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Single or Taken: The Effect of Relationship Status, Gender, and Interaction with the Opposite Sex on Arousal and Spatial Ability

Kylie McGee
Gardner-Webb University

Single or Taken: The Effect of Relationship Status, Gender, and Interaction with the Opposite Sex on Arousal and Spatial Ability

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Kylie McGee

Accepted by the Honors Faculty

_____	_____
Dr. Ivelina Naydenova; Thesis Advisor	Dr. Tom Jones; Associate Dean; Univ.Honors
_____	_____
Dr. Candice Rome, Honors Committee	Dr. Lorene Pagcaliwagan, Honors Committee
_____	_____
Dr. Don Olive, Honors Committee	Dr. Anna Sieges Beal, Honors Committee

Abstract:

The purpose of this project is to examine the effect that relationship status, gender, and interaction with the opposite sex has on nervous system arousal and spatial ability. In the first experiment, 20 female participants were selected, 10 being in a committed relationship and 10 being single. Spatial ability and heart rate was measured for each participant before and after mixed-sex dyadic interactions. Results showed that a person's relationship status does indeed have an effect on nervous system arousal after a mixed-sex dyadic interaction. In experiment two, 25 participants were studied, 13 participants were male and 12 were female. 7 males and 5 females were single and 6 males and 7 females were in a committed relationship. Spatial ability and heart rate for each participant was measured before and after mixed-sex dyadic interactions. Results showed that if a person is in a committed relationship, he or she will score significantly higher on spatial awareness intelligence. However, the results showed no significant difference in their nervous system arousal or spatial ability after interacting with the opposite sex. The descriptive statistics were in the hypothesized direction, showing that males outperform females on spatial ability tasks and males show a decrease in cognitive functioning after interaction with the opposite sex. Our two experiments broadly support extant research. More research should be conducted on a larger scale in order to examine this subject.

Keywords: spatial ability, gender differences, mixed-dyadic interaction

Literature Review

Being single or taken has consequences. One consequence is that if a person is in a committed relationship, this person is off the market, and therefore have no need to find a new mate. This has implications for how people in a relationship now interact in the presence of people of the opposite sex, regarding those who have heterosexual attraction. It can have an impact on how attractive that person views members of the opposite sex as opposed to others who are single and ready to mingle (Miller, 1997). The status of one's relationship not only impacts the interactions a person has with others, but also it can also have an impact on both nervous system arousal and cognitive functioning when in the presence of the opposite sex. The purpose of this research is to examine the impact relationship status and interaction with the opposite sex have on nervous system arousal and cognitive abilities as measured by spatial ability intelligence. The spatial ability gap that occurs between males and females will also be discussed and examined.

There is a common saying that states beauty is in the eye of the beholder. However, this idea contradicts what research has found to be true. According to studies conducted by Cunningham and colleagues (1995), what is seen as physically attractive remains consistent across varying cultures. Studies have also shown that infants, who do not yet have the capacity to be influenced by social or cultural pressures, show preference for people who are considered to be physically attractive (Slater et al. 2000). These findings mean that beauty is in fact not in the eye of the beholder, but instead that there is a formulaic, consistent set of standards underlying what is considered to be beautiful. Through dedicated research, psychologists have uncovered what the typical physical attractiveness standards are. The findings of this research suggest that overall both men and women prefer faces that are

proportionate and symmetrical, having no feature that is overpowering or diminutive (Perilloux et al., 2010). Other, more specific, standards vary for both men and women. On average, women show more variability in what they view as attractive in a potential mate when compared to men. Men typically find women with soft features, large eyes, a small nose, prominent cheek bones, full lips, and broad smiles attractive (Miller, 2015). Women, however, can find men who have either strong masculine features, such as a prominent jaw line, or men with soft feminine features physically attractive. This usually varies depending on the stage a woman is at in her menstrual cycle. Directly before and during ovulation, women tend to find the more dominantly featured men, those with stronger and sharper features, more handsome. However, when women are not fertile, women may find men with more feminine features more attractive (Little et al., 2002).

Facial features are not the only thing that matters when assessing what people find physically appealing. Studies have found that waist to hip ratio can have an impact on whether a man or woman is seen as physically attractive. Men typically prefer someone with a waist to hip ratio of .7, having the waist proportionately smaller than the hip, whereas women prefer a waist to hip ratio of .9, meaning that the waist to hip measurements are closer to one another (Miller, 2015). What people find physically attractive does impact social interactions in several different ways. Studies have shown that people tend to ascribe favorable qualities to those who they find physically attractive, whether or not this attribution is true (Segal-Caspi et. al, 2012). This accreditation of pleasant personality characteristics can aid in increasing favorability, liking, and attraction toward a person (Miller, 2015).

There are several aspects, aside from physical features, which impact one person's attraction to another. One theory is that people are attracted to others whose presence benefits

them in some way, shape, or form (Clore & Byrne, 1974). There are several different ways in which one person's presence can be rewarding to another. This reward, in turn, has an impact on the level of attraction within dyadic interactions. The various ways in which a person's presence can be rewarding are simplified into two categories, including both direct rewards and indirect rewards. Direct rewards are more easily observed while indirect rewards occur much more discretely. Indirect rewards are areas that have a secondary impact on attraction. These associations or benefits may not be overtly perceived, however, still play a role in initial attraction and can be linked to direct rewards (Miller, 2015). Indirect rewards can include choosing a partner who will provide future benefits in regards to mating purposes and protection of one's offspring (Buss, 2012). Typically, when a person offers another person more direct rewards, the potential for attraction increases (Miller, 2015). However, while "attraction does involve the perceived characteristics of the person who appeals to us" (Miller, p.69, 2015), it is important to remember that it "depends on our individual needs, preferences, and desires, and on the situation in which we find ourselves" (Miller, p. 69, 2015).

Another theory of attraction examines the effect which physical proximity has on attraction levels. This theory states that close physical proximity is rewarding and increases familiarity which, in turn, increases attraction. Therefore, when a person sees, or interacts with someone else more often their sense of fondness towards that person increases (Miller, 2015). This process is termed the "mere exposure effect" (Zajonc, 2001). The mere exposure effect can be exemplified when examining a study completed by Moreland and Beach (1992). In this study, researchers instructed women to sit in on a college course either five, ten, or fifteen times, not interacting with anyone else within the class. They then proceeded to

show the class pictures of the women who had previously sat in on a few classes. All of the students claimed not to know the women shown in the pictures. When they rated the pictures, it was found that the confederates who attended more classes were rated more attractive than the confederates who had attended less classes. They also rated all three women at a higher score than pictures of faces that the students had never seen before. This suggests that proximity and familiarity aid in producing liking and attraction (Moreland & Beach, 1992).

