when alone. However, targets with opposite-sex females were found to be less desirable than when alone, $BF_{01} = 1.6 \times 10^{-7}$. Turning to female participants, females rated female targets less desirable when surrounded by opposite-sex males than when with same-sex females ($BF_{10} = 1.5 \times 10^5$), as well as being rated less than when targets were alone (although this was predicted to be an invariance; $BF_{01} = 6.6 \times 10^{-6}$). Targets with same-sex females were rated to be more desirable than when targets were alone, $BF_{10} = 1.7 \times 10^3$.

The second Bayesian ANCOVA controlled for ratings of sexual tension. Table 12 shows model comparison for the second Bayesian ANCOVA, including both covariates. Comparing the full model to the next preferred model lacking the main effect of stimulus condition indicated invariance for the inclusion of stimulus condition, $BF_{01}$ of 5.73 to 1. Equivocal evidence was found for the inclusion of the main effect of participant sex, $BF_{10}$ of 1.38 to 1. Positive evidence, however, was found for the inclusion of the interaction effect, $BF_{10}$ of 5.17 to 1. Interaction effects were similarly examined by using restricted order models, separated by participant sex. For these final restricted order models, no differences were predicted between any comparisons. However, contrary to these

predictions, male participants rated male targets to be more desirable when surrounded by opposite-sex females compared to when surrounded by same-sex males, $BF_{01}$ = 3.7 x $10^{-4}$. Targets with same-sex males were judged less desirable than when those targets were alone, $BF_{10}$ = 3.7 x $10^{-4}$. Targets with opposite-sex females were judged less desirable than when alone, $BF_{01}$ = 4.3 x $10^{-4}$. Regarding female participants, female targets were judged less desirable when with opposite-sex males compared to when surrounded by same-sex females, $BF_{01}$ = 2.3 x $10^{-4}$. Targets with same-sex males were judged more desirable than targets who were alone, $BF_{01}$ = 14.4 x $10^{-3}$. Finally, female targets with opposite-sex males were judged less desirable than when those same targets were alone, $BF_{01}$ = 2.3 x $10^{-4}$.

# DISCUSSION

Mate-choice copying is a phenomenon where females take into consideration mating histories of males, and social information from surrounding females when assessing males as potential mates (Dugatkin, 1992, 1996; Wade & Pruett-Jones, 1990). Mate-choice copying is especially advantageous when differences are small or hard to distinguish between two or more males. This copying phenomenon has been observed in a large array of non-human species (Galef et al., 2008; Hill & Ryan, 2006; Mery et al., 2009; Schlupp, Marler, & Ryan, 1994; Swaddle et al., 2005; White & Galef, 1998). More recently, mate-choice copying has been extended towards human mating dynamics, as researchers have suggested this to be the case (Dugatkin, 2000; Kundera, 1978). While human-mate choice copying has been observed, research regarding this phenomenon in humans is still somewhat inconsistent, mixed, and subsequently ongoing.

The purpose of the current project was to replicate Hill and Buss (2008), Experiment 1, and to extend their findings to include homosexual populations. Hill and Buss found opposing sex differences while investigating the presence of others on judgments of desirability. Hill and Buss found evidence for the desirability enhancement effect, where females judged male targets surrounded by opposite-sex females to be more desirable than when those same females were surrounded by same-sex males. Desirability judgments had the opposite effect on male participants, known as the desirability diminution effect. Male participants rated target females as less desirable when surrounded by opposite-sex males, compared to when those same females were surrounded by same-sex females. Females were suggested to employ mate-choice

copying mating tactics, such as social information provided in stimulus photographs when making mate assessments. Evolutionarily speaking, females take into consideration the presence of opposite-sex females, providing cues to the mate quality of males. Specifically, with females surrounding males, mate quality was assumed to be higher, influencing desirability judgments. Men were shown not to use typical mate-choice copying mating tactics. Females surrounded by opposite-sex males were shown to be less desirable as a romantic partner. Males were suggested to assess potential mates with a probabilistic orientation, suggesting that the presence of other males in the scene hint at a decreased probability of gaining access to that mate, negatively influencing desirability judgments of that target female (Hill & Buss, 2008).

**Replication**

As predicted, the current project successfully replicated the findings of Hill and Buss, (2008), Experiment 1, when the only covariate included was attractiveness differentials. Strictly examining heterosexual participants, females exhibited the desirability enhancement effect when rating target males. Females rated target males to be more desirable when surrounded by opposite-sex females, compared to when surrounded by same-sex males. Male targets were also found to be more desirable when surrounded by opposite-sex females than those same males who were alone. Male participants also exhibited the desirability diminution effect. Male participants rated female targets surrounded by opposite-sex males as less desirable than those same target individuals surrounded by same-sex females and when alone.

Our second prediction stated that we would fail to replicate Hill and Buss (2008), Experiment 1, when also controlling for sexual tension ratings between target and peripheral individuals, considering some potential confounds in the original stimuli. Overall, this second prediction was not supported. Even with sexual tension ratings significantly adjusting mean desirability judgments, we still successfully replicated both the desirability enhancement and diminution effect. Male participants still rated target individuals in the opposite-sex condition as less desirable, and the opposite for female participants. It could be that desirability enhancement and diminution effects in women and men, respectively, are simply a more robust phenomenon, even after controlling for potential differences in perceived sexual tension levels across stimuli. Another reason for this could include that perceptions of sexual tension, or showing interest in mates broadly, mediate mate-choice copying. Rodeheffer, Leyva, and Hill (2016) tested the presumed interest of attractive females, and found that when males are paired with attractive mates, females were more likely to assume that males possess qualities that are typically unobservable with mates. Rodeheffer et al. suggest that mate-choice copying might emerge from processes women use involving perceptions of interest (which might be like that of the presence of sexual tension) of other woman, indicative of unobservable qualities in potential mates.

