THE INFLUENCE OF ROMANTIC PARTNERS ON MALES' DECISION-MAKING

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ABSTRACT

Evolutionary models of adolescent and young adult risk-taking posit that risk-taking increases during this period of the life span as a strategic way for males, in particular, to show dominance, increase perceptions of attractiveness by the opposite-sex, and maximize their chances of acquiring a romantic partner (and ultimately produce offspring). Consistent with this perspective, existing research demonstrates that attractive females increase risk-taking in single males, in part by enhancing males' sensitivity to rewards and diminishing their ability to inhibit impulsive behavior. By contrast, romantically committed males engage in less risk taking than their single counterparts, although the mechanisms underlying the effect of romantic partners/partnerships on male risk-taking are less clear.

In the present study, I employed a behavioral paradigm that has been used in prior studies of peer influence to examine how romantic partners affect decision-making processes and risk-taking behavior in young heterosexual males (18 to 24 years old). I also explored whether there are particular individual and relationship characteristics that moderate the effect of romantic partners on males' decision-making. This study was conducted using a sample of 134 romantically involved males (mean age=20.2, SD=1.65; 64% White) who were randomly assigned to participate in one of three experimental conditions: alone, in the presence of an attractive female confederate, or in the presence of their romantic partner. Across conditions, I compared males' behavioral performance on five outcome measures: risk taking (using the Stoplight Task), preference for immediate rewards (using a Delay Discounting Task), reward learning and cost

avoidance (using a modified version of the Iowa Gambling Task), and inhibitory control over both neutral and emotionally charged stimuli (using cognitive and emotional versions of the Stroop Task).

I found that the presence of romantic partners diminishes risk taking in males, but that romantic partners do not have a significant impact on males' sensitivity to rewards (neither immediate nor long-term), sensitivity to loss (i.e., cost avoidance), or their ability to inhibit attention to interfering—neutral or emotional—stimuli. However, improvements in cognitive control in the presence of romantic partners were observed among males who report low levels of passionate love. That is, mildly infatuated males exhibited better cognitive control in the presence of their romantic partners relative to mildly infatuated males who were alone. Partner presence had no such effects among males who reported being highly infatuated with their girlfriends. The presence of an attractive female stranger triggered a protective response among romantically involved males—prompting them to take fewer risks (when they are highly committed to their partners), to more quickly avoid decisions that lead to long-term loss (among older males only), and to exhibit better cognitive control (only among males in relatively longer relationships). The presence of an attractive female stranger did not affect males' sensitivity to rewards.

Evidently, the relative impact of an attractive female stranger on males' risk taking and decision-making is highly dependent on individual and relationship factors, a finding that emphasizes the importance of context when it comes to understanding males' relative susceptibility to temptation (e.g., other females) and opportunities for potential

risk (e.g., infidelity). By contrast, the dampening effect of romantic partners on male risk taking is neither dependent on individual or relationship characteristics nor the result of romantic partners' influence on reward sensitivity or inhibitory control. However, given the finding that romantic partners enhance cognitive control when feelings of passionate love are relatively low, future research should examine how passionate love and cognitive control interact to predict risk taking.

Although I could not identify potential mechanisms to explain why the presence of romantic partners diminishes males' risk-taking, the current study demonstrates that under specific circumstances—such as when there is high relationship commitment or when the relationship is relatively long—the presence of an attractive female stranger can stimulate romantically involved males to engage regulatory processes that may contribute to their reduced inclination toward risky behavior in that context. This finding is consistent with prior studies and suggests that the presence of tempting stimuli and potential threats to relationship fidelity can trigger males' deliberate engagement of regulatory processes in effort to maintain their current romantic relationship. In contrast, males' reduced inclination to engage in risky behavior in the presence of their romantic partners may be automatically activated (without inducing a particular psychological state) regardless of individual and relationship characteristics.

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CHAPTER 1

INTRODUCTION

A widely recognized phenomenon in human development is the increase in risk taking that occurs in adolescence before declining into adulthood. Abundant research demonstrates that adolescents (including individuals in their early 20s) are more likely than children and slightly older adults to engage in risky behaviors such as criminal activity, promiscuity, reckless driving, and substance use (Institute of Medicine & National Research Council, 2011; Steinberg, 2008). A notable characteristic of adolescent risk taking, however, is that it tends to occur in certain social contexts and be influenced by particular social relationships, such as those involving peers. For instance, adolescent drivers are much more likely to speed and drive recklessly when accompanied by same-age passengers than when driving alone (Lee & Abdel-Aty, 2008; Ouimet et al., 2010; Simons-Morton, Lerner, & Springer, 2005).

In addition to these epidemiological data on automobile accidents, several experimental studies have shown that, relative to how they behave when they are alone, adolescents take more risks in the presence of same-age peers (Albert, Chein, & Steinberg, 2013; Chein et al., 2011; Gardner & Steinberg, 2005; Silva, Chein, & Steinberg, 2016; Smith, Chein, & Steinberg, 2014). By contrast, when adolescents are in the presence of an adult, they take fewer risks than they do when they are alone (Telzer, Ichien, & Qu, 2015), and the impact of peers on risk taking is significantly reduced (Silva, Chein, & Steinberg, 2016). These studies suggest that the extent to which

adolescents engage in risky activities is highly contingent on social context and particularly sensitive to the presence of same-age peers.

An evolutionary model of adolescent risk-taking posits that adolescents' tendency to engage in risk-taking is strategically tuned to the social demands and opportunities of the surrounding environment, sometimes unconsciously (Ellis et al., 2012). Because this period of the life span is critical for attaining status and setting social and reproductive goals, some argue that adolescents' heightened propensity to engage in risk behaviors is evolutionarily adaptive, and that adolescent males, in particular, may be developmentally "primed" for risk taking in peer contexts (Crone & Dahl, 2012; Ellis et al., 2012; Trivers, 1972). Specifically, because the demands of reproduction are much greater for females than males (in terms of time and physical effort from conception to reproduction; Buss, 1989; Li, Bailey, Kenrick, & Linsenmeier, 2002), males must compete among themselves for reproductive access to females. From this perspective, natural selection favors males' heightened propensity to take risks around peers because doing so serves as a means to display social dominance (e.g., frighten off competitors) and to increase social and reproductive status (e.g., attract the opposite sex).

Consistent with this idea, most forms of risk taking (e.g., substance use, antisocial activities) are more common among adolescent males than females (Brodbeck, Bachmann, Croudace, & Brown, 2013; Svensson, 2003). While some argue that gender differences in some forms of risk taking may, at least in part, be due to gender differences in opportunity and time spent with peers (e.g., adolescent males tend to be less monitored than females; Svensson, 2003), there is evidence that males are significantly more

inclined than females to conform to peers' pressure to engage in risky, but not neutral, behaviors (Brown, Clasen, & Eisher, 1986). Moreover, it has been shown that young males give greater weight to the benefits of risky decisions than females do, especially when in a group than when alone (Gardner & Steinberg, 2005). Thus, consistent with evolutionary theory, risk taking may have greater social value for males than it does for females.

Consider, for example, the ways in which young males across several species engage in behaviors that expose them to potential harm yet also function to leverage access to potential females (Gallup, O'Brien, & Wilson, 2011; Sylwester & Pawlowski, 2011). In one relevant study of human males, Ronay and van Hippel (2010) had a male experimenter ask young male skateboarders in public parks to perform one easy trick (i.e., one they could successfully complete on most attempts) and one difficult trick (i.e., one they were currently learning and only could successfully complete approximately 50% of the time). The young skateboarders attempted each trick 10 times while being video-recorded by a male experimenter. After a short break, the skateboarders were randomly assigned to attempt each trick 10 more times, either for the same male experimenter or for an attractive, 18-year-old female experimenter. Risk taking was assessed in terms of the number of aborted attempts of the difficult trick between the first and second trials. Skateboarders were less likely to abort difficult attempts (i.e., they took more risks) in the presence of the attractive female experimenter relative to their performance in the presence of the male experimenter. This heightened tendency to attempt difficult tricks in the presence of an attractive female led to more crash landings

but also to more successful tricks, and was partially mediated by increases in testosterone, which is known to facilitate displays of "bravery" and courting efforts by temporarily increasing physical strength, reducing fear responses, and increasing risk taking, all of which increase the probability of approaching and attracting potential mates (Eisenegger, Haushofer, & Fehr, 2011; Roney & Gettler, 2015).

In accordance with an evolutionary model of adolescent risk-taking (Ellis et al., 2012), evidence from developmental neuroscience supports the idea that the neurobehavioral changes that occur in adolescence and into the early 20s function to intensify motivation for peer status, acceptance, and resultant mating opportunities (Crone & Dahl, 2012). Throughout this developmental period, the brain becomes increasingly sensitive to social and emotional rewards, whereas the development of regulatory functions that help foster impulse control is not complete until the early-to-mid twenties (Casey et al., 2011; Shulman, Smith, et al., 2016; Somerville, Jones, & Casey, 2010; Steinberg, 2008). This sensitivity to social rewards at a time when self-regulatory skills are not yet fully mature creates a "maturational gap" that is thought to underlie adolescents' susceptibility to risk taking, especially in peer contexts, relative to children and adults (Casey et al., 2011; Shulman, Smith, et al., 2016; Somerville, Jones, & Casey, 2010).

In samples of adolescents and young adults, studies have shown that the mere presence of same-sex and attractive opposite-sex peers heightens activation of the adolescent brain's reward circuitry (in particular, the ventral striatum; Aharon et al., 2001; Aron et al., 2005; Bartels & Zeki, 2004; Fisher et al., 2010; Guyer et al., 2009;

Ortigue et al., 2007; Smith, Steinberg, Strang, & Chein, 2015; Xu et al., 2010), which provokes adolescents to be more oriented toward immediate relative to future rewards (Silva, Chein, & Steinberg, 2016; Weigard et al., 2014; Wilson & Daly, 2004), and contributes to adolescents' increased likelihood of risk taking in peer settings (Chein et al., 2011; Frankenhuis, Dotsch, Karremans, & Wigboldus, 2010; Ronay & van Hippel, 2010; Silva, Chein, & Steinberg, 2016). Notably, however, studies show that heterosexual males' increased propensity to engage in risky behaviors in the presence of attractive females is evident primarily among males who are uninvolved and motivated to pursue a potential partner (Baker & Maner, 2008, 2009). In addition, it specifically is attractive (relative to unattractive) females that provoke males to be more oriented toward immediate relative to future rewards (Wilson & Daly, 2004). These findings are consistent with the idea that males are likely to be particularly oriented toward reward-seeking behaviors in the context of a mating opportunity.

Examinations of how these different peer contexts affect adolescents' ability to regulate impulses have shown that, although same-sex peers do not appear to affect adolescents' ability to inhibit impulses (Rosenbaum, 2014; Smith, Rosenbaum, Botdorf, Steinberg & Chein, under review), their impact on reward-related processes potentially widens the relative functional imbalance between brain regions involved in processing rewards and those that support impulse control, thereby contributing to higher rates of risk taking in same-sex peer contexts (Chein et al., 2011; Smith et al., 2014). In contrast, the presence of attractive opposite-sex peers not only increases young males' sensitivity to rewards (Wilson & Daly, 2004), as it does in the presence of same-sex peers, but also

weakens their ability to inhibit impulses (Karremans, Verwijmeren, Pronk, & Reitsma, 2009; Nauts et al., 2012), both of which are thought to contribute to increases in risk taking among sexually motivated males. The extant literature thus suggests that although there may be a "maturational gap" in the relative functional engagement of reward-processing and impulse control regions during adolescence and early adulthood (Casey et al., 2010; Steinberg, 2008), the extent to which this functional imbalance is experienced, or behaviorally manifested (particularly among young males), depends on the affective salience of the surrounding social context as well as individuals' motivational goals.

The Present Study

If, from an evolutionary perspective, a major function of young males' susceptibility to risk taking in peer contexts is to increase social dominance and status, and to ultimately attain reproductive access (Ellis et al., 2012), and adolescent brains are adaptively and flexibly wired to facilitate the achievement of these developmental goals (Crone & Dahl, 2012), it raises the question of whether, and how, membership in a romantic partnership diminishes risk taking, once the individual's motivational goal is (presumably) to maintain that relationship and secure long-term reproductive success. In the current study, I employed a behavioral paradigm that has been used in prior studies of peer influence to examine how romantic partners affect decision-making processes and risk-taking behavior among romantically involved young males. The present work is guided by two perspectives described earlier: the evolutionary model of adolescent risk-taking, which posits that adolescent males' risky decision-making is adaptively tuned to optimize social, biological, and developmental needs (namely, social bonding, social

status, and reproduction; Ellis et al., 2012; Trivers, 1972), and neurobehavioral models of adolescent risk-taking, which posit that adolescents' propensity to engage in risky decisions in peer contexts results from a relatively greater functional and behavioral imbalance between adolescents' sensitivity to social rewards and their impulse control capabilities (Smith, Shulman, et al., 2016; Somerville, Jones, & Casey, 2010). Although partly guided by prior neurodevelopmental work, the present study uses a battery of behavioral assessments known to measure key psychological processes (e.g., reward sensitivity and impulse control) implicated in risky decision-making.

In the next section, I first review the literature on the association between romantic status and risk taking in late adolescence and early adulthood. I focus exclusively on studies of late adolescents and young adults because it is during this period that forming romantic relationships becomes a salient developmental task. I then review studies that shed light on potential mechanisms through which romantic partners or partnerships affect risky decision-making, focusing primarily on studies that examine the impact of romantic partners or romantic partnerships on reward sensitivity and impulse control.

Although the focus of the present study is on young adult men, in my discussion of potential mechanisms through which risk taking is potentially influenced, I review studies that rely on samples of somewhat older individuals, because a large amount of work on this topic comes from investigations that examine associations between marriage and desistance from risk behaviors. In addition, I review studies that examine how romantically committed males behave in the presence of other attractive females, as some

have argued that the presence of attractive female strangers creates an ecologically valid context for understanding how involved and uninvolved males behave in the face of temptation (and, presumably, when there is a potential opportunity for risk taking). Lastly, following the discussion of pertinent literature, I outline the research questions and specific hypotheses that the current study aimed to address.

Relationship Status and Risk Taking

Studies of late adolescents and young adults show that individuals who are in romantic relationships report less substance use and criminal activity than their single counterparts (Amato & Kane, 2011; Barr, Culatta, & Simon, 2013; Braithwaite et al., 2010; Fleming, White, & Catalano, 2010a; Fleming et al., 2010b; Salvatore, Kendler, & Dick, 2014; Staff et al., 2010; Uecker, 2012). For example, Fleming, White, and Catalano (2010a) followed a community sample of recent high school graduates for two years (from age 18 to 20) to examine the association between relationship status and changes in substance use. They found that, after controlling for age as well as individual differences in baseline levels of substance use, employment, school enrollment, and parenthood, youth in dating, cohabiting, and marital relationships engaged in less heavy drinking and marijuana use than single individuals over the two-year study period. Among both males and females, this effect was strongest among married individuals, moderate among those in cohabiting partnerships, and weakest among those in dating relationships (Fleming, White, & Catalano, 2010a). These findings suggest that establishing a romantic partnership in late adolescence or early adulthood may offer some protective effects

against risk taking, but that the magnitude of this effect varies by the type of relationship or degree of commitment.