While proximity and familiarity may have an impact on attraction, it is important to have validation within that interaction. Researchers have found as well that validation and similarity in beliefs is an important aspect of attraction. They have found that with similarity and validation of one's beliefs, comes an increased likelihood that one person will like or feel an attraction to the other (Singh et. al, 2017).

As mentioned above, attraction is a complex construction impacted by several different areas. "Whether one is perceived to be attractive is determined by cultural, social, contextual, and biological factors" (Madey et al., 1996). In one study, the researchers sought to examine the effect of closing time and relationship status on perceived attractiveness levels by surveying one-hundred and twenty male college students and one hundred and seventeen female college students who were in a local bar. This study found that as closing time approached, people were rated as increasingly more attractive, but only if the person rating was single. This is assumed to be because as closing time approaches, people feel an increased sense of pressure to choose an alternative. Therefore, it heightens the perceptive attractiveness of the people being viewed. When running the data, researchers also found

that those who were not in a relationship rated the attractiveness levels of the opposite sex higher than participants who were in a relationship (Madey et al., 1996).

Several studies have been conducted which back up the data, regarding relationships, found in the study above. Relationship status does tend to have an impact on how attractive that person may find someone else. Lydon, Fitzisimons, and Naidoo conducted two experiments that were meant to demonstrate this idea (2003). In the first experiment, the experimenters instructed the participants to complete questionnaires which discussed whether they were in a relationship, and, if so, their level of commitment within that relationship. The participants were then asked to pick up a folder which contained a fake biography paired with a picture of a physically attractive person of the opposite sex. All participants received the same biographical information for the person they were evaluating. One piece of information varied between both single and committed participants, indicating that the person in the picture was either in a committed relationship or single. Through this study, it was observed that commitment to a relationship and attraction to the stranger were negatively correlated. This means that people in a committed relationship rated the attractiveness of the confederate of the opposite sex lower than those who were single (Lydon, Fitzsimons, & Naidoo, 2003). The author attributes this occurrence to the calibration hypothesis which says "when the level of threat is below or above the level of commitment, there will not be a cognitive or behavioral defense of the relationship" (Lydon, Fitzsimons, & Naidoo, p. 357, 2003). The participant then devalues the attractiveness level of a person of the opposite sex, in accordance with their level of commitment to a relationship, acting as a protective agent against the relationship. (Lydon, Fitzsimons, & Naidoo, 2003).

Another term used to study the interaction of a person, in regards to the perceived attractiveness levels of other people is attentiveness to alternatives. Attentiveness to alternatives measures how much attention people pay, usually to a member of the opposite sex. In one experiment, in order to examine the effects of relationship status and its impact on attentiveness to alternatives, researchers gathered student including ninety-nine male participants and one-hundred and forty-seven female participants. These participants had varying degrees of relationship status. The researcher asked the participants basic demographic questions, along with surveying their satisfaction, commitment, and investment levels within their relationships. During this process, the researchers also measured the participant's attention to alternatives. A portion of the participants volunteered for a lab session which studied how behavioral attentiveness was related to interest in alternatives. At the conclusion of this study, it was found that three groups significantly differed in regards to their attentiveness to alternatives; casual daters, exclusive daters, and married or co-habitating participants. Causal daters showed the most attentiveness to alternatives, meaning that they had a high level of focus on members of the opposite sex. This is likely because people who are single, casual daters, are free to be on the lookout for differing mates. Co-habitating partners showed less attentiveness to alternatives than people who were single or casual daters, but more attentiveness to alternatives than married people. People who were married showed the least attentiveness to alternatives. Satisfaction and commitment were negatively correlated with attention to alternatives showing that those who are more satisfied and committed in their relationship pay less attention to alternative partners. The author provides these results as an explanation for the belief that inattentiveness to alternatives is a

defense mechanism which is set in place to preserve desirable relationships, promoting commitment and dedication to that relationship (Miller, 1997).

Other studies suggest that even a person's sexual partner status can have an impact on whether or not they pay attention to alternatives. In a study conducted by Rupp, Librach, Feipel, Ketterson, Sengelaub, and Heiman, researchers examined the effect of sexual partner status on attractiveness ratings (2009). Within this study, there were 56 female college students and 59 male college students being surveyed. The participants were divided into four different groups and then asked to examine a photo of the opposite sex. After they examined the photo, the participants were asked to evaluate the picture on its realism, masculinity versus femininity, and attractiveness. The results showed that there was no significance regarding a woman's relationship status and her subjective ratings on faces of the opposite sex. There was, however, a difference in response times. Male participants showed no difference in response times or ratings. This difference is attributed to the fact that "women, on average, are relatively committed to their relationships and current partners, which possibly suppresses their attention to and appraisal of alternative partners" (Rupp et al., 2009). There are several other factors that could have an influence on a person's behavior with the opposite sex, causing these results. Such factors include hormonal state, the attitude towards or goals for a relationship, and the social environment that impacts a person and their behavior. Also, a suggestion for reasons women and men differ in their evaluations of the opposite sex is simply attributed to evolution and biology. Women are biologically inclined to be attentive to their reproductive responsibilities. They have an innate need to secure a preferable mate who can aid in passing on favorable genes to their offspring. They also have a need to secure stability for their offspring which then limits their interest to one partner in

order to attain or maintain this stability. Men, however, may be biologically and evolutionarily inclined to fertilize as many females as possible to ensure reproductive success and the greatest chance to pass on their genes. This produces a greater attentiveness to alternatives for a male than it would in a female. It was seen, as well, that women found men who were single more attractive than those who were married, and men rated women who were single and women who were married equally. This evolutionary based idea can be used to explain such results (Rupp et. al, 2009). Whether the reason behind attention to alternatives is attributed to evolutionary proceedings or not, it is clear that relationship status has an impact on interactions with the opposite sex.