## Extension: Homosexual Participants

An important aspect of Hill and Buss (2008) was the exclusion criteria of homosexual participants. Compared to heterosexual individuals, homosexual mating preferences are relatively understudied. Gaining insights into homosexual mating

preferences can elucidate on mating dynamics considering a broader population. Especially, (to the best of our knowledge), no one has yet examined sexual orientation in human mate-choice copying to show if different subgroups of the human population consistently exhibit mate-choice copying, per their biological sex, or if homosexual participants exhibit mate-choice copying effects at all.

Results showed that considering homosexual men, males judged target males surrounded by opposite-sex females more desirable, compared to targets surrounded by same-sex males. Female participants, however, showed the opposite effect. Females rated target females less desirable when surrounded by opposite-sex males compared to when surrounded by same-sex females. This is contrary to our third prediction, suggesting that heterosexual and homosexual judgments would both follow similar patterns, dictated per biological sex (regardless of sexual orientation). That is, homosexual and heterosexual men would both exhibit the desirability diminution effect, and both homosexual and heterosexual women would exhibit the desirability enhancement effect. Surprisingly, homosexual females were shown to exhibit the desirability diminution effect, and homosexual males exhibited the desirability enhancement effect. While homosexual mating preferences, for the most part, tend to line up with biological sex (regardless of sexual orientation), the current findings point to clear and opposing findings with mate-choice copying tactics, not just across sex, but sexual orientation as well.

An important issue to discuss concerns who are perceived as competitors considering different sexual orientations. For heterosexual individuals, competitors are simply those of the same-sex. Therefore, peripheral individuals in the opposite-sex condition (e.g. females rating males surrounded by opposite-sex females) would be

considered competitors of the person judging stimuli. Peripheral individuals in the same-sex conditions (e.g. females rating males surrounded by same-sex males) would not be considered competitors, because females do not compete directly with other males for access to a target male, only so with other females. However, this concept is not as straight forward with homosexual populations. On the surface, it might seem that peripheral individuals in the same-sex condition (e.g. a male rating a male surrounded by same-sex males) would be perceived as competitors, because the participant rating target individuals is interested in same-sex individuals. If one takes this interpretation, then no sexual orientation difference would emerge, and these desirability enhancement and diminution heuristics would extend across sexual orientations based on biological sex. For instance, heterosexual females rated target males surrounded by opposite-sex females (in this case, opposite-sex females are same-sex competitors of the participant) more desirable than when surrounded by same-sex males (males are not direct competitors of female participants). Homosexual females rated target females surrounded by same-sex females as more desirable than females surrounded by opposite-sex males. Assuming this interpretation, same-sex females would be competitors, and opposite-sex males would not be considered competitors.

However, this interpretation runs into problems when assuming competitors of homosexual participants (in this case, same-sex competitors) are also homosexual. Homosexual men and women comprise a small subset of the overall human population. Roughly two to six percent of men and one to two percent of women have a primarily homosexual orientation (Buss, 2015). These estimates are conservative, however, and it is likely that more accurate estimates are slightly higher than this. It seems improbable,

given that such a small subset of the population identifies as homosexual, that the default perception for homosexual individuals of competitors are those of the same-sex. It is much more likely that homosexual men still perceive opposite-sex females to be more relevant competitors, and that same-sex males are, at least initially, perceived to be heterosexual. The same can be said with females. It is more likely that homosexual females perceive opposite-sex males to be potential competitors, compared to same-sex females, who are likely to be perceived as heterosexual. Thus, we suggest that the more appropriate interpretation for homosexual patterns of desirability judgments indicate clear and opposing sexual orientation differences in desirability heuristics. Heterosexual men and homosexual females (both rating target females) exhibited the desirability diminution effect, rating targets less desirable when surrounded with opposite-sex peripheral individuals (competitors), compared to targets with same-sex peripheral individuals (non-competitors). Homosexual males and heterosexual females (both rating target males) exhibited the desirability enhancement effect, rating targets more desirable when surrounded with opposite-sex peripheral individuals (competitors), compared to same-sex peripheral individuals (non-competitors).

It is interesting to note that, with both female and male homosexual participants, desirability judgments of targets in the same-sex condition were deemed less desirable than targets in the alone condition. This pattern is similar to the pattern found in Hill and Buss (2008), experiment 2, in which participants judged how desirable same-sex targets would be to the opposite sex. An explanation discussed in Hill and Buss described that both women and men could perceive targets who are alone to be more desirable, because the appearance of multiple individuals from which to choose could decrease baseline

desirability judgments of those targets. Schwartz (2004) also discussed that participants are less satisfied with choices when there are more options to choose from, as opposed to when participants had fewer options available. This explanation can be used to explain the patterns seen in homosexual participants. However, specifically concerning homosexual males, no differences were found between target males in the opposite-sex or alone condition. This could suggest that for heterosexuals, while the mere presence of opposite-sex individuals can drive these effects, this might not be the case for homosexual individuals. For homosexual males, it could be that these effects are more constrained and only emerge when making the comparison between same-sex competitors and opposite-sex non-competitors. It could also be the case that even though both heterosexual women and homosexual men exhibit mate-choice copying tactics, these effects are more strongly salient in females than males, even if the target individual of interest is the same.

**Statistical Comparisons**

Apart from replicating and extending Hill and Buss (2008) Experiment 1, from a statistical point of view, three different statistical analyses were implemented. Through comparisons of traditional NHST, MLM, and Bayes factors, the robustness of mate-choice copying tactics were examined with multiple options. For most analyses and comparisons, conclusions were very similar across different statistical analyses. Table 13 shows comparisons between stimulus conditions, separated by type of statistical analysis, participant sex, and sexual orientation.

