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Effects of Sexual Arousal on Monetary and Sexual Decision-Making in College Men

by

Brittney M. Holcomb, M. S.

A dissertation

submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy in the Department of Psychology

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EFFECTS OF SEXUAL AROUSAL ON DECISION-MAKING

To the Graduate Faculty:

The members of the committee appointed to examine the dissertation of BRITTNEY M. HOLCOMB find it satisfactory and recommend that it be accepted.

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EFFECTS OF SEXUAL AROUSAL ON DECISION-MAKING

Feb 9, 2018

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RE: regarding study number IRB-FY2016-133: Decision Making in College Men

Dear Ms. Holcomb:

Your request for approval of the new protocol listed above was reviewed at the Feb 9, 2018 8:30 AM MST meeting of the Idaho State University Human Subjects Committee. This is to confirm that your protocol was approved.

You are free to proceed with your study as described in your protocol effective immediately. The study is subject to renewal on or before Feb 9, 2019, unless closed before that date.

Please note that any changes to the protocol as approved must be immediately reported and approved. Contact Tom Bailey (208-282-2179; email humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Approved for continued data analysis only on 01/23/2019

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Effects of Sexual Arousal on Monetary and Sexual Decision-Making in College Men

Dissertation Abstract--Idaho State University (2019)

Sexual arousal is associated with increases in a variety of impulsive choices, such as engaging in unprotected sex, having sex with strangers, and more frequent sexual activity. Little is known about sexual arousal's association with impulsive choice for domain-specific outcomes using a laboratory measure of impulsive choice. This study investigated sexual arousal's impact on delay discounting—which measures impulsive behavioral choice—for both monetary and sexual outcomes. Participants ($N=70$) were assigned randomly to one of two video groups (erotic or control) and completed delay discounting tasks for either money or sexual activity. Repeated-measures ANCOVA tested the first hypothesis and found a domain-specific effect of video group on discounting task, when controlling for sexual risk taking, such that watching an erotic video (as compared to a neutral video) was associated with significantly more impulsive (i.e., more discounted) decision-making for sexual activity but not money ($F(1,32)=14.071$, $p<.01$, partial $\eta^2=.305$) using k as an estimate of discounting rate. Repeated-measures ANOVA found the same effect using Area Under the Curve (AUC) to measure discounting rate ($F(1,33)=7.038$, $p<.05$, partial $\eta^2=.305$). A simple mediation model could not be properly analyzed to test the second hypothesis due to significant multicollinearity between the independent variable, video group, and the mediator, sexual arousal. However, sexual arousal better accounted for variance in sexual activity discounting scores using k and AUC, compared to video group. Sexual arousal, elicited in this case by viewing erotica, appears to have a domain-specific effect on college men's impulsivity for sexual decisions, rather than a more general impact on behavioral choice. This proclivity to make short-sighted sexual decisions under sexually aroused conditions may be associated with negative health outcomes. Future

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studies should extend these findings to diverse samples in more ecologically valid settings using a range of outcomes.

Key Words: behavioral choice, impulsivity, sexual activity, sexual arousal, visceral influence

Introduction

Decision-making is a complex part of life, and the consequences of these decisions can vary greatly in severity, extent, and valence (i.e., positive, advantageous, healthy or negative, disadvantageous, harmful). Negative consequences, however, do not necessarily stop an individual from continuing to make the decisions leading to those consequences. It is important to understand under which circumstances one chooses to make those decisions with negative health consequences (e.g., unprotected sex, intravenous drug use, excessive food intake, tobacco use). Better understanding the influences under which people make decisions possibly leading to negative consequences can guide intervention and prevention efforts targeted at reducing behavioral decisions associated with negative health outcomes. Bodily urges or sensations represent one type of influence on decision-making. The bodily urge of sexual arousal is of interest, as the extant literature provides evidence of associations between sexual arousal and changes in patterns of decision-making. However, it remains unclear upon which types of decisions (e.g., impulse behavioral choice) and which outcomes (e.g., sexual or something more universal) sexual arousal has influence.

Impulsivity

Broadly speaking, impulsivity is a multifaceted construct that refers to several different traits or behaviors, including, but not limited to, an inability to delay gratification, acting without forethought of consequences, disinhibition or lack of self-discipline, abilities to self-regulate, and sensation seeking (de Wit, 2008; MacKillop, Weafer, Gray, Oshri, Palmer, & de Wit, 2016; McCrae, 1992; Weafer, Baggot, & de Wit, 2013; Odum, 2011b; Whiteside & Lynam, 2001; Winstanley, Eagle, & Robbins, 2006). MacKillop and colleagues (2016) determined through

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factor analysis that impulsivity can best be described as a multidimensional construct with three broad categories: impulsive choice, impulsive action, and impulsive personality traits. *Impulsive choice* accounts for a tendency to devalue rewards based upon delay in their receipt. Those making impulsive choices, therefore, choose rewards that are available more immediately, despite being objectively less valuable relative to a reward available after a delay. *Impulsive action* refers to difficulty inhibiting a motor response when necessary or beneficial. In other words, difficulty controlling one's actions, or acting before thinking, represents impulsive action. *Impulsive personality traits* include evaluations of one's ability to self-regulate behavior, as well as identifiable stable patterns of impulsive thoughts, feelings, and behaviors (see Costa & McCrae, 1992; MacKillop et al, 2016; Patton, Stanford, & Barratt, 1995).

These categories (i.e., impulsive choice, impulsive action, and impulsive personality traits) are largely unrelated to each other, which suggests impulsivity can take several forms (Murphy & MacKillop, 2012). For example, if one has a tendency toward impulsive action, this person isn't necessarily also above average on impulsive personality traits or impulsive choice. Others have found that the strength of relation between these three categories of impulsivity varies from no relation at all to moderate associations (Petry, 2001; Baumann & Odum, 2012). Understanding and measuring these categories as separate concepts can be useful in guiding research related to impulsivity. In this case, only impulsive choice is of interest.

Impulsive action and impulsive personality traits are important facets to better understand human behavior (e.g., Macapagal, Janssen, Fridberg, Finn, & Heiman, 2011), but impulsive choice offers unique insights into human health problem behaviors. Impulsive choice has long been interpreted as difficulty delaying gratification. This is based upon observed behavioral choice preferences to receive an objectively less valuable option rather than a more valuable

outcome not as immediately available (Ainslie, 1975; Logue & King, 1991). Ainslie (1975) inferred that the tendency to choose less valuable choice occurs when it is available sooner than the more valuable choice. Impulsive choice is distinctively related to alcohol (MacKillop et al, 2016), illicit substance (Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014; Kollins, 2003; MacKillop et al, 2011), and tobacco use (Johnson, Bickel, & Baker, 2007; Reynolds, Karraker, Horn, & Richards, 2003; Reynolds, Richards, Horn, & Karraker, 2004). Impulsive choice also differentiated children with poor motivational style (i.e., inattentive) Attention Deficit Hyperactivity Disorder (ADHD), a behavioral and attentional control disorder marked by negative health consequences (Sarver, McCart, Sheidow, & Letourneau, 2014), from children with behavioral dysregulation (i.e., hyperactive) ADHD and healthy children (Sonuga-Barke, 2002).

Impulsive Choice and Human Problem Behaviors

Impulsive choice is associated with many negative long-term outcomes. In a historic study of the relationship between problems delaying gratification and long-term outcomes, Mischel, Ebbesen, and Zeiss (1972) offered children a small amount of a tasty reward (e.g., a marshmallow) immediately or, if the subject waited some time without consuming the small amount, more of the reward (e.g., two marshmallows). When followed up several years later, children who ate the immediate, smaller reward had significantly more behavioral and academic problems, such as poorer social and emotional coping, lower Scholastic Assessment Test (SAT) scores, greater cocaine/crack use, and lower educational attainment, than their self-controlled counterparts (Ayduk et al, 2000; Mischel et al, 1972; Mischel, Shoda, & Rodriguez, 1989; Mischel et al, 2011).

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Among adolescents and adults, impulsive choice is associated with a range of problem health behaviors, including illicit drug use (Amlung, Gray, & MacKillop, 2016; Anokhin, Golosheykin, Grant, & Heath, 2011; Coffey, Gudleski, Saladin, Brady, 2003; Kirby, Petry, & Bickel, 1999; Petry, 2003), problematic alcohol use (Khurana et al, 2013), tobacco use (Audrain-McGovern et al, 2009; Baker, Johnson, & Bickel, 2003), unprotected sex (Derefinko et al, 2014; Herrmann, Johnson, & Johnson, 2015; Johnson & Bruner, 2012; Lawyer & Mahoney, 2018; Victor, 2017; Zapolski, Cyders, & Smith, 2009), pathological sexual behaviors (Leppink, Chamberlain, Redden, & Grant, 2016), binge and purging behaviors (Smyth et al, 2007), and weight problems (Rasmussen, Lawyer, & Reilly, 2010). Others have found impulsive choice differentiated problematic and pathological gamblers from non-gamblers (Brevers et al, 2012; Holub, Hodgins, & Peden, 2005; Madden, Petry, & Johnson, 2009).

Delay Discounting to Measure Impulsive Choice

Delay (or temporal) discounting is the devaluing of a reward based upon delay in its receipt and represents a behavioral indicator of impulsive choice (Ainslie, 1975; Rachlin, Raineri, & Cross, 1991). In other words, the longer one must wait to receive a reward, the less that person tends to subjectively value that reward. Individuals vary in their rates of delay discounting, which means that some individuals are more sensitive to delayed rewards. As such, these individuals who are more sensitive to delayed rewards tend to opt for more immediate, albeit of less value (e.g., quantity, quality), rewards rather than having to wait for a larger reward. Based on these observed behavioral tendencies, some researchers have inferred that individuals highly sensitive to delayed rewards have difficulty delaying gratification (Ainslie, 1975).

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In delay discounting tasks, individuals choose between a series of smaller rewards available immediately and a larger reward available after a delay (e.g., \$3.50 now or \$10 in one week, with \$10 representing the highest possible reward) to obtain one's subjective value of the reward at the particular delay. Individuals generally select the larger-later reward when the more immediate reward is very small, but eventually select the smaller-sooner reward as it increases in value across the series of choices. The point at which the individual reverses their choice from the larger, later reward to the smaller, sooner reward is called the indifference point, which represents the individual's subjective value of the larger-later reward at that delay. For example, if for a \$10 reward available after one week, the individual chose the larger-later reward over \$5 now, \$6 now, and \$7 now, but finally selected \$8 now over the larger-later reward, then the individual's indifference point would equal \$7.50. Thus, the individual subjectively values \$10 available after one week as \$7.50 currently.

Domain-specific Discounting

The majority of discounting studies use monetary outcomes to assess impulsive choice, but researchers have used other rewards besides money, such as tobacco (Baker et al, 2003), alcohol (Petry, 2001; Vuchinich & Simpson, 1998), illicit drugs (Kirby & Petry, 2004), food (Rasmussen et al, 2010), erotica (Lawyer, 2008), and sex (e.g., Lawyer, Williams, Prihodova, Rollins, & Lester, 2010; Mahoney & Lawyer, 2018; Thamotharan, Hahn, & Fields, 2017). Selecting an appropriate type of reward, or domain, is important as domains differentially correlate to certain discounting patterns. Individuals discount certain domains more steeply than others, especially when rewards within that domain are tempting to them. For example, when participants found a reward, such as chips, particularly enjoyable they evidenced steeper delay discounting patterns for chips (compared to other outcomes) than others who did not have such a

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desire for chips (Tsukayama & Duckworth, 2010). Rasmussen and colleagues (2010) also found domain-specific discounting in a study on delay and probability discounting of food and money. Their results revealed that percent body fat (PBF) was associated with steeper delay (i.e., more impulsive) and steeper probability (i.e., risk-averse) discounting of food, but not money. Similarly, a mindfulness-based eating intervention evidenced a domain-specific effect on delay discounting of food (i.e., less impulsive food choices) but not money (Hendrickson & Rasmussen, 2013; Hendrickson & Rasmussen, 2017).

In comparison to discounting of money, discounting of other domains usually presents much steeper (i.e., more impulsive) delay discounting rates. In healthy populations, alcohol (Lemley, Kaplan, Reed, Darden, & Jarmolowicz, 2016), cigarettes (for smokers only; Baker et al, 2003; Odum, 2011a), and food (Odum, Baumann, & Rimington, 2006), are discounted at steeper rates than money. In substance abusing populations, the substance of choice is sometimes discounted more steeply than money, such as heroin (which was standardized to be equal in unit price with money; Kirby et al, 1999; Madden, Petry, Badger, & Bickel, 1997) and cocaine (Coffey et al, 2003).

It is important to thoughtfully choose the domain to be discounted. As mentioned above, obesity outcomes were associated with delay discounting of food, but not discounting of money (Rasmussen et al, 2010). Other research suggests that patterns of delay discounting for sexual activity are differentially associated with sexual outcomes, as compared to non-sexual outcomes (Lawyer & Schoepflin, 2013). The authors found that sexual activity delay discounting rates were associated with sexual outcomes, such as sexual excitability (i.e., how one reacts to sexual stimuli). Monetary discounting, however, was unrelated to any sexual outcome measure. In youth, tobacco and marijuana users evidenced greater sexual risk-taking choices (but not

monetary impulsivity) compared to non-users (Thamotharan et al, 2017). Therefore, when investigating impulsivity related to specific outcomes, it is most useful to use a decision-making paradigm involving factors associated with that outcome.

“Visceral” Factors that Influence Decision-making

The visceral influences hypothesis (Loewenstein, 1996) holds that internal states associated with deprivation (e.g., thirst, pain, sexual desire) can significantly influence the behavioral decisions an individual makes (e.g., drinking, consuming pain relief medication, having sex). Visceral factors include negative emotions (e.g., anger or fear), drive states (e.g., sexual desire, hunger), and feeling states (e.g., pain; Loewenstein, 2000) that influence behavior (Peters, Västfjäll, Gärling, & Slovic, 2006). Loewenstein outlines several research-supported propositions within his visceral influences hypothesis (1996).

One proposition purports that the impact on behavior increases as the visceral factor’s intensity (i.e., physiological and psychological changes due to deprivation) increases, which sets the stage for self-destructive patterns of decisions (e.g., overeating, sexual misconduct, sexual risk-taking). As an individual becomes more viscerally aroused (e.g., hungry, tired, sexually aroused), the individual becomes increasingly willing to expend more resources to obtain satiation. Another proposition recognizes the influence of the visceral factors on the individual’s time preference in receiving the desired stimulus. When a stimulus is immediately available (i.e., within an individual’s physical proximity or the individual becomes aware that the stimulus will be readily available), visceral sensations increase and the individual will prefer to receive the stimulus more immediately, rather than after a delay (relative to their preference prior to realizing the stimulus’s availability; Ditto, Pizzaro, Epstein, Jacobson, & MacDonald, 2006; Loewenstein, 1996). As such, ready availability of a stimulus and related visceral responses

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increase the likelihood of one shifting their typical behavioral choices toward riskier or more impulsive choices in service of satiation (Ditto et al, 2006).

Visceral factors have also been found to narrow attention and behaviors onto cues and activities related to the visceral factor (e.g., hunger directs attention toward food cues and increases motivation to engage in behaviors that lead to eating; Easterbrook, 1959). The visceral factors not only direct attention toward cues that would lead to satiation, but also away from cues unrelated to the visceral factor (Loewenstein, 1996). For example, individuals addicted to illicit substances directed attention (as measured by eye movement) toward cues related to the drug they crave (e.g., pictures of the drug, paraphernalia) and away from unrelated cues (e.g., food, money; Field, Mogg, & Bradley, 2006).