Relationship status and interactions with the opposite sex can have an impact on cognitive functioning as well. Nauts, Verwijmeren Rommenswinkel, and Karremans set out to prove this theory (2012). The experiment they conducted was a two study experiment. Rather than having the participant physically interact with a person of the opposite sex, the researchers sought to discover if simple anticipation of interaction with the opposite sex would decrease cognitive functioning. In the first study, the researchers recruited seventy-one students, thirty-nine of them being female. These participants were escorted to their cubicle by a research assistant of the same sex. Then, the participant took the Stroop test (a test that uses colors and words to test selective attention) , acting as a baseline measure for their cognitive functioning. After the test, they were told that they were going to participate in a lip reading task, while someone of the opposite sex would be evaluating them, instant messaging them about their experience. After compiling the results, it was seen that through perceived interaction with the opposite sex, males did worse on the Stroop test. However, female's scores remained un-affected by the perceived interaction. In their second study ninety-one

students participated, sixty-four being female. This study followed the same procedure as their previous study, except the participants were simply told that they would be interacting with a person of the opposite sex via webcam, rather than actually interacting. This study found that even the anticipation of interacting with a person of the opposite sex decreased a male's cognitive function. Males performed worse on the post test scores for the Stroop test than they did on the baseline measurement. Once again, women did not significantly differ in their cognitive functioning abilities. Both studies suggest that interaction or even perceived interaction with a woman is cognitively taxing for males. The author suggests that this is due to the impression management theory in which the male has to balance his impressions and tailor his interactions accordingly, taking up valuable cognitive space that could be otherwise used to complete the task before him. Perhaps, since this research shows the impact of interaction on cognitive functioning, specifically in regards to executive function, this idea can be generalized to other cognitive areas, including spatial ability (Nauts, Metzmacher, Verwijmeren, Rommensqinkel, & Karremans, 2012).

Cognitive ability and pathways used for certain cognitive functions differ in general between males and females. One study aims to view the differences in the cognitive processes or strategies that men versus women initiate when dealing with visuo-spatial or mathematical issues. In order to examine the differences that may occur, ten males and ten females were examined, the average age being around twenty-five years old. There were four tasks that each participant was asked to complete including a task utilizing mental rotation. Mental rotation is a sub category of spatial awareness where the person takes two dimensional objects that represent three dimensional ideas, and cognitively manipulate the object. Using questions that utilize this task is one way to test spatial ability. The other three

tasks included the participant doing mathematical calculations, magnitude comparison, and a control tasks. During these tasks, neuroimaging was conducted to map out the areas of the brain which were being utilized to complete each individual task. The results of this study indicated that women and men differ in brain activation patterns for exact calculation, approximation, and mental rotation. For both men and women there was activation in the occipital lobe which is the center for processing information. There was also activity in the inferior parietal lobe, which functions mainly in visuo-spatialization, and the frontal lobe, which plays a role in motor functioning and problem solving. In women, additional activation patterns were examined in the temporal region, the right inferior frontal lobe, and the primary motor areas. This indicates that when processing and solving mental rotation and number related problems, women use areas of the brain which are reserved for working memory and speech/ head-motor mechanisms. However, men utilize visuo-spatial strategies. Women show preference for predicative thinking, which is more complex, focusing on the inner workings of a relationship between two things more so than men do. Men prefer functional thinking which is simplified, focused on the course of action for one specific thing (Kucian, Loenekker, Dietrich, 2005). The "preferred processing strategies of women seem equally effective in visuospatial and arithmetical tasks if no emphasis is placed on speed" (Kucian, Loenekker, Dietrich, p. 127, 2005).

Several studies have shown, however, that males consistently outperform females when dealing with spatial ability tasks. A study conducted by Goodrich et. al. examined if spatial ability varied among gender, and then if it varied within differing gender roles. One-hundred women and fifty-nine men were tested, ranging from ages seventeen to fifty-one. These participants were first given the Bem Sex Role Inventory (BSRI) which is a tool used

to measure sex role orientation. Then they were instructed to take a V/H test, which is used to measure a person's ability to understand the relationship between objects and space both vertically and horizontally. On this test was a representation of a truck that was filled horizontally with water and had a vertical pull rope at the end. Participants were instructed to draw a horizontal line representing where the liquid would be and a vertical line representing the pull rope at varying angles throughout the duration of the test. Any line deviating from the allotted ten degrees was marked as incorrect. Women typically drew more lines that were inconsistent with the correct answers than men did. A significant difference was found in spatial ability, but only between sexes and not between differing gender roles. This difference favored men, having a higher score than women did on spatial ability (Goodrich et. all, 1993).

Spatial ability can be split into three categories in order for the sex difference to be more readily analyzed. These categories include spatial perception, cognitive and strategic perspective, and mental rotation. When meta-analysis of spatial ability was calculated, a significant difference favoring males on both spatial perception and mental rotation was found. There was, however, no significant difference in the cognitive and strategic perspective category of spatial ability (Linn & Peterson, 1985). This conclusion can lead to the assumption that "Sex differences in spatial ability are large only for mental rotation, medium for spatial perception, and small for spatial visualization" (Linn & Peterson, p. 1495, 1985).

Studies typically analyze the mental rotation aspect of spatial ability, it being an easy way to indicate this type of functioning. One way to test for this is through the Purdue Spatial Visualization Test (Guay, 1976). Researchers Maeda and Yoon utilized this test to study the

difference between the sexes and their ability to reason spatially (2016). With their large sample size of two-thousand four-hundred and sixty-eight college freshman, one-thousand eight-hundred and eighty-eight being male and the rest being female, they studied spatial awareness. These students were given the PSVT:R (Purdue Spatial Visualization Test: Revised), a test which measures spatial ability and mental rotation. The results showed gender based spatial reasoning difference, males answering 77 percent correct and females averaging sixty-seven percent correct. Males consistently performed better on the spatial reasoning tests and abilities than females did (Maeda & Yoon, 2016).

An explanation for this sex difference regarding spatial ability can be attributed to areas other than sex based cognitive processing differences. Hormonal levels may play a factor in males consistently outperforming females as well. In order to study this hypothesis, Hausmann et. al. looked at the impact which sex based hormones have on spatial awareness (2000). Throughout this study, they looked at mental rotation. In order to conduct this study, researchers gathered twelve women and tested their spatial ability at differing levels of their menstrual cycle. The researchers monitored their hormonal levels throughout the cycle through regular blood samples. The women then periodically had to complete a mental rotation test, a hidden figures test, and a mirror pictures test. The results indicated that women scored higher on the mental rotation test during the menstrual phase when estradiol, a form of estrogen, was lower and testosterone higher. The results reversely indicated that women's scores were lower during the midluteal phase when estradiol is higher and testosterone is lower. The sex hormones, both testosterone and estradiol, influence spatial ability during the menstrual cycle. Estradiol is then negatively correlated with spatial ability and testosterone is positively correlated. Since testosterone is positively correlated with

spatial ability, this gives males, who naturally have higher testosterone, a clear advantage in regards to completing and understanding spatial ability tasks. Women, who normally have higher estradiol compared to men, are at an enormous disadvantage when it comes to spatial tasks such as mental rotation and spatial perception. This leads to the conclusion that elevated testosterone in males, when compared to females, allows men an increased advantage in spatial ability and mental rotation (Haussmann et. al, 2000).