Indeed, some studies report that greater relationship commitment, rather than romantic involvement *per se*, is a better predictor of individual differences in risk taking among youth and adults (Collibee & Furman, 2015; Fischer & Wiersma, 2012; Gudonis-Miller et al., 2012; Monahan, Dmitrieva, & Cauffman, 2014; Simons, Stewart, Gordon, Conger, & Elder, 2002). For example, Gudonis-Miller et al. (2012), using data from the first three waves of the National Longitudinal Study of Adolescent Health (Add-Health), found that young men and women who reported greater increases in relationship seriousness from ages 17 to 23 reported lower rates of marijuana use at age 23, after controlling for marijuana use at age 17. Thus, the more serious a romantic relationship became during this period, the less likely individuals were to report marijuana use over time. In another study, Collibee and Furman (2015) found that, in both adolescence and early adulthood, individuals in a high-quality romantic relationship (measured in terms of support, positive interactions, and relationship satisfaction) engaged in less risk-taking behavior relative to those in low-quality relationships.

Consistent with the evolutionary model of adolescent risk-taking (Ellis et al., 2012) discussed earlier, existing studies demonstrate that young single males are more prone to risk taking, whereas those who are already in a relationship are less likely to engage in risky behaviors, particularly when involved in high-quality, committed partnerships. Lacking in this literature, however, is an understanding of the potential mechanisms that impel young males to engage in less risk taking once they have

established a romantic partnership. Given what we know about how same-sex and opposite-sex peer presence affect key processes implicated in risky decision-making (e.g., by increasing reward sensitivity or diminishing impulse control), it is possible that romantic partners influence how males process rewards (e.g., decreasing the rewarding value of tempting stimuli), how successful they are at inhibiting the impulse to respond to tempting stimuli (e.g., increasing impulse control), or both.

Romantic Relationships, Reward Processing, and Impulse Control

Research on the influence of romantic partners on reward processing is scant. Our understanding is limited to what we have learned from a few imaging studies showing that neural activity in reward-processing regions (e.g., ventral tegmental area and striatum) increases when heterosexual individuals view pictures of their romantic partners relative to when they view pictures of an opposite-sex close friend (Aron et al., 2005; Bartels & Zeki, 2004; Fisher et al., 2010; Ortigue et al., 2007; Xu et al., 2010). In one relevant study, the differential increase in reward-related activation when individuals view pictures of their partners relative to when they view pictures of another individual of the same gender as their beloved was more pronounced among individuals who report relatively higher feelings of passionate love toward their romantic partners (Aron, Fisher, Mashek, Strong, Li, & Brown, 2005). In other words, individuals who are intensely infatuated with their partners exhibit relatively greater reward activity to cue representations of their romantic partners than less infatuated individuals.

The same study (Aron, Fisher, Mashek, Strong, Li, & Brown, 2005) also found a positive association between relationship duration and increased activity in the anterior

cingulate cortex (ACC), a cognitive control region involved in monitoring conflict during response selection and conveying a feedback signal to brain areas involved in the actual execution of a response (such as the prefrontal cortex; Botvinick et al., 1999; Carter et al., 1998). Although these results must be interpreted with caution because they are cross-sectional, and because they tell us nothing about risk-taking behavior per se, they demonstrate that exposure to cues of passionately loved partners increases activity in reward regions and suggest that the relative activation of regions involved in cognitive control may be greater with increasing relationship duration. Other related work on the role of passionate love in decision-making processes suggests that intense feelings of passionate love toward a partner can also impair cognitive control (van Steenbergen, Langeslag, Band, & Hommel, 2014). In an examination of how passionate love affects cognitive control performance, van Steenbergen and colleagues (2014) studied a group of heterosexual males and females who had recently fallen in love, because feelings of passionate love (or infatuation) are likely to be particularly intense in the early stages of a romantic partnership. Participants, all of whom were in relatively new relationships (between 1 to 6 months, with an average duration of 2.8 months), completed a measure of passionate love (which includes items such as intrusive thoughts about one's partner, feelings of attraction, desire for physical closeness, and self-reported physiological arousal). The researchers then induced a state of "amorous mood" by instructing participants to write about a past romantic event or to focus on a romantic vignette presented by the experimenter. During this 10-minute affect induction, participants listened via headphones to their favorite romantic music, which they had brought with

them (a procedure known to evoke intense feelings of romantic love). Finally, participants completed the Stroop and Flanker tasks, both of which measure individuals' ability to inhibit attention to distracting, yet tempting, stimuli (i.e., control the impulse to respond to interfering information). Participants also rated their degree of affective arousal several times throughout the experiment. Males and females who reported high levels of passionate love were significantly worse at regulating the impulse to attend to distracting information, compared to individuals who reported low levels of passionate love. The findings were independent of the individuals' affective state at the moment they performed the tasks (van Steenbergen, Langeslag, Band, & Hommel, 2014). Along with previously discussed work, these findings support the possibility that intense feelings of passionate love toward a romantic partner may create a particularly vulnerable state for risk taking, as studies show that feelings of passionate love are positively associated with reward activity (Aron, Fisher, Mashek, Strong, Li, & Brown, 2005) and negatively associated with impulse control (van Steenbergen, Langeslag, Band, & Hommel, 2014). However, no study has explicitly addressed how the impact of passionate love on reward processing and impulse control systems contributes to risky decision-making.

Additional related work on the topic of romantic partners and risk taking include investigations that assess psychological changes that occur after people marry, and examine whether these changes explain why marriage is associated with lower rates of crime (Barr & Simons, 2015) and substance use (Forrest & Hay, 2011). In one study, Forrest and Hay (2011) examined whether gains in self-control when individuals transition into a marital relationship account for differences in marijuana use between

married and unmarried individuals. Using a subsample of adolescent and young adult marijuana users from the National Longitudinal Study of Youth, who were between 14 and 21 years old at baseline and followed longitudinally for 25 years, the authors found that individuals who married during the study period exhibited significant increases in self-control relative to individuals who remained unmarried. Importantly, because the analyses controlled for age, gender, employment, education, and baseline levels of self-control, these improvements in self-control could not be attributed to individual differences in initial levels of self-control, the passage of time, or social transitions other than marriage (e.g., changes in schooling or employment). The authors then tested the association between marital transition and marijuana use, and found that individuals who married during the period study were less likely to report using marijuana than individuals who did not marry. However, after controlling for improvements in self-control, married individuals were no longer significantly less likely to stop using marijuana than unmarried individuals. These findings suggest that the improvements in self-control that coincide with marriage may, at least in part, explain why married individuals are more likely than unmarried individuals to stop using marijuana.

While informative, the study is limited by the inability of the authors to make causal or even directional inferences. An additional limitation of this study is that self-control was operationalized using items that conflate *impulsivity* (e.g., I often get into a jam because I do things without thinking; I think that planning takes the fun out of things) and *sensation-seeking* (e.g., I enjoy new and exciting experiences, even if they are a little frightening or unusual), despite evidence that these psychological traits are distinct

(Whiteside & Lynam, 2001) and independent constructs (Shulman, Harden, Chein, & Steinberg, 2014) that follow separate developmental trajectories (Harden & Tucker-Drob, 2011; Steinberg, 2008). Therefore, even if marriage had led to a decline in marijuana use, it is unclear whether the effect of marriage on marijuana use is driven by changes in impulse control, in sensation seeking, neither, or both.

Attractive Female Strangers as Evokers of Males' Risky Decision-Making

In the real world, attractive female strangers can be a significant source of temptation to married men, often inducing internal conflict for the individual and creating the potential for risk taking (e.g., infidelity). An extant body of work focused on how romantically committed males behave in the presence of other attractive females informs our understanding of processes and factors that encourage or deter males from responding to appealing stimuli (e.g., an attractive woman) that ultimately present a challenge or threat to their motivational goals (e.g., to maintain the relationship or to remain faithful). Given this context, experiments that expose romantically involved men to attractive female strangers create a unique and ecologically valid context for understanding the ways in which romantically involved males are psychologically and behaviorally affected by potentially tempting interpersonal stimuli.

In one relevant study, Frankenhuis and Karremans (2012) found that, in the presence of an attractive female, young males who were romantically involved took fewer risks than single males, and that this difference in risk-taking behavior was even more pronounced when the males believed that the female observer was highly attracted to risk-takers, and when the partnered males reported being deeply committed to their

current partners. Thus, the presence of a female signals a potential mating opportunity for young, single males, prompting them to engage in risk taking, while the same cue motivates romantically involved males to engage in less risky behavior, especially if they are deeply committed to their partners (Frankenhuis & Karremans, 2012). Although this study does not address potential mechanisms underlying this effect, related studies in this area have shown that romantically committed males are repelled, rather than enticed, by images of attractive opposite-sex others, often rating the females in these pictures as less attractive than do single males (for reviews see Lydon & Karrevans, 2015; Maner & Ackerman, 2015; Maner, Gailliot, & Miller, 2009; Maner, Rouby, & Gonzaga, 2008; Ritter, Karremans, & van Schie, 2011).

Although this devaluation of other females may suggest an underactive reward system in the presence of a potential temptation, this pattern of behavior observed among romantically committed men in response to cues of another attractive female appears to require the exercise of cognitive control. Specifically, in a series of experiments, Ritter and colleagues (2010) demonstrated that in conditions where there is time pressure, or when cognitive control resources are temporarily depleted (e.g., by having participants suppress emotional responses to an emotionally-charged film), romantically involved males and single males rate the attractiveness of female strangers comparably (Ritter, Karremans, & van Schie, 2010), pointing to the role of self-regulation among romantically involved men in successfully suppressing attraction to other females. Related studies also show that romantically committed males exhibit greater self-regulation and impulse control in the presence of attractive (relative to unattractive)

females (Maner & Ackerman, 2015; Maner, Rouby, & Gonzaga, 2008; Meyer, Berkman, Karremans, & Lieberman, 2011; Ritter, Karremans, & van Schie, 2010), and that seeing images of attractive females increases activation in brain areas implicated in regulatory control (e.g., right ventrolateral prefrontal cortex), particularly among participants who report being more strongly committed to their romantic partners (Meyer, Berkman, Karremans, & Lieberman, 2011).

In addition, individual differences in regulatory ability predict males' likelihood of resisting the temptation of other attractive females. For instance, Pronk, Karremans, and Wigboldus (2012) had a sample of young males and females complete a task in which they saw emotional words (e.g., happy) on the screen, displayed in either blue, green, or white, and were instructed to press one of two buttons to indicate whether the word on the screen was positive (right button) or negative (left button), but only if the word appeared in white. If the word on the screen was blue or green, participants had to ignore the content of the word and instead press one of two buttons to indicate whether the word on the screen was blue (right button) or green (left button). Performance on this difficult task requires the input of several executive functions (e.g., goal maintenance, conflict monitoring, inhibition) and was used as a measure of cognitive control. Results from a series of experiments in this study showed that, compared to individuals with low cognitive control, young men and women who exhibited greater cognitive control reported less difficulty staying faithful to their partners, showed less flirting behavior toward attractive opposite-sex confederates, and were less likely to express desire to meet attractive members of the opposite sex (Pronk, Karremans, & Wigboldus, 2012).

This body of work suggests that romantically involved males' ability to successfully suppress attraction to potentially tempting stimuli, and to engage in less risk taking in the presence of an attractive female stranger, may require both a devaluation of the rewarding aspects of the stimuli and the active engagement of regulatory control. (Although these findings apply to both males and females, I am emphasizing the effect of attractive females on male decision-making because theoretical and empirical work suggests that males, not females, are prone to engaging in risky behaviors as a tactic for increasing their own attractiveness as potential partners). These studies provide insight into the processes and strategies that committed males may rely on to resist temptation and maintain their current relationships. It is clear that stimuli that potentially threaten the maintenance of a romantic relationship stimulate these protective processes. What remains unknown is whether the actual presence of a romantic partner even in the absence of a threat to the relationship stimulates similar processes to foster the same motivational goal (i.e., relationship maintenance), or whether it is only in the presence of a threat to the relationship that these protective processes are activated. It is possible that in the absence of a potential threat (e.g., when no attractive females are present), the presence of romantic partners has no effect on males' responsiveness to rewards, sensitivity to loss, impulse control, or risk taking, as it would no longer be a situation of temptation and thus there would be no triggering of a protective response. Conversely, it is possible that even in the absence of a potential threat, the presence of a romantic partner could stimulate a reward response (as demonstrated in existing imagining studies; Aron et al., 2005; Bartels and Zeki, 2004; Fisher et al., 2010; Ortigue et al., 2007; Xu et

al., 2010), which, combined with a partner-induced increase in cognitive control, may contribute to males being more oriented toward the long-term goal and reward of staying together, and less inclined to take risks.

Research Questions and Hypotheses

Using a paradigm that compares behavioral performance among romantically involved males in three experimental conditions (alone, in the presence of an attractive female confederate, or in the presence of their romantic partner), the present study addressed the following research questions and tested two specific hypotheses:

1) What is the effect of romantic partner presence on young adult males' risk taking, reward sensitivity, and cognitive control?
2) Among romantically involved males, how are risk-taking tendencies and decision-making processes differentially affected by the presence of a romantic partner relative to presence of an attractive female alternative?
3) Is it possible to identify individual and/or relationship characteristics that moderate the effect of female presence on male decision-making?

Hypothesis 1—Males tested in the presence of their romantic partner will engage in less risk taking, be more oriented toward future relative to immediate rewards, be more sensitive to experiences of loss, and show greater cognitive control than males tested alone. The magnitude of this effect will depend on relationship duration, relationship commitment, and feelings of passionate love. Specifically, in relatively longer relationships, and when commitment is high, the presence of romantic partners will have a dampening effect on risk-taking behavior (and decrease reward sensitivity, heighten

sensitivity to loss, and increase cognitive control). When feelings of passionate love are high, the presence of romantic partners will have the opposite effect (increase risk taking and reward sensitivity, and decrease sensitivity to loss and cognitive control).

Hypothesis 2—When relationship commitment is high, the presence of an attractive female confederate will activate a protective response, and males will behave similarly to how committed males behave in the presence of their romantic partners. Conversely, when relationship commitment is low, males who are in presence of an attractive female confederate will engage in more risk taking, be more oriented toward immediate relative to future rewards, be less sensitive to losses, and demonstrate lower cognitive control relative to males who are alone.

CHAPTER 2
METHODS

Participants

Young heterosexual couples between the ages of 18 and 24 were recruited from local colleges in a large northeastern U.S. city. The study was publicized through printed advertisements aimed to recruit romantically involved individuals, between 18 and 24 years old, to participate in a decision-making study for young couples. Interested individuals who contacted our research team were screened to ensure they met the age criteria and were able to come to the lab with their romantic partner for a 75-minute visit.

Based on prior studies of peer influences on decision-making, I planned to test 50 couples in one of three experimental conditions: 1) *Alone*, where the couple was separated and each partner in the pair was tested alone; 2) *Confederate Presence*, in which the male partner was tested in the presence of an attractive female confederate and the romantic partner was tested alone; and 3) *Romantic Partner Presence*, in which the male partner was tested in the presence of his romantic partner. In conditions 2 and 3, the male subject was selected as the target subject to complete the study tasks while the partner or confederate observed.

Study compensation for each target participant and each partner was a $15 Amazon gift card. In addition to this baseline compensation, all participants were informed they could win a $10 bonus on the gift card depending on how they performed on the test battery. When the target subject was tested in the presence of his partner (condition 3), the partner's bonus was also contingent on the performance of the target participant. This compensation strategy was used to increase motivation and engagement

in the tasks. In reality, however, both the target participant and his partner received both the baseline and bonus compensation (i.e., each received a $25 gift card).