Taken together, these visceral influences focus attention on cues that are related to the stimulus of which one is currently deprived or craving and away from unrelated cues (Easterbrook, 1959; Loewenstein, 1996). Left ungratified, these visceral states are associated with increases in one's likelihood of engaging in behaviors to obtain what is desired or reduce the visceral sensations in another way. Visceral factors turn one's preferences toward immediate outcomes associated with satiating the visceral factor, despite possible negative consequences of ignoring the future.

Sexual Arousal as a Visceral Influence

Intensifying sexual arousal elicits increased attention toward cues leading to immediate (or sooner, rather than later) sexual gratification, similar to the way in which hunger draws attention toward present, food-related cues (Ariely & Lowenstein, 2006; Loewenstein, 1996). It should divert attention away from other rewards not related to sexual gratification (i.e., money, food, health; 2006). Individuals who experience high levels of sexual arousal have a greater

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temptation to engage in risky behaviors (e.g., unprotected sex) to more quickly obtain sexual gratification, as compared to less aroused individuals (Ariely & Loewenstein, 2006; Loewenstein, 1996; Victor, 2017). Those high in sexual excitability, or sexual arousal, tend to engage in sexual activity more frequently (Walton, Lykins, & Bhullar, 2016). Being in a state of sexual arousal also shows increased deviant sexual interests (Ariely & Loewenstein, 2006) and endorsement of sexual assault tactics (e.g., verbal coercion, intoxicating date, aggression) hypothetically used to obtain sexual activity, despite risk of legal consequences (Ariely & Loewenstein, 2006; Bouffard, 2015; Loewenstein, Nagin, & Paternoster, 1997).

Skakoon-Sparling, Cramer, and Shuper (2016) tested the visceral influences hypothesis with men and women by eliciting sexual arousal via exposure to videos of consensual, non-violent erotica and measuring sexual decision-making. Participants made behavioral decisions in hypothetical sexual scenarios in which they rated their likelihood of engaging in immediately available but unprotected sex. They found that these sexually aroused men and women tended to focus upon immediately available but unsafe sexual gratification in their responses, rather than protected-sex practices, as compared to non-aroused participants. These sexually aroused participants also demonstrated “general risk-taking” decisions in a modified game of Blackjack. Both sexually aroused men and women chose riskier plays in this Blackjack game, as compared to non-aroused participants, which indicated sexual arousal not only impacted sexual risk-taking but risk-taking in a monetary game as well. With these findings taken together, manipulation of sexual arousal led to increased risky decision-making related to unprotected, but immediate, sexual activity and monetary gain. It remains unknown whether sexual arousal or simply viewing erotica influences impulsive decision-making related to the delay in receipt of sexual activity, without a focus on risk of contracting a sexually transmitted infection (STI).

Priming

When testing the influence of sexual arousal or sexual attraction on decision-making, researchers often expose participants to erotica (i.e., video clips or pictures of sexual activity or nudity) to generate sexual arousal. Sexual arousal is often highlighted as the factor most closely associated with the change in decision-making, but that is not the only possible explanation for the findings. Although the experience of sexual arousal may influence individual decisions, it is also possible simply ‘priming’ participants by showing them sexual stimuli affects behavior aside from their experience of sexual arousal.

Priming results in a change of one’s ability to identify or label a stimulus (i.e., identifying something as sexual, harmful, beneficial, etc.), as a result of exposure to a similar stimulus. Exposure to a sexual stimulus (e.g., erotic images or videos) may therefore increase one’s attention toward other sexual stimuli or increase one’s identification of stimuli as sexual. This priming effect does not necessitate sexual desire nor metacognitive awareness of one’s state of arousal in order to influence stimulus identification (Spiering, Everaerd, & Janssen, 2003).

In one example of priming, Spiering and colleagues (2003) asked participants to classify pictures into one of two categories (i.e., sex or plant) after being exposed to a priming image. The priming images were sexual, plant-related, or threatening. Participants classified sexual images significantly faster than plant images, only when focusing on a preceding sexual prime. This priming effect is believed to draw attention to cues related to the focused-upon prime, which facilitates faster classification or identification of that cue (Spiering, Everaerd, & Elzinga, 2002). Spelman and Simons (2018) placed participants in a mock-bar setting or a standard laboratory and exposed them to either an erotic or neutral film. Participants completed a behavioral choice task in which they evaluated motivation for alcohol. There was an interaction

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of mock-bar and erotic stimuli conditions associated with increased motivation for alcohol (Spelman & Simons, 2018). Primes, erotic or otherwise, are related to a variety of effects, including changes in behavioral decision-making.

Primes need not be related to the task that they precede, such as sexual image primes preceding sexual decision tasks. Primes can be unrelated to the task, as found in a study with participants viewing images of nature demonstrated different rates of delay discounting of money compared to participants viewing other images. Those participants that viewed images of mountains, rather than those viewing buildings or triangles (i.e., control condition), discounted money less steeply (Berry, Sweeney, Morath, Odum, & Jordan, 2014). This suggests that priming individuals with nature images leads to less impulsive monetary decision-making (i.e., greater willingness to wait for a larger sum of money) in the short-term. In a similar task of delay discounting of money, priming participants to focus on future outcomes, rather than past or present outcomes, was associated with significantly less discounting of money (i.e., less impulsivity; Sheffer et al, 2016). A focus on one's future-self mediated the relationship between participants primed with a hypothetical position of power (i.e., manager of resources and team leader) and delay discounting of hypothetical monetary outcomes and hypothetical air quality control decisions (Joshi & Fast, 2013).

Wilson and Daly (2004) investigated the effect of attractive faces on delay discounting of money. They found a significant effect of exposure to attractive women's faces on men's rates of monetary discounting, such that men discounted money received at a later date more steeply than their baseline discounting rates. However, there was no such effect for men exposed to unattractive women's faces. There was no effect for women exposed to attractive or unattractive men's faces. This suggests, for men, exposure to women alone doesn't necessarily result in

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behavioral changes, but rather exposure to attractive women yields a shift in one's behavioral decision-making (2004). In a similar study, men who viewed photos of highly sexually attractive women (compared to women rated as low on attractiveness) evidenced poorer self-control through impulsive responding on a Stroop task (Chiou, Wu, & Cheng, 2017). Because sexual arousal was not measured, it remains unknown whether the exposure to attractive women primed men's change in decision-making or another mechanism (e.g., sexual arousal, sexual desire) accounted for the change.

Taken together, using erotica and assuming sexual arousal has occurred is problematic due to not actually measuring sexual arousal. In those cases, sexual arousal cannot be assumed as a mechanism of change in the outcome variable. In contrast, only using sexual arousal in analyses does not account for possible priming effects that may occur due to viewing erotica. A mediation model would account for the effects of priming an individual through erotica exposure and determine whether sexual arousal was actually responsible as the mechanism of change. As of yet, a mediation model has not been used to determine the effects of erotica exposure and sexual arousal on delay discounting of sexual outcomes.

Present Study

This study sought to address gaps within behavioral choice impulsivity literature. Specifically, it evaluated the influence of subjective sexual arousal on impulsivity-related decision-making for monetary and sexual outcomes. Previous studies have used certain types of sexual health risk outcomes, such as condom availability in hypothetical sex scenarios (Johnson & Bruner, 2012; Skakoon-Sparling et al, 2016) or percent chance of contracting an STI (Schoepflin & Lawyer, *in progress*). As the effects of sexual arousal on sexual activity by itself are unknown, the sexual outcome in this study was free of health risks and served more purely as

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a measure of impulsivity. Impulsivity is such a complex phenomenon that it is essential to specify to which traits, behaviors, or facets of impulsivity one is referring. For this novel study, temporal discounting is used to investigate sexual arousal's effect on impulsive behavioral choice across two domains (i.e., money and sexual activity) in college men.

The following hypotheses were formulated based upon the aforementioned literature:

Hypotheses

Hypothesis 1: There will be a domain-specific effect of viewing erotica on discounting task outcomes, such that there will be an interaction between video group and time (i.e., pre- and post-video) on sexual activity discounting scores but not monetary discounting scores, such that the group viewing the erotic video will have significantly higher k and lower AUC sexual activity discounting scores post-video, than the control video group.

Hypothesis 2: Post-video total subjective sexual arousal scores will mediate the relationship between video group and delay discounting k and AUC scores for sexual activity, such that higher sexual arousal is associated with steeper delay discounting as indicated by larger k scores and smaller AUC scores.

Method

All established requirements and ethical standards for the use of human research subjects set forth by the Idaho State University (ISU) Institutional Review Board (IRB) were met (IRB-FY2016-133).

Participants

Power analysis

An *a priori* power analysis using G*Power indicated a total sample size of 64 participants (i.e., 16 participants per condition or cell) was needed to detect an effect with high power for two

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repeated-measures ANOVA analyses or 58 for two multiple linear regression with two predictors (i.e., independent variable, mediator). For this analysis, the alpha level was set to .05 and power was set to .80 (i.e., $1 - \beta$; $\beta = .20$), which are typical settings in a priori power analyses. Similar research has found an effect size of Cohen's $d = .52$ for sexual arousal's effect on sexual decision-making (Skakoon-Sparling et al, 2016). As such, the effect size for this analysis was set to $d = .52$, which is also considered a medium effect size and typically used when no previous study information is available. In terms of missingness, Enders (2003) found that psychological research has an average amount of 15% of data missing. A total of 72 participants were collected, which allowed for participants with missing data or those not meeting inclusion criteria to be removed from analyses, if needed.

Demographics

Participants were adult, male students attending Idaho State University (ISU) recruited through the ISU online research system (SONA). This sample of college men was both a sample of convenience and a sample of a target population, as some college men tend to engage in risky and impulsive sexual activity (MacDonald & Hynie, 2008; Zawacki, Abbey, Buck, McAuslan, & Clinton-Sherrod, 2003). Participants were compensated for their time by receiving research credit for their undergraduate psychology courses. Inclusionary criteria for analyses included: being at least 18 years of age, cisgender male, sexually active, willing to watch an erotic film clip that includes sexual intercourse, and willing to provide voluntary, informed consent.

A total of 72 participants completed this study. The average age of participant was 23.9 years ($SD = 6.7$ years), with an age range of 18 to 45 years. The majority of the sample (97.2%) identified as male, while two participants selected either 'gender queer' or 'other.' These two participants were excluded from analyses, as they did not identify as male. For sexual

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orientation, 81.9% identified as straight, while 19.1% identified as gay, bisexual, questioning, or other (see Appendix M: Table 1). Most of the sample was in some form of relationship, such as dating but not living with a partner (25.0%), dating and living with a partner (16.7%), or married (23.6%), while 34.7% were single. Most participants identified as White (70.8%), and 15.3% selected two or more options that were combined to form the group “multiracial” (see Appendix M: Table 2 for specific racial identification choices prior to combining into multiracial group). The remainder of participants identified as Latino (8.3%), Asian (2.8%), or other (2.8%; see Appendix M: Table 3). Most participants completed at least some college (93.1%). Annual income was determined by participants’ annual household income divided by the number of people supported by that income. The mean annual income was \$15,612.22 (SD=\$10,012.75; range from \$0.00 to \$410,000.00).

Materials

Self-Report Measures

Demographics (Appendix A). The demographics questions surveyed participant’s age, sexual orientation, gender identity, racial/ethnic background, relationship status, level of education, annual household income.

Subjective Sexual Arousal (Appendix B). Participants rated their subjective sexual arousal and other visceral sensations on a Likert scale from 1 (i.e., not at all) to 7 (i.e., intensely) using Brotto, et al.’s (2016) adaptation of Heiman and Rowland’s self-report measure of psychological and physiological responses to viewing erotica (Heiman & Rowland, 1983). Three questions were totaled together to yield a sexual arousal composite score (i.e., “sexual desire,” “mentally sexually aroused,” and “sexually turned off” (reverse scored)). This measure has good to excellent reliability (i.e., Cronbach’s alpha = .82 to .94) and researchers commonly

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use an adapted form of the Heiman and Rowland (1983) to measure sexual arousal (Janssen, 2002).

Sexual Behaviors Questionnaire (SBQ; Appendix C). The SBQ is a 14-item, self-report instrument that queries that frequency of participants' sexual behaviors over the last month, including sexual activity with and without a condom, number of different partners, drug and alcohol use surrounding sexual activity, and tendencies to engage in sexual activity with unknown (i.e., known less than 24 hours) partners. It also asks participants first age of sex, number of pregnancies, and lifetime STI contraction. The first 10 questions were adapted from the Sexual Risk Survey (SRS; Turchik & Garske, 2009), which is a 23-item self-report measure of sexual risk-taking behaviors over the last six months. The SRS has evidenced adequate factor structure and good psychometric properties (e.g., internal consistency reliability=.88, test-retest reliability=.93) within a college student sample (Turchik & Garske, 2009). Questions 1 through 10 had point values assigned to correspond with each possible response (e.g., "No times" = 0, "1-2 times" = 1, "3-5 times" = 2, etc.) to obtain a total score for this measure.

To control for the possible effects of recent sexual gratification, participants answered questions about their most recent sexual experiences, including when they last participated in sexual activity with a partner resulting in orgasm and when they last reached orgasm by self-gratification (i.e., masturbation).

Erotica Consumption Scale (ECS; Lawyer, unpublished; Appendix D). The ECS is a seven item self-report of one's use of erotica and the frequency of such use. Participants answer yes or no to whether they watch erotica and rate their desire to watch erotica on a Likert scale from 1 to 10. Participants report their average monthly frequency of use of five different types

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of erotica media (e.g., erotic magazines, pornographic websites). These five frequencies were added to yield a total score.

Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993; Appendix E). The AUDIT is a 10-item alcohol abuse screening instrument that gauges one's typical intake, as well as harmful patterns of consumption (i.e., intake frequency and volume, contextual factors, dependence). The instrument yields a total score that ranges from 0 to 40. A cutoff score of 8 or higher for males (6 or higher for females) indicates that one has reached a threshold of harmful alcohol consumption and possible alcohol dependence (Reinert & Allen, 2002). The AUDIT has strong test-retest reliability ($r_{\text{retest}}=.84$ to $.95$) and good convergent validity and internal consistency reliability. The AUDIT has been used in several studies of college students and found to be valid among these samples (Kokotailo, Egan, Gangnon, Brown, Mundt, & Fleming, 2004).

Drug Use Disorder Identification Test (DUDIT; Berman, Bergman, Palmstierna, & Schlyter, 2005; Appendix F). The DUDIT is an 11-item self-report screening instrument used to detect illicit drug use and prescription drug misuse (i.e., drug abuse) behaviors within the past year. The instrument yields a total score that ranges from 0 to 44, with a cutoff score of 25 or higher indicating possible heavy dependence on drugs (Berman et al, 2005). Hazardous substance abuse is associated with a cutoff score of 6 for males (2 for females). The DUDIT possesses strong internal consistency reliability ($\alpha=.93$) and good convergent validity with a similar drug screening measure ($r=.85$). An additional item assessed for current nicotine use status, which was analyzed separately and not counted toward the DUDIT total score.

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Delay Discounting Tasks (Appendix G)

Delay Discounting for Money. A computerized discounting task established discounting rates of money by asking participants to make a series of hypothetical choices between a smaller amount of money available immediately and a larger amount of money available after a delay. The first smaller, immediate choice was random, then titrated by at least 50 cent increments depending upon the choices the participant made until an indifference point, as described above, was established. The range in possible smaller, immediate values narrowed as the participant selected his choices, which reduced the number of questions needed to establish an indifference point. This procedure was similar to the double limit procedure (see Richards et al, 1999). For example, the task could present the participant with the choices “\$3 available now or \$10 available in one week.” Should the participant choose the larger, later choice, then the next smaller, sooner choice is titrated to a higher amount, such as “\$6 available now or \$10 available in one week.” The larger amount of money available after the given delay remained fixed at \$10.