Studies have also shown that training can increase spatial ability for both males and females. Training could act beneficially to increase scientific and mathematical skills. These skills show a positive correlation with spatial ability (Linn & Peterson, 1985). What better way to train to increase such skills than to play video games? In a study conducted by Cherney, where they examined the effect of practicing 3-D and 2-D video games on mental rotation, they found even a minuscule amount of video game play can improve mental rotation ability (2008). Interestingly enough, they found that women increased their mental rotation skills after practicing playing the game at a greater rate than men did. Along the lines of practicing effectively they found that mass practice produced greater benefits than distributed practice. Therefore, if a person wants to maximize their spatial ability training, they should play an ample amount of video games in aggregated time frames rather than just a little bit of practice every day. Within society video games and other play, such as little boys playing with trucks and tools, can increase spatial ability and are typically geared more towards males rather than females. This environmental and societal factor can pose a problem to women, giving them a slight spatial ability handicap. Such environmental facts may be an underlying cause to men out-performing women regarding spatial ability and mental rotation. However, as the above study illustrates, there is hope for women to improve

their skills through practice, increasing their chances of effectively solving spatial ability problems or tasks (Cherney, 2008).

The reason why spatial ability and training to increase spatial ability is important is because "spatial ability has shown a positive link to academic and career success, particularly in science, technology, engineering, and mathematics (STEM) fields, and the ability is a prerequisite for developing quantitative reasoning skills, a spatial test often has been used to predict student's academic success" (Maeda & Yoon, p. 400, 2013). If females are naturally worse at spatial ability due to hormones and the way they cognitively process information, as well as environmental factors, this discourages women from pursuing success in subjects or careers that involve science, technology, engineering, and mathematics thus giving males an unfair advantage in such fields. To examine this phenomena, Project Talent gathered data including students from 9th to 12th grade. There were 400,000 students in total, about 50,000 male and 50,000 female from each grade. These students were given a series of tests over a period of a week that included questions which measured cognitive abilities such as mathematical, verbal, and spatial abilities. Longitudinal data was then collected at one, five, and eleven years post-high school. Viewing the eleven year mark of those who had continued the study, it could be seen that, "first, spatial ability is a salient psychological characteristic among adolescents who subsequently go on to achieve advanced educational and occupational credentials in STEM. Second, spatial ability plays a critical role in structuring educational and occupational outcomes in the general population as well as among intellectually talented individuals" (Wai, Lubinski, & Benbow, p. 827, 2009). This exemplifies the importance of spatial ability and the effects which it has on one's academic success, future, and career choice.

Therefore, based on all the above mentioned research, the present study aims to examine the sex difference in spatial ability. Specifically, I want to examine whether relationship status and mixed dyadic interactions affect how a person views the attractiveness levels of others, their nervous system arousal, or their cognitive abilities. Those who are in a relationship are said to downplay the attractiveness levels of people of the opposite sex, enacting a cognitive safeguard for their existing relationship. By measuring a participant's heart rate, indicating nervous system arousal, before and after a mixed dyadic interaction, I hypothesize that those in a relationship have no significant difference in nervous system arousal, whereas those who are single increase in their nervous system arousal. The opposite goes for the spatial ability. Those who are in a relationship should show relatively the same score before and after the interaction, whereas those who are single should show decreased spatial ability following the interaction. Two separate experiments are planned on being conducted. For both experiments, based on extant research, it is hypothesized that participants who are in a relationship would show lower physiological signs of arousal than those who are not in a relationship, following interaction with the opposite sex. The second hypothesis stated that single participants will show a decrease in spatial visualization ability following the interaction with a male confederate. No such change was expected for participants in a committed relationship. For the second experiment, which is to include males as well, it is also hypothesized that males would show a greater decline in cognitive ability post-interaction than females would, and males overall would outperform females in their spatial abilities.

Study 1

Method

Participants. Participants (*N*= 20) were college aged students from a small southern liberal arts college. All participants were female. Relationship status was acquired previous to the study. The participants were either in a committed relationship for at least six months (*N*=10), or single (*N*=10).

Instrumentation. Two instruments were used to collect data including both the Purdue Spatial Visualization Test and the Samsung Health Heart Rate Monitor application (Guay, 1976; Samsung, 2018).

***Purdue Spatial Visualization Test*.** (Guay, 1976). This test is administered in order to measure an individual's spatial ability. It includes thirty questions which have the participant utilize a sub-division of spatial awareness called mental rotation. Six questions taken from the test were utilized in the pre-test, and six different questions taken from this test were used as the post-test (Guay, 1976).

***Samsung Health Heart Rate Monitor*.** This is an application available to Samsung devices that measures an individual's bpm or heart rate (Samsung, 2017). The participant is asked to place her finger over the heart rate sensor, and then a red light flashes measuring and recording the participants heart rate.

Design and Experimental Condition.

***Design*.** In this study, a within subjects design was used. The control group was the pre-test and set of heart rate measurements whereas the experimental group was the heart rate

measurement after the interaction with a confederate and the scores on the post-test. The independent variable is the interaction with the confederate of the opposite sex. The dependent variables include the test scores, and the heart rate measurements.

***Experimental condition*.** Participants interacted with a confederate of the opposite sex by participating in a game of UNO accompanied by light conversation for three minutes. After the interaction, the participant's heart rate was measured. The participant then took the post test.

***Control condition*.** Participant's heart rate was measured in order to receive a baseline reading. The participant then took the pre-test measuring spatial ability. No interaction with the opposite sex occurred in the control portion of the experiment.

Procedure.