Procedure

Social Context Manipulation

Upon arrival in the laboratory, each couple was pseudo-randomly assigned to one of the three experimental conditions. Specifically, I counterbalanced conditions, assigning one participant couple to condition 1, the next participant couple to condition 2, and so forth, such that I systematically rotated among the three conditions until the target sample for each condition was met. A 24-year-old attractive female was recruited to serve as the study confederate in condition 2. Confederate attractiveness was established by having 32 independent male undergraduates view 3 photographs of the female and rate how attractive they found her on a scale from 1 (very unattractive) to 9 (very attractive). The mean attractiveness rating was 7.28 (SD=0.81), which was significantly higher than the scale midpoint of 5, $t(31)=15.88$, $p<.001$, $d=3.97$.

Members of couples assigned to conditions 1 (alone) and 2 (confederate) were separated, and each partner in the pair was escorted to different testing rooms. In order to introduce the confederate in condition 2, a second experimenter approached the testing room to say that a female participant had just arrived without a partner—that she and her boyfriend were scheduled to be tested but because they recently broke up, she wanted to know whether she could still participate in the study. The experimenters exchanged this information in the front of the male participant and briefly pretended to ponder how to accommodate the extra participant. The male participant was subsequently asked if he

would be comfortable participating with another female. (No participants declined to participate with the "extra participant"). The confederate was thereafter escorted to the testing room and introduced as a study participant. Other than affirming that she was unattached (if the male participant asked), the confederate was instructed to interact naturally with the participant during the experiment.

Because a primary interest of this study is to examine behavior of romantically involved young males across different social contexts (alone, in the presence of an attractive female, or in the presence of a romantic partner), each participant in conditions 2 and 3 was asked to write his/her name on a piece of paper for the experimenter to "randomly" select which of the two participants would complete the test battery while the other person observed. In actuality, the experimenter always selected the male member of the couple to complete the test battery while the female (confederate or romantic partner) observed. While males assigned to condition 2 were tested in the presence of the study confederate, their girlfriends were simultaneously tested alone. Because I was concerned that participants might discuss the study with fellow students who might be interested in participating, I decided to wait before debriefing participants until I was sure that all data had been collected and enrolled was permanently halted. Upon approval of this dissertation, a written letter will be sent to debrief all study participants on the study's social manipulation and findings. The university's Institutional Review Board approved all study procedures.

Measures

Self-Report Measures

Participants reported age, race/ethnicity, how long they had been dating, number of days per week they spend with their romantic partners, and whether they had ever cheated on a romantic partner (present or past). In addition, all subjects (target participants and their romantic partners) completed a series of self-report measures that assessed several aspects of personality that have been shown in previous studies to be correlated with risk taking (sensation seeking, impulsivity, future orientation, and risk preference) and relationship characteristics (overall relationship satisfaction, feelings of passionate love, and commitment). Each of these measures was examined as a potential moderator of the hypothesized relationship between experimental condition and behavior (risk taking, reward sensitivity, feedback learning, and inhibitory control). All self-report measures are described below and reprinted in Appendices A through F. Group means and standard deviations for each measure of interest are presented in Table 1.

Sensation-Seeking

As in prior studies (Chein et al., 2011), sensation seeking was assessed using a subset of six items from the Zuckerman Sensation Seeking Scale (Zuckerman, Eysenck & Eysenck, 1978). In this measure, participants answered true (1) or false (0) to the following six items: "I like to have new and exciting experiences and sensations even if they are a little frightening; I like doing things just for the thrill of it; I'll sometimes do crazy things just for fun; I'll try anything once; I sometimes like to do things that are a little frightening; I like wild and crazy parties." A mean sensation-seeking score was calculated for each participant. The 6-item measure showed good reliability in this sample (alpha=0.81). The 6-item measure is reprinted in Appendix A.

Impulsivity

The Barratt Impulsiveness Scale, Version 11 (Patton, Stanford, & Barratt, 1995) was used to assess impulsivity. This measure has been shown to have good construct, convergent, and discriminant validity. Guided by prior studies (e.g., Steinberg et al., 2009), I used 18 of the 30 the items in this measure from three 6-item subscales: *motor impulsivity* (e.g., ‘‘I act on the spur of the moment’’), *inability to delay gratification* (e.g., ‘‘I spend more money than I should’’), and *lack of perseverance* (e.g., ‘‘It’s hard for me to think about two different things at the same time’’). Each item is scored on a 4-point scale (rarely/never, occasionally, often, almost always/ always), with higher scores indicative of greater impulsivity. A mean score was calculated for each participant. The measure showed good reliability in the current sample (alpha=.73). The 18-item measure is reprinted in Appendix B.

Future Orientation

On the future orientation measure (Steinberg et al., 2009), respondents are presented with a series of 15 pairs of statements describing two different types of people (e.g., ‘‘Some people would rather be happy today than take their chances on what might happen in the future” BUT “Other people will give up their happiness now so that they can get what they want in the future’’). For each statement pair, participants are asked to choose which of the two statements best describes what they are like. After selecting the better descriptor, participants then indicate whether the description is *really true* or *sort of true*. Responses are coded on a 4-point scale, ranging from *really true* for one descriptor to *really true* for the other descriptor, and averaged to calculate a future orientation score.

The overall measure showed good reliability in the current sample (alpha=.73). The full measure is reprinted in Appendix C.

Relationship Satisfaction

The Relationship Assessment Scale (RAS; Hendrick, 1988) was used to measure relationship satisfaction. The RAS is a seven-item questionnaire developed for use with dating university students (Hendrick, 1988). Items are worded so that they are general enough to apply to all types of romantic relationships. Respondents reply to items such as, "How well does your partner meet your needs?" on a 5-point scale. The RAS is unidimensional, correlates highly with other existing measures of relationship satisfaction (Dinkel & Balck, 2005; Vaughn & Baier, 1999), and discriminates between dating partners who stay together and those who break up (Vaughn & Baier, 1999). The measure showed good reliability in the current sample (alpha= .74). The full measure is reprinted in Appendix D.

Passion and Commitment

The Triangular Love Scale (Sternberg, 1986) is a measure of *passion* (factors leading to physical attraction; e.g., "I can't imagine my life without my current partner; I fantasize about my current partner"), *intimacy* (closeness, connectedness; e.g., "I am able to count on my current partner in times of need; I can really trust my current partner"), and *commitment* (motivation to maintain one's relationship; e.g., "I view my relationship with my current partner as permanent; I have confidence in the stability of my current relationship"). Participants rated their level of agreement with each statement using a 9-point scale (from 0-*not at all*, 5-*moderately*, 9-*extremely*). The entire scale includes 45

items, 15 of which are used to assess passion, 15 to assess intimacy, and 15 to assess commitment. Scores were summed to determine the degree to which participants experience each of these components of love in their current romantic relationships. However, because I only made predictions about the role of passion and commitment as potential moderators, intimacy scores were not used in the analyses. The measure showed high reliability for items assessing passionate love (alpha=.88) and commitment (alpha=.94). The full triangular love scale is included in Appendix E.

Risk Preference

I included a self-report measure of beliefs about the costs and benefits of certain risky behaviors. Adapted from the Benthin Risk Perception Scale (Benthin, Slovic, & Severson, 1993), a measure of risk processing, participants are given a list of 9 risky behaviors (drinking alcohol, driving in a car with a drunk driver, smoking cigarettes, having unprotected sex, vandalizing property, stealing from a store, getting into a physical fight, going into a dangerous part of town, and threatening or injuring someone with a weapon). For each risk behavior, participants answered the question, "How would you compare the benefits (or pleasures) of this activity with the risks?" The 4-point response scale is: (1) risks are much greater than the benefits; (2) risks are somewhat greater than the benefits; (3) benefits are somewhat greater than risks; and (4) benefits are much greater than risks. Responses were averaged to compute a risk preference score, with higher scores indicating a greater tendency to favor the benefits (and undervalue the costs) of risk behaviors. Full measure is reprinted in Appendix F.

Additionally, participants were asked how often in the past month they have consumed each of the following substances: tobacco, alcohol, alcohol to the point of drunkenness, cannabis, and prescription drugs for recreation (response scale: (0) *never*, (1) *1 to 3 times a month*, (2) *1 to 2 times a week*, (3) *3 to 6 times a week*, (4) *daily*), and whether they had engaged (no/yes) in theft, violence, driving while intoxicated, or substantial damage to property of others in the previous 12 months. These four risk behaviors were combined into one dichotomous measure, which was coded as "yes" if any one of the behaviors was endorsed and "no" if not.

Behavioral Outcomes

Risk Taking—The Stoplight Task.

In order to measure risk taking, I used a modification of the Stoplight game (Steinberg et al., 2008), which is a computerized driving task in which subjects control the progress of a vehicle along a straight track, from the driver's point of view. A timer appears on the screen and subjects are instructed to reach the end of the track as quickly as possible, and informed that a traffic signal will turn yellow as the car approaches each of the 32 intersections along the track. Before the vehicle enters into an intersection, the subject must decide whether to stop the car (by using the space bar) and wait for the light to turn green, or go through the intersection and chance a possible crash. Subjects are informed that if they decide to brake, the car will stop safely, but that they will lose time waiting for the light to cycle from yellow to red to green. They are also told that if they decide to go through the intersection, the car may cross the intersection successfully and they will save time, or the car may crash into a crossing vehicle (an event that is

accompanied by squealing tires and a loud crash, as well as the image of a shattered windshield), and that they will lose even more time than if they had decided to brake. Thus, subjects must decide whether to drive through the intersection in order to save time but chance a collision with another vehicle that will cause them to lose time, or to stop and wait, and willingly lose a smaller amount of time. Importantly, both the timing of the traffic signals and the probability of a crash in the associated intersections are varied and are unpredictable by the subjects. Risky decisions offered the potential payoff of experiencing no delay, but also the potentially costly consequence of a crash, which added significantly to the delay. I computed a risk-taking index for each subject as the proportion of the 32 intersections at which the brakes were not applied (regardless of whether the subject crashed or ran the intersection successfully).

Preference for Immediate Rewards—Delay Discounting Task.

The Delay Discounting task assesses subjective preference for smaller, immediate rewards relative to larger, delayed rewards. I used the same version of the measure on which prior studies have reliably found effects of the presence of same-sex peers (O'Brien, Albert, Chein, & Steinberg, 2011; Silva, Chein, & Steinberg, 2016; Steinberg et al., 2009; Weigard et al., 2014). In the task, participants are presented with a series of choices between a relatively small reward received immediately and a larger reward received later (e.g., "Would you rather have $200 today or $1000 in 1 year?"). Participants are informed that there is no right or wrong answer, and to simply choose which of the two (hypothetical) options they prefer. In contrast to the Stoplight game, the delay-discounting task was introduced as a measure of preference, not performance. The

experimenter explicitly told participants that their choices on this task had no impact on their final compensation. By removing this contingency, I maintained the delay-discounting task as a measure of reward processing outside the context of risk, where the main consideration is simply a choice between a smaller reward sooner versus a larger reward later.

The outcome of interest in delay discounting is the extent to which participants prefer the immediate but less valuable reward over the delayed but more valuable one. In our adaptation of the task, the amount of the delayed reward was held constant at $1,000. The delay interval is varied across six blocks (1 week, 1 month, 6 months, 1 year, 5 years, and 15 years), which are presented in a random order. For each block, the starting value of the immediate reward is $200, $500, or $800, randomly determined for each participant. The participant is then asked to choose between the immediate reward and a delayed reward of $1,000. If the immediate reward is preferred, the subsequent question presents an immediate reward midway between the prior one and zero (i.e., a lower figure). If the delayed reward is preferred, the subsequent question presents an immediate reward midway between the prior one and $1,000 (i.e., a higher figure). Participants work their way through a total of nine ascending or descending choices until their responses converge, and their preference for the immediate and delayed rewards is equal, at a value reflecting the "discounted" value of the delayed reward (i.e., the subjective value of the delayed reward if it were offered immediately; Green, Myerson, & Macaux, 2005), which is referred to as the *indifference point* (Ohmura, Takahashi, Kitamura, & Wehr, 2006). For each individual, the task generates six indifference points (one for each delay

interval). Using these indifference points, I then computed a *discount rate* (*k*) for each individual. The *discount rate* (*k*) is an index of the degree to which an individual devalues a reward as a function of the length of delay to receipt, which I computed using the standard equation, $V=A/(1+k\mathrm{D})$, where *V* is the subjective value of the delayed reward (i.e., the indifference point), A is the actual amount of the delayed reward, *D* is the delay interval, and *k* is the discount rate. Because, as is usually the case (O'Brien, Albert, Chein, & Steinberg, 2011; Silva, Chein, & Steinberg, 2016), the distribution of *k* is highly positive skewed (4.64), I employed a natural log transformation to reduce skew to an acceptable level (0.06). Higher log-transformed discount rates indicate greater orientation toward immediate relative to future rewards.

Reward and Cost Avoidance Learning— Modified Iowa Gambling Task.

The Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) is a neurocognitive measure that has been extensively used in studies of individuals who persistently engage in risky behavior despite experiencing negative consequences, such as compulsive gamblers or substance abusers (e.g., Verdejo-Garcia et al., 2007). In the original version of the task, participants are presented with four decks of cards, turned face down, and told that two of the decks are advantageous (i.e., choosing from them ultimately leads to wins) and two are disadvantageous (i.e., choosing from them ultimately leads to losses). They are then asked to draw cards from the decks so as to maximize their winnings.

I used a modified version of the task (Cauffman et al., 2010), in which participants make a play/pass decision on one of 4 decks that is pre-selected by the

computer on each trial, rather than deciding to choose to draw from any of 4 decks on any trial, as in the original task. Each subject starts the task with $2,000 (of pretend money) and is instructed that his goal is to win as much money as possible. Participants are told that there are good decks and bad decks in the task and that they will earn the most money by learning to play more from the good decks while avoiding the bad ones. As mentioned, the computer selects a card from one of the four decks and participants are given 4 seconds to decide to either play the card (revealing the monetary win or loss) or pass (in which case no feedback is provided). Subjects play a total of 120 trials, which were divided and analyzed into six blocks of 20 trials each. This modification has been used successfully in a prior study of peer effects on IGT performance (Silva, Shulman, Chein, & Steinberg, 2015), and reliably allows us to determine the independent effects of negative (loss) and positive (reward) outcomes, because the percentage of advantageous decks chosen on a given trial is *not* contingent upon the percentage of disadvantageous decks avoided.

In the present study, I operationalized IGT performance in two ways: (1) the percentage of plays from advantageous decks over the course of the task (reward learning), and (2) the percentage of plays on disadvantageous decks over the course of the task (cost avoidance learning). For reward learning, the expected pattern of behavior is an increase in the percentage of plays on good decks, while for cost avoidance learning, the expected pattern of behavior is a decline in the percentage of plays on bad decks over the course of the task. The rates at which this incline and decline of "good" and "bad" plays, respectively, occur are the main outcomes of interest. As in prior studies

(e.g., Cauffman et al., 2010; Silva et al., 2015), the rate of change across the task (i.e., slope) in percentage of good plays served as a measure of reward sensitivity or reward learning (i.e., approach behavior), with more steeply positive slopes indicating increasing attraction to rewarding decks and quicker detection of which decks result in monetary gains over repeated play. The rate of change in percentage of bad plays across the task served as a measure of cost sensitivity or cost-avoidance learning, with more steeply negative slopes indicating greater sensitivity to losses produced by the disadvantageous decks.