This computer program was created using the same algorithm as Baker, et al. (2003), who found very strong test-retest reliability for this monetary discounting task (Pearson’s $r=.82$ to $.90$). Other studies using delay discounting for money have evidenced good test-retest and alternate-form reliability (see Odum, 2011). The task established five indifference points per participant, one at each time delay in ascending order (i.e., one day, one week, one month, six months, and one year). The average number of choices participants answered per task was 48.53 (Standard Deviation (SD)=10.84; range: 3 to 25).

There is evidence to suggest that using hypothetical rewards yields similar results (i.e., discounting patterns) to potentially real (Johnson & Bickel, 2002; Lawyer, Schoepflin, Green, &

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Jenks, 2011) and real rewards (Lagorio & Madden, 2005). There is also evidence to suggest the contrary that hypothetical rewards are discounted less steeply than real rewards (Hinvest & Anderson, 2010), although the amount of money for the real rewards are much less (e.g., less than \$1) than what hypothetical tasks typically use (\$10-\$1,000; Stewart, Reimers, & Harris, 2015). Hinvest and Anderson (2010) used similar hypothetical and real reward amounts (.10 and .20 British pounds) and found a discrepancy between hypothetical and real delay discounting. However, the generalizability of this finding is questionable, given that most hypothetical tasks use much greater monetary values (e.g., \$10-\$1,000) and these values result in shallower discounting patterns (see the magnitude effect; Green, Myerson, & McFadden, 1997; Greenhow, Hunt, Macaskill, & Harper, 2015). Kirby, Petry, & Bickel, 1999; Stewart et al, 2015). For practical, ethical, and statistical reasons, hypothetical discounting tasks are a sound choice for measuring discounting patterns.

Delay Discounting of Sexual Activity. Using the same computerized program as the monetary discounting task, participants answered a series of hypothetical, titrating choices between a shorter duration, in minutes, of their preferred sexual activity available immediately or a longer amount available after a delay. For example, participants chose between “three minutes of sexual activity available now or 30 minutes of sexual activity available in one week.” Five indifference points were established across the same five time delays, as in the monetary task. The longer amount of sexual activity available after the given delay stayed fixed at 30 minutes, while the smaller, immediate choice titrated in one minute increments. This task produces hyperbolic discounting patterns similar to those of monetary discounting, meaning it has evidence of being a valid task for hyperbolic decay modeling of delay discounting of sexual outcomes in college men (Lawyer et al, 2010; Lawyer & Schoepflin, 2013). The average

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number of choices participants answered per task was 59 (Standard Deviation (SD)=11.52; range: 5 to 25).

I characterized discounting patterns by plotting individual (or group median) indifference points graphically. A hyperbolic function described these patterns, wherein time, or delay in receipt, was plotted along the x-axis and the subjective value of the reward was plotted along the y-axis. Mazur (1987) created the hyperbolic function to mathematically describe this pattern (Eq. 1):

$$V = \frac{A}{1+kD}$$

in which V represents the individual's subjective value of the reward (A) at the specified delay (D) and k serves as a free parameter designed to capture the rate at which an individual discounts rewards over several delays. The larger k is the more steeply one is said to discount rewards based on their delayed receipt (i.e., a proclivity toward selecting smaller sooner, rather than larger later rewards). Therefore, the steeper the discounting rate is, the more impulsive are the individual's behavioral choices.

Establishing a rate of discounting using the k parameter is based upon economic theories of exponential discounting (i.e., Loewenstein, 1992 and Samuelson, 1937, as cited by Myerson, Green, & Warusawitharana, 2001). Myerson and colleagues (2001) created an atheoretical alternative to the use of k parameter. Their alternative estimate of discounting rates calculates the area under the curve (AUC). AUC is calculated by plotting indifference points along a graph, the same as when using k (except delay is expressed across the x-axis in proportion of largest delay, rather than in days), and “drawing” straight lines to connect each indifference point. Straight lines are drawn vertically from the indifference point to the x-axis, which creates a series of trapezoids. The area of the trapezoids are calculated by using the formula ($x_2 -$

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$x_1) * [(y_1 + y_2)/2]$, where x_1 and x_2 represent consecutive delay proportions and y_1 and y_2 represent subjective value proportions associated with the respective delays. The area of the trapezoids are then added together to yield a total AUC score. In contrast to k scores, larger AUC scores indicate less impulsivity or devaluing of a reward due to delay in its receipt.

Video Clips

Erotic Video. A four-minute clip from the pornographic film titled *Under the Covers* (Royalle, 2007) served as the experimental (i.e., erotic) condition. Other studies played clips ranging from 90 seconds to eight minutes (e.g., four clips of two minutes each) to elicit sexual arousal (Suschinsky, Lalumière, & Chivers, 2009; Skakoon-Sparling et al, 2016). This clip depicts consensual petting, oral sex, and condomless vaginal penetration between a man and a woman. This video is non-demeaning and tends to induce subjective sexual arousal in men and women (Skakoon-Sparling et al, 2016). Further, the Candida Royalle films are used frequently in sexuality research (Suschinsky et al, 2009).

Control Video. A four-minute film clip (*Woman and Man Talking*, Holcomb, 2017) created using university student volunteers served as the video in the control condition. The actors in the video did not have any live interactions with participants. The clip is of a woman and a man talking about recreational activities and the weather. The clip contains no sexual content. This video was an attempt to control for the effects of merely watching a video, as well as the effects of seeing a man and woman interact in a non-sexual manner on sexual arousal and delay discounting.

Procedure

Prior to participant arrival, participants were assigned randomly using a block randomization procedure (to ensure for even sample sizes) to one of the two video conditions—

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erotic and control. Within each condition, half of the participants completed the delay discounting task for money and half completed the delay discounting task for sexual activity. All participants completed their respective discounting task twice. All procedures took place in a private laboratory room in Garrison Hall on the Pocatello ISU campus. A research assistant oriented the participant to the study. The research assistant read aloud the informed consent form to the participant, emphasizing that the participant should only agree if he is comfortable with watching an erotic video of a man and woman having oral and vaginal sex, and ask him if he has any questions. If the participant gave consent to participate, then study commenced. The participant completed the study on a computer in a private room with the door shut.

All self-report data were collected using MediaLab software. Delay discounting data were collected using an online application. Participants first answered demographic questions, then switched to the online program to complete the first discounting task. Participants switched back to MediaLab to complete the remainder of self-report measures and subjective sexual arousal questions. Next, the video clip automatically played within the MediaLab program. After the video ended, participants rated the same subjective sexual arousal questions. Participants were prompted by the MediaLab program screen to switch to the online program to complete their second discounting task. Lastly, participants switched back to MediaLab and read a debriefing script, which included more information regarding the true purpose of the study, brief STI education and information about prevention techniques (e.g., using condoms consistently, attending regular sexual health exams), and a prompt indicating that the study is complete and the participant can leave the room when he feels comfortable to do so.

Analyses

Statistical Analyses

IBM SPSS Statistics 25 program with PROCESS v3.1 by Hayes extension (SPSS) and a solver add-on in Microsoft Excel (Excel) completed all analyses. SPSS obtained descriptive statistics of demographics, which were compared for group differences on the outcome variable using *t*-tests for independent samples, one-way analysis of variance (ANOVAs), and Pearson bivariate correlations. Two repeated-measures analysis of covariance (ANCOVAs) tested hypothesis 1. The PROCESS extension used ordinary least squares (OLS) path analysis to conduct a simple mediation model to test hypothesis 2. Excel, using a solver add-on, established discounting rates (i.e., *k* values) and the goodness-of-fit (absolute sums of squares) of the theoretical discounting curve. Excel also determined AUC for discounting tasks.

Alterations to Original Proposed Analyses

The original proposal for these analyses involved using the theoretically derived *k* value as a measure of delay discounting rate. Although this a commonly used estimate of discounting, it is subject to several issues. Mainly, it is a free parameter that estimates the hyperbolic non-linear slope and is sensitive to data that deviate from the predicted curve (Mazur, 1987). When many data deviate from the theorized curve, poor goodness of fit occurs, and the estimate of this curve (*k*) does not hold much meaning. This study observed typical frequencies of nonsystematic responding (Smith et al, 2018), but there was generally quite poor goodness of fit amongst groups' *k* values to the observed data (median R^2 pre-video=0.46, post-video=0.00; median absolute sum of squares (SS) pre-video=0.0806, post-video=0.0761). Due to this poorness of fit, AUC was added as an outcome variable to increase the robustness of findings.

AUC makes no assumptions about the observed data and is also commonly used as a measure of discounting (Myerson et al, 2011).

Results

Data Organization

Missing data

There were 16 delay discounting indifference points missing of 720 (5 delays across 144 discounting patterns). As so few data points (2.2%) were missing at random (i.e., discounting program error, participant forgetting to complete post-video discounting, missingness is not apparently associated with the variable measured; Graham, 2009), mean replacement substituted values in place of the missing data. There were no other missing data across any of the items or tasks.

Nonsystematic Response

The delay discounting task data were screened for nonsystematic response patterns prior to analyses using Johnson and Bickel's (2008a) two algorithms for identifying nonsystematic response patterns in discounting outcomes. The first algorithm asserts that no indifference point should be more than 20% larger than the indifference point preceding it. The second algorithm asserts that the last indifference point should be at least 10% less than the first. Data qualifying as nonsystematic could occur due to participant inattention, user error, participant indifferent toward delay in receiving a reward, or the stimulus discounted was not desirable. Johnson and Bickel (2008b) do not provide recommendations as to the statistical handling of nonsystematic data (i.e., they do not make a case for or against removing these data from analyses).

Of the 140 discounting patterns established (of 70 participants discounting twice), 25 (17.9%) demonstrated nonsystematic response according to the criteria outlined by Johnson and

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Bickel (2008). Eight participants demonstrated nonsystematic responding at pre- and post-video discounting (making up for 16 of the 25 patterns). There were 16 (22.2%) nonsystematic response patterns in the monetary discounting group, while there were 9 (12.5%) in the sexual activity discounting group. A meta-analysis on discounting studies indicated that an average of 18.2% of participants respond in irregular, non-systematic patterns to discounting tasks (Smith, Lawyer, & Swift, 2018). Smith and colleagues (2018) specified that the studies using monetary outcomes had an average of 16.1% of responses qualify as non-systematic, while studies using non-monetary outcomes (e.g., drugs, sex, food) had an average of 21% of non-systematic responding. This difference in number of nonsystematic response patterns between discounted commodities was surprising, given that monetary discounting yields more systematic response patterns than non-monetary commodities (Smith et al, 2018). See Appendix M: Table 4 for the goodness of fit (absolute SS) for each group, including non-systematic responder patterns in the analyses. AUC adds an additional assessment of participant discounting, which is not affected by non-systematic responding. Therefore, all participants' discounting responses remained in analyses.

The slight differences in findings (detailed below) using k and AUC arise from the differences in how these measure discounting rate (i.e., theoretically and nontheoretically, respectively). Goodness of fit measured by absolute SS indicated no significant difference in fit between the observed data and theoretical discounting rate (i.e., k) for monetary discounting compared to sexual activity discounting pre-video ($t(68)=-1.535, p=.068$) or post-video ($t(68)=-1.857, p=.129$; see table 4). Regardless of the goodness of fit using k , AUC provided a more exact measurement of discounting rate.

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Zero-Delay Choices

Participants answered a zero-delay choice for their respective outcome (i.e., “would you rather have \$0 (0 minutes of sex) now or \$10 (30 minutes of sex) now?”) before answering the series of choices across five delays. This choice did not affect one’s discounting rate, but rather determined if participants preferred to receive the outcome at all (i.e., found the outcome desirable). For those discounting money, 11 of 35 participants chose \$0 now over \$10 now pre-video, while 1 of 35 participants chose \$0 now over \$10 now post-video (see Figure 1). The number of participants choosing the smaller outcome pre-video is surprising, given money has an objective value and is typically desirable (Heyman & Ariely, 2004). It is possible that the zero-delay question was misunderstood, as it was the first choice of the task. Only one participant chose the smaller amount of money post-video, which suggests participants may have become accustomed to the task. For sexual activity, 14 out of 34 participants chose 0 minutes of sexual activity now over 30 minutes of sexual activity now pre-video, while 3 of 34 participants chose the smaller amount of sexual activity post-video. There could be a similar explanation for the number of participants choosing the smaller outcome, such that participants better understood the task post-video. It is unlikely the video condition had an effect on participants’ no delay choices, as there was not a significant difference between the erotic and control video groups on the number of participants choosing the smaller outcome over the larger outcome post-video for money ($\chi^2=1.090$, $p>.050$) or sexual activity ($\chi^2=0.249$, $p>.050$).

Group Differences

Groups did not differ in the distribution of participants in each of the conditions based on demographics, meaning there were nearly equal numbers of participants in each demographic category (see Table 1). There was a significant negative correlation between SBQ total score

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and k score for sexual activity discounting pre-video and post-video. There were no other significant relationships between sexual factors (i.e., ECS total score, time since last orgasm) and discounting rates (see Table 2). There were no significant correlations between alcohol use (i.e., AUDIT total score), substance use (i.e., DUDIT total score), or tobacco use and discounting rates (see Table 3).

Manipulation Check

To determine if video group (i.e., control or erotic video) produced an effect on the participant's subjective sexual arousal, a repeated-measures ANOVA analyzed subjective sexual arousal total scores pre-video (before the video) and post-video (just after the video) across video groups. There was a significant interaction ($F(1,68)=49.565$, $p<.001$, partial $\eta^2=.422$). As such, the erotic group (Mean=15.71, SD=4.725) rated significantly greater subjective sexual arousal post-video than the control group (Mean=7.89, SD=3.234). Further, a total score rating of 15.71 falls between “somewhat” and “intensely” sexually aroused on the arousal measurement scale, which indicates clinical significance in that erotic video participants actually felt aroused (see figure 2).

Primary Analyses

Hypothesis 1: Domain-specific Effects of Erotica Exposure on Delay Discounting

Three repeated-measures ANOVA and one repeated-measures ANCOVA tested the first hypothesis. The assumptions of ANOVA were met (see Appendix K for detailed information on assumptions). Video group was the independent variable and $\log_{10}$ transformed k scores for monetary discounting was the dependent variable. There was a significant main effect of time ($F(1,33)=4.932$, $p<.05$, partial $\eta^2=.130$) in which k scores decreased, or evidenced less impulsivity, across time. There was not a significant main effect of video group ($F(1,33)=0.085$,

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$p=.772$) or interaction ($F(1,33)=0.082$, $p=.776$; see Figure 3). With AUC scores for monetary discounting as the dependent variable, there was a significant main effect of time ($F(1,33)=12.577$, $p<.01$, partial $\eta^2=.276$) in which AUC scores increased, or evidenced less impulsivity, across time. There was not a significant main effect of video group ($F(1,33)=0.000$, $p=.984$) or interaction ($F(1,33)=0.007$, $p=.935$; see Figure 4).