A consent form was given to the participant to fill out before the study begins. There were two types of participants, participants who have been in a relationship for six months or more, and participants who are single. A physiological measure of the participant's heart rate was taken to attain a baseline measure using the Samsung Health heart rate application. The participant had two minutes to complete the pre-test portion consisting of six questions taken from the Purdue Spatial Visualization Test (Guay, 1976). This test acted as a measure for their spatial awareness. The participant then interacted with a confederate of the opposite sex for three minutes, playing Uno. The participant's heart rate was taken again using the same application to see if nervousness is induced by the interaction. Spatial awareness was again measured by a timed spatial visualization post-test consisting of six questions that differ from the pretest questions. The participants were then debriefed.

Results

Several paired-sample t-tests were performed in order to discover if any significant differences in arousal and spatial visualization ability may have occurred. Consistent with our first hypothesis, the pattern of results suggested that there was a significant increase in heart rate for single participants following the mixed-sex dyadic interaction , $t(9)= -3.203$, $p<.011$. No significant difference in heart rate was found for participants in a committed relationship, $t(9)= .813$, $p=.437$. Our second hypothesis was not supported by the present study as we found no significant decrease in spatial ability for single participants $t(9)=.313$, *ns*. The descriptive statistics were indeed, in the expected direction, but the difference between the pretest and the post test scores did not reach significance (pretest: .M=3.2, SD= 1.751 and posttest: M= 2.8, SD= 1.032). Overall, the results showed the status of a participant's relationship affects arousal in a mixed-sex dyadic interaction.

	Mean	Standard Deviation	*t*	*df*	Sig. 2 tailed
Single					
Baseline Heart Rate	73.5	13.03	-3.2	9	.01*
Post-Interaction Heart Rate	84.6	13.91			
Pre-test	3.2	1.75	.54	9	.61
Post test	2.8	1.03			
Relationship					
Baseline Heart Rate	87.1	20.82	.62	9	.55
Post-Interaction Heart Rate	85.3	15.71			
Pre-test	3.2	1.75	1.07	9	.31
Post-test	2.6	1.26			

Discussion

The pattern of results supports the hypothesis that the status of a person's relationship does have an effect on their nervous system arousal after interacting with the opposite sex. These results are consistent with past research that states people who are single show an increase in arousal when interacting with the opposite sex, whereas those who are in a committed relationship do not exhibit such an increase. In the present study, the heart rate of the participants in the committed relationships actually declined, albeit not significantly, after the interaction. This is a result of the cognitive mechanism meant to guard important existing relationships. The study found no significant increase or decrease in spatial awareness abilities for females following an interaction with a male confederate. One of the major limitations of this study was that we did not include male participants. Therefore, in order to alleviate that I conducted a second experiment, which would include testing males in addition to females to see if their cognitive function would decrease as studies suggests it does in regard to spatial awareness in a dyadic interaction (Karremans, Verwijmeren, Pronk ,& Reitsma, 2009). Furthermore, my second study used a different method in order to assess spatial intelligence (not just spatial awareness), utilizing the block test found within the Wechsler Adult Intelligence Scale - Third Edition (Wechsler, 1997). Last, the second study aimed to address another limitation of the first study, namely the concern that playing UNO does not affect nervous system arousal sufficiently as it tends to be associated with fun. Therefore, I used a different method of interaction in order to affect nervous system arousal, having the participants discuss their ideas behind relationships with a confederate of the opposite sex.

Study 2

A second study was completed in order to expand upon the findings of study one. Males, along with females were studied in experiment two. The interaction method with the opposite sex was also changed, opting for an interaction where the confederate asked the participant questions regarding the participant's relationship ideas. In study two, males, along with females were studied in order to examine the effect of interaction with the opposite sex and gender on cognitive ability, more specifically spatial intelligence, and nervous system arousal. In this experiment, it is hypothesized that men will score higher on spatial intelligence than women. The second hypothesis is that single participants will have a significant increase in nervous system arousal after interaction with the opposite sex, whereas participants in a committed relationship will not show a significant increase in arousal, as demonstrated in Study 1. Hypothesis three is that those who are in a committed relationship will score higher on spatial intelligence after interaction with the opposite sex. The fourth hypothesis is that mixed-sex dyad interaction will have a greater cognitive impact as measured by declines in spatial intelligence on men than it will on women.

Method

Participants. Participants (*N*=25) were college aged students from a small south-eastern liberal arts college. In the study 13 of the participants were male and 12 were female. Of the male participants 7 were single and 6 were in a committed relationship. 5 of the female participants were single and 7 were in a committed relationship. A convenience sample method was used to recruit participants.

Instrumentation. Four different instruments ,or measures, were used to collect data in this study including a demographic questionnaire, a pulse rate oximeter, and the Wechsler Adult Intelligent Scale - Third Edition (Wechsler, 1997).

Demographic questionnaire. This questionnaire consisted of three questions including if the participant was male or female, if they were single or in a relationship, and if they indicated they were in a relationship, how long that relationship has lasted.

Pulse rate oximeter. This device uses infrared light to detect and measure heart rate. This device is clipped onto the finger and light is allowed to pass through the skin to the blood vessels in order to measure the participants pulse.

Wechsler adult intelligent test third edition. (Wechsler, 1997). The portion of this test that was used was named the Block Design test. It is administered in order to measure an individual's spatial intelligence. Within this test there were fourteen tasks for the participant to complete. Each task consisted of the participant looking at a diagram of blocks organized in a specific pattern. First the participant was given an example by the observer of how to construct a pattern then asked to copy. The participant then had to construct the pattern they saw on the picture using the blocks provided which had different shading patterns on each side of the block. Each pattern created was then scored by the observer based on the correctness of the pattern and the amount of time in which the participant completed the pattern. Overall there are fourteen questions on the intelligence test. The test was split into a pre and post test format. Questions seven, nine, eleven, and thirteen were used as the pretest and eight, ten, twelve, and fourteen were used as the post test.

Relationship questionnaire. *This* questionnaire consisted of four questions used to encourage a mixed sex interaction through the confederate asking questions involving the participant's ideas on relationships. There were four questions that were asked including topics such as what the participant looked for in a relationship, what qualities they looked for in potential partners, what their biggest deal breakers were in a relationship, and what were little pet peeves that would annoy them about a potential partner.

Design and Experimental Condition.

Design. In this study a within-subjects design was used. The control group included the participant's heart rate and portion of the intelligence test before the mixed sex dyadic interaction. The experimental group included the heart rate measure and test scores post interaction. The independent variables for this study include the interaction with the confederate of the opposite sex and the sex of the participant. The dependent variables include the heart rate and the test scores.