Inhibitory Control

I measured inhibitory control using two variants of the classic Stroop Task: a cognitive version and an emotional version. Both versions of the Stroop are designed to measure individuals' ability to inhibit attention to salient but irrelevant stimuli in favor of more deliberate and controlled actions (Huizinga et al., 2006; McKenna & Sharma, 1995; Nee et al., 2007; Veroude, Jolles, Croiset, & Krabbendamn, 2013). The cognitive version requires control over interfering stimuli that are affectively neutral, whereas the emotional variant of the task requires control over emotionally charged stimuli. I included both of these variants in our test battery because recent evidence suggests that the ability to exercise control over affectively arousing stimuli is more predictive of individual differences in risk taking than the ability to inhibit attention to neutral information (Botdorf, Rosenbaum, Patrianakos, Steinberg, & Chein, 2016). The data analysis for both tasks excluded incorrect trials, as well as trials with extreme dispersion (i.e., trials in which the response time (RT) was 4 standard deviations above the

participant's own mean RT, as advised by Hoeflich & Preston, 2011). For both tasks, the variable of interest is the difference in response time and accuracy between incongruent and congruent trials (i.e., *Incongruent – Congruent*). Incongruent trials contain salient, but irrelevant information, and, as such, require participants to inhibit attention to interfering stimuli. There is no interfering information on congruent trials. Because incongruent trials are harder than congruent trials, lower accuracy scores and longer response times are expected on incongruent trials relative to congruent trials. This change in accuracy and response time between congruent and incongruent trials is referred to as the *Stroop Effect* (Andrews-Hanna et al., 2011; Long & Prat, 2002; Morey et al., 2012), which is thought to result from cognitive conflict induced by incongruent trails (where subjects have to resist attention to interfering stimuli). A larger Stroop effect for response time is typically characterized by longer response times on incongruent relative to congruent trials, and a larger Stroop effect for accuracy is characterized by lower accuracy on incongruent relative to congruent trials. A larger Stroop effect for both accuracy and response time indicates lower inhibitory control over interfering information. High inhibitory control is characterized by a smaller Stroop effect for both response time (less slowing down) and accuracy (lower drop in accuracy) (e.g., Kane & Engle, 2003; Long & Prat, 2002). The Cognitive and Emotional Stroop Tasks are described in detail below.

Cognitive Inhibition—Cognitive Stroop Task.

Participants completed a practice block consisting of 36 trials, followed by three continuous rounds of 36 trials each (for a total of 108 trials). On each trial, participants

are presented with the name of a color word (RED, YELLOW, GREEN, or BLUE) shown in a colored font (red, yellow, green, or blue). Participants are instructed to respond by pressing a colored key (on a specialized keypad) corresponding to the font color of the word, while ignoring the written word name. Thus, participants must inhibit the impulse to read the word and instead identify the color in which the word appears. Trials are either congruent, where the written word and font color are the same (e.g., the word "RED" displayed in red font), or incongruent, where the written word and the font color are mismatched (e.g. "RED" displayed in blue font). Half the trials are congruent and half are incongruent. On all trials, the stimulus is presented for 4000 ms or until a key is pressed. Performance is calculated in terms of overall accuracy and response time on incongruent relative to congruent trials. In this task, slow performance and a high error rate indicate greater difficulty in inhibiting attention to interfering stimuli.

Emotional Inhibition—Emotional Stroop Task.

In this variation of the task, participants are presented with a series of pictures of individual faces displaying different emotional expressions, which vary among happy, sad, and angry. A word corresponding to one of these three emotion categories is overlaid on the picture. Participants are given a special keypad with three keys, marked "A" for angry, "H" for happy, and "S" for sad. They are instructed to press the key on the keypad that corresponds to the emotion of the facial expression, while ignoring the word overlaid. Similar to the cognitive Stroop, participants must suppress the impulse to read the word and instead identify the facial expression. Congruent trials contain a face and word of the same emotional valence (e.g., angry face with the word "angry" overlaid),

whereas incongruent trials present a face in one emotion category and a word in another category (e.g., an angry face with the word "happy" overlaid). As with the Cognitive Stroop Task implementation, half of the trials on the Emotional Stroop Task are congruent and half are incongruent.

In order to accommodate the lengthier period of time it takes to process emotional stimuli (relative to colored fonts and words), each stimulus in the series is presented until a response is made, with no time limit. Trial-based feedback is provided immediately following the response—when subjects respond correctly, a screen flash appears in green; when subjects respond incorrectly, a red screen flash appears. Subjects complete a practice round consisting of 16 trials, followed by three continuous rounds of 48 trials each (for a total of 144 experimental trials). Similar to the Cognitive Stroop, performance on the Emotional Stroop is operationalized in terms of overall accuracy and response time on incongruent relative to congruent trials. Slow performance and a high error rate are indicative of greater difficulty inhibiting attention to interfering emotional stimuli.

Data Analysis

The first step in the analysis was to conduct a series of One-Way Analysis of Variance (ANOVA) to test whether there were individual differences in self-reported measures across experimental conditions (alone *vs*. confederate *vs*. romantic partner). If the groups differed on any of the self-reported measures, that variable was included as a covariate (and also tested as a moderator) in subsequent behavioral analyses.

To assess the effect of social context on risk taking and delay discounting, I conducted an Analysis of Covariance (ANCOVA) for each outcome, specifying social

context as the between-subjects variable, while controlling for any covariates. For the IGT, latent linear growth models were fitted in Mplus (version 7.0; Muthen & Muthen, 2012) to examine the rates at which participants across experimental conditions learned to play from the good decks and learned to avoid the bad decks. Time (Blocks 1 through 6) was used as the repeated measure to determine the extent to which participants changed their behavior over the course of the task. Social context (alone, confederate, romantic partner) was specified as a between-subjects variable to explain variation in rates of change for percentage of plays (rather than passes), plays from advantageous decks, and plays from disadvantageous decks.

For both the Cognitive and Emotional Stroop tasks, I conducted two repeated-measures General Linear Models to examine Stroop effects on accuracy and response time, and to determine whether Stroop effects differed across social contexts. In these models, I used trial type (congruent, incongruent) as a within-subjects measure and social context (alone, confederate, romantic partner) as a between-subjects factor, controlling for any covariates.

To test whether observed behavioral differences across conditions were moderated by individual differences in age, personality (impulsivity, sensation seeking, and future orientation), or relationship characteristics (duration, relationship satisfaction, passion, and commitment), a model comparison approach was undertaken. This approach involves assessing the fit of two outcome models, one with and one without the interaction between experimental condition and the potential moderating variable (Hayes, 2013). Although the fit for the model with an interaction will likely be nominally better

(as adding a variable to a model almost always increases the model fit), a formal test of significance for the change in model fit was conducted. Specifically, a statistically significant increase in R^2 when the interaction term (between condition and the potential moderator) is added to the model is evidence that the effect of condition on behavior is moderated by the variable in question. Because all of the potential moderators in the present study are continuous variables, a series of regressions were conducted to test whether the interaction between experimental condition and the potential moderator significantly improved model fit. In these regression models, the multi-categorical predictor (experimental condition) was dummy coded. Two dummy variables were computed (one for the confederate condition and one for the romantic partner condition), and the alone condition was used as the reference group. Regressions were performed to test each of the potential moderators in question (e.g., age, impulsivity, sensation-seeking, future orientation, risk preference, relationship duration, relationship satisfaction, passionate love, and commitment). Each of these self-report variables was tested for moderation on each of the behavioral outcomes (risk taking, delay discounting, reward learning, cost avoidance, cognitive control, and emotional inhibition). For a given outcome, the first model included the two dummy variables for social context and the moderator of interest. The second model included the interaction terms between social context and the moderator in question. A significant interaction term and improved the model fit (i.e., significant increase in R-square) was used as evidence that the influence of social context on behavior was moderated by the variable in question. Pairwise deletion was used to handle all missing data (i.e., four cases missing a future orientation score).

CHAPTER 3

RESULTS

Sample

Approximately 190 couples were screened—24 of which were ineligible to participate in the study (because they did not meet the age criteria or were unable to come to lab together). Of the 166 eligible couples, 140 participated in this study (the remaining 26 couples either did not show up to their appointment, or did not enroll due to a scheduling conflict). The target sample for this study was 150 heterosexual couples. However, data collection was terminated after testing 140 couples when it was learned that participants had begun to refer friends to the study and had potentially conveyed information about the social context manipulation. Of the 140 couples tested, six couples were excluded from the analysis because they disclosed after completing the testing that they were not in fact romantically involved, despite having said so on the screener and on their self-report questionnaire. The analytic sample for the present analyses is based on data from 134 romantically involved males (47 who were tested alone, 43 who were tested in the presence of an attractive female confederate, and 44 who were tested in the presence of their romantic partner). Overall, sixty-four percent (n=86) of males in this study were Caucasian, approximately 13% (n=18) were Black/African American, 14% (n=19) were Asian/Pacific Islander, and 8% (n=8) were Hispanic. The mean sample age was 20.2 (SD=1.65).

Sample characteristics are included in Table 1. Participant age differed modestly but significantly across conditions. As a result, all behavioral analyses include age as a

covariate (and test it as a moderator). There were no statistically significant differences between conditions on any other self-report measure (Table 1). Correlations between all self-report measures of interest are presented in Table 2. Of the 134 males included in the sample, one subject had missing data on the stoplight task, and four subjects did not complete the future orientation measure. These individuals did not differ from those without any missing data. To optimize statistically power, I used pairwise deletion in all analyses.

Impact of Social Context on Risk Taking

Social context had a significant effect of risk-taking behavior, $F(3, 132)=4.17$, $p<.01$, $d=.38$ (see Figure 1). Consistent with our hypothesis, males took significantly fewer risks in the presence of their girlfriends compared to both solos (B=-.09, SE=.03, 95% CI=-.15 to -.04, $t(132)=-3.17$, $p<.01$, $d= .62$), and males who were in the presence of the confederate, B=-.08, SE=.03, 95% CI=-.14 to -.02, $t(132)=-2.55$, $p<.05$, $d=.54$. There were no significant differences in risk taking between participants in the confederate and alone conditions (B=-.01, SE=.03, p=.64).

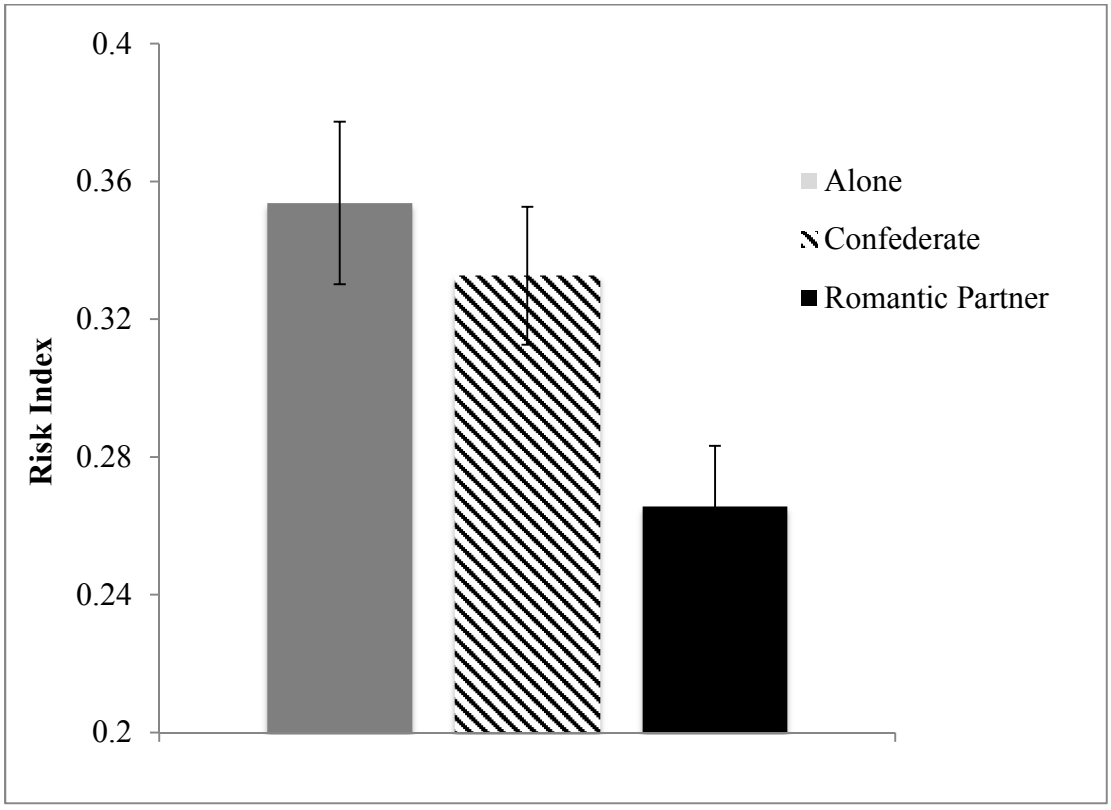
Impact of Social Context on Delay Discounting

Participants in all conditions behaved in a systematic and predictable fashion on the delay-discounting task, such that the subjective value of a future reward (i.e., indifference point) decreased as the delay interval increased, $F (5,346)=319.56$, $p<.001$ (Figure 2). A subsequent ANCOVA examining the effects of social context on the discount rate revealed a marginally significant difference across conditions, $F(3, 133)=3.14$, p=.057 (Figure 3). There were no differences in the discount rates of males in

the presence of their romantic partners (B=-.31, SE=.35, p=.37), or in the presence of the confederate (B=.59, SE=.34, p=.10), relative to those who were alone. However, males in the presence of their partners evinced significantly lower discount rates than those in the confederate condition (B=.91, SE=.37, 95% CI=.18 to 1.64, t(133)=2.47, p<.05). Lower discount rates indicate a weaker orientation toward immediate, relative to future, rewards (i.e., a stronger willingness to delay gratification).

Figure 1

Risk-taking Behavior across Social Context



Note. Error bars represent ±1 *SE*.

Table 1

Scores on Selected Measures by Social Context Group

		Social Condition			
Characteristic	**Total Sample (N=134)**	**Alone (n=47)**	**Confederate (n=43)**	**Romantic Partner (n=44)**	**Group Differences**
Age	20.23 (1.65)	20.15 (1.59)	20.79 (20.79)	19.84 (1.58)	F(2, 132)=3.91*
% White (n)	64 (86)	57 (27)	63 (27)	73 (32)	ns
Impulsivity	2.10 (.35)	2.06 (.31)	2.15 (.38)	2.09 (.35)	ns
Sensation-Seeking	.64 (.28)	.64 (.29)	.59 (.31)	.69 (.21)	ns
Future Orientation	3.01 (.51)	3.21 (.51)	3.17 (.55)	3.03 (.6)	ns
Risk Preference	1.42 (.27)	1.44 (.32)	1.40 (.25)	1.42 (.24)	ns
Rel. Duration [a]	16.40 (13.87)	15.09 (11.73)	16.88 (13.25)	17.28 (16.49)	ns
Rel. Satisfaction	4.37 (.50)	4.31 (.48)	4.42 (.44)	4.39 (.57)	ns
Passionate Love	111.53 (20.51)	110.79 (20.28)	112.49 (19.85)	111.39 (21.78)	ns
Commitment	118.99 (17.80)	118.36 (17.04)	120.44 (17.94)	118.25 (18.76)	ns

Note: Standard deviations are in parentheses unless otherwise noted. *p<.05. [a] Measured in months.