A repeated-measures ANCOVA tested video group as the independent variable, SBQ total score as a covariate, and sexual activity discounting k scores as the dependent variable. SBQ total score was entered as a covariate as it was significantly correlated with sexual activity discounting k scores (but not AUC scores). The interaction between video group and time was significant ($F(1,32)=14.071$, $p<.01$, partial $\eta^2=.305$, see Figure 5), indicating the erotic group evidenced greater impulsivity, controlling for self-reported sexual behaviors, than the control group post-video. There was not a main effect of time ($F(1,32)=0.896$, $p=.351$) or main effect of video group ($F(1,32)=0.697$, $p=.410$).

A repeated-measures ANOVA tested video group as the independent variable and sexual activity discounting AUC scores as the dependent variable. The interaction between video group and time was significant ($F(1,33)=7.038$, $p<.05$, partial $\eta^2=.176$, see Figure 6), indicating the erotic group evidenced greater impulsivity than the control group post-video. There was not a main effect of time ($F(1,33)=3.743$, $p=.062$). There was not a main effect of video group ($F(1,33)=3.134$, $p=.086$). Taken together, these findings support hypothesis 1 in that there was an interaction of time and video group for sexual activity but not monetary discounting using k and AUC scores. Further, using t -tests for independent samples, the variability between types of discounting groups was compared across type of domain (i.e., money or sexual activity). When using k scores, there was not significant difference between variabilities ($F(1,68)=2.47$, $p=.121$).

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However, AUC scores yielded a significant difference in variabilities between money and sexual activity ($F(1,68)=8.618, p<.010$). Therefore, it may have been easier to detect a change in discounting rate in the sexual activity group, compared to the monetary group, when using AUC scores. As this difference was not found with k scores, this finding is not as concerning. Also, greater variability is expected in the group targeted to be impacted by the independent variable.

Hypothesis 2: Sexual Arousal as a Mediator

A simple mediation model using ordinary least squares (OLS) path analysis through the PROCESS program extension in SPSS and simple linear regression analyses through SPSS tested hypothesis 2. All but one of the assumptions of regression were met with the exception of little to no multicollinearity. It is difficult to determine if the degree of relationship between predictor variables violates the assumption until the mediation analysis is performed (see Appendix K for detailed information). As such, the mediation models were tested in order to determine if there was excessive multicollinearity. Video condition was the independent variable (X), post-video subjective sexual arousal total score was the mediator (M), SBQ total score was entered as a covariate (C), and post-video sexual activity discounting k score was the dependent variable (Y; see Figure 7a). A Sobel test (see Equation 3) determined sexual arousal did not significantly ($Z=1.507, S.E.=0.381, p=.132$) mediate the relationship between video group and sexual activity discounting scores, thus hypothesis 2 was not supported. As the sample size was smaller and prone to non-normal distribution, bootstrapped confidence intervals were used to detect significance of the indirect effect (i.e., mediator). The bootstrap confidence interval [0.033, 2.004] based on 5,000 bootstrap samples indicated that mediation was significant, as the interval did not include zero and it can be certain that the indirect effect is significantly different from zero.

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Sobel test (Eq. 3):

$$z = \frac{a*b}{\sqrt{(a^2 s_b^2 + b^2 s_a^2)}}$$

where a represents the regression of video condition onto post-video subjective sexual arousal scores, b represents the regression of post-video subjective sexual arousal scores onto sexual activity discounting $\log_{10}$ AUC scores, s_a represents the standard error of a , and s_b represents the standard error of b , will evaluate the significance of the indirect effect (i.e., $a*b$ path), which yields a z score. If the z score has an absolute value greater than 1.96, it can be concluded that mediation occurred and the indirect effect is significant.

Hypothesis 2 was also tested using AUC as the outcome. Video condition was the independent variable (X), post-video subjective sexual arousal total score was the mediator (M), and post-video sexual activity discounting AUC score was the dependent variable (Y ; see Figure 7b). A Sobel test determined sexual arousal did not significantly ($Z=-1.408$, $S.E.=0.135$, $p=.159$) mediate the relationship between video group and sexual activity discounting scores, thus hypothesis 2 was not supported. The bootstrap confidence interval $[-0.745, 0.036]$ based on 5,000 bootstrap samples also indicated that mediation was not significant, as the interval included zero and it cannot be certain that the indirect effect is significantly different from zero. The total effect of video group on post-video sexual activity discounting, including its effect on arousal, was significant ($c=-.325$, $t(33)=-2.547$, $p<.05$). The total effect model was significant, $R^2=.164$, $F(1,33)=6.485$, $p<.050$. This model resulted in a large effect size, Cohen's $d=.88$.

Although the indirect effect (i.e., mediation) was not significant using k or AUC, the alpha (α) path was significant and yielded a very large effect size ($R^2=0.522$, Cohen's $d=2.09$), accounting for much of the variance in the mediator and reducing the variance the mediator

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would account for in the outcome variable (i.e., *b* path). This causes the mediator to be a proximal mediator. This also means those in the erotic group reported a mean sexual arousal score approximately 2.09 standard deviations greater than those in the control group. The direct effect for both outcomes was not significant, which suggests video group did not have a meaningful influence on post-video *k* or AUC sexual activity discounting scores independent of its effect on post-video subjective sexual arousal (see Table 4).

It appeared sexual arousal could not be properly tested as a mediator due to high multicollinearity (i.e., high correlation between the independent variable and mediator, Point Biserial Correlation, $r_{pb}=.722$, $p<.001$), which effectively violated the assumption of multicollinearity. So, a mediation model in this case is improper to evaluate the effect of erotica exposure and sexual arousal on discounting, but rather one or the other based on which accounts for more variance in the outcome variable. When comparing the mediation path coefficients (removing SBQ as a covariate for these comparisons), post-video sexual arousal accounted for more unique variance in sexual activity discounting *k* and AUC scores than did video group (see Table 5). Further, bivariate correlation analyses revealed sexual arousal accounted for 16% of sexual activity discounting using *k* variance, while video group accounted for 0.0025% of the variance independent of sexual arousal. Sexual arousal accounted for 20.3% of the variance using AUC, while video group accounted for 1.3% of the variance independent of sexual arousal. Using sexual arousal alone as a predictor of sexual activity discounting appears justified, rather than video condition.

Linear regression analyses were performed to test the impact of sexual arousal on sexual activity discounting without inclusion of video group due to the issues of multicollinearity. Post-video sexual arousal total score served as the predictor variable and post-video sexual activity

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discounting using k and AUC served as the outcome variables. SBQ total score was entered as a covariate when using k . Regression analyses revealed sexual arousal and sexual risk-taking behaviors significantly predicted impulsivity for sexual activity using k , $F(2,32)=5.94$, $p<.010$. Sexual arousal and sexual risk-taking accounted for 27.1% of the variance in sexual activity discounting k scores with adjusted $R^2=0.225$, or 22.5%, which is a large effect size (Cohen, 1988). The linear regression equation can be used to predict impulsive sexual decision-making, predicted $y=-3.106 + 0.075(\text{Sexual Arousal}) + 0.061(\text{Sexual Risk-taking})$. Similarly, sexual arousal significantly predicted impulsivity for sexual activity using AUC, $F(1,33)=8.39$, $p<.010$. Sexual arousal accounted for 20.3% of the variance in sexual activity discounting AUC scores with adjusted $R^2=0.178$, or 17.8%, which is a large effect size (Cohen, 1988). The linear regression equation can be used to predict impulsive sexual decision-making, predicted $y=-0.382 - 0.031(\text{Sexual Arousal})$.

Discussion

Impulsive choice represents a potentially fundamental mechanism that underlies risk-taking and other behaviors that lead to detrimental consequences (e.g., unintended pregnancy, STI contraction; Johnson & Bruner, 2012). There is still a need to better understand the factors that influence impulsive decision-making. Loewenstein (1996, 2000) proposed the visceral influences hypothesis in which bodily sensations (e.g., hunger, tiredness, drug cravings, sexual arousal) are thought to increase the likelihood of engaging in behaviors that lead to satiation of the respective visceral sensation, even if those behaviors might be considered risky or impulsive. We know exposure to erotic or sexually appealing stimuli is associated with impulsive choice (Skakoon-Sparling et al, 2016), and sexual arousal may represent the mechanism (visceral influence) responsible for this association (Ariely & Loewenstein, 2006; Loewenstein et al,

1997). No research to date has tested whether sexual arousal, rather than mere exposure to erotic stimuli (e.g., priming), accounts for the relationship between exposure to sexual stimuli and impulsive choice. This study evaluated both the effect specificity of exposure to erotica on delay discounting and sexual arousal as a potential mechanism that accounts for the relationship between viewing erotic stimuli and sexual decision-making.

The Domain-specific Effects of Erotica Exposure

This study assessed the domain-specific effects of viewing an erotic video on delay discounting for monetary and sexual outcomes. Domain-specificity occurs when outcomes of various types or commodities (i.e., domains) differentially correlate to certain discounting or behavioral choice patterns. These findings indicated a domain-specific effect. Watching a neutral or erotic video had no impact on choice patterns for money. In contrast, those viewing erotica had significantly more impulsive choice patterns for sexual activity than those viewing the neutral video. This was consistent with other research in which preferences shifted toward more immediately available related cues, while there was no impact on immediate preference for an unrelated domain (Ariely & Loewenstein, 2006; Loewenstein, 1996; Rasmussen et al, 2010; Hendrickson & Rasmussen, 2013; Hendrickson & Rasmussen, 2017; Tsukayama et al, 2010).

When using k (but not AUC) as a discounting measure, sexual risk-taking also accounted for a significant portion of the change in sexual activity discounting. Those who frequently engage in risky sexual practices may be more prone to have trouble delaying sexual gratification. This was similar to other studies finding associations between risky tendencies and impulsive behavioral choice (Baumann & Odum, 2012; Mahoney & Lawyer, 2018; see Petry, 2001). However, unexpected zero-delay discounting patterns and non-systematic response patterns cautioned the use of k alone as an estimate of impulsive behavioral choice. Together, these

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findings support the first hypothesis in that viewing sexual stimuli differentially impacted choices for sexual and non-sexual outcomes.

Surprisingly, there was decreased discounting of money (i.e., less impulsivity) for both groups across time. This questions the test-retest reliability of this task being taken twice across a short time span of approximately 15 minutes, although other studies have found sound test-retest reliability across longer time spans (Baker et al, 2003; Hendrickson, Rasmussen, & Lawyer, 2015; see Odum, 2011). Another explanation for this main effect of time could be increased familiarity with the task. There were a curiously large number of participants choosing the smaller reward during the no-delay choice (i.e., choosing to be give no money immediately over \$10 immediately) of the first discounting task, which greatly reduced during the second task. So, participants may have become more familiar with the discounting task during its second administration and discounting rates changed accordingly. However, a similar pattern of no-delay choices was observed for sexual activity discounting and there was not a main effect of time. This finding still supports the hypothesis in that those watching erotica would demonstrate more impulsive decisions for sexual activity, while decision-making for money was not impacted by video exposure.

These findings differed from other studies of the effects of erotica on behavioral choice. One study found those viewing erotica made riskier sexual and monetary choices compared to those viewing a non-erotic film clip (Skakoon-Sparling et al, 2016). These tasks did not use delay discounting and assessed risk-taking, specifically willingness to engage in unprotected sex and gambling behaviors. This suggests sexual arousal affects impulsivity and risk-taking differently. However, another study found men who were exposed to attractive women's faces made more impulsive monetary choices in a delay discounting task (Wilson & Daly, 2004). Of

course, viewing attractive faces likely results in different physiologic responses than viewing erotica.

This finding of domain-specificity has several important implications. The domain-specific effects of exposure to erotica on delay discounting support the use of domain-related outcome measures (Lawyer & Schoepflin, 2013; Mahoney & Lawyer, 2018). Using domain-specific outcomes better captured the effects of erotica exposure in this study, rather than assuming erotic stimuli had a generalizable impact on impulsive choice. If only a more universal domain (i.e., money) was measured, the effect of viewing erotica on impulsive choice would have been missed altogether. We also have a better understanding of the conditions under which impulsiveness for sexual activity increases. Exposure to erotica is one such condition in which this occurred, but further testing was needed to determine if the effect was derived specifically from this exposure or rather sexual arousal that occurred as a result of the exposure.

The Role of Sexual Arousal on Delay Discounting

In the simple mediation model, there was a significant relationship between video group and sexual arousal, in which those watching the erotic video reported greater sexual arousal. Still, there was no significant indirect effect within this model, meaning sexual arousal did not mediate the relationship between video group and sexual activity discounting using k or AUC. There are some explanations as to why this hypothesis was unsupported. Subjective sexual arousal could be considered a proximal mediator, which creates multicollinearity between itself and video group, the independent variable. A proximal mediator occurs when there is a relatively large α path and relatively smaller b path, which was observed in this model. This lowered power may have made it less likely to detect an effect. The mediator was also susceptible to measurement error, as subjective sexual arousal is indeed subjective and possibly

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prone to desirability effects. These factors might explain how the b path was underestimated and the indirect effect was not significant (Kenny, 2018, retrieved August 2018). Perhaps sexual arousal was not a mechanism of change in discounting rates due to low statistical power, another factor may better account for the change in discounting rate after exposure to erotic stimuli, or it is unnecessary to account for both stimuli exposure and sexual arousal.

Priming (see Spelman & Simons, 2018; Spiering et al, 2002; Spiering et al, 2003; Wilson & Daly, 2004) was one alternative explanation for the lack of mediation, which would suggest sexual arousal does not have a significant influence but rather mere exposure to erotic stimuli relates to changes in decision-making. However, it is doubtful that priming explains these findings, as sexual arousal neared statistical significance as a mediator and had a significant relationship with sexual activity discounting. In fact, sexual arousal accounted for nearly all of the regression variance in discounting of sexual activity, perhaps because video group is categorical and sexual arousal is a continuous variable. Using only sexual arousal as a predictor of discounting eliminates the problem of multicollinearity and increases statistical predictive power.

In accordance with Loewenstein's (1996) hypothesis, the visceral influence observed here (i.e., sexual arousal) lead to impulsive behavioral choice patterns associated with more immediate satiation of that urge (i.e., sexual activity), rather than unrelated cues (i.e., money). This provides beneficial insights into one condition (i.e., sexual arousal) associated with individuals making short-sighted or impulsive choices, particularly choices that would lead to more immediate sexual gratification. These choices can lead to sexual risk taking and greater numbers of sexual partners (Victor, 2017). These results corroborate other studies related to the visceral influences hypothesis (e.g., Easterbrook, 1959; Field et al, 2006; Loewenstein, 1996;

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Tsukayama & Duckworth, 2010). The findings also support similar studies investigating sexual arousal's effects on domain-related outcomes (Lawyer & Schoepflin, 2013; Loewenstein et al, 1997).

Strengths of Present Study

This study possesses several strengths. This was the first time, as evidenced by the literature review performed here, that sexual arousal was statistically tested as a mechanism to explain change in delay discounting patterns for hypothetical preferred sexual activity. Previous studies (Loewenstein et al, 1997; Skakoon-Sparling et al, 2016) utilized only erotica exposure as a predictor variable but did not degree of sexual arousal. The relationship between exposure and sexual arousal and their unique effects on behavioral choice were unexamined. This study's strength also pertains to its use of psychometrically-supported, theoretically-derived outcome measures that assess impulsive choice for sexual activity. Delay discounting measures evaluate the degree of impulsive choice individuals evidence in relation to various outcomes (Baker, et al, 2003; Lawyer et al, 2010; Lawyer & Schoepflin, 2013; Odum, 2011). In other words, delay discounting uses the choices individuals actually make to draw conclusions about those choice patterns. This differs from tasks that assess behaviors distantly related to impulsivity (see Delis, Kaplan, & Kramer, 2001; Greenberg, 2011; Lejuez et al, 2002; Logan, Schachar, & Tannock, 1997; Verbruggen & Logan, 2008). The discounting tasks used here also avoid issues that surface when relying on retrospective self-evaluations of one's impulsive choice tendencies, like social desirability and difficulty acknowledging one's problematic behaviors (see Emery & Levine, 2017; Nisbett & Wilson, 1977).