Experimental condition. In the experimental condition participants interacted with the confederate of the opposite sex. The confederate asked the participant questions regarding their relationship ideology in order to activate their relationship schemas, and induce nervous system arousal through the interaction. The participant's heart rate was then taken using the pulse rate oximeter followed by the participant completing the posttest involving questions eight, ten, twelve, and fourteen from the Wechsler Adult Intelligent Test Third Edition (Wechsler, 1997).

***Control condition*.** Participant's heart rate was taken to act as a baseline for the experiment. After the heartrate was measured, the participants completed the post test, completing questions seven, nine, eleven, and thirteen of the Wechsler adult intelligent test third edition (Wechsler, 1997). No interaction with the opposite sex occurred during this portion of the experiment.

Procedure. Both male and female participants were gathered through a convenience sample. There are four types of participants: males who were single, males who were in a relationship, females who were single, and females who were in a relationship. Each participant was then asked to sign a consent form prior to their participation in the study. After signing the consent form the participants were asked to place the pulse rate oximeter on their finger, in order to get a physiological measure of the participant's heart rate. After their heart rates were taken, the participants were given an example of how to complete the Wechsler adult intelligent test third edition, using question number six on the block design portion (Wechsler, 1997). Once their tasks were demonstrated and it was ensured that the participant understood how to complete the tasks asked within the block design task, the researcher flipped to the first question of the pretest and had the participant begin to form their answers using the blocks. Each question was timed and then rated by the observer on the score sheet provided. Following the pretest, the participant was asked to fill out the demographic questionnaire. Once this was filled out the same sex observer exited the room and the opposite sex confederate entered to interact with the participant by asking them the relationship questions on the questionnaire. Following the mixed dyadic interaction, the participant's heart rate was once again taken. The post test was then administered. Participants were debriefed following the completion of the experiment.

Results

Several paired-sample t-tests were performed in order to test the hypotheses. An independent t-test was performed in order to see if sex had any impact on spatial ability.

Hypothesis 1: Men will score higher on spatial intelligence than women. Consistent with extant research, men did score higher than women on their overall spatial intelligence but that difference did not reach significance (t (23) = - .85, *ns*. However, the descriptive statistics were in the hypothesized direction (females: *M=30.45 SD=10.6*, males: *M=37.42 SD=12.5*). Pretest (females: *M=14.91, SD=6.19*, males: *M=19.5, SD=8.61)* and post test scores (females: *M=15.5, SD=5.17*, males: *M=17.92, SD=5.07)* were also in the hypothesized direction, however these differences were also not statistically significant.

Hypothesis 2: Single participants will have a significant increase in nervous system arousal after interaction with the opposite sex, whereas participants in a committed relationship will not show a significant increase in arousal as measured by their heart rate. Hypothesis two was also partially supported by the data. As suspected there was no significant change in physiological arousal in either female participants (t(4)=1.52, *ns*), or male participants (*t(6)*=.48, *ns*) who were in a relationship. Those in a relationship actually lowered their heart rate (female: *M*=98.17 *SD*=15.72 pre interaction to *M*=94, *SD*=20.37 post interaction, males: *M*= 79 *SD*=13.89 pre interaction to *M*=78.6 *SD* 6.02 post interaction). This is consistent with our hypothesis that people in a committed relationship will not be negatively affected in terms of terms of their physiological arousal by a mixed-sex interaction. However, no increase in heart rate was found in people who were single (females t(4)=.278 , *ns*, males: t(6)=1.549, *p=ns)*. Contrary to our hypothesis, the heart rate actually

decreased (females: M=88 SD= 9.7 pre interaction to *M*=86.2, *SD*=8.53 post interaction, males: *M*=78.43 *SD*=21.7 pre interaction to *M*=73 *SD*=13.2 post interaction).

Hypothesis 3: Participants in a committed relationship will score higher on spatial awareness intelligence was supported. Participants in a committed relationship did indeed score significantly higher than participants who were single based on their overall scores (*t* (23) = -2.02, *p* = .05. This trend also pertained to pretest and posttest scores with participants in a committed relationship consistency outperforming singe participants (For pre-test : *t* (23) -1.92, *p* =.06; posttest *t*(23) = -1.79, *p* = .08). The descriptive statistics were: Single females showed a slight increase in their scores following the interaction (*M*=12.2, *SD*=6.017 – *M*=13.2, *SD*=5.07). Females in a relationship showed no difference in their mean scores (*M*= 18.57, *SD*= 6.5 – *M*=18.43, *SD*= 5). Males who were single showed a slight increase in their scores following the interaction (M=15.86, SD=7.14 – M= 16.57, SD=5.75), whereas males who were in a relationship showed a decrease in their functioning (M=24.6, SD= 10.12 – M=19.8, SD=3.85).

Hypothesis 4: Mixed-sex dyad interaction will have a greater cognitive impact as measured by the declines in spatial intelligence on men than it will on women. In regards to hypothesis four, that men have more significant decline in cognitive functioning than women do in regards to interaction with the opposite sex (males: *M*= 19.5 *SD*=8.6 – *M*=15.55 *SD*= 5.165, females: *M*=14.91, *SD*= 6.19 – *M*=15.55, SD=5.165) . None of these results, however, reached significance.

Other Results

One interesting finding of significance within the study is that women have a significantly higher heart rate than men. Heart rate pre-interaction, t (23) =1.85, p=.039 and heart rate post interaction, t (23) = 1. 59, p=.014, both showed women having significantly higher heart rate than men. The descriptive statistics also showed that on average females had the higher hear rate both pre and post interaction (M= 93.55, SD=13.76 – M= 90.45, SD=15.908) than males did (M= 78.67, SD= 18.087- M=75.33, SD=10.84).