For heterosexual males rating female targets, comparisons of opposite-sex versus same-sex, and opposite-sex versus alone yielded the same conclusions across all statistical analyses. However, differences between same-sex and alone conditions differed slightly. Significant differences were not significant while adding the second covariate of sexual tension. Interestingly, Bayes factors showed opposite results than ANCOVA or MLM (showing weaker evidence for an effect with only the single covariate, and stronger evidence when adding both covariates). For heterosexual females (rating male targets), the trend was similar across different analyses, showing patterns consistent with the desirability enhancement effect. However, ANCOVA and Bayes factors showed marginal significance/weak evidence for this pattern of data, whereas MLM showed significant differences. This same pattern of results emerged when also considering the second covariate.

Turning to homosexual male participants (rating male targets), similar conclusions were met across all conditions, analyses, and whether including only one or two covariates. The only exception to this is that whereas ANCOVA and MLM did not yield significant effects for the opposite-sex versus alone conditions, Bayes factors showed positive evidence for lower desirability judgments in the opposite-sex conditions compared to alone conditions. For homosexual female participants (rating female targets), statistical analyses yielded matching results across all comparisons, except for when adding the second covariate in the ANCOVA analysis, the significant difference between the same-sex condition and alone condition disappeared.

While most statistical analyses were congruent with one another, there were some minor discrepancies in the conclusions from these analyses. Considering the debated

appropriateness of using ANCOVA for repeated measures design, we suggest caution in interpreting these results. Repeated measures designs violate the independence assumption, as well as suffer from a lapse in statistical power from using aggregate data (Field et al., 2012; Miller & Chapman, 2001). Therefore, relying on MLM for statistical interpretations would seem more appropriate. Furthermore, data were shown to be hierarchical in nature, and that nesting by participant was significantly better. Using MLM better controlling for correlated error, random effects or noise due to participants, and confers higher sensitivity to detect effects, due to the unaggregated nature of the data (Gelman, 2006; Hayes, 2006). Bayesian analyses offer an appealing alternative to traditional NHST, considering criticism of NHST that has emerged (Wagenmakers, 2007). While using Bayesian analyses offer the possibility to state probabilities for hypotheses, as well as stating invariance evidence, some concerns still surface considering the current project. There have been some disagreements in the field for whether Bayesian analyses are best utilized with default (non-informed) or informed priors (Gigerenzer & Marewski, 2015). The cornerstone of Bayesian analysis is the updating of priors, given the observation of evidence. Thus, what priors researchers place on hypotheses do carry weight. Overall, we suggest that, given the design and analysis plan of the current project, interpretations from the MLM analyses are suggested, compared to results from ANCOVA and Bayes factor analyses.

**Limitations and Future Research**

Our current sample included 44 heterosexual females (Age: $M = 34.82$, $SD = 11.33$), 78 heterosexual males (Age: $M = 32.19$, $SD = 8.54$), 32 homosexual females ($M =$

31.88, *SD* = 9.21), and 74 homosexual males (*M* = 29.51, *SD* = 6.22). Sample sizes were asymmetrically higher for both heterosexual and homosexual males. Future research could implement more symmetrical and larger sample sizes, especially for homosexual participants. Replications with larger sample sizes will serve to address the reliability of these effects, especially considering homosexual populations. Asking participants to rate the amount of sexual tension in stimulus photographs is a limiting factor, because sexual tension was not sufficiently defined, operationally. Sexual tension can be perceived differently for different participants, and questions regarding whether participants can reliably judge this may call into question the inclusion of that question. A better approach would be to use different photographs where sexual tension is specifically manipulated to be present or not. Participants were also not told to assume that the target or peripheral individuals is homosexual, which can be perceived as a limiting factor. However, it is doubtful that being told if a target in stimulus photographs is homosexual or heterosexual would change desirability judgments of a given target in a meaningful way. Nonetheless, it was not specified in the current project. Alternatively, Hill and Buss (2008) did not specifically tell participants that the target they would be viewing was heterosexual. Participants were free to make their own internal judgments about target individuals. Same was the case for the current project considering homosexual participants.

One area of mate-choice copying that was not currently addressed here is that of generalized mate-choice copying. Some evidence with non-human species (Swaddle et al., 2005; Galef & White, 2000), as well as humans (Bowers et al., 2011; Little et al., 2011) suggest that copying behaviors can elicit a generalization of attraction to novel mates who share similar features with previously encountered target individuals, referred

to as trait-based mate-choice copying. Copying behaviors can possibly be transmitted over time, and learned preferences can be applied in other situations. This especially, might be the case, considering that younger, more inexperienced females rely on copying behaviors more than older individuals (Bowers et al., 2011; Dugatkin & Goldin, 1993). Future research should further explore these topics with larger, more variable populations (in terms of age and culture), as well as considering multiple sexual orientations. Finally, while the current project included both heterosexual and homosexual participants, bisexual and transgender populations were not considered. Further research could examine whether mate-choice copying tactics are used in humans in other sexual orientations.

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Table 1. MLM Model Comparisons with Heterosexual Participants

| Model | df | AIC | BIC | LogLik | Test | L. Ratio | p |
|---|---|---|---|---|---|---|---|
| Intercept Only | 1,2 | 17545.06 | 17557.47 | 8770.53 | | | |
| Random Intercept | 2,3 | 14888.09 | 14906.70 | -7441.04 | 1 vs 2 | 2658.97 | <.001 |
| Attractiveness Diff. | 3,4 | 13363.92 | 13388.74 | -6677.96 | 2 vs 3 | 1526.17 | <.001 |
| Sex | 4,5 | 13318.81 | 13349.83 | -6654.40 | 3 vs 4 | 47.12 | <.001 |
| Condition | 5,7 | 13281.81 | 13325.24 | -6633.90 | 4 vs 5 | 41.00 | <.001 |
| Random Slopes | 6,12 | 12935.53 | 13009.99 | -6455.77 | 5 vs 6 | 356.28 | <.001 |
| Interaction | 7,14 | 12763.47 | 12850.34 | -6367.74 | 6 vs 7 | 176.06 | <.001 |

Note. This table shows model comparisons from the multilevel modeling analysis for heterosexual participants. These model comparisons only include the covariate of attractiveness differentials.