Table 2

Correlations among Variables Tested for Moderation

	1	2	3	4	5	6	7	8	9
1. Age	-								
2. Impulsivity	-0.01	-							
3. Sensation-Seeking	-0.02	0.29**	-						
4. Future Orientation	0.04	-0.62***	-0.20*	-					
5. Risk Preference	-0.09	0.22*	0.20*	-0.20*	-				
6. Rel. Duration	0.21*	-0.07	-0.07	-0.05	-0.01	-			
7. Rel. Satisfaction	-0.07	-0.09	-0.31***	0.09	-0.19	-0.16	-		
8. Passionate Love	0.01	-0.01	-0.23**	0.09	-0.03	0.09	0.62***	-	
9. Commitment	0.07	-0.07	-0.25**	0.16	-0.06	0.15	0.63***	0.87***	-

*p<.05; **p<.01; ***p<.001.

Figure 2

Indifference Points as a Function of Time Delay across Social Context

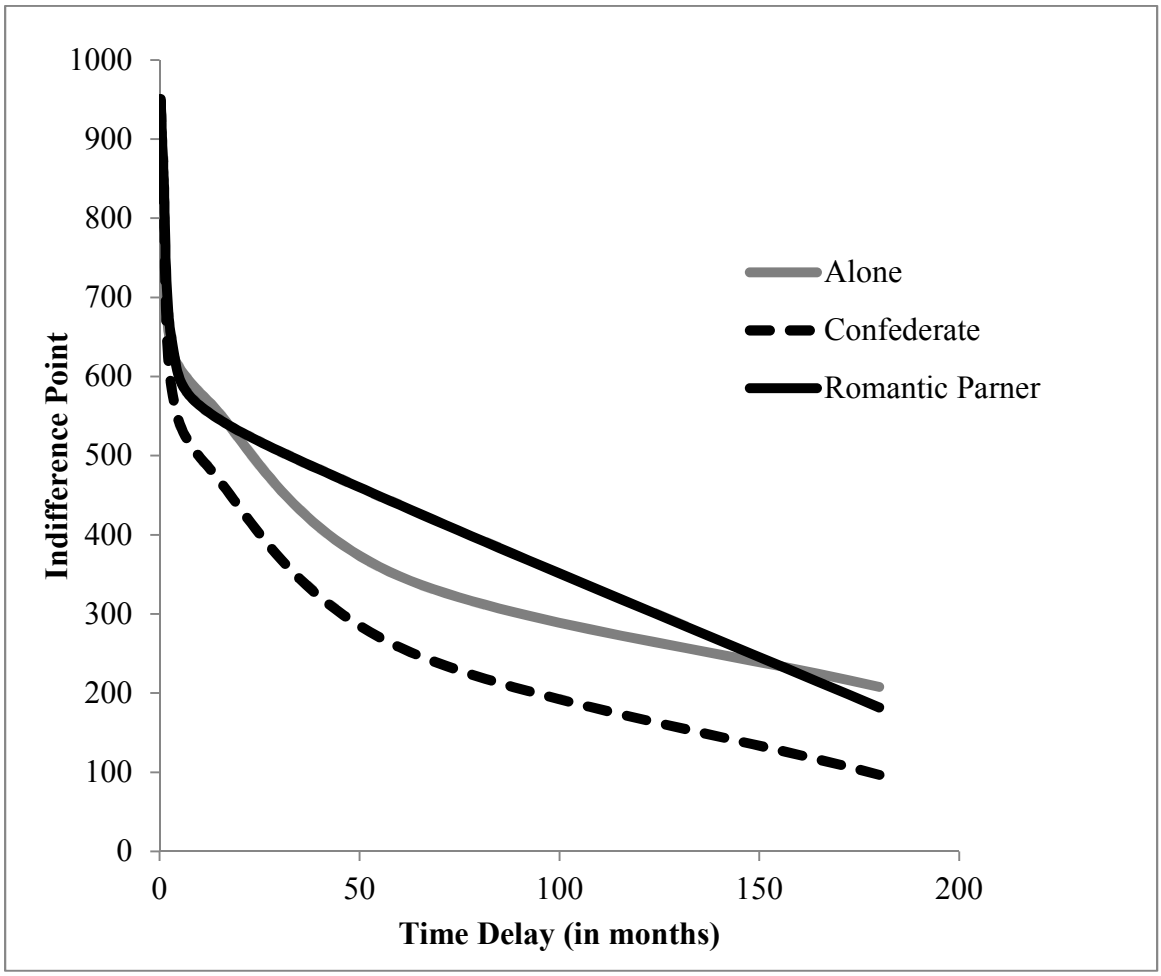
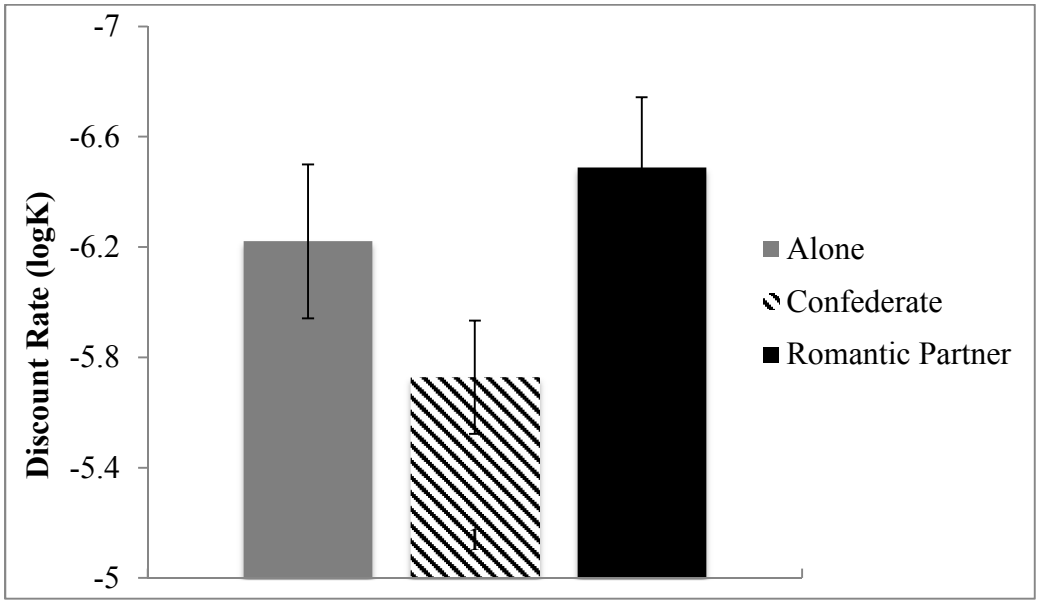


Figure 3

Discount Rates across Social Context



Note. Less negative discount rates (i.e., closer to zero) on the Y-axis indicate greater sensitivity to immediate rewards. Error bars represent ±1 *SE*.

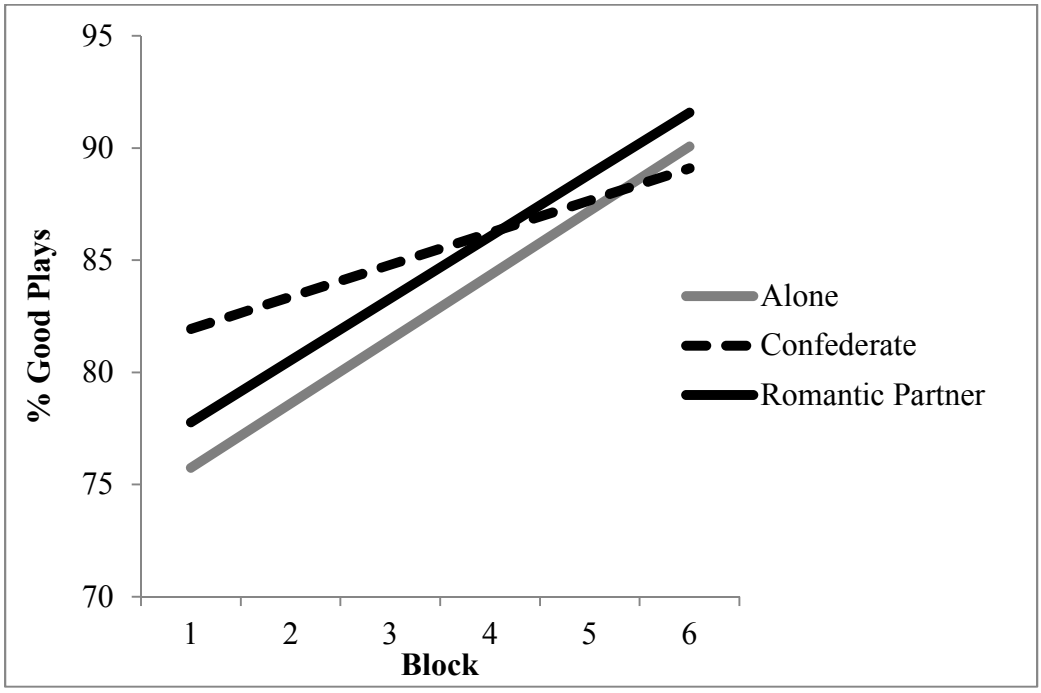
Impact of Social Context on Feedback Learning

As described earlier, there are two relevant outcomes in the Iowa Gambling Task (IGT). The first is a measure of individuals' ability to learn from positive outcomes (approach-motivated behavior, or reward learning); the second is a measure of individuals' ability to learn from negative outcomes (cost avoidance, or punishment learning). Regarding the first outcome, analyses indicated that the average slope for all groups was positive and significant, B=2.86, SE=.79, 95% CI=1.33 to 4.40, p<.001, indicating that participants learned to increase their percentage of plays from rewarding

decks over time. This rate of increase in plays from rewarding decks did not differ by social context (Figure 4).

Figure 4

Reward Learning across Social Context in the Iowa Gambling Task

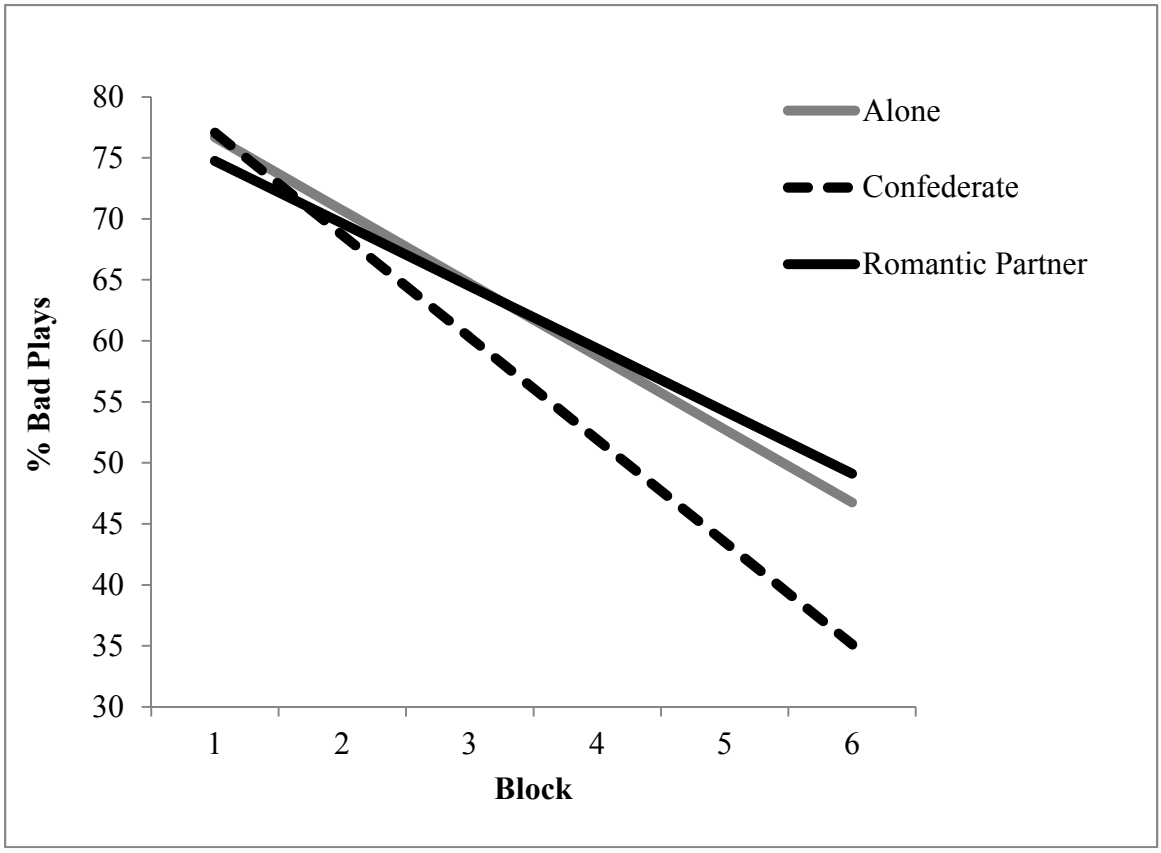


With respect to participants' ability to learn from negative outcomes, I found that the average slope for all participants was negative and significant (B=-5.98, SE=1.03, 95% CI=-8.65 to -3.96, p< .001), indicating that participants learned to avoid playing on bad decks over time. Males who were in the presence of the confederate exhibited a steeper rate of decline on bad plays relative to both solo participants (B=-2.41, SE=1.21, 95% CI= -4.78 to -.03, p< .05, *d*=.59), and to those who were in the presence of their

romantic partners (B=-3.26, SE=1.24, 95% CI= -5.70 to -.83, p<.01, *d*=.81; Figure 5). By the end of the task (block 6), males in the confederate condition were also playing significantly less often on bad decks than those tested alone (B=-11.64, SE=5.18, 95% CI=-21.79 to -1.49, p<.05, *d*=.21), or in the presence of their partners (B=-13.99, SE=5.30, 95% CI= -24.39 to -3.60, p<.01, *d*=.23). Romantic partner presence had no significant effect on cost avoidance behavior relative to the alone condition.

Figure 5

Cost Avoidance Learning across Social Context



Impact of Social Context on Inhibitory Control

On the Cognitive Stroop, there was a main effect of trial type (incongruent *vs*. congruent) on both accuracy (F (1, 133)=10.60, p< .01), and response time (F (1, 133)=225.35, p< .001), indicating that participants had more difficulty inhibiting attention to interfering information on incongruent, relative to congruent, trials (i.e., a significant Stroop interference effect). However, this decline in cognitive control during incongruent relative to congruent trials was similar across conditions (accuracy: F (3, 133)=. 38, p= .68; response time: F (3, 133)=.68, p=.51), indicating that social context had no impact on inhibitory control (Figure 6).