Figure 1

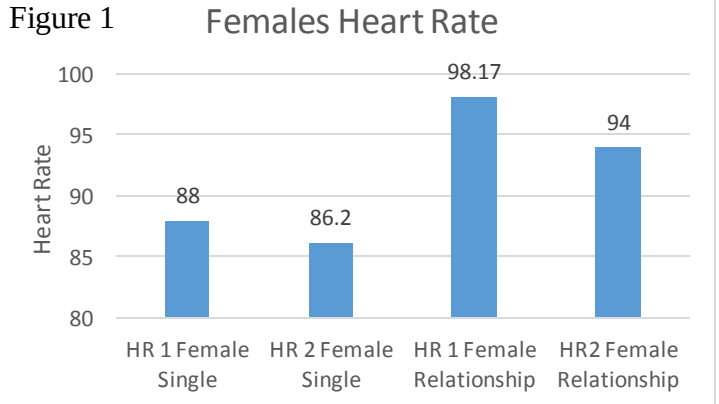


Figure 2

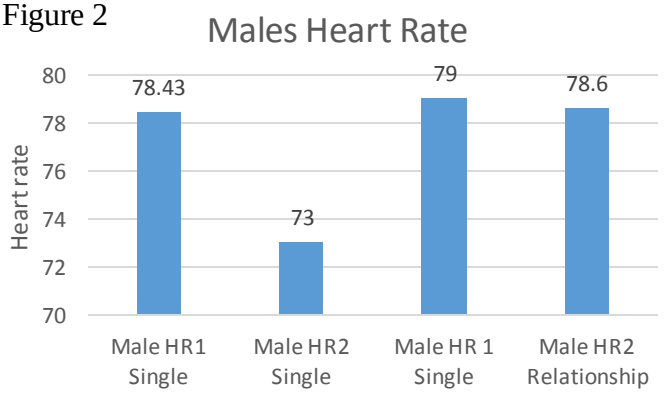


Figure 3

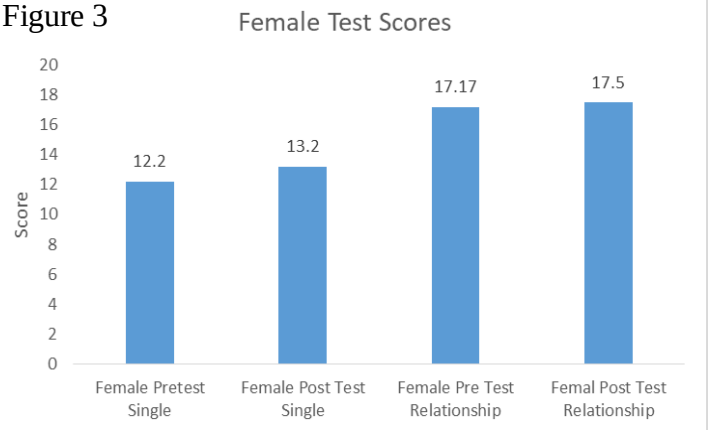
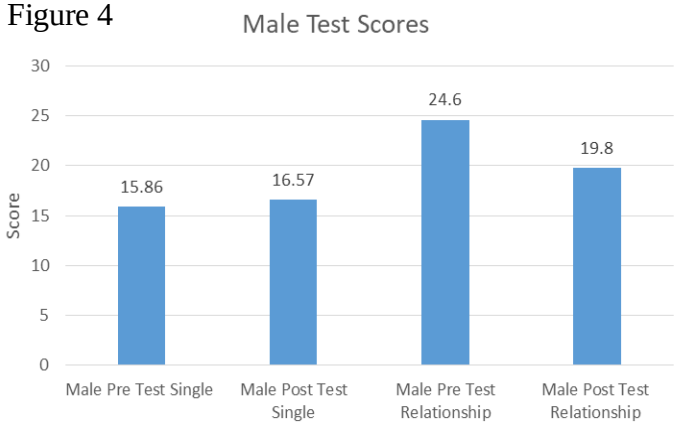


Figure 4



Discussion

The patterns of results from the present research supported the conclusion that men outperform women on spatial awareness intelligence tasks. Although the gender difference was not statistically significant, there was a clear trend. On the pretest, males scored five points higher than females, continuing that advantage over to the post test where they scored two points higher than females. Males, over all, scored seven points higher than females on the spatial ability test. This implies that males have an increased ability, whether this is an innate ability or is encouraged and honed environmentally, in spatial awareness when contrasted with females. This gives males a clear advantage in tasks which require elevated spatial ability.

An explanation for the means consistently favoring men in regards to which sex has better spatial ability, could be that men are naturally better at spatial tasks. The sex hormones, both testosterone and estrogen, seem to play a huge role in how well a person can complete a spatial ability task. Typically higher spatial awareness is associated with higher testosterone. The testosterone opposed hormone, estrogen, has contradictory consequences; instead of increasing spatial ability, estrogen is associated with lowered spatial ability. Men naturally have higher testosterone than women correlating with their increased ability for spatial awareness. Women naturally have more estrogen and less testosterone than men correlating with their lack of spatial ability (Hausmann et. al, 2000).

Biology is not the only explanation for increased spatial ability among males. As in many psychology debates, the question of nature versus nurture comes into play. Spatial ability could perhaps be due to the environment a person is placed in. While humans would like to believe that society treats everyone equally, society treats both men and women differently. This can be seen even among children. Little boys are encouraged to play with more tactile things that can increase spatial awareness, such as Legos. Boys are also encouraged to play more video games, which is a way to improve or train spatial awareness, while girls are encouraged to play with things that seem more relational, such as dolls or playing imaginary games such as house, which does not require much spatial ability. From a young age boys are given an increased advantage related to spatial ability (Cherney, 2008).

Whatever the reasoning for the advantage that males have over females in spatial ability, the fact remains that they do seem to have that advantage. This advantage can offer many benefits and successes to males that females are not privy to. One such advantage is within the STEM (science, technology, engineering, and mathematics) fields. Spatial ability is important for success within these types of fields, which is one reason why fields associated with STEM areas are predominantly male. Women, then, are at a disadvantage when it comes to pursuing such areas, and are therefore discouraged from succeeding in these areas. It is important to offer ways for women to close this gender gap, in order to allow females a greater chance at succeeding both academically and career wise. Inequality of the STEM fields can then be lessened paving the way for women to flourish (Maeda. & Yoon, 2016).

The current research, therefore, has implications for the way a female's environments should be constructed. Since females are at disadvantage regarding spatial ability, they

should be offered chances to excel in it. Because spatial ability is so important in academic and career success, and females have a disadvantage, their environment should be instructed in such a way that encourages the use of spatial ability, in order to train to increase it. This means that little girls should be encourage to play with toys that promote spatial awareness including things such as building blocks and video games. This offers females a greater chance at success and promotes STEM fields (Cherney, 2008).

The present study also looked at relationship status and its effect on nervous system arousal. Specifically, there was no significant difference in the heart rate of participants who were in a committed relationship after interaction with the opposite sex suggesting that interacting with the opposite sex does not produce a heightened nervous system response for that group. For those in a relationship, their heart rates dropped after the interactions (females dropping by one beat per minute, and males dropping by four beats per minute), as shown by the descriptive statistics (refer to Figure 1 and Figure 2). This is due to the mechanism within the brain that works to safeguard an existing relationship. This process allows the participant to downplay the impact that interaction with a person of the opposite sex may have, such as attraction, lowering their heart rate and nervous system arousal. By downplaying the attractiveness of the person of the opposite sex, who is not their partner, the existing relationship remains under no threat of disruption (Miller, 1997).