Limitations of Present Study

There were several limitations to this study. First, the computerized discounting program was recently developed and had not been through extensive testing. There were some problems with the program, such as timing out due to inactivity after less than one hour, logging the user out unexpectedly, and missing data. Further testing and development should address these issues. Fortunately, this study was minimally impacted by these problems and sufficient data were collected from the discounting program. The discounting program was online, while MediaLab is an installed software program. So, participants had to manually switch between programs, which could have distracted from the study tasks (e.g., rating sexual arousal, discounting).

Another potential issue pertained to the magnitude of the monetary discounting task. The larger, delayed choice of \$10 is a relatively small amount of money compared to \$100 or \$1000. The magnitude effect suggests smaller amounts of money are discounted more steeply than larger amounts (Green, Myerson, & McFadden, 1997; Kirby, Petry, & Bickel, 1999; Stewart et al, 2015), which could cause a floor effect that restricts variability in responses. As such, it may have been more difficult to determine if video group or sexual arousal had an impact on monetary discounting. To combat this problem, a larger amount of money could be tested as the discounted outcome.

The study setting lacked ecological validity (e.g., taking place in lab, research assistant nearby) and may have suppressed the effects of sexual arousal on discounting or suppressed sexual arousal itself. This could be improved by allowing participants to complete the study entirely online and in a private room of their choice (e.g., bedroom). A private room of choice, however, would not control for participants choosing to sexually gratify themselves before

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completing the discounting task. The measurement of sexual arousal could be expanded upon, as this study relied on self-report and measured only subjective sexual arousal. This may have been prone to social desirability effects, lack of self-awareness of visceral sensations, or misinterpretation of the subjective sexual arousal items. This could be addressed by also recording physiological indicators of sexual arousal to test for sexual discordance.

The generalizability of this study is limited in that the sample was primarily comprised of younger men attending a four-year university. Provided that the university is in a predominantly White city, it was encouraging to find 19.1% of participants endorsed a sexual minority orientation and 29.2% identified as a race other than exclusively White. Lastly, this study only measured two discounting domains (i.e., money and sexual activity), which questions if sexual arousal impacts choices for other commodities like food, drugs, alcohol, or tobacco. This study assessed sexual arousal's effect on a reward without a component of risk. It is worthwhile to determine sexual arousal's association with risk-related outcomes, such as unprotected sex or sexual aggression (i.e., risk of adjudication).

Conclusions and Future Directions

This study supports the visceral influences hypothesis (Loewenstein, 1996), in which a visceral sensation (e.g., sexual arousal) influences one's desire to obtain satiation of this sensation (i.e., preferred sexual activity), while sexual arousal is not associated with changes in preferences for a commodity that will not lead to satiation (i.e., money). Exposure to erotic stimuli evidenced a domain-specific effect on college men's delay discounting rates between two outcomes. Specifically, college men who watched an erotic video, rather than a video of a neutral conversation, made more impulsive choices for sexual activity but evidenced no differences in their discounting of money. This distinction in discounting also highlights the

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importance of using an outcome measure related to the influence or variable of interest (see Lawyer & Schoepflin, 2013). A mediation analysis could not be properly tested, as exposure to erotic stimuli and sexual arousal were highly correlated and overlapped in the variance accounted for in delay discounting rates. Sexual arousal better accounted for changes in sexual decision-making than did erotica exposure. Together this suggests it is unnecessary to account for both video exposure group and sexual arousal, but rather simply use sexual arousal as a predictor of impulsive sexual decision-making.

Future research should address the limitations discussed here, including discounting program problems, increasing ecological validity, expanding measurement of sexual arousal, addressing test-retest reliability, and diversifying outcomes measured. One study found improvement of test-retest reliability for a fixed-choice delay discounting task by using an alternate form (Kuang, Milhorn, Stuppy-Sullivan, Jung, & Yi, 2018). Other discounting domains could be added, such as alcohol and drugs (Coffey et al, 2003; Kirby & Petry, 2004) or food (see Hendrickson, Rasmussen, & Lawyer, 2015; Rodriguez, Hendrickson, & Rasmussen, 2018). Researchers are encouraged to extend these findings by exploring sexual arousal's impact on risk-sensitivity behavioral choice patterns. Probability discounting could evaluate risk-sensitivity for a variety of outcomes, such as sexual activity, money, alcohol and drugs, or food. To further extend findings on sexual arousal's influence, health risk-taking behaviors (likelihood of condom usage; see Johnson & Bruner, 2012) and sexual assault behaviors (see Bouffard, 2015; see Loewenstein et al, 1997) could be studied as outcomes. Provided that alcohol is associated with sexual risk-taking behaviors (Abbey, Wegner, Woerner, Pegram, & Pierce, 2014; Abrams & Wilson, 1983; Banks & Zapolski, 2017), future studies could investigate the effects of sexual arousal and alcohol on sexual outcomes (see Woerner, Abbey, Pegram, & Helmers,

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2018). In contrast to reward-based outcomes, sexual arousal may differentially be related to loss-based outcomes (e.g., loss of sexual gratification opportunities) or risk sensitivity (i.e., probability discounting of sexual activity). These procedures could be tested using a sample of women, as women have had differing results in sexual arousal studies compared to men (Skakoon-Sparling et al, 2016; Walton et al, 2016). Lastly, generalizability would improve if samples included community members, greater racial diversity, individuals with psychiatric disorders like ADHD, and offenders.

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Figures

Figure 1. Participants Choosing Nothing over Larger Outcome without Delay

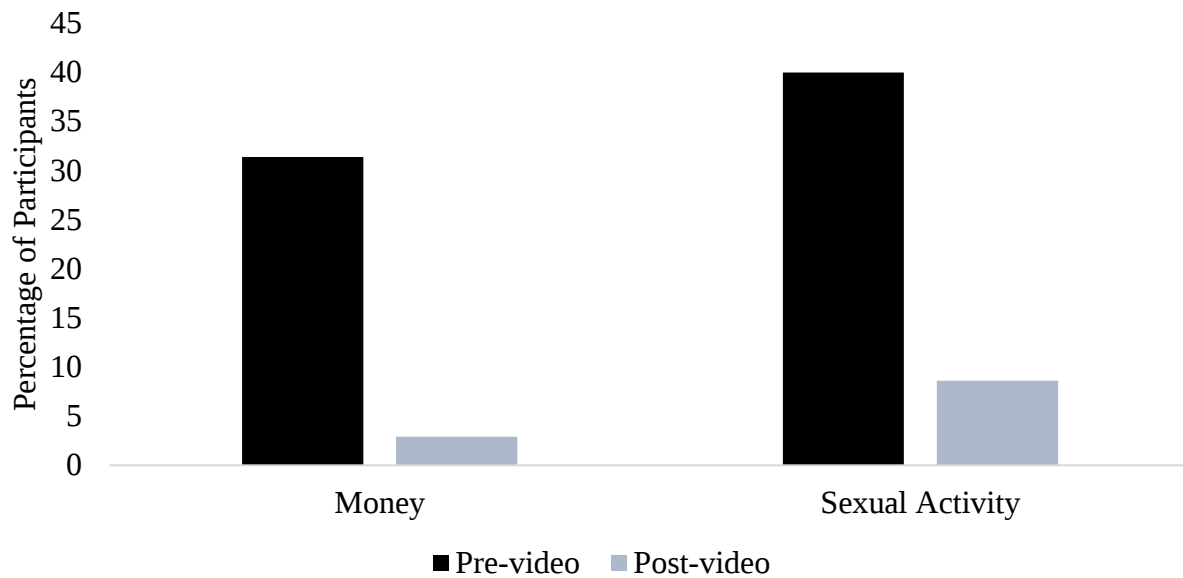
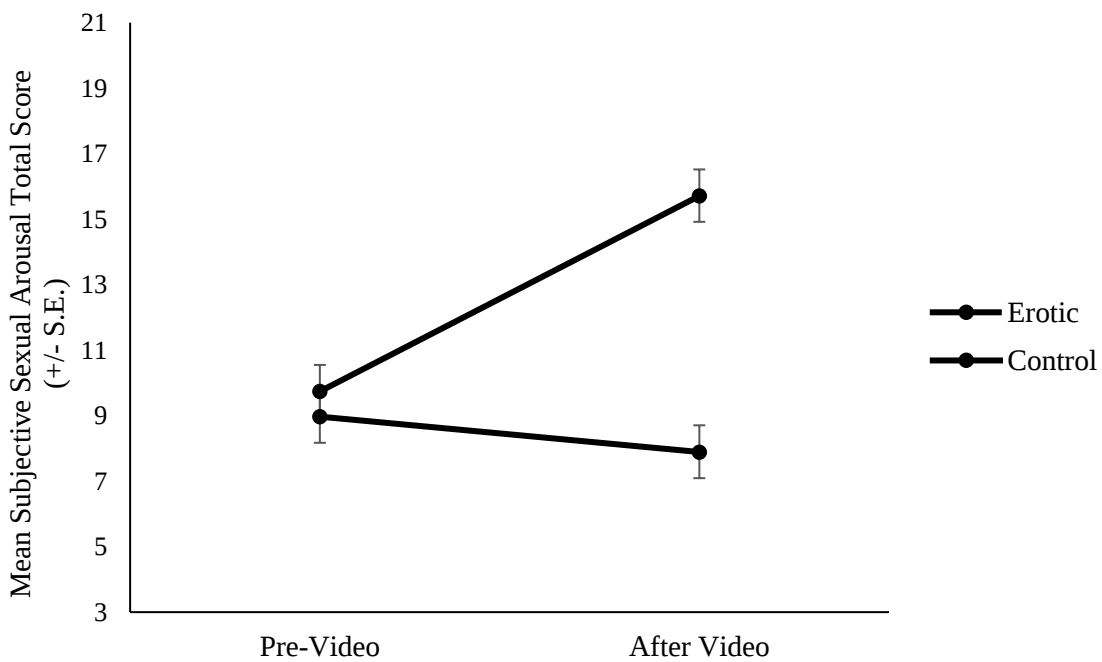
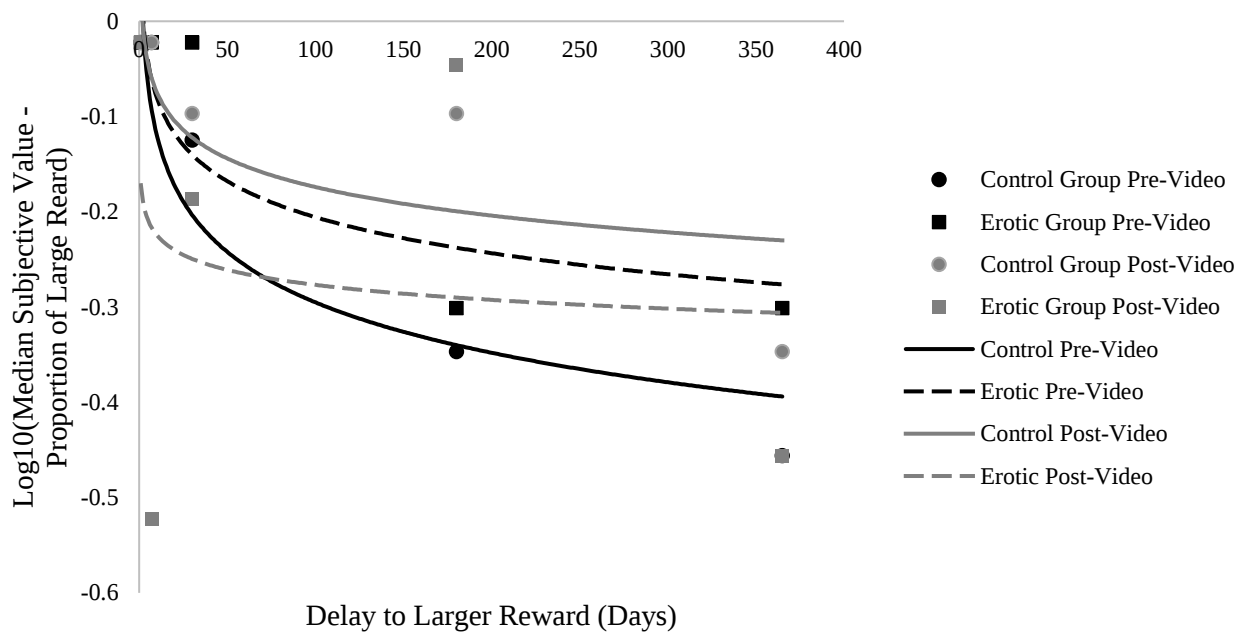


Figure 2. Manipulation Check: Effect of Video Condition on Subjective Sexual Arousal (scale ranges from 3 to 21).



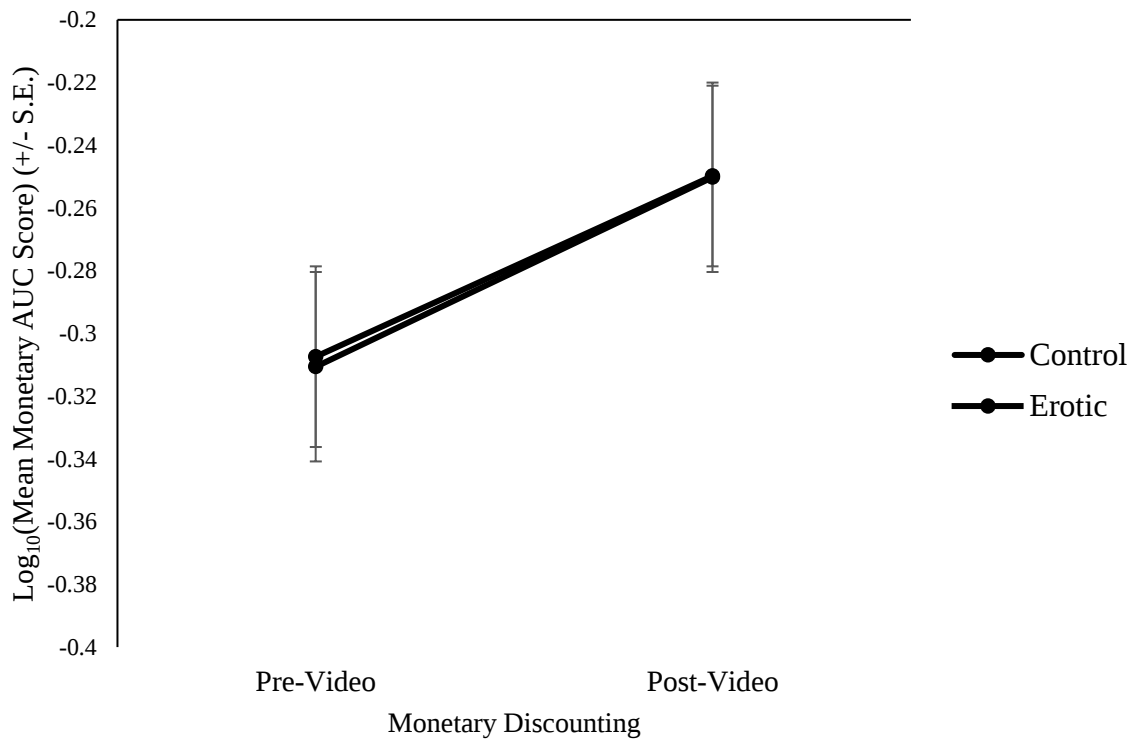
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Figure 3. Monetary Discounting Repeated-measures ANOVA using k