Table 2. MLM Moderation Analyses with Heterosexual Participants

| Predictor | b | SE | t | p |
|---|---|---|---|---|
| Intercept | 4.85 | 0.14 | 35.38 | < .001 |
| Attractiveness Diff. | 0.58 | 0.01 | 43.54 | < .001 |
| Sex | 1.56 | 0.18 | 8.63 | < .001 |
| Condition: OS vs. SS | 0.28 | 0.08 | 3.71 | < .001 |
| Condition: OS vs. AL | 0.49 | 0.13 | 3.66 | < .001 |
| Condition: SS vs. AL | 0.21 | 0.11 | 1.95 | .0510 |
| Female Targets: OS vs. SS | 0.99 | 0.07 | 14.47 | < .001 |
| Female Targets: OS vs. AL | 1.36 | 0.15 | 9.30 | < .001 |
| Female Targets: SS vs. AL | 0.37 | 0.15 | 2.55 | .01 |
| Male Targets: OS vs. SS | -0.60 | 0.08 | -7.21 | < .001 |
| Male Targets: OS vs. AL | -0.53 | 0.16 | -3.19 | < .01 |
| Male Targets: SS vs. AL | 0.08 | 0.16 | 0.46 | .64 |

Note. This table shows regression values for all predictors from the multilevel model analysis, with heterosexual participants, in the step they were entered into the model. These values are from the analysis that only include the covariate of attractiveness differentials.

Table 3. MLM Model Comparisons with Heterosexual Participants Including Two Covariates

| Model | df | AIC | BIC | LogLik | Test | L. Ratio | p |
|---|---|---|---|---|---|---|---|
| Intercept Only | 1,2 | 17545.06 | 17557.47 | 8770.53 | | | |
| Random Intercept | 2,3 | 14888.09 | 14906.70 | -7441.04 | 1 vs 2 | 2658.97 | <.001 |
| Covariates | 3,5 | 13328.36 | 13359.39 | -6659.18 | 2 vs 3 | 1526.17 | <.001 |
| Sex | 4,6 | 13282.07 | 13319.30 | -6635.03 | 3 vs 4 | 48.30 | <.001 |
| Condition | 5,8 | 13234.72 | 13284.36 | -6609.36 | 4 vs 5 | 51.35 | <.001 |
| Random Slopes | 6,13 | 12854.29 | 12934.96 | -6414.15 | 5 vs 6 | 390.43 | <.001 |
| Interaction | 7,15 | 12706.77 | 12799.85 | -6338.39 | 6 vs 7 | 151.52 | <.001 |

Note. This table shows model comparisons from the multilevel modeling analysis for heterosexual participants. These model comparisons include both the covariate of attractiveness differentials and sexual tension ratings.

Table 4. MLM Moderation Analyses with Heterosexual Participants Including Two Covariates

| Predictor | b | SE | t | p |
|---|---|---|---|---|
| Intercept | 4.54 | 0.14 | 31.34 | < .001 |
| Attractiveness Diff. | 0.55 | 0.01 | 40.06 | < .001 |
| Sexual Tension | 0.08 | 0.01 | 6.14 | < .001 |
| Sex | 1.78 | 0.23 | 7.68 | < .001 |
| Condition: OS vs. SS | 0.54 | 0.07 | 7.28 | < .001 |
| Condition: OS vs. AL | 0.43 | 0.14 | 3.16 | < .01 |
| Condition: SS vs. AL | -0.12 | 0.12 | -0.97 | .33 |
| Female Targets: OS vs. SS | 1.13 | 0.07 | 15.75 | < .001 |
| Female Targets: OS vs. AL | 1.29 | 0.15 | 8.42 | < .001 |
| Female Targets: SS vs. AL | 0.16 | 0.16 | 1.01 | .31 |
| Male Targets: OS vs. SS | -0.36 | 0.11 | -3.40 | < .001 |
| Male Targets: OS vs. AL | -0.53 | 0.17 | -3.20 | < .01 |
| Male Targets: SS vs. AL | -0.18 | 0.18 | -0.98 | .33 |

Note. This table shows regression values for all predictors from the multilevel model analysis, with heterosexual participants, in the step they were entered into the model. These values are from the analysis that both covariates of attractiveness differentials and sexual tension ratings.

Table 5. Bayesian ANCOVA Model Comparisons with Heterosexual Participants

| Models | P(M) | P(M\|data) | $BF_M$ | $BF_{10}$ | Error % |
|---|---|---|---|---|---|
| Null model | 0.20 | $3.79 \times 10^{-10}$ | $1.52 \times 10^{-9}$ | 1.00 | |
| Condition | 0.20 | $6.80 \times 10^{-10}$ | $2.72 \times 10^{-9}$ | 1.79 | 10.40 |
| Sex | 0.20 | 0.14 | 0.65 | $3.68 \times 10^{8}$ | 8.08 |
| Condition + Sex | 0.20 | 0.19 | 0.95 | $5.07 \times 10^{8}$ | 21.82 |
| Condition + Sex + Interaction | 0.20 | 0.67 | 8.06 | $1.76 \times 10^{9}$ | 22.85 |

Note. This table shows model comparisons for the Bayesian ANCOVA for heterosexual participants. All models included random effects of the participant, as well as the covariate of attractiveness differentials as a nuisance variable.