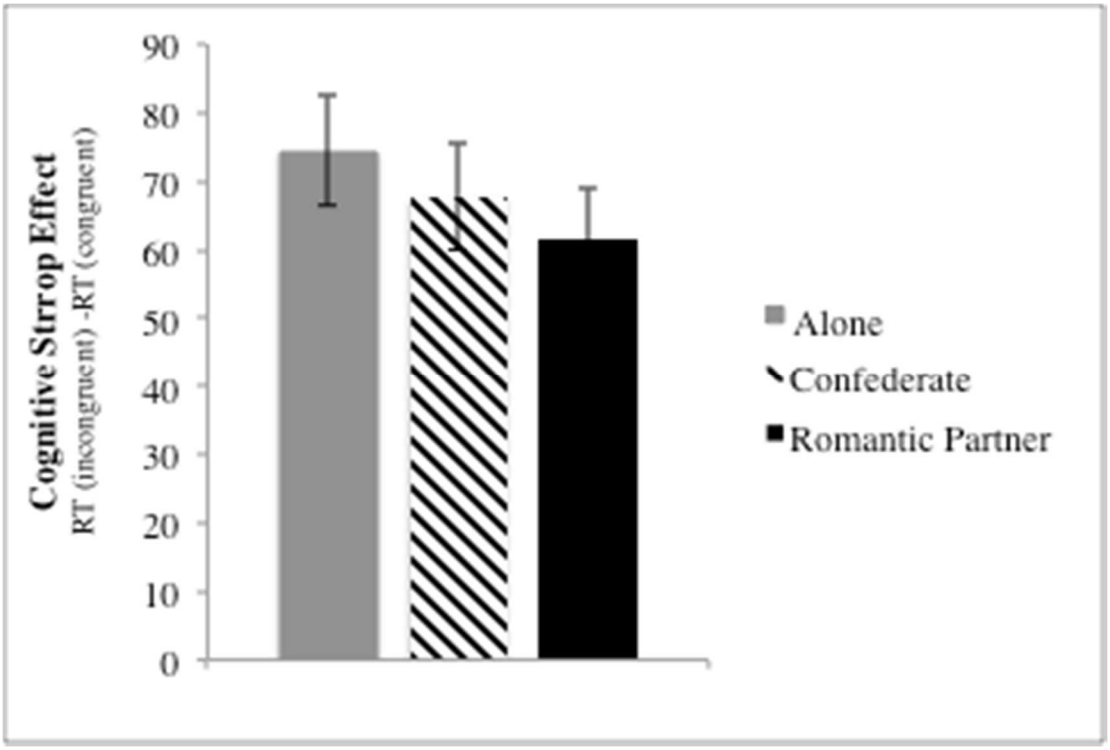
There was a significant main effect of social context on response time, F (3, 133)=6.83, p< .01. Post-hoc analyses indicated that participants who were in the presence of their romantic partner took significantly longer to respond correctly relative to participants in both the alone (B=120.73, SE=34.04, 95% CI=53.38 to 188.07, t (133)=3.25, p< .01, *d*=.87), and confederate conditions (B=96.10, SE=35.67, 95% CI=25.53 to 166.67, t(133)=2.69, p<.01, *d*=.64). The main effect of social context on overall accuracy was only marginally significant (F (3, 133)=2.40, p=.10).

On the Emotional Stroop Task, there was a significant effect of trial type on both accuracy (F(1, 133)=102.45, p<.001) and response time (F(1, 133)=111.25, p<.001), indicating that all participants performed less accurately and took longer to respond correctly on incongruent, relative to congruent, trials (i.e., a significant emotional Stroop interference effect). This change in inhibitory control over emotionally salient information did not differ by social context (Figure 7). That is, the drop in accuracy and

increase in response time were the same across all conditions (accuracy: F(3, 133)=1.08, p=.34; response time: F(3, 133)=2.35, p=.10).

Figure 6

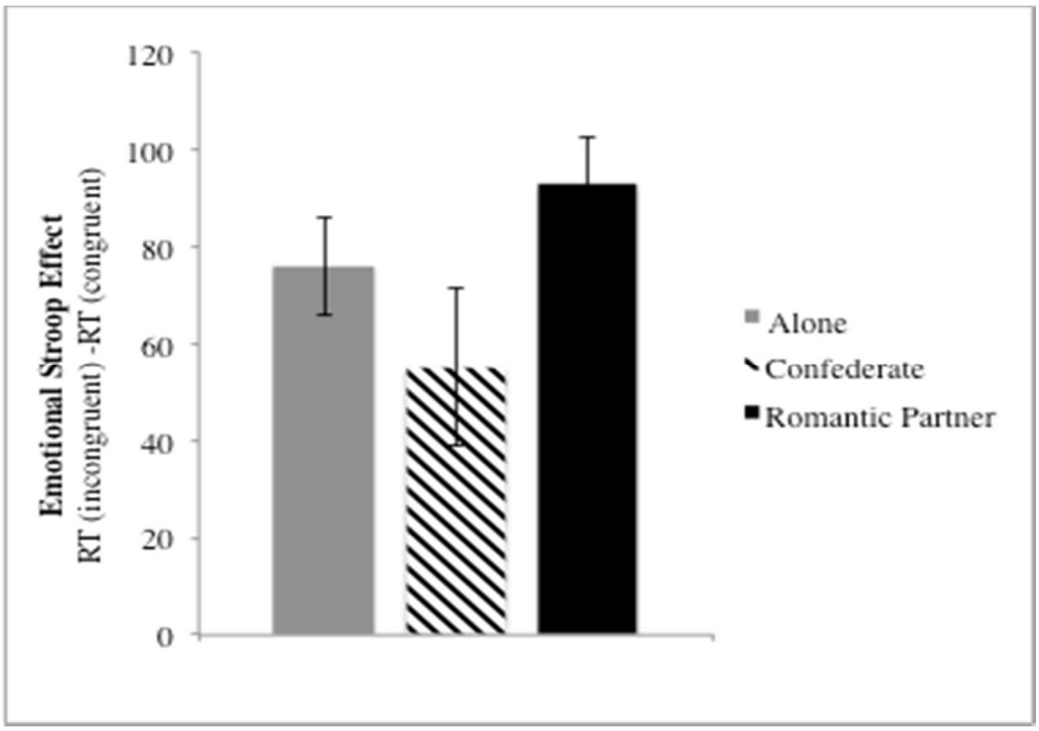
Cognitive Control Did Not Vary by Social Context



Note. Error bars represent ±1 *SE*.

Figure 7

Inhibitory Control over Emotional Stimuli Did Not Vary by Social Context



Note. Error bars represent ±1 *SE*.

Moderation Analyses

I examined whether the effects of social context on behavior across the six outcomes was moderated by individual or relationship characteristics. I found no evidence that individual differences in personality (e.g., sensation-seeking, impulsivity, future orientation, and risk preference) moderated the relationship between social context and behavior on any of the outcome measures. However, relationship commitment, feelings of passionate love, and age emerged as significant moderators. Appendix G includes a summary of all moderation findings.

First, I found evidence that relationship commitment moderated the effect of social context on risk taking (Table 3). Specifically, there was a significant interaction between commitment and confederate presence (B=-.01, SE=.002, 95% CI=-.008 to -.001, p<.01). Inclusion of this interaction in the model significantly improved model fit (increase in R^2=0.053, p<.05). Post-hoc analysis indicated that when males reported greater relationship commitment (1 SD above the sample mean), they engaged in less risk taking in the presence of the confederate relative to alone, B=-.12, SE=.04, 95% CI=-.19 to -.04, t(132)=-2.96, p<.01 (Figure 8).

Table 3

Relationship Commitment Moderates the Effect of Social Context on Risk Taking

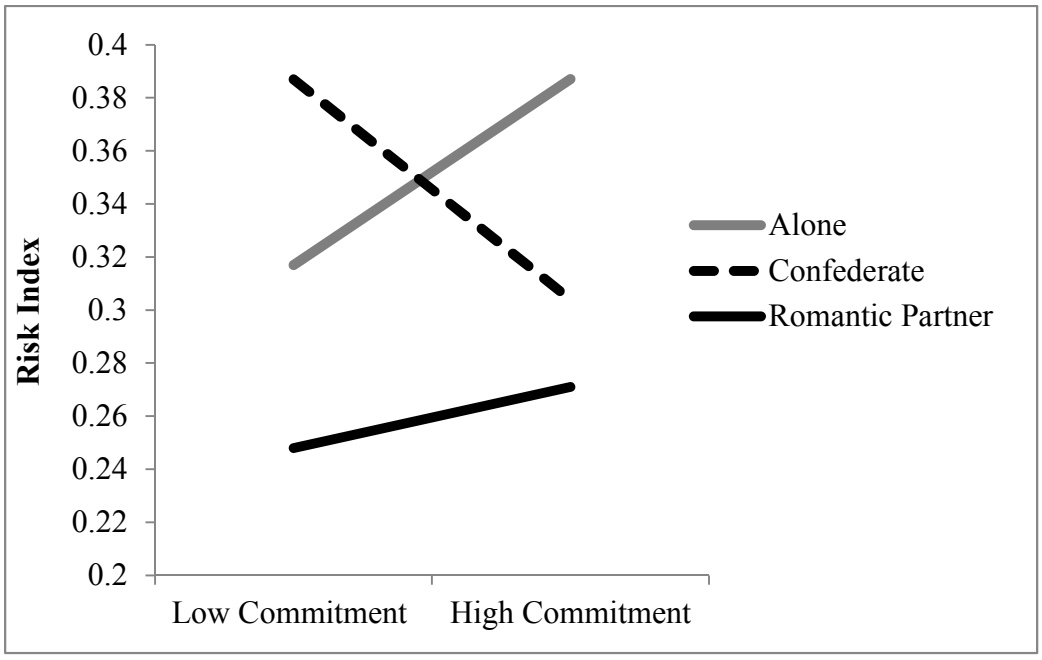
	Outcome: Risk-taking **Moderator: Commitment**						
Model		B	SE	t	Sig.	95% CI	
1	Alone	0.577	0.168	3.433	0.001	0.245, 0.910	
	Confederate	-0.014	0.030	-0.477	0.634	-0.073, 0.045	
	Romantic Partner	-0.092	0.029	-3.156	0.002	-0.149, -0.034	
	Age	-0.012	0.008	-1.558	0.122	-0.027, 0.003	
	Commitment	0.000	0.001	0.151	0.88	-0.001, 0.001	
2	Alone	0.400	0.204	1.960	0.052	-0.004, 0.803	
	Confederate	0.525	0.200	2.626	0.010	0.129, 0.921	
	Romantic Partner	0.072	0.193	0.370	0.712	-0.311, 0.454	
	Age	-0.014	0.008	-1.919	0.057	-0.029, 0.000	
	Commitment	0.002	0.001	1.766	0.080	0.000, 0.004	
	Commit*Confed.	-0.005	0.002	-2.721	0.007	-0.008, -0.001	
	Commit*Romantic	-0.001	0.002	-0.859	0.392	-0.005, 0.002	
Model			Change Statistics				
	R^2	SE	ΔR^2	Δ F	df1	df2	Sig.
1	0.088	0.138	0.088	3.096	4	128	0.018
2	0.141	0.135	0.053	3.870	2	126	0.023

Note. Alone is the reference group; CI=Confidence Interval.

At low levels of commitment (1 SD below the sample mean), confederate presence marginally increased risk taking relative to alone (B=.07, SE=.04, 95% CI= -.01 to .15, t(132)=1.66, p=.10). In addition, there was a significant association between commitment and risk taking only within the confederate condition. Specifically, males in the presence of the confederate who reported being highly committed to their partners engaged in less risk taking than those who reported being relatively less committed (B=-.002, SE=.001, 95% CI=-.01 to .00, t(41)=-2.22, p<.05). Figure 8 illustrates the interaction between commitment and social context in the prediction of risk taking.

Figure 8

Commitment Interacts with Social Context to Predict Risk Taking



Note. Low commitment is 1 standard deviation (SD) below the sample mean, where high commitment is 1SD above the mean.

Second, I found evidence that participants' age moderates the effect of social context on cost avoidance behavior. As shown in Table 4, there was a significant interaction between confederate presence and participant age in predicting the rate of learning (i.e., slope) from negative feedback on the IGT (B=-1.23, SE=.53, 95% CI=-2.268 to -0.187, $p<.05$). Inclusion of this moderator significantly contributed to the fit of the model (increase in $R^2=.043$, $F(2, 128)=1.92$, $p<.05$). These results indicate that the previously reported effect of confederate presence on both the rate of decline in bad plays varied as a function of participants' age.

Table 4

Age Moderates the Effect of Social Context on Cost Avoidance Behavior

	Outcome: Cost Avoidance **Moderator: Age**					
Model		B	SE	t	Sig.	95% CI
1	Alone	-4.625	4.493	-1.03	0.305	-13.514, 4.263
	Confederate	-2.482	0.873	-2.844	0.005	-4.209, -0.755
	Romantic Partner	0.797	0.859	0.928	0.355	-0.902, 2.496
	Age	-0.059	0.221	-0.265	0.791	-0.496, 0.379
2	Alone	-14.045	7.531	-1.865	0.064	-28.946, 0.856
	Confederate	22.739	10.794	2.107	0.037	1.381, 44.096
	Romantic Partner	3.816	10.762	0.355	0.723	-17.479, 25.111
	Age	0.409	0.373	1.097	0.275	-0.328, 1.146
	Age* Confederate	-1.228	0.526	-2.335	0.021	-2.268, -0.187
	Age*Romantic	-0.145	0.537	-0.27	0.788	-1.207, 0.917

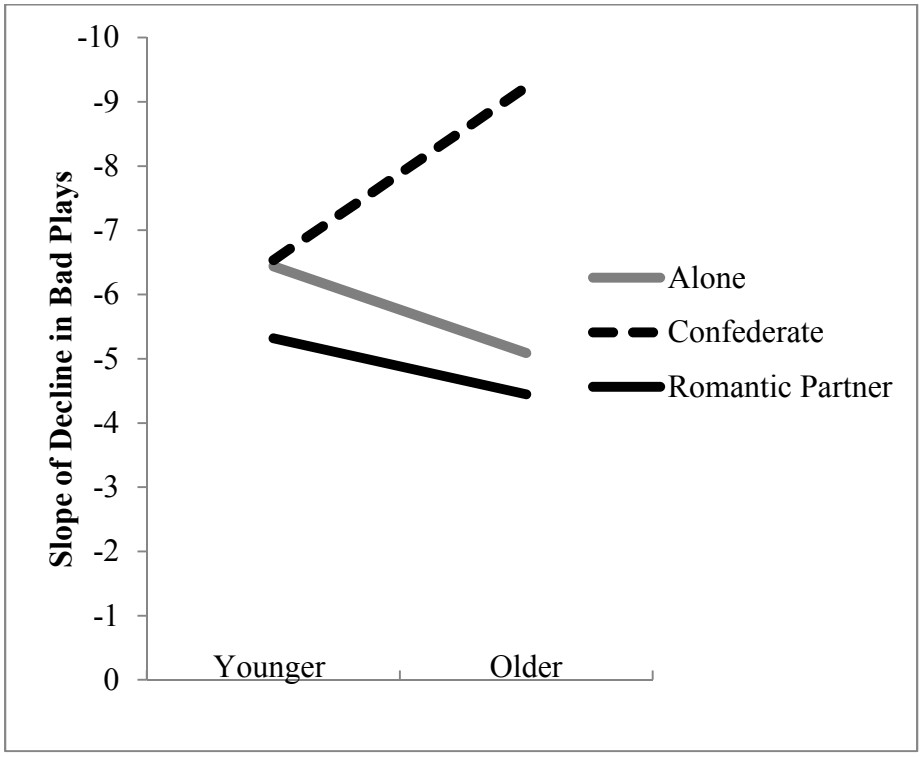
Model			Change Statistics				
	R^2	SE	ΔR^2	ΔF	df1	df2	Sig.
1	0.109	4.081	0.109	5.288	3	130	0.002
2	0.152	4.013	0.043	3.237	2	128	0.043

Note. Alone is the reference group; CI=Confidence Interval.

As illustrated in Figure 9, older males (those who were approximately 21.9 years old, or 1 SD above the mean sample age) in the presence the confederate who exhibited a steeper rate of decline in bad plays on the IGT relative to older males who were alone (B=-4.15, SE=1.15, 95% CI= -6.41 to -1.88, t(133)=-3.62, p<.001). In addition, among subjects in the confederate condition, those who were relatively older were also marginally quicker at learning to avoid bad decks on the IGT than younger subjects (B=-.82, SE=.41, t(42)=-1.99, p=.055).