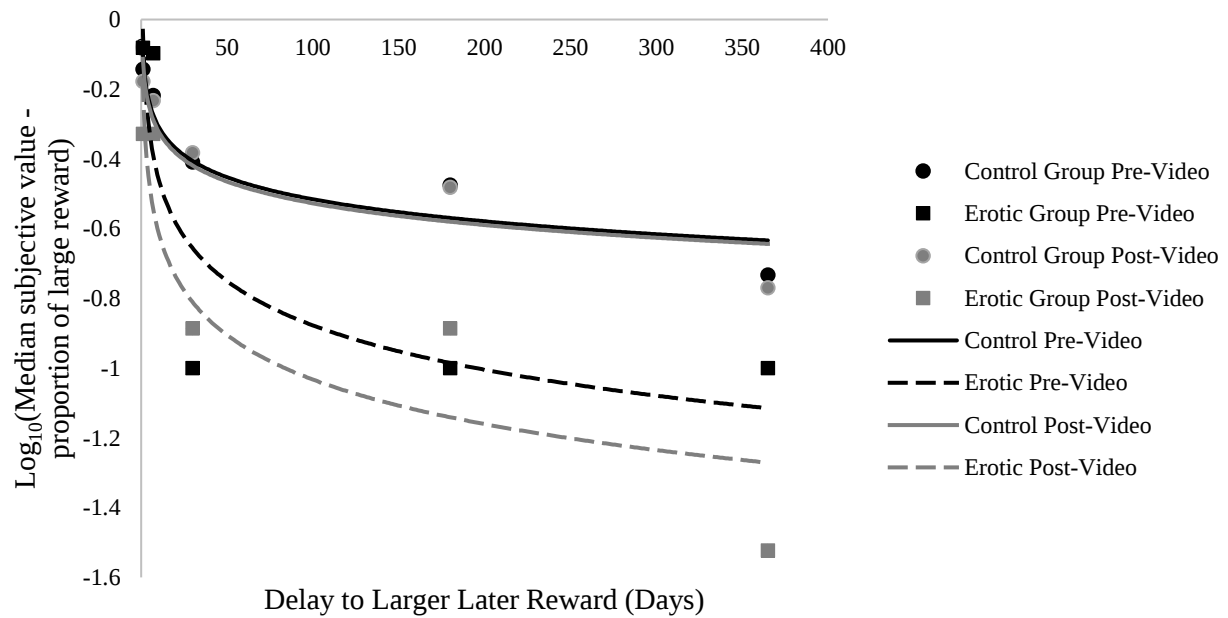
Note. Significant difference between pre-video and post-video monetary discounting for control and erotic group

Figure 4. Monetary Discounting Repeated-measures ANOVA using AUC



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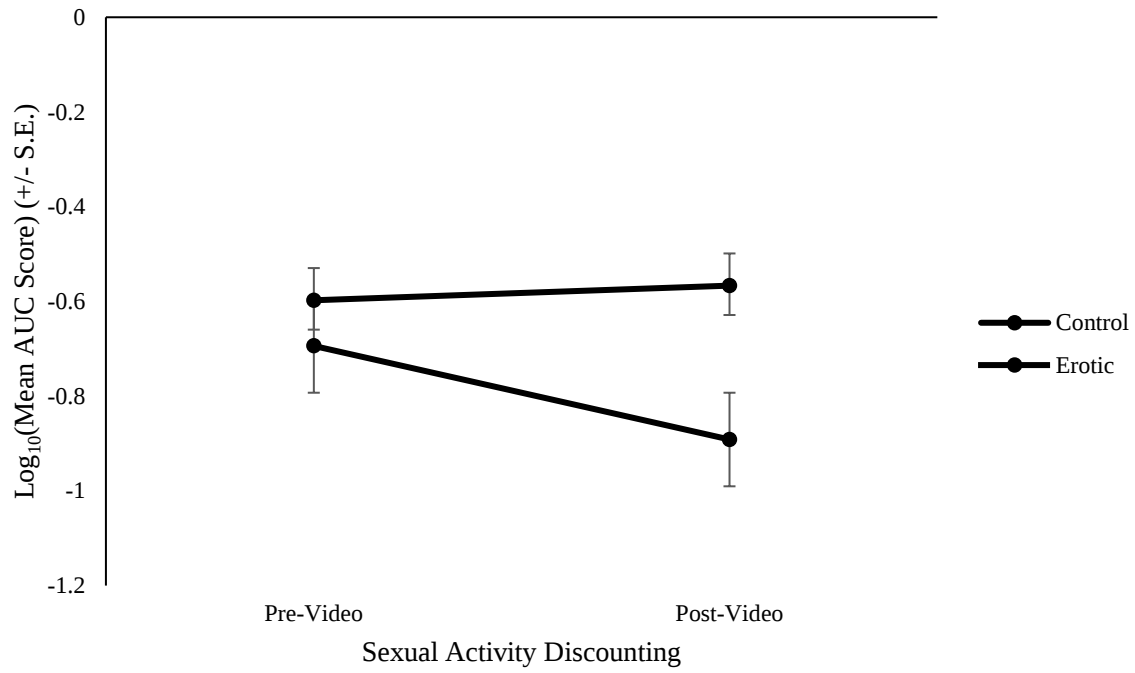
Figure 5. Sexual Activity Discounting Repeated-measures ANCOVA with SBQ as a Covariate using k



Note. Significant difference between post-video erotic and control sexual activity discounting.

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Figure 6. Sexual Activity Discounting Repeated-measures ANOVA using AUC



Note. Significant interaction of video condition and time.

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Figure 7a. Simple Mediation Model of Video Group (X), Post-Video Sexual Arousal (M), SBQ (C), and Post-Video Sexual Activity k Scores (Y)

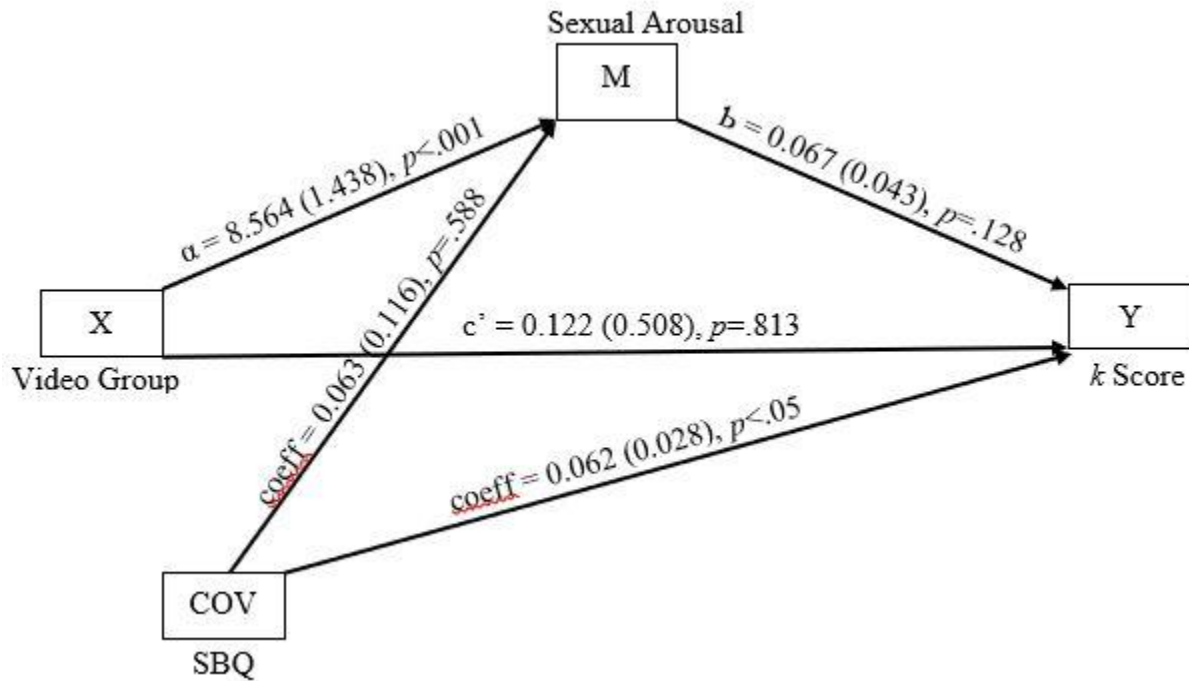
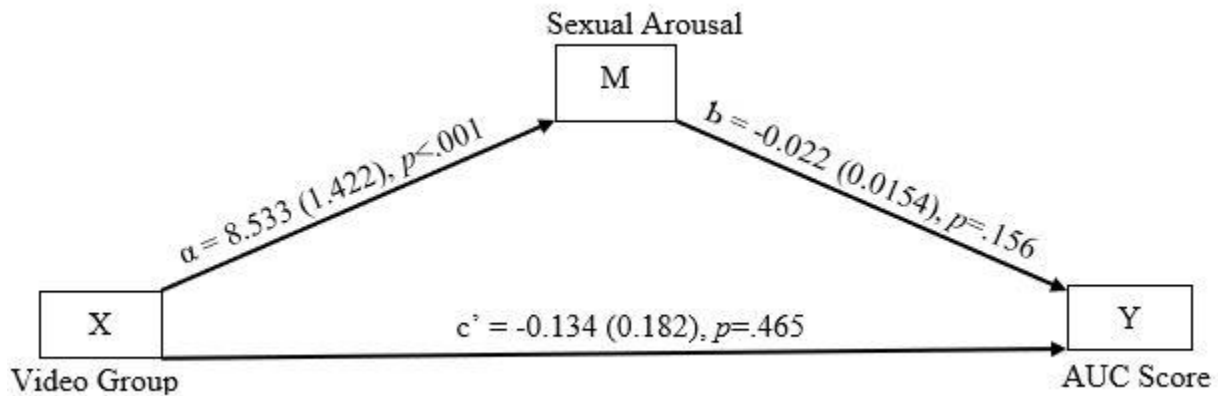


Figure 7b. Simple Mediation Model of Video Group (X), Post-Video Sexual Arousal (M), and Post-Video Sexual Activity AUC Scores (Y)



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Tables

Table 1.

Demographic Differences in Participant Distribution between Conditions

Demographic	Statistical Test	Significance
Age	$F(3,66) = 0.15$	ns
Sexual Orientation	$\chi^2(9) = 10.83$	ns
Race	$\chi^2(12) = 6.72$	ns
Annual Income	$F(3,66) = 0.59$	ns
Relationship Status	$\chi^2(9) = 9.64$	ns
Level of Education	$\chi^2(9) = 9.14$	ns

Note. Not significant (ns).

Table 2.

Outcome Comparisons Based on Sexual Factor Differences

Outcome Measure	ECS	SBQ	Time Since Last Orgasm
<i>k</i> Pre-Video Money	$r = .12$	$r = .12$	$r = -.17$
<i>k</i> Post-Video Money	$r = .18$	$r = .21$	$r = -.19$
<i>k</i> Pre-Video Sex. Activity	$r = .13$	$r = .44^*$	$r = -.26$
<i>k</i> Post-Video Sex. Activity	$r = -.11$	$r = .35^*$	$r = -.14$
AUC Pre-Video Money	$r = .19$	$r = .08$	$r = -.19$
AUC Post-Video Money	$r = .21$	$r = .14$	$r = -.21$
AUC Pre-Video Sex. Activity	$r = -.05$	$r = -.32$	$r = .28$
AUC Post-Video Sex. Activity	$r = .18$	$r = -.30$	$r = .10$

Note. p is $>.05$ unless otherwise noted. * denotes $p < .05$. All correlations are Pearson r correlations.

Table 3.

Delay Discounting Rate Associations with Substance Use

Discounting Measure	AUDIT	DUDIT	Tobacco Use	Yes use Mean (SD)	No use Mean (SD)
<i>k</i> Pre-Video Money	$r = .06$	$r = .05$	$t(33) = 0.762$	-1.51 (1.03)	-1.80 (1.17)
<i>k</i> Post-Video Money	$r = .09$	$r = .15$	$t(33) = 0.695$	-1.59 (1.18)	-1.88 (1.24)
<i>k</i> Pre-Video Sex. Activity	$r = .09$	$r = .11$	$t(33) = 1.088$	-1.55 (1.15)	-1.95 (1.02)
<i>k</i> Post-Video Sex. Activity	$r = .02$	$r = -.13$	$t(33) = 1.148$	-1.08 (1.34)	-1.66 (1.54)
AUC Pre-Video Money	$r = .07$	$r = .12$	$t(33) = 0.793$	0.18 (0.07)	0.16 (0.09)
AUC Post-Video Money	$r = .01$	$r = .09$	$t(33) = 0.765$	0.17 (0.08)	0.15 (0.09)
AUC Pre-Video Sex. Activity	$r = .03$	$r = .02$	$t(33) = 1.135$	0.19 (0.08)	0.16 (0.09)
AUC Post-Video Sex. Activity	$r = .05$	$r = .19$	$t(33) = 1.402$	0.20 (0.09)	0.16 (0.09)

Note. p is $>.05$. All correlations are Pearson r correlations. Tobacco use was determined via yes or no answer with groups compared using t-tests for independent samples.

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Table 4.

Model Coefficients for the Sexual Activity Discounting Simple Mediation Analysis Using AUC

		Consequent						
		M (Arousal)			Y (Discounting)			
Antecedent		Coeff.	S.E.	<i>p</i>		Coeff.	S.E.	<i>p</i>
X (Video Group)	α	8.533	1.422	<.001	c'	-0.134	0.182	.465
M (Arousal)		---	---	---	b	-0.022	0.015	.156
Constant	i_1	-1.477	2.228	.512	i_2	-.275	.198	.175
$R^2 = 0.522$					$R^2 = 0.216$			
$F(1,33)=36.027, p<.001$					$F(2,32)=4.409, p<.05$			

Note. Coeff. refers to the unstandardized regression coefficient.

Table 5.

*Select Mediation Coefficients for Sexual Activity Discounting Using *k* and AUC*

Mediation Pathway	Coefficient (SE)	Significance
Post-Video Sexual Arousal (b) for <i>k</i>	0.076 (0.045)	ns
Video Group (c') for <i>k</i>	0.014 (0.535)	ns
Post-Video Sexual Arousal (b) for AUC	-0.022 (0.015)	ns
Video Group (c') for AUC	-0.134 (0.182)	ns

Note. Coefficients are unstandardized regression coefficients.

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Chapter II: Appendices Appendix A: Demographics Questionnaire

1. How old are you in years? _____
2. Which option below best describes your sexual orientation?
 - a. Straight/heterosexual
 - b. Gay/homosexual
 - c. Bisexual
 - d. Questioning
 - e. Other: _____
3. What is your gender identity? Select the answer that fits best.
 - a. Man
 - b. Woman
 - c. Transgender
 - d. Gender Queer
 - e. Other: _____
4. What best describes your race? Select all that apply.
 - a. Black/African American
 - b. Latino/a/x/Hispanic
 - c. White/European American
 - d. American Indian
 - e. Asian/Asian American/Pacific Islander
 - f. Multiracial
 - g. Other: _____
5. What is your average annual household income? _____. How many people are supported on that income (including yourself)? _____
6. Which best describes your relationship status?
 - a. Single
 - b. Dating but not living with partner
 - c. Dating and living with partner
 - d. Married
 - e. Divorced
 - f. Widower
 - g. Other: _____
7. What is your highest level of education?
 - a. High School Diploma/GED
 - b. Some college
 - c. Bachelor's degree
 - d. Master's degree
 - e. Doctorate/Professional degree

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Appendix B: Subjective Sexual Arousal (Before and After Video)

Instructions: Please use the following scale to evaluate how you feel at this moment. Please answer honestly and carefully. On the scale, circle any of the numbers from 1 (not at all) to 7 (intensely).