Table 6. Bayesian ANCOVA Model Comparisons with Heterosexual Participants Including Two Covariates

| Models | P(M) | P(M\|data) | $BF_M$ | $BF_{10}$ | Error % |
|---|---|---|---|---|---|
| Null model | 0.20 | $2.88 \times 10^{-10}$ | $1.53 \times 10^{-9}$ | 1.00 | |
| Condition | 0.20 | $6.59 \times 10^{-10}$ | $2.64 \times 10^{-9}$ | 2.29 | 19.12 |
| Sex | 0.20 | 0.10 | 0.45 | $3.54 \times 10^{8}$ | 24.26 |
| Condition + Sex | 0.20 | 0.14 | 0.63 | $4.72 \times 10^{8}$ | 30.32 |
| Condition + Sex + Interaction | 0.20 | 0.76 | 12.80 | $2.64 \times 10^{9}$ | 42.48 |

Note. This table shows model comparisons for the Bayesian ANCOVA for heterosexual participants. All models included random effects of the participant, and both covariates of attractiveness differentials and sexual tension ratings as nuisance variables.

Table 7. MLM Model Comparisons with Homosexual Participants

| Model | df | AIC | BIC | LogLik | Test | L. Ratio | p |
|---|---|---|---|---|---|---|---|
| Intercept Only | 1,2 | 14682.69 | 14694.83 | -7339.35 | | | |
| Random Intercept | 2,3 | 12507.00 | 12525.19 | -6250.50 | 1 vs 2 | 2177.70 | < .001 |
| Attractiveness Diff. | 3,4 | 11227.45 | 11251.70 | -5609.72 | 2 vs 3 | 1281.55 | < .001 |
| Sex | 4,5 | 11227.90 | 11258.22 | -5608.95 | 3 vs 4 | 1.55 | .21 |
| Condition | 5,7 | 11125.33 | 11167.78 | -5555.66 | 4 vs 5 | 106.57 | < .001 |
| Random Slopes | 6,12 | 10826.68 | 10899.46 | -5401.34 | 5 vs 6 | 308.64 | < .001 |
| Interaction | 7,14 | 10677.58 | 10762.49 | -5324.79 | 6 vs 7 | 153.11 | < .001 |

Note. This table shows model comparisons from the multilevel modeling analysis for homosexual participants. These model comparisons only include the covariate of attractiveness differentials

Table 8. MLM Moderation Analyses with Homosexual Participants

| Predictor | b | SE | t | p |
|---|---|---|---|---|
| Intercept | 5.26 | 0.13 | 40.14 | < .001 |
| Attractiveness Diff. | 0.55 | 0.01 | 39.77 | < .001 |
| Sex | -0.35 | 0.28 | -1.25 | .21 |
| Condition: OS vs. SS | -0.24 | 0.08 | -3.00 | < .01 |
| Condition: OS vs. AL | 0.50 | 0.13 | 4.01 | < .001 |
| Condition: SS vs. AL | 0.74 | 0.11 | 6.55 | < .001 |
| Male Targets: OS vs. SS | -0.76 | 0.06 | -11.87 | < .001 |
| Male Targets: OS vs. AL | 0.13 | 0.15 | 0.86 | .39 |
| Male Targets: SS vs. AL | 0.89 | 0.15 | 5.97 | < .001 |
| Female Targets: OS vs. SS | 0.90 | 0.10 | 9.21 | < .001 |
| Female Targets: OS vs. AL | 1.41 | 0.19 | 7.46 | < .001 |
| Female Targets: SS vs. AL | 0.51 | 0.18 | 2.74 | .01 |

Note. This table shows regression values for all predictors from the multilevel model analysis, with homosexual participants, in the step they were entered into the model. These values are from the analysis that only include the covariate of attractiveness differentials.

Table 9. MLM Model Comparisons with Homosexual Participants Including Two Covariates

| Model | df | AIC | BIC | LogLik | Test | L. Ratio | p |
|---|---|---|---|---|---|---|---|
| Intercept Only | 1,2 | 14682.69 | 14694.83 | -7339.35 | | | |
| Random Intercept | 2,3 | 12507.00 | 12525.19 | -6250.50 | 1 vs 2 | 2177.70 | < .001 |
| Covariates | 3,5 | 11197.91 | 11228.23 | -5593.95 | 2 vs 3 | 1313.09 | < .001 |
| Sex | 4,6 | 11198.03 | 11234.42 | -5593.01 | 3 vs 4 | 1.88 | .17 |
| Condition | 5,8 | 11109.37 | 11157.89 | -5546.69 | 4 vs 5 | 92.66 | < .001 |
| Random Slopes | 6,13 | 10748.48 | 10827.33 | -5361.24 | 5 vs 6 | 370.89 | < .001 |
| Interaction | 7,15 | 10616.18 | 10707.15 | -5293.09 | 6 vs 7 | 136.31 | < .001 |

Note. This table shows model comparisons from the multilevel modeling analysis for homosexual participants. These model comparisons included both covariates of attractiveness differentials and sexual tension ratings.