Figure 9

Age Moderates the Effect of Social Context on Rate of Learning to Avoid Bad Decks on the Iowa Gambling Task



Note. The more negative the value on the Y-axis, the steeper the decline in decisions to play on disadvantageous decks over the course of the IGT. Younger participants are 1 standard deviation (SD) below the mean age for the sample, whereas older participants are 1 SD above the mean sample age.

Third, I found evidence that passionate love moderated the effect of context on cognitive control (Table 5). Specifically, there was a significant interaction between self-reported feelings of passionate love and romantic partner presence (B=1.15, SE=.52, 95% CI=.12 to 2.19, p<.05). Including this interaction in the model improved model fit (increase in R^2= .045, p=.05).

Table 5

Passionate Love Moderates the Effect of Social Context on Cognitive Control

	Outcome: Cognitive Control **Moderator: Passionate Love**						
Model		B	SE	t	Sig.	95% CI	
1	Alone	91.408	62.305	1.467	0.145	-31.864, 214.68	
	Confederate	-6.548	11.16	-0.587	0.558	-28.629, 15.533	
	Romantic Partner	-12.567	10.976	-1.145	0.254	-34.284, 9.149	
	Age	0.794	2.825	0.281	0.779	-4.794, 6.383	
	Passionate Love	-0.298	0.221	-1.35	0.179	-0.734, 0.139	
2	Alone	160.865	73.016	2.203	0.029	16.381, 305.35	
	Confederate	-10.875	61.994	-0.175	0.861	-133.551, 111.8	
	Romantic	-141.061	59.228	-2.382	0.019	-258.262, -23.859	
	Age	-0.258	2.813	-0.092	0.927	-5.823, 5.308	
	Passionate Love	-0.734	0.374	-1.96	0.052	-1.474, 0.007	
	Passion*Confed.	0.051	0.546	0.093	0.926	-1.03, 1.132	
	Passion*Romantic	1.153	0.523	2.204	0.029	0.118, 2.188	
Model			Change Statistics				
	R^2	SE	ΔR^2	ΔF	df1	df2	Sig.
1	0.025	52.155	0.025	0.827	4	129	0.51
2	0.07	51.340	0.045	3.065	2	127	0.05

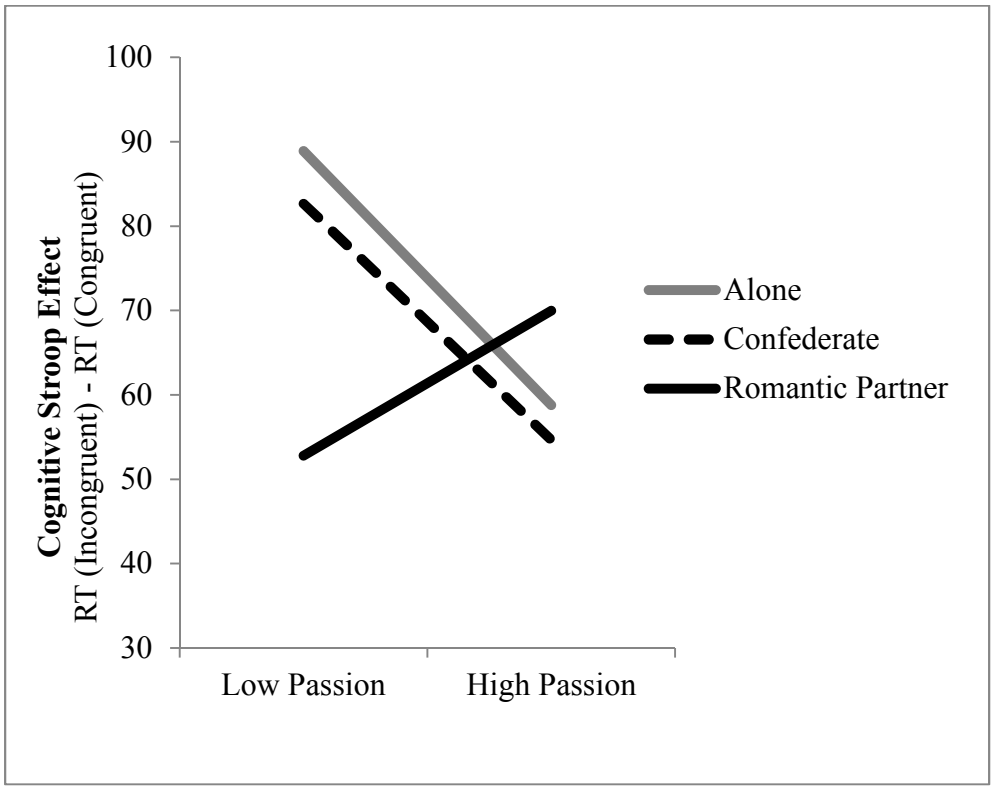
Note. Alone is the reference group; CI=Confidence Interval.

Probing this interaction revealed that when passionate love was low (1 SD below the mean), males in the presence of their romantic partners showed greater cognitive

control than solo participants, B=-36.11, SE=15.14, 95% CI= -66.08 to -6.14, t(133)=-2.38, p<.05 (Figure 10). Social context had no effect on cognitive control when passionate love was high (1 SD above the mean). In addition, there was a marginally significant negative association between cognitive control and feelings of passionate love among solo subjects (B=-.75, SE=.39, p=0.063) and among those in the presence of the confederate (B=-.68, SE=.40, p=0.095).

Figure 10

Passionate Love Interacts with Social Context to Predict Cognitive Control

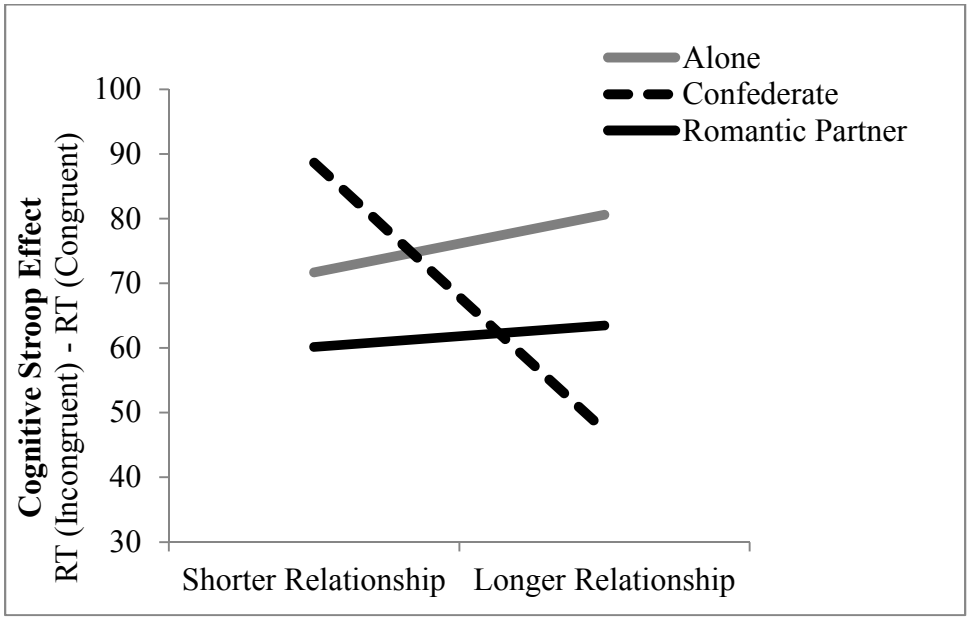


Note. Low passionate love is 1 standard deviation (SD) below the sample mean, where high passionate love is 1SD above the mean.

Lastly, I found marginal evidence that relationship duration moderates the relationship between social context and cognitive control. A significant interaction between relationship duration and confederate presence (B=-1.82, SE=.89, 95% CI=-3.584 to -.062, p<.05; increase in R^2 =.042, p=.064) indicated that males in relatively longer relationships (approximately 30.3 months, or 1 SD above the sample mean) tended to exhibit greater cognitive control when in the presence of a confederate relative to alone (B=-33.32, SE=16.91, 95% CI= -66.80 to 0.15, t(133)=-1.97, p=.051; Figure 11). Moreover, among males in the confederate condition, those in relatively longer relationships exhibited greater cognitive control than those in shorter relationships (B=-1.51, SE=.57, t(43)=-2.64, p=.012).

Figure 11

Relationship Duration and Social Context in the Prediction of Cognitive Control



Note. Shorter relationships are 1 standard deviation (SD) below the sample mean, where longer relationships are 1SD above the mean.

Summary of Findings

Hypothesis 1: males tested in the presence of their romantic partner may engage in less risk taking, be more oriented toward future relative to immediate rewards, be more sensitive to experiences of loss, and exhibit greater cognitive control than males tested alone. Relationship duration, relationship commitment, and feelings of passionate love may moderate the effect of romantic partners on behavior. Specifically, relationship duration and commitment will have a dampening effect on risk-taking behavior, decrease reward sensitivity, heighten sensitivity to loss, and increase cognitive control. In addition, when feelings of passionate love are high, the presence of romantic partners may have the opposite effect (i.e., increase risk taking and reward sensitivity, and decrease sensitivity to loss and cognitive control).

Consistent with the hypothesis, the presence of romantic partners diminishes risk taking in males. However, partners did not have a significant impact on males' sensitivity to rewards (neither immediate nor long-term), sensitivity to loss, or their relative ability to inhibit to attention to interfering emotional or neutral stimuli. Improvements in cognitive control in the presence of romantic partners were observed only among males who report low levels of passionate love. That is, mildly infatuated males exhibited better cognitive control in the presence of their romantic partners relative to mildly infatuated males who were alone. Contrary to the hypothesis, there was no evidence that relationship duration or commitment (or any other self-report variable) moderated the effect of romantic partners on any of the behavioral outcomes.

Hypothesis 2: When relationship commitment is high, the presence of an attractive female confederate may activate a protective response, and males will behave similarly to how committed males behave in the presence of their romantic partners. Conversely, when relationship commitment is low, males who are in presence of an attractive female confederate may engage in more risk taking, be more oriented toward immediate relative to future rewards, be less sensitive to losses, and demonstrate lower cognitive control relative to males who are alone.

Partially consistent with the hypothesis, I found that the presence an attractive female stranger triggers a protective response among males who report relatively high relationship commitment. Contrary to the hypothesis, relationship commitment did not moderate the effect of social condition on reward sensitivity, cost avoidance, or cognitive control. Regarding cost avoidance behavior, however, I found that, in the presence of an attractive confederate, older males are quicker to avoid decisions that lead to losses relative to older males in the other two social conditions. Age did not moderate the effect of social context on any other behavioral outcome. Evidently, the relative impact of an attractive female stranger on males' risk taking and cost avoidance depended on individual and relationship factors, a finding that emphasizes the importance of these variables for understanding males' susceptibility to temptation and opportunities for potential risk. The presence of an attractive female confederate did not affect males' sensitivity to rewards. Relationship duration and cognitive control were negatively associated only among subjects in the confederate condition.

In summary, I found that males take fewer risks in the presence of their romantic partners relative to alone or presence of an attractive female stranger. Although I could not identify potential underlying mechanisms driving this effect, I found that when feelings of passionate love are relatively low, males exhibit more cognitive control in the presence of the romantic partners relative to alone. In addition, I found that the presence of an attractive female stranger evokes less risk-taking among highly committed males (relative to less committed individuals), greater cost avoidance behavior among older (relative to younger) males, and more cognitive control among males in relatively longer (as opposed to shorter) relationships.

CHAPTER 4

DISCUSSION

The main aim of the present study was to examine the influence of romantic partners on male risk-taking and identify potential mechanisms through which the presence of romantic partners affects risky decision-making among late adolescent and young adult males. This is the first experimental study to demonstrate, as predicted, that young males take fewer risks when they are in the presence of their romantic partners than when they are alone. Contrary to my hypothesis, however, males' sensitivity to rewards and to experiences of loss did not differ as a function of whether they were alone or accompanied by their romantic partner. These results suggest that neither a decrease in reward sensitivity nor an increase in cost avoidance serves as a potential explanation for why romantic partner presence has a negative effect on male risk taking.

The present results are consistent with previous, non-experimental research suggesting a protective effect of romantic partnerships against male risk taking, such as substance use or criminal behavior (Amato & Kane, 2011; Barr, Culatta, & Simon, 2013; Collibee & Furman, 2015; Fischer & Wiersma, 2012; Fleming, White, & Catalano, 2010; Fleming et al., 2010b; Gudonis-Miller et al., 2010; Monahan, Dmitrieva, & Cauffman, 2014; Siennick et al., 2014; Simons, Stewart, Gordon, Conger, & Elder, 2002; Staff et al., 2010; Uecker, 2012van Dulmen, Goncy Haydon, & Collins, 2008). However, and to my surprise, the dampening effect of romantic partners on risk taking observed in the present study did not depend on factors such as relationship duration or level of commitment, as has been reported in prior research (Fischer & Wiersma, 2012; Gudonis-Miller et al.,

2010; Monahan, Dmitrieva, & Cauffman, 2014; Simons, Stewart, Gordon, Conger, & Elder, 2002).

I had hypothesized that males would exhibit greater inhibitory control over neutral and emotionally charged stimuli when they were in the presence of their partners, but this hypothesis was only partially supported. Specifically, only those males who reported relatively lower levels of passionate love showed greater cognitive control in the presence of their partners relative to when they were alone. Prior studies demonstrate that individuals who report being intensely infatuated with their partners show greater activation of reward-processing regions when viewing pictures of their romantic partners than when they view pictures of an opposite-sex friend (Aron, Fisher, Mashek, Strong, Li, & Brown, 2005). The present findings complement existing research in showing that individuals who report *low* levels of infatuation exhibit greater cognitive control in the presence of their romantic partners than when they are alone. Thus, whereas prior imaging research suggests that romantic partners may stimulate reward-related responses when infatuation is high (a phenomenon not seen in the present behavioral study), the current findings suggest that the presence of a romantic partner stimulates greater cognitive control when infatuation is low.

Although it is unclear how these neural and behavioral responses affect males' risk-taking propensity, it suggests that the extent to which young males engage reward-related and cognitive control processes in the presence of their partners may vary as a function on how infatuated they are with those individuals. For instance, given prior findings, it is possible that when males are highly infatuated with their partners (as tends

to be the case in the early stages of a romantic partnership) the propensity toward reward-seeking behaviors may be relatively higher (Aron, Fisher, Mashek, Strong, Li, & Brown, 2005). One may easily imagine how a young couple in love may be more likely to explore and experiment early in their relationship as opposed to later on, a tendency that likely fosters mutual attraction and bonding in those initial stages of a romance. As feelings of infatuation become less intense, exerting more cognitive control likely serves to foster the maintenance of that romantic relationship. That is, regulatory control may be especially necessary to ensure the longevity of a relationship (and individuals' reproductive success) when feelings of passionate love are no longer a motivating factor or driving force keeping the lovers together. Perhaps familiarity breeds self-regulation or higher self-regulation facilitates relationship stability.

Consistent with this interpretation, I found that, in the presence of an attractive female stranger, males in relatively longer relationships tend to demonstrate greater cognitive control relative to those in shorter relationships. Moreover, there was marginal evidence that among males in longer relationships, being in the presence of an attractive confederate is associated with greater cognitive control than being alone. These findings are related to prior research showing that committed males exhibit greater impulse control in the presence of attractive (relative to unattractive) female strangers (Maner & Ackerman, 2015; Maner, Rouby, & Gonzaga, 2008; Meyer, Berkman, Karremans, & Lieberman, 2011; Ritter, Karremans, & van Schie, 2010), and often employ a number of strategies, such as devaluing other females' level of attractiveness, presumably in effort to remain faithful to their current partner (for a review, see Lydon & Karrevans, 2015).