Extant research suggests that single participants show an increase in heart rate following interaction with the opposite sex. The finding was supported within our first study, but not in our second study. The descriptive statistics in Study 2 actually, showed the exact opposite trend occurring. The means for heart rate in single participants, both male and female, show that heart rate actually decreased following the interaction with the opposite

sex. Females heart rates decreased by two beats per minute when males decreased by five beats per minute.

There are several reasons why this may have occurred. One reason is again, that the sample size was too small. The small sample size reduced the power of the experiment, therefore making it harder to find statistically significant results. Another reason why no significance was found among participants who were single could be that there is not a great deal of variability among the heart rate within college students. It is no secret that college is stressful. There are many academic and social pressures, as well as pressures regarding one's future path, pressed on the shoulders of these students. Each student also is placed in a similar environment, typically overstressed and having a high heart rate, especially in female students, which causes decreased variability. Simply put, the lack of variability in heart rate among college students could have an impact on the findings of this study. Theoretically, heart rate variability could be low among the participants, producing non-significant results. Finally, another reason that could have impacted the findings of this study could be the mode and duration of the interaction which occurred. There was no set time for each interaction with the participant. The participant was only asked to answer a list of questions given by the confederate of the opposite sex regarding relationship ideas. If the participant answered the questions quickly, the interaction could be cut short. Likewise, if the participants took their time answering the questions, the interaction could drag on. The varying amount of time interacting with the confederate could either allow the participants to not have enough interaction with the confederate to impact their heart rate in any meaningful way, or it could cause them to become at ease with the confederate and by the time their heart rate was taken, have slowed down. Also, the mode of the interaction could play a role in why the results

were not significant. While the participant did interact with the confederate, the confederate did not always provide feedback within the interaction. Therefore, it was very different from how a normal social interaction would occur and could supply differing, insignificant results.

The present study also showed that participants in a committed relationship score higher on spatial intelligence measures, evidenced by them having a high total score than single participants. Furthermore, participants in a committed relationship did not show signs of decreased cognitive functioning after the mixed-sex interaction. There was no significant difference found regarding the pretest scores versus the post test scores. This finding can be potentially explained by the protective effects of the cognitive mechanism built in to safeguard the existing relationship which are important to an individuals' framework discussed above. In females who were in a relationship, the pretest and post test scores remained practically unchanged, staying at approximately eighteen points for both. The descriptive statistics for men, however, showed a lowering of scores from the pretest to the post test by five points. The lowering of the means between the pre and post test for men in a relationship can be explained by hypothesis four, that interaction with the opposite sex has a greater impact cognitively on men.

Hypothesis four stated that mixed-sex dyadic interaction has a greater impact on cognitive functioning on male participants. The findings of this study seem to suggest that men do indeed have a greater cognitive functioning decline after interacting with the opposite sex than women do. Although the findings did not reach significance, the descriptive statistics showed that men had a greater decrease after interacting with the opposite sex than women did. These statistics show that men's intelligence decreased by four points in their score from the pretest to the post test. Women, however, increased their performance by one

point. This shows that interacting with the opposite sex has a greater cognitive implication for men than it does women. Extant research has supported this idea (Karremans, Verwijmeren, Pronk.,& Reitsma, 2009). There are several reasons why this pattern of results did not reach statistical significance in the present study. A common theme throughout this research, one of importance, was the small sample size.

Furthermore, there was an unexpected result found when comparing the heart rate both pre- and post interaction between males and females. This unexpected result showed that women consistently had a much higher heart rate than men. Pre-interaction, women's heart rate averaged ninety-four beats per minute whereas men's heart rate averaged seventy-nine beats per minute. Post interaction, women's heart rate averaged ninety beats per minute, whereas men had a significantly lower heart rate of approximately seventy-five beats per minute. This pattern of results showed that college women, in our particular sample, have a significantly higher heart rate than the male participants did.

There are several different explanations for this finding. One reason this could have occurred relates to sex hormones. There seems to be a link between estrogen levels and heart rate. When women are pre-menopausal, their heart rate remains higher, however, after menopause, their heart rate seems to decrease, a positive correlation to estrogen levels. Male naturally have less estrogen than female, which would explain why this study found that female's heart rates were higher (Ryan, Goldberger, Pincus, Mietus, & Lipsitz, 1994). Another explanation for this finding is that women are under much more stress than men. One study found that females report more stress than their male counterparts. A higher stress level would correlate with a higher heart rate. Males, being less stressed on average than

women, would exhibit lower physiological signs of arousal than women would. (Cohen, & Janicki-Deverts, 2012).

Females and males are clearly different, not only in how fast their hearts beat, but in their ability to reason spatially as well. This idea is supported in previous studies conducted as well as shown in the descriptive statistics within experiment two. Females and males also seem to differ on how interaction with the opposite sex impacts their cognitive functioning, shown in the previous research. Mixed-sex dyadic interaction impacts both sexes when a person is single, showing an increase in heart rate post interaction. Those who are in a relationship show no significant difference in nervous system arousal. In fact, the means for a participant's heart rate decreases following interaction with the opposite sex. This is the brain's way of safeguarding the existing relationship, downplaying the attractiveness level of others, lowering the threat to the relationship. The present study supported past research that suggests there is a relationship between the physiological and cognitive responses to mixed-sex dyadic interactions. It is important to conduct future research with larger samples, more specifically regarding mixed dyadic interactions and spatial ability, in order to increase the chance of gaining significance. Also, this study consisted of mostly heterosexual participants. It would be interesting to test whether interaction with the same sex, for those who are homosexual, has an impact on these variables and compare these findings to interaction with the opposite sex for heterosexuals. There has not been an ample amount research published on this topic and therefore this would be a great idea for future studies.

In conclusion, through examination of past literature as well as experimentation, it seems that a person's relationship status does influence that person's attentiveness to alternatives. This has important implications social interactions with people of the opposite

sex as well as a person's cognitive abilities when in the presence of the opposite sex. Interaction can have both physiological and psychological consequences associated with it. This information can change how psychologists, and society in general, view everyday interactions between men and women.

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