Table 10. MLM Moderation Analyses with Homosexual Participants Including Two Covariates

| Predictor | b | SE | t | p |
|---|---|---|---|---|
| Intercept | 4.82 | 0.15 | 32.95 | < .001 |
| Attractiveness Diff. | 0.51 | 0.02 | 33.99 | < .001 |
| Sexual Tension | 0.09 | 0.02 | 5.81 | < .001 |
| Sex | -0.37 | 0.27 | -1.38 | .17 |
| Condition: OS vs. SS | -0.12 | 0.08 | -1.57 | .12 |
| Condition: OS vs. AL | 0.53 | 0.13 | 3.97 | < .001 |
| Condition: SS vs. AL | 0.65 | 0.13 | 5.14 | < .001 |
| Male Targets: OS vs. SS | -0.61 | 0.07 | -8.99 | < .001 |
| Male Targets: OS vs. AL | 0.19 | 0.16 | 1.16 | .25 |
| Male Targets: SS vs. AL | 0.80 | 0.16 | 4.92 | < .001 |
| Female Targets: OS vs. SS | 0.91 | 0.10 | 9.30 | < .001 |
| Female Targets: OS vs. AL | 1.36 | 0.20 | 6.70 | < .001 |
| Female Targets: SS vs. AL | 0.45 | 0.20 | 2.28 | .02 |

Note. This table shows regression values for all predictors from the multilevel model analysis, with homosexual participants, in the step they were entered into the model. These values are from the analysis included both covariates of attractiveness differentials and sexual tension ratings.

Table 11. Bayesian ANCOVA Model Comparisons with Homosexual Participants

| Models | P(M) | P(M\|data) | $BF_M$ | $BF_{10}$ | Error % |
|---|---|---|---|---|---|
| Null model | 0.20 | 0.59 | 5.83 | 1.00 | |
| Condition | 0.20 | 0.05 | 0.22 | 0.09 | 15.25 |
| Sex | 0.20 | 0.24 | 1.27 | 0.41 | 19.74 |
| Condition + Sex | 0.20 | 0.03 | 0.11 | 0.04 | 36.33 |
| Condition + Sex + Interaction | 0.20 | 0.09 | 0.38 | 0.15 | 80.81 |

Note. This table shows model comparisons for the Bayesian ANCOVA for homosexual participants. All models included random effects of the participant, and the covariate of attractiveness differentials as a nuisance variable.

Table 12. Bayesian ANCOVA Model Comparisons with Homosexual Participants Including Two Covariates

| Models | P(M) | P(M\|data) | $BF_M$ | $BF_{10}$ | Error % |
|---|---|---|---|---|---|
| Null model | 0.20 | 0.68 | 8.44 | 1.00 | |
| Condition | 0.20 | 0.03 | 0.13 | 0.05 | 29.78 |
| Sex | 0.20 | 0.24 | 1.27 | 0.36 | 23.20 |
| Condition + Sex | 0.20 | 0.01 | 0.03 | 0.01 | 23.13 |
| Condition + Sex + Interaction | 0.20 | 0.04 | 0.18 | 0.06 | 25.25 |

Note. This table shows model comparisons for the Bayesian ANCOVA for homosexual participants. All models included random effects of the participant, and both covariates of attractiveness differentials and sexual tension ratings as nuisance variables.

Table 13. Statistical Comparisons

| Orientation | Sex | Analysis | OS vs. SS | OS vs. AL | SS vs. AL |
|---|---|---|---|---|---|
| Heterosexual | Male | ANCOVA AD | **OS<SS** | **OS<AL** | **SS<AL** |
| Heterosexual | Male | MLM AD | **OS<SS** | **OS<AL** | **SS<AL** |
| Heterosexual | Male | Bayes AD | **OS<SS** | **OS<AL** | SS=AL |
| Heterosexual | Male | ANCOVA AD ST | **OS<SS** | **OS<AL** | SS=AL |
| Heterosexual | Male | MLM AD ST | **OS<SS** | **OS<AL** | SS=AL |
| Heterosexual | Male | Bayes AD ST | **OS<SS** | **OS<AL** | **SS<AL** |
| Heterosexual | Female | ANCOVA AD | OS>SS* | OS>AL* | SS=AL |
| Heterosexual | Female | MLM AD | **OS>SS** | **OS>AL** | SS=AL |
| Heterosexual | Female | Bayes AD | OS>SS* | OS>AL* | SS>AL* |
| Heterosexual | Female | ANCOVA AD ST | OS=AL | OS>AL* | SS=AL |
| Heterosexual | Female | MLM AD ST | **OS>SS** | **OS>AL** | SS=AL |
| Heterosexual | Female | Bayes AD ST | OS>SS* | OS>AL* | SS>AL* |
| Homosexual | Male | ANCOVA AD | **OS>SS** | OS=AL | **SS<AL** |
| Homosexual | Male | MLM AD | **OS>SS** | OS=AL | **SS<AL** |
| Homosexual | Male | Bayes AD | **OS>SS** | **OS<AL** | **SS<AL** |
| Homosexual | Male | ANCOVA AD ST | **OS>SS** | OS=AL | **SS<AL** |
| Homosexual | Male | MLM AD ST | **OS>SS** | OS=AL | **SS<AL** |
| Homosexual | Male | Bayes AD ST | **OS>SS** | **OS<AL** | **SS<AL** |
| Homosexual | Female | ANCOVA AD | **OS<SS** | **OS<AL** | **SS<AL** |
| Homosexual | Female | MLM AD | **OS<SS** | **OS<AL** | **SS<AL** |
| Homosexual | Female | Bayes AD | **OS<SS** | **OS<AL** | **SS>AL** |
| Homosexual | Female | ANCOVA AD ST | **OS<SS** | **OS<AL** | SS=AL |
| Homosexual | Female | MLM AD ST | **OS<SS** | **OS<AL** | **SS<AL** |
| Homosexual | Female | Bayes AD ST | **OS<SS** | **OS<AL** | **SS>AL** |

Note. This table shows each pairwise comparison between the effect of stimulus condition. Comparisons are split between both participant sex and sexual orientation. Significant relationships are bolded ($p < .05$), and marginally significant relationships are denoted with * ($p < .10$). AD refers to the covariate of attractiveness differentials, ST refers to the covariate of sexual tension ratings, OS refers to the opposite-sex peripheral individuals condition, SS refers to the same-sex peripheral individuals condition, and AL refers to the alone condition.