Also consistent with prior research, I found that among highly committed males, being in the presence of another attractive female decreases risk taking, in much the same way that the presence of a romantic partner does (the coefficient for the main effect of romantic partners on risk taking was -0.09, and the coefficient for the effect of the confederate among committed males was a comparable -0.12). Together, the present findings indicate that being in the presence of an attractive female stranger has a dampening effect on male behavior—decreasing risk taking and increasing cognitive control—but only when males are in highly committed and relatively longer relationships.

I also found that the presence of an attractive female stranger increases males' sensitivity to punishment, a finding that may alert romantically committed males' to the potential negative consequences of yielding to the potential temptation of another female. This confederate-induced effect on males' sensitivity to punishment is similar to findings from a prior study in which colleagues and I have demonstrated that young males are quicker to avoid making costly decisions in the presence of other male peers relative to when they are alone (Silva, Shulman, Chein, & Steinberg, 2015). In that study, the coefficient for the effect of male peers was -3.39 and, in the present study, the coefficient for the effect of an attractive female peer is -2.41. While one should be cautious in comparing these relative effects because there are notable differences between the two studies, it is clear that in both the presence of other male peers or an attractive female stranger, males respond more quickly to experiences of loss than they do when they are alone. Notably, however, in prior research, the effect of same-sex peers on males'

sensitivity to punishment is also accompanied by a peer-induced increase in reward sensitivity, a pattern that I did not observe when males are in the presence of an attractive female.

Given this discrepancy, it is possible that the shared effect of same-sex peers and attractive female strangers on males' cost avoidance behavior has different functions for the individual in each given context. In the case of same-sex peers, males may be unconsciously motivated to be competitive and strategic in the ways in which they exert dominance around other males. Prior studies have shown that the presence of same-sex peers increases males' orientation toward rewards (Chein et al., 2011; Silva, Chein, & Steinberg, 2016; Smith et al., 2015), as well as their propensity to take risks (Silva, Chein, & Steinberg, 2016), but evidently not at the expense of ignoring long-term costs (Silva, Shulman, Chein, & Steinberg, 2015). These findings may reflect males' strategic attempt to maximize rewards without jeopardizing other males' perceptions of their wit, status, or dominance. By contrast, in the presence of an attractive female, romantically involved males may have little incentive to competitively seek opportunities for rewards and take chances. They may, instead, be more concerned with avoiding appealing, yet costly, stimuli altogether. In other words, a heightened sensitivity to rewards may have benefits in male-dominated settings, but may serve little to no purpose in the presence of an attractive female (particularly among romantically involved males). In both peer contexts, however, learning from negative outcomes may be similarly beneficial. Together, what these findings show is that when a heightened sensitivity to punishment is not accompanied by a sensitivity to rewards—as is the case when romantically involved

males are in the presence of an attractive female— there is no concurrent increase in risk-taking behavior. By contrast, a heightened sensitivity to both rewards and punishment (Silva, Shulman, Chein, & Steinberg, 2015)—as is the case when males are in the presence of other male peers— appears to result in more risk taking (Silva, Chein, & Steinberg, 2016).

Limitations

The present study has several limitations. One is that because I recruited couples to come to the lab together there may have been a selection bias toward couples who were relatively more comfortable and familiar with each other than couples who may have been interested in the study but who were hesitant to ask their partners to join them. A second is that the findings from the present study are based on older adolescents and young adults, between 18 and 24 years old. It is possible that different patterns of behavior would be observed among younger individuals with less dating experience and perhaps more willingness to explore alternative partners. Finally, it may be the case that the presence of romantic partners does in fact affect reward sensitivity, but that any such effect may be unconscious and only discernible through brain imaging, which was not used in the present study.

As noted earlier, it is surprising that the presence of romantic partners does not affect males' sensitivity to rewards or punishment, yet does provoke males to take fewer risks than when they are alone, a phenomenon I am unable to explain with the current data. The relative impact of romantic partners on risk taking, however, is similar to the protective effect of parents on adolescent risk-taking reported in a prior study (Telzer,

Ichien, & Qu, 2015). However, while the protective effect of parents on adolescent risk-taking has been associated with less activation of reward-processing brain areas and more activation of regions involved in self-regulation (Telzer, Ichien, & Qu, 2015), romantic partners do not appear to have such effects on reward sensitivity or impulse control, at least as demonstrated behaviorally in the present study. In this regard, the null effect of romantic partners on reward-related processes parallels that of a prior study in which colleagues and I found that young males become less sensitive to immediate rewards in a male peer context that also includes an older adult, relative to contexts where all members of the peer group are the same age (Silva, Chein, & Steinberg, 2016). In other words, the impact of romantic partners on males' decision-making may be somewhat similar to that of older adults on adolescent behavior (Silva, Chein, & Steinberg, 2016; Telzer, Ichien, & Qu, 2015). Perhaps the same inclination to behave themselves in the presence of their parents or older strangers operates to lead young men to behave themselves in front of their girlfriends.

Future Directions

Given that I was unable to identify mechanism through which romantic partners influence male risk-taking, it is possible that self-report and behavioral data collected from the romantic partners may shed light on the current results. A natural step next of this investigation will be to examine whether romantic partner characteristics moderate the effect that girlfriends have on males' risk-taking behavior. In addition, given the protective effect of romantic partners on male risk-taking, a future extension of the present study may be an investigation to examine whether romantically involved males

are less susceptible to the influence of other male (single) peers in the presence of a) an attractive female confederate, and b) their romantic partners. In other words, is the protective effect of romantic partners on male behavior also evident when males are in other socially valued settings, such as those involving same-sex peers? Lastly, given the finding that romantic partners enhance cognitive control when feelings of passionate love are relatively low, future research should examine how passionate love and cognitive control interact to predict risk taking.

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APPENDIX A

SENSATION SEEKING SCALE

If you agree with the statement or decide that it describes you, answer TRUE. If you disagree with a statement or feel that it is not descriptive of you, answer FALSE. Answer every statement either True or False even if you are not entirely sure of your answer

1. I like to have new and exciting experiences and sensations even if they are a little frightening……TRUE FALSE
2. I like doing things just for the thrill of it……TRUE FALSE
3. I sometimes like to do things that are a little frightening……..TRUE FALSE
4. I'll try anything once……..TRUE FALSE
5. I sometimes do "crazy" things just for fun…….TRUE FALSE
6. I like wild and uninhibited parties……...TRUE FALSE

APPENDIX B

BARRATT IMPULSIVENESS SCALE

People differ in the ways they act and think in different situation. This is a test to measure some of the ways in which you act and think. Read each statement and select how often you act or think in that particular way using the response scale below.

1	2	3	4
Never	Sometimes	Often	Almost Always

1. I do things without thinking.
2. I make-up my mind quickly.
3. I am happy-go-lucky.
4. I have thoughts that race, changing quickly from one thing to another.
5. I am able to control myself.
6. I regularly save my money.
7. I say things without thinking.
8. I change my mind about what I like to do.
9. I act on the spot.
10. I get easily bored when I have to figure out problems.
11. I act on the spur of the moment.
12. I change friends frequently.
13. When I see something I like, I just buy it.
14. It's hard for me to think about two different things at the same time.
15. I change the things I like to do a lot.
16. I spend more money than I earn.
17. When I think about something other thoughts pop up in my mind.
18. I like to solve games and puzzles.

Scoring. All items are left to right on a scale of 1-4. Items 5, 6, and 18 are reverse coded, so that higher scores indicate more impulsivity.

APPENDIX C

FUTURE ORIENTATION SCALE

	Really True of Me	Sort of True of Me				Sort of True of Me	Really True of me
1.	o	o	Some people like to plan things out one step at a time.	**BUT**	Other people like to jump right into things without planning them out beforehand.	o	o
2.	o	o	Some people spend very little time thinking about how things might be in the future.	**BUT**	Other people spend a lot of time thinking about how things might be in the future.	o	o
3.	o	o	Some people like to think about all the possible good and bad things that can happen before making a decision.	**BUT**	Other people don't think it's necessary to think about every little possibility before making a decision.	o	o
4.	o	o	Some people usually think about the consequences before they do something.	**BUT**	Other people just act—they don't waste time thinking about the consequences	o	o
5.	o	o	Some people would rather	**BUT**	Other people will give up	o	o

			be happy today than take their chances on what might happen in the future.		their happiness now so that they can get what they want in the future.		
6.	o	o	Some people are always making lists of things to do.	**BUT**	Other people find making lists of things to do a waste of time.	o	o
7.	o	o	Some people make decision and then act without making a plan.	**BUT**	Other people usually make plans before going ahead with their decisions.	o	o
8.	o	o	Some people would rather save their money for a rainy day than spend it right away on something fun.	**BUT**	Other people would rather spend their money right away on something fun than save it for a rainy day.	o	o
9.	o	o	Some people have trouble imagining how things might play out over time.	**BUT**	Other people are usually pretty good at seeing in advance how one thing can lead to another.	o	o
10.	o	o	Some people don't spend much time worrying about how their decision will affect others.	**BUT**	Other people think a lot about how their decisions will affect others.	o	o

11.	o	o	Some people often think what their life will be like 10 years from now.	**BUT**	Other people don't even try to imagine what their life will be like in 10 years.	o	o
12.	o	o	Some people think that planning things out in advance is a waste of time.	**BUT**	Other people think that things work out better if they are planned out in advance.	o	o
13.	o	o	Some people like to take big projects and break them down into small steps before starting to work on them.	**BUT**	Other people find that breaking big projects into small steps isn't really necessary.	o	o
14.	o	o	Some people take life one day at a time without worrying about the future.	**BUT**	Other people are always thinking about what tomorrow will bring.	o	o
15.	o	o	Some people think it's better to run through all the possible outcomes of a decision in your mind before deciding what to do.	**BUT**	Other people think it's better to make your mind without worrying about things you can't predict.	o	o

Scoring. All items are scored left to right on a scale of 1-4. Items 1, 3, 4, 11, 13, and 15, so that higher scores indicate a stronger future orientation.

APPENDIX D

RELATIONSHIP ASSESSMENT SCALE

How well does your partner meet your needs?

1	2	3	4	5
Poorly				Extremely well

In general, how satisfied are you with your relationship?

1	2	3	4	5
Unsatisfied				Extremely satisfied

How good is your relationship compared to most?

1	2	3	4	5
Poor				Excellent

How often do you wish you hadn't gotten in this relationship?

1	2	3	4	5
Never				Very often

To what extent has your relationship met your original expectations?

1	2	3	4	5
Hardly at all				Completely

How much do you love your partner?

1	2	3	4	5
Not much				Very much

How many problems are there in your relationship?

1	2	3	4	5
Very few				Very many

APPENDIX E

STERNBERG'S TRIANGULAR LOVE SCALE

Read each of the following statements and rate the degree to which you agree with each statement using the scale below.

1 2 3 4 5 6 7 8 9

Not at all Moderately Extremely

1. I am actively supportive of my partner's well-being.
2. I have a warm relationship with my partner.
3. I am able to count on my partner in times of need.
4. My partner is able to count on me in times of need.
5. I am willing to share myself and my possessions with my partner.
6. I receive considerable emotional support from my partner.
7. I give considerable emotional support to my partner.
8. I communicate well with my partner.
9. I value my partner greatly in my life.
10. I feel close to my partner.
11. I have a comfortable relationship with my partner.
12. I feel that I really understand my partner.
13. I feel that my partner really understands me.
14. I feel that I can really trust my partner.
15. I share deeply personal information about myself with my partner.
16. Just seeing my partner excites me.
17. I find myself thinking about my partner frequently during the day.
18. My relationship with my partner is very romantic.
19. I find my partner to be very personally attractive.
20. I think my partner is perfect.
21. I cannot imagine another person making me as happy as my partner does.
22. I would rather be with my partner than with anyone else.
23. There is nothing more important to me than my relationship with my partner.
24. I especially like physical contact with my partner
25. There is something almost "magical" about my relationship with my partner.
26. I adore my partner.
27. I cannot imagine life without my partner.
28. My relationship with my partner is passionate.
29. When I see romantic movies and read romantic books, I think of my partner.

30. I fantasize about my partner.
31. I know that I care about my partner.
32. I am committed to maintaining my relationship with my partner.
33. Because of my commitment to my partner, I would not let other people come between us.
34. I have confidence in the stability of my relationship with my partner.
35. I could not let anything get in the way of my commitment to my partner.
36. I expect my love for my partner to last for the rest of my life.
37. I will always feel a strong responsibility for my partner.
38. I view my commitment to my partner as a solid one.
39. I cannot imagine ending my relationship with my partner
40. I am certain of my love for my partner
41. I view my relationship with my partner as permanent.
42. I view my relationship with my partner as a good decision.
43. I feel a sense of responsibility toward my partner.
44. I plan to continue my relationship with my partner.
45. Even when my partner is hard to deal with, I remain committed to our relationship.

Scoring. Items 1-15 reflect intimacy; items 16-30 measure passionate love; items 31-45 measure commitment. Scores are summed for each group of 15 items.

APPENDIX F

RISK PREFERENCE

1. How would you compare the benefits of **DRINKING ALCOHOL** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks
   - o Benefits are much greater than the risks

2. How would you compare the benefits of **DRIVING IN A CAR WITH A DRUNK DRIVER** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks
   - o Benefits are much greater than the risks

3. How would you compare the benefits of **SMOKING CIGARETTES** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks
   - o Benefits are much greater than the risks

4. How would you compare the benefits of **HAVING UNPROTECTED SEX** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks
   - o Benefits are much greater than the risks

5. How would you compare the benefits of **VANDALIZING PROPERTY** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks
   - o Benefits are much greater than the risks

6. How would you compare the benefits of **STEALING FROM A STORE** with the risks?
   - o Risks are much greater than the benefits
   - o Risks are somewhat greater than the benefits
   - o Benefits are somewhat greater than the risks

- Benefits are much greater than the risks

7. How would you compare the benefits of **GETTING INTO A PHYSICAL FIGHT** with the risks?
   - Risks are much greater than the benefits
   - Risks are somewhat greater than the benefits
   - Benefits are somewhat greater than the risks
   - Benefits are much greater than the risks

8. How would you compare the benefits of **GOING INTO A DANGEROUS PART OF TOWN** with the risks?
   - Risks are much greater than the benefits
   - Risks are somewhat greater than the benefits
   - Benefits are somewhat greater than the risks
   - Benefits are much greater than the risks

9. How would you compare the benefits of **THREATENING OR INJURING SOMEONE WITH A WEAPON** with the risks?
   - Risks are much greater than the benefits
   - Risks are somewhat greater than the benefits
   - Benefits are somewhat greater than the risks
   - Benefits are much greater than the risks

APPENDIX G

SUMMARY OF MODERATION RESULTS

Outcome	Main Effect	Variable Tested for Moderation								
	Social Context	Age	IMP	SS	FO	RF	Rel. Duration	Rel. Satisfaction	Passionate Love	Commitment
Risk-taking	** A>RP** C>RP*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	* High: A>C** Low: A<C^{+} C: low>high*
Delay Discounting	+	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Reward Learning	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Cost Avoidance	*** A<C* C>RP**	* Older: A<C* C>RP*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Cognitive Control	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	* Long: A<C^{+} C: Long>Short*	*ns*	* Low: A<RP*	*ns*
Emotional Inhibition	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Note. A=Alone; C=Confederate; RP=Romantic Partner; IMP=impulsivity; SS=sensation-seeking FO=future orientation; RF=risk preference; *ns*=not significant; $^{+}$ p<.10; *p<.05; **p<.01; ***p<.001.