At this moment, I feel:

	<u>Not at all</u>	<u>Intensely</u>
1. Pleasant.....	1.....2.....3.....4.....5.....6.....7	
2. Sexual desire.....	1.....2.....3.....4.....5.....6.....7	
3. Anxious.....	1.....2.....3.....4.....5.....6.....7	
4. Excited.....	1.....2.....3.....4.....5.....6.....7	
5. Worried.....	1.....2.....3.....4.....5.....6.....7	
6. Physically sexually aroused.....	1.....2.....3.....4.....5.....6.....7	
7. Mentally sexually aroused.....	1.....2.....3.....4.....5.....6.....7	
8. Angry.....	1.....2.....3.....4.....5.....6.....7	
9. Relaxed.....	1.....2.....3.....4.....5.....6.....7	
10. Sexually turned off.....	1.....2.....3.....4.....5.....6.....7	

Julia R. Heiman 1977/1998 ©

EFFECTS OF SEXUAL AROUSAL ON DECISION-MAKING

Appendix C: Sexual Behaviors Questionnaire

Please answer the following questions about your sexual behavior over the **last month**:

1. During the **last month**, approximately how often did you engage in sexual activity with a partner (for example, touching each other's genitals, giving or receiving oral stimulation, intercourse, etc.)?

☐ Not at all / 0 times ☐ 1 time ☐ 2 times ☐ 3-4 times
☐ 5-8 times ☐ 9-15 times ☐ 16-30 times ☐ 31+ times

2. How many different people did you engage in sexual activity within the **last month**?

☐ None ☐ One ☐ Two ☐ 3-5 people
☐ 6-10 people ☐ More than 10 people

3. How often did you use protection (e.g., condom, dental dam) when you engaged in sexual activity in the **last month**?

☐ I did not engage in sexual activity in the last month
☐ Every time ☐ Often ☐ Sometimes ☐ Rarely ☐ Never

4. How many times did you have vaginal sex in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

5. How many times did you have anal sex in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

6. How many times have you left a social event with someone you just met in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

7. How many times did you go out to bars/parties/social events with the intent of "hooking up" and having sex with someone in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

8. In the **last month**, how many people did you have sex with that you know but are not involved in any sort of a relationship with (i.e., "friends with benefits", "fuck buddies")?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

9. How many times did you have sex with someone you didn't know well or just met in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

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10. How many times did you or your partner use alcohol or drugs before or during sex in the **last month**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

Please answer the following questions about sexual behavior **over the course of your life**:

11. How old were you when you had penetrative sexual intercourse for the first time?

12. How many times have you been pregnant (or gotten someone pregnant) **unintentionally**?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

13. How many times have you been tested for a sexually transmitted infection or HIV/AIDS?

☐ No times ☐ One time ☐ Two times ☐ 3-5 times
☐ 6-10 times ☐ More than 10 times

14. Please indicate any sexually transmitted infections you have had at some time in your life, including those you currently have (check all that apply):

☐ Chlamydia ☐ Gonorrhea ☐ Hepatitis B ☐ Herpes
☐ HIV/AIDS ☐ HPV/warts ☐ Syphilis ☐ Trichomoniasis
☐ Other (please specify): _____

15. When was the last time you reached orgasm when engaging in sexual activity with a partner?

_____ . (Example: 3 weeks ago)

16. When was the last time you reached orgasm when self-stimulating (i.e., masturbation)?

_____ . (Example: 3 hours ago)

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Appendix D: Erotica Consumption Scale

ECS

Please read the following questions with regard to your past use of erotic material.

1. Have you ever watched a sexually explicit adult video? ____ yes(1)____ no (2)
2. Using the scale below, please indicate how much you would enjoy watching a sexually explicit adult video if given the chance (*assuming that it contained your favorite content, whatever that happens to be*) _____

1	2	3	4	5	6	7	8	9	10
Not at all				Somewhat					Very much

During the past year, approximately how many times in an average month have you done the following?

3. Viewed sexual magazines available at outlets such as convenience stores and newsstands (examples include Playboy, Playgirl, Penthouse, and Hustler). _____ times
4. Viewed sexual magazines or books that show actual sexual intercourse and other sexual acts, such as those usually available in “adults only” bookstores? _____ times
5. Viewed movies or videos that include graphic, *but simulated*, sexual acts, such as those rated X or NC-17? _____ times
6. Viewed movies or videos that show actual sexual intercourse and other sexual acts, such as those usually found only in “adults only” (XXX) sections of video rental stores? _____ times
7. Visited web sites that contain sexually explicit pictures (i.e., pictures of nude men, nude women and/or sexual acts including sexual intercourse) _____ times

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Appendix E: Alcohol Use Disorder Identification Test

These questions refer to your use of alcohol. Please select the answer that is correct for you.

1. How often do you have a drink containing alcohol?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Monthly or less	2-4 times/month	2-3 times/week	4 or more times/week

2. How many drinks containing alcohol do you have on a typical day when you are drinking?

0 (1)	0 (2)	1 (3)	2 (4)	3 (5)	4 (6)
None	1 or 2	3 or 4	5 or 6	7 to 9	10 or more

3. How often do you have six or more drinks on one occasion?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

4. How often during the last year have you found that you were not able to stop drinking once you had started?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

5. How often during the last year have you failed to do what was normally expected from you because of drinking?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking occasion?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

7. How often during the last year have you had a feeling of guilt or remorse after drinking?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
-------	-------	-------	-------	-------

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	Never	Less than monthly	Monthly	Weekly	Daily or almost daily
9. Have you or someone else been injured as a result of your drinking?	0 (1)		2 (2)		4 (3)
	Never		Yes, but not in the last year		Yes, during the last year
10. Has a relative or friend or a doctor or other health worker been concerned about your drinking or suggested you cut down?	0 (1)		2 (2)		4 (3)
	Never		Yes, but not in the last year		Yes, during the last year

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Appendix F: Drug Use Disorder Identification Test

INSTRUCTIONS: These questions refer to your use of **ILLCIT DRUGS EXCLUDING ALCOHOL AND PRESCRIPTION MEDICATION**. Please select the answer that is correct for you.

1.* Have you used drugs other than alcohol in your life? Yes (1) No (2)

2. How often do you use drugs other than alcohol?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Once a Month or less	2-4 times/month	2-3 times/week	4 or more times/week or more

3. Do you use more than one type of drug on the same occasion?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Once a Month or less	2-4 times/month	2-3 times/week	4 or more times/week or more

4. How often do take drugs on a typical day when you use drugs?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
0	1-2	3-4	5-6	7 or more

5. How often are you influenced heavily by drugs?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than once a month	Every month	Weekly	Daily or almost daily

6. Over the past year, have you felt that your longing for drugs was so strong that you could not resist it?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than once a month	Every Month	Weekly	Daily or almost daily

7. Has it happened, over the past year, that you have not been able to stop taking drugs once you started?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

8. How often during the last year have you taken drugs and then neglected to do something you should have done?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

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9. How often during the past year have you needed to take a drug the morning after heavy drug use the day before?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

10. How often over the past year have you had guilt feelings or a bad conscience because you used drugs?

0 (1)	1 (2)	2 (3)	3 (4)	4 (5)
Never	Less than monthly	Monthly	Weekly	Daily or almost daily

11. Have you or someone else been hurt (mentally or physically) because you used drugs?

0 (1)	2 (2)	4 (3)
Never	Yes, but not in the last year	Yes, during the last year

12. Has a relative or friend, a doctor or nurse, or anyone else, been worried about your drug use or said to you that you should stop using drugs?

0 (1)	2 (2)	4 (3)
Never	Yes, but not in the last year	Yes, during the last year

13.* Do you currently, regularly use nicotine products (for example: cigarettes, vape)?

_____ Yes

_____ No

*denotes item is not part of the DUDIT and not included in DUDIT total

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Appendix G: Delay Discounting Tasks

Delay Discounting of Money:

Instructions: "Now you will make some decisions about which of two monetary rewards you would prefer. One of the rewards will be available right now, and the other will only be available after you have waited for some period of time. For example, you might choose between \$5 delivered right now and \$10 delivered in a month. The choices you make are completely up to you. You will not receive any of the rewards that you choose, but we want you to make your decisions as though you were really going to get the rewards you choose."

Example:

Choose one option:

\$5 now

or

\$10 in one month

Delay Discounting of Sexual Activity:

Instructions: "In the task that follows, you will choose between different durations of sexual activity with a person of your choice, who may be either real or imagined. The survey consists of questions such as the following: "Which would you prefer? 9 minutes of sex with this person right now or 30 minutes of sex with this person in 1 week?" "Sex" is used here to refer to sexual activity, which means different things for different people, but you should answer each question in terms of whatever kind of sexual activity you personally find very appealing. You will not receive any of the rewards that you choose, but we want you to make your decisions as though you were really going to engage in whichever sexual activity you choose. Remember, your responses are anonymous. Please respond to all questions in a thoughtful and honest manner."

Example:

Choose one option:

9 minutes
of sex now

or

30 minutes of
sex in one week

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Appendix H: Debriefing Script

“Thank you for your participation in this study. The purpose of this study is to examine the effects of sexual arousal on various types of decision making. Previous research has indicated that sexually aroused individuals sometimes make choices they normally wouldn’t when not sexually aroused, including risky activities (e.g., not using a condom) or sexually aggressive behaviors (e.g., giving a date excessive drinks in hopes of increasing the chance for sexual activity, continually pressuring a date to have sex after they have said “no”). These risky activities have great consequences, including (but not limited to) contracting a sexually transmitted illness, unintentionally impregnating someone, or receiving a prison sentence and sex offender registry requirements (in the case of sexually aggressive behaviors). The best way to prevent sexually transmitted infections is to use a condom every time you have sex (including with a steady partner) and to regularly attend sexual health exams/screenings.

Ways to prevent yourself from engaging in sexually aggressive behaviors, include: not engaging in sexual activity if your partner is too intoxicated to give consent (i.e., even if he/she says “yes” his/her decision making capacity is compromised and unable to give willing, competent consent), not allowing yourself to be around potential partners if you know that you become too uninhibited when drinking, using drugs, or very sexually aroused (i.e., willing to engage in sexually aggressive behaviors you wouldn’t if sober or not aroused), explicitly or verbally asking for permission/consent from your partner and only going forth with sexual activity after a confident and clear “yes,” and not engaging in sexual activity if you are not absolutely sure you have your partner’s consent. You are encouraged to think about how you might make different choices under sexually aroused states and the possible consequences of those choices. If you would like to learn more about consent related to sexual activity and what

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you can do to help reduce the occurrence of sexual assault, ISU offers a free program called “Green Dot.” *You might still be experiencing sexual arousal, so please take this time to allow yourself to return to an unaroused state. There is no rush to exit the room. When you feel comfortable, feel free to leave, as the study is now complete. Thank you again for your participation.”

*The portion stating “You might still be experiencing sexual arousal, so please take this time to allow yourself to return to an unaroused state. There is no rush to exit the room” will be omitted for the control group, as sexual arousal should not have been elicited.

Appendix I: Informed Consent

Idaho State University
Human Subjects Committee

CONSENT TO PARTICIPATE IN RESEARCH

Reactions to Visual Stimuli in College Men

Dear Participant,

You are asked to volunteer for a research study conducted by Brittney M. Holcomb and Steven R. Lawyer, Ph.D., (208-282-2142), from the Department of Psychology at Idaho State University. You have been asked to participate in this research because you are at least 18 years old, male, are sexually active, willing to watch an erotic video of a man and woman having sex, and attend ISU. Your participation in this research is voluntary. You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

1. PURPOSE OF THE STUDY

The purpose is to better understand how different affective experiences influence choices in college men.

2. PROCEDURES

If you volunteer to participate in this study, we will ask you to do the following things:

- I. Questionnaires: You will be asked to sign this consent form and complete several brief self-report measures about demographics, substance use, patterns of behaviors (including sexual behavior), and rating how you feel on a computer.
- II. Video: You might watch a four minute video that either shows a man and woman having oral and vaginal sex, or you might watch a non-erotic video. You do not have a choice in which video you watch. To participate you must be willing to watch the erotic video.
- III. Decision-making tasks: You will complete behavioral choice tasks in which you will answer questions about your preference for different hypothetical monetary or hypothetical sexual outcomes.
- IV. Duration: Participation in the study may involve 45-60 minutes of your time.

3. POTENTIAL RISKS AND DISCOMFORTS

You may experience some discomfort answering personal questions, such as about past drug use and sexual behaviors, though this discomfort is not anticipated to be significant. You may also feel the effects of sexual arousal.

4. ANTICIPATED BENEFITS TO SUBJECT

There are no tangible benefits to you for your participation.

5. ANTICIPATED BENEFITS TO SOCIETY

Results of this research will be used to better understand how we measure behavioral

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processes associated with sexual behavior, as well as various influences on the choices people make.

6. ALTERNATIVES TO PARTICIPATION

An alternative is to not participate in the study.

7. PAYMENT FOR PARTICIPATION

You will be rewarded one SONA credit for each half-hour, or part thereof, of participation. If you choose to withdraw your participation for any reason, you will be compensated for however much time you spent on the study. We anticipate that this study will take approximately 45-60 minutes to complete.

8. FINANCIAL OBLIGATIONS

There are no financial obligations to you in the study.

9. PRIVACY AND CONFIDENTIALITY

To protect your privacy, the information you provide to us is anonymous and will never be connected with your name. All research-related information will be identified with only a subject number. No information about you, or provided by you during the research, can be disclosed since only subject numbers are used.

10. PARTICIPATION AND WITHDRAWAL

Your participation in this study is VOLUNTARY. If you choose not to participate in the study, this will not affect any benefits from ISU to which you are entitled. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time. You should contact the investigator in charge of this study if you decide to do this.

11. WITHDRAWAL OF PARTICIPATION BY THE INVESTIGATOR

The investigator or a research assistant may stop your participation in this study at any time if circumstances arise which warrant doing so. The investigators, Brittney M. Holcomb and Steven R. Lawyer, Ph.D., will make the decision and let you know if it is not possible for you to continue. You may also be forced to withdraw if you do not follow the investigator's instructions.

If you must drop out because the investigator asks you to (rather than because you have decided on your own to withdraw), for any reason other than not complying with the investigator's instructions, you will be compensated with research credits according to the procedures described above.

12. IDENTIFICATION OF INVESTIGATORS

If you have any questions about the research or your participation in the study, please feel free to contact:

Steven R. Lawyer, PhD, Garrison Hall, 921 S. 8th Ave, Stop 8112, Idaho State University, Pocatello, ID 83209-8112, (208) 282-2142

13. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have any questions regarding your rights as a research subject, you may contact the Idaho State University Human Subjects Committee at (208) 282-2179.

14. CONSENT FOR DATA TO BE USED IN FUTURE STUDIES

Data collected for this project will be retained for the foreseeable future and may be used for several different studies. Your responses are completely anonymous and cannot be connected to you in any way.

INDICATION OF CONSENT BY RESEARCH SUBJECT
--

I am 18 years or older and have read (or someone has read to me) and understood the information provided above. I have been given a chance to ask questions about this research study, and all of my questions have been answered to my satisfaction. I have been offered a copy of this form for my own records.