Figure 1. Example stimulus photograph depicting male target, identified by an arrow, surrounded by four female peripheral individuals.

Figure 2. Example stimulus photograph depicting female target, identified by an arrow, surrounded by four male peripheral individuals.

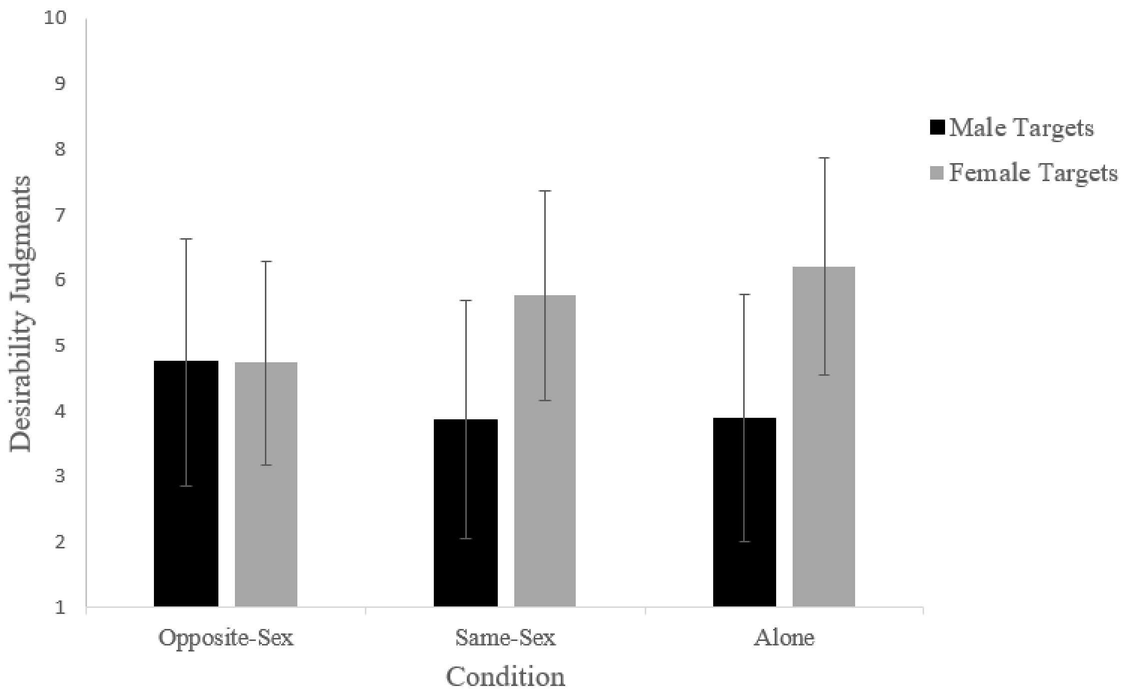

Figure 3. Adjusted means graph with heterosexual participants (with standard deviation as error bars) between stimulus conditions and participant, with attractiveness differentials as the only covariate included.

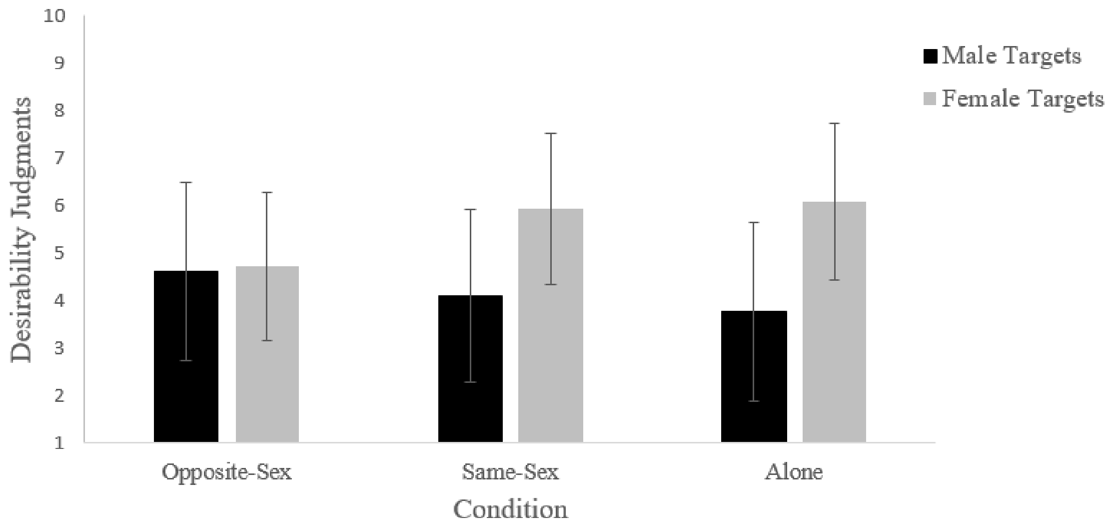

Figure 4. Adjusted means graph with heterosexual participants (with standard deviation as error bars) between stimulus conditions and participant sex, with both covariates of attractiveness differentials and sexual tension ratings included.