**BY SIGNING BELOW, I WILLINGLY AGREE TO PARTICIPATE IN THE
RESEARCH.**

Signature: _____

Name: _____ (Please Print)

Date: _____

Appendix J: Instructions to Start Discounting Task

Now you will begin another task on the computer. Hit on the windows keyboard key (see picture below), then click the toolbar icon (see picture below) to start the task. It takes place on a website – do not open any other tabs or windows, only stay on the designated website.

Here is a picture of the keyboard key you should hit:

[PICTURE OF WINDOWS KEY]

Here is a screen shot of the icon you should click on:

[SCREEN SHOT OF ICON]

Simply hit “start” once you get to the task main page. Here is a screen shot of the task main page:

[SCREEN SHOT OF TASK MAIN PAGE]

The task will let you know when you have finished. Please go to the task and click the “start” button now.

Appendix K: Assumptions of regression and ANOVA

Normality: The distribution of monetary discounting k scores for pre-video and 2 were corrected using $\log_{10}$ transformation, as these distributions are typically positively skewed. After the transformation, the distributions more closely resembled a normal distribution and were not overly skewed (beyond ± 1.96) or peaked (see Appendix L: Figure 1). Although kurtosis over 3 begins to be considered as excessive kurtosis, greater than 3 kurtosis values are typical for logistic distributions (The Foundations of Data Science, retrieved 2018; Engineering Statistics Handbook, retrieved 2018). The $\log_{10}$ transformed distribution of sexual activity discounting k scores for pre-video and post-video resembled a normal distribution and were not overly skewed or peaked (see Appendix L: Figure 2).

The distribution of monetary discounting AUC scores for pre-video and 2 were negatively skewed based upon the frequency histograms. A $\log_{10}$ with reflection transformation was applied to normalize the distributions. After the transformation, the distributions more closely resembled a normal distribution and were not overly skewed or peaked (see Appendix L: Figure 3). The distribution of sexual activity discounting AUC scores for pre-video and post-video were positively skewed based upon the frequency histograms. A $\log_{10}$ transformation was applied to normalize the distributions. After the transformation, the distributions more closely resembled a normal distribution and were not overly skewed or peaked (see Appendix L: Figure 4).

Linearity: Probability plots revealed that the assumption of linearity was met between the predictor variables: video group, SBQ total score (for k only), and subjective sexual arousal and post-video $\log_{10}$ (AUC scores) and post-video $\log_{10}(k$ scores) for sexual activity discounting (see Figures 5 and 6).

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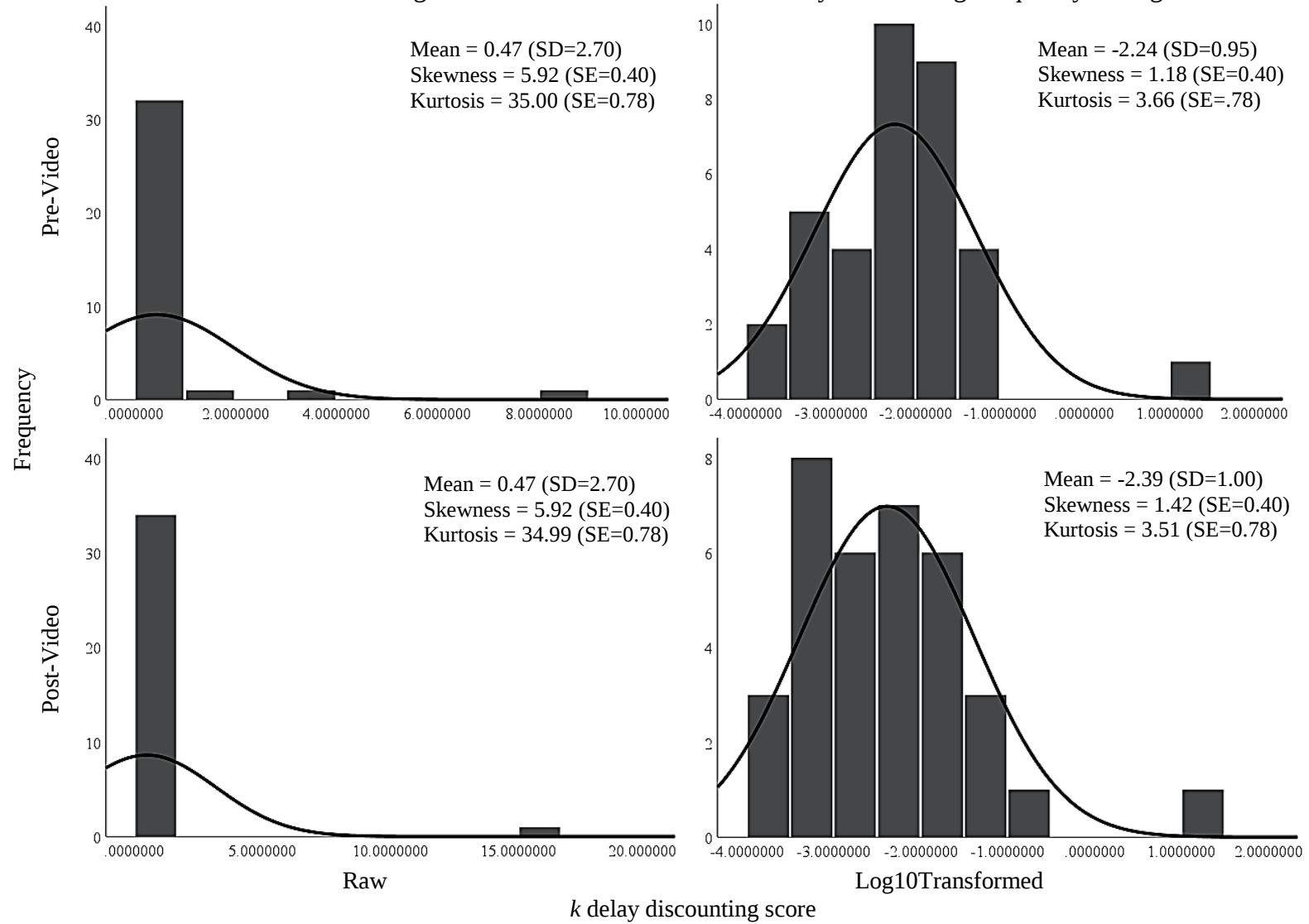
Homoscedasticity: Homoscedasticity, or an equal distribution of residuals of the dependent variable (i.e., post-video sexual activity discounting k and AUC scores), was observed in the regression standardized predicted value scatterplot (see Figures 7 and 8). There was not a clear, observable pattern to the residuals (e.g., cone-like formation), and it can therefore be assumed that homoscedasticity was met.

(Exclusive to regression) Multicollinearity: The assumption of multicollinearity holds that no independent variables in the regression analysis should be overly correlated with each other. This was not violated for ANOVA analyses as there was only one independent variable. However, it was unclear if this assumption was violated for regression analyses to test a mediation model until the analyses were performed. Point biserial correlation analysis indicated the regression predictor variables (i.e., video group, post-video total sexual arousal score) were strongly correlated, $r_{pb}=0.722$. The mediation analyses revealed a proximal mediator, meaning strong correlation between the independent variable and mediator (i.e., multicollinearity) rendered the indirect path insignificant. This was due to the mediator accounting for insufficient unique variance in the dependent variable after removing the shared variance accounted for by the independent variable and the mediator.

(Exclusive to regression) Auto-correlation: The assumption of auto-correlation holds that there is little or no auto-correlation, meaning the residuals are independent from each other. A Durbin-Watson tested indicated this assumption was met (Durbin-Watson using k , $d=2.122$; Durbin-Watson using AUC, $d=1.859$), as values falling between 1.5 and 2.5 suggest little to no auto-correlation.

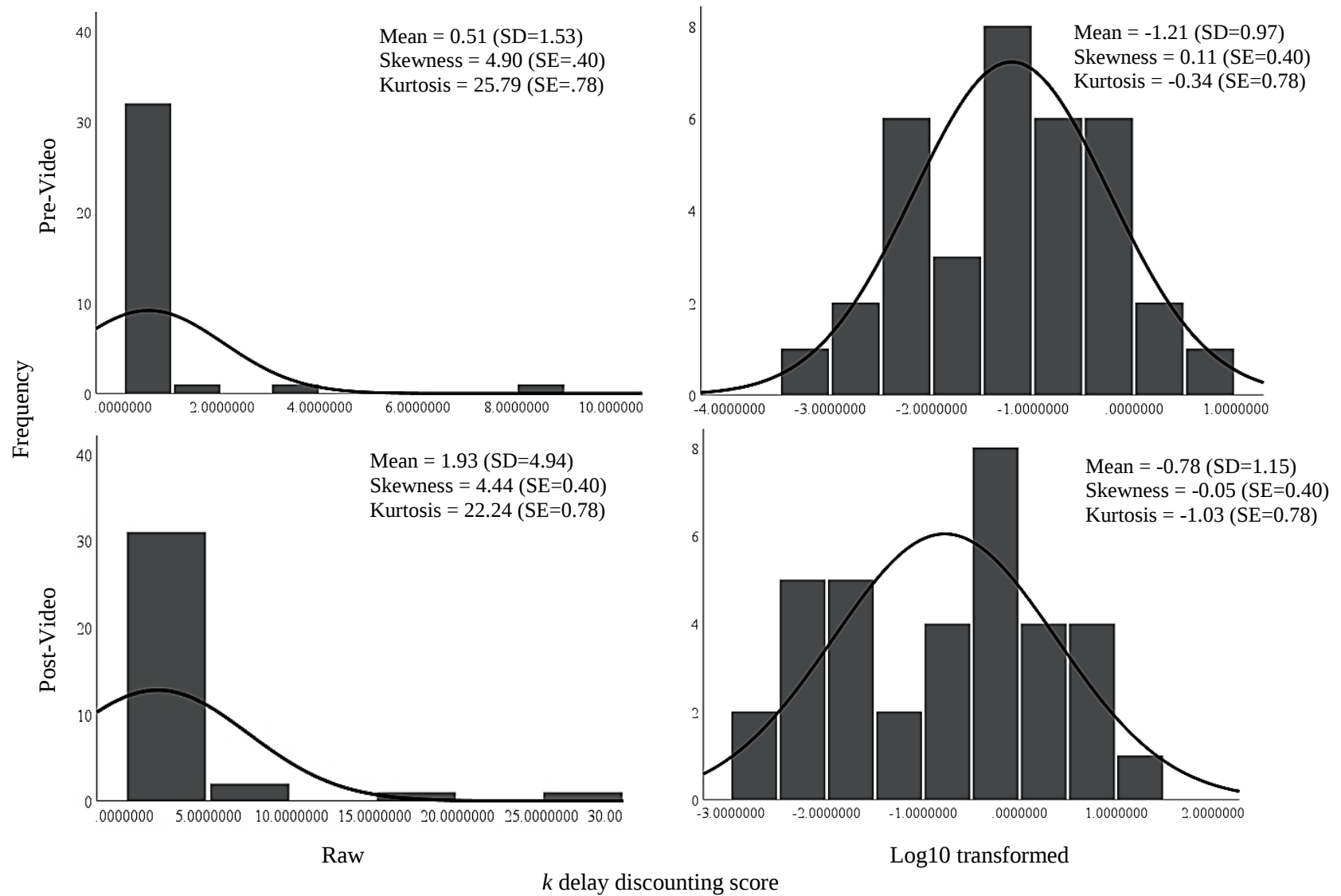
Appendix L: Supplementary Figures

Figure 1. Pre- and Post-Video Raw and Log10 transformed k Scores for Monetary Discounting Frequency Histograms



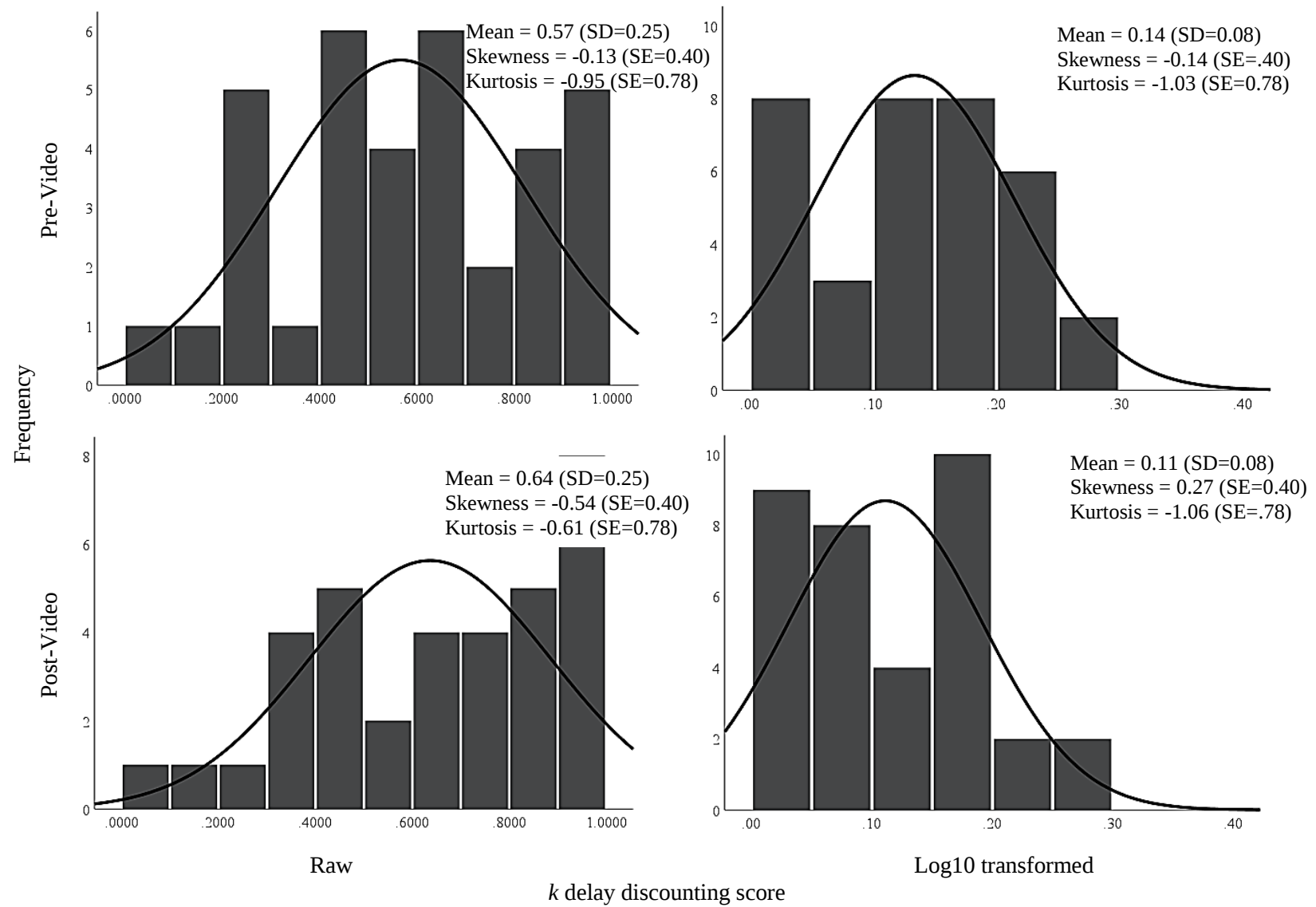
EFFECTS OF SEXUAL AROUSAL ON DECISION-MAKING

Figure 2. Pre- and Post-Video raw and Log10 transformed k Scores for Sexual Activity Discounting Frequency Histograms