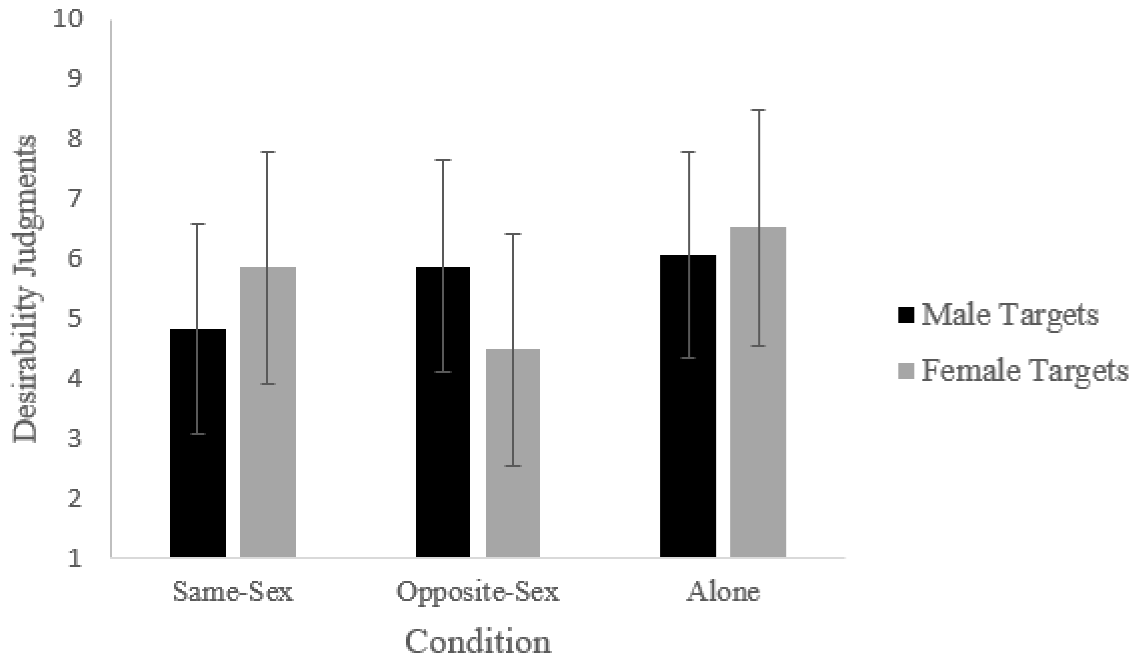


Figure 5. Adjusted means graph with homosexual participants (with standard deviations as error bars) between stimulus conditions and participant, with the covariate of attractiveness differentials included.

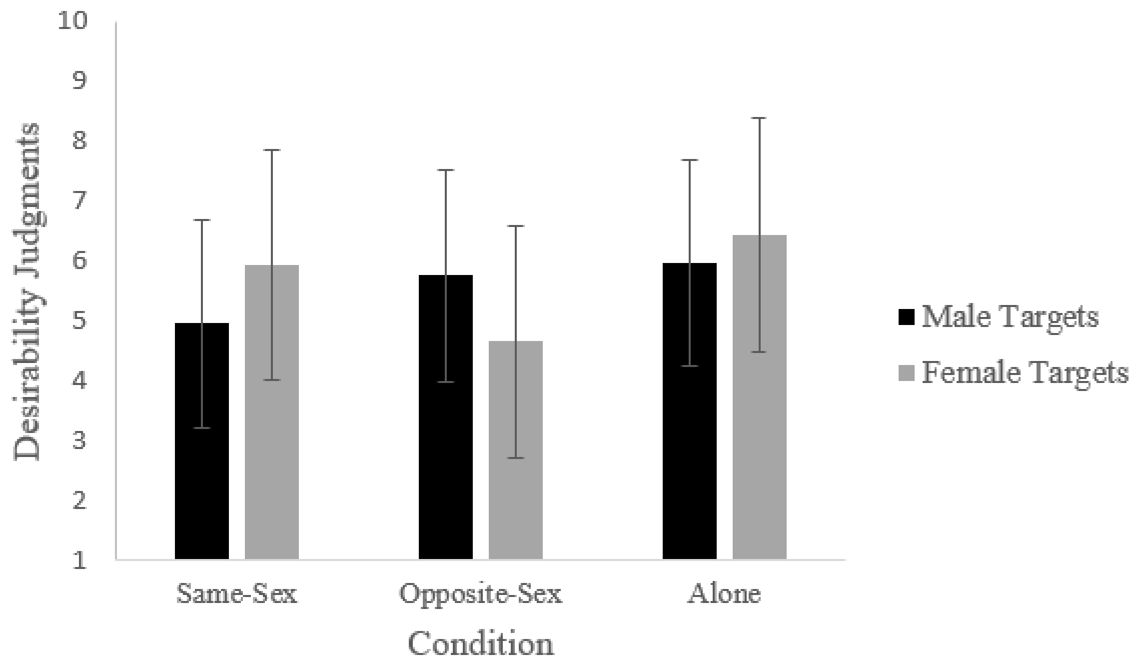


Figure 6. Adjusted means graph with homosexual participants (with standard deviation as error bars) between stimulus conditions and participant sex, with the covariates of attractiveness differentials and sexual tension ratings included.

# APPENDIX

Characteristics Pertaining to Desirability as a Romantic Partner

All questions are made on 10-point rating scales. Ratings range from 1 (not at all attractive, desirable, likely) to 10 (very attractive, desirable, likely).

1. How attractive do you find this person?

   *Not at all attractive* *Very attractive*
   1 2 3 4 5 6 7 8 9 10

2. How desirable is this person to you as a prospective sexual partner?

   *Not at all desirable* *Very desirable*
   1 2 3 4 5 6 7 8 9 10

3. How desirable is this person to you as a prospective long-term romantic partner (i.e., a committed romantic partner)?

   *Not at all desirable* *Very desirable*
   1 2 3 4 5 6 7 8 9 10

4. If this person were to ask you on a date, what is the likelihood that you would say yes?

   *Not at all likely* *Very likely*
   1 2 3 4 5 6 7 8 9 10

5. In general, how desirable do you find this person?

   *Not at all desirable* *Very desirable*
   1 2 3 4 5 6 7 8 9 10

6. Rate the amount of sexual tension between people in this scene overall.

   *No sexual tension at all* *A lot of sexual tension*
   1 2 3 4 5 6 7 8 9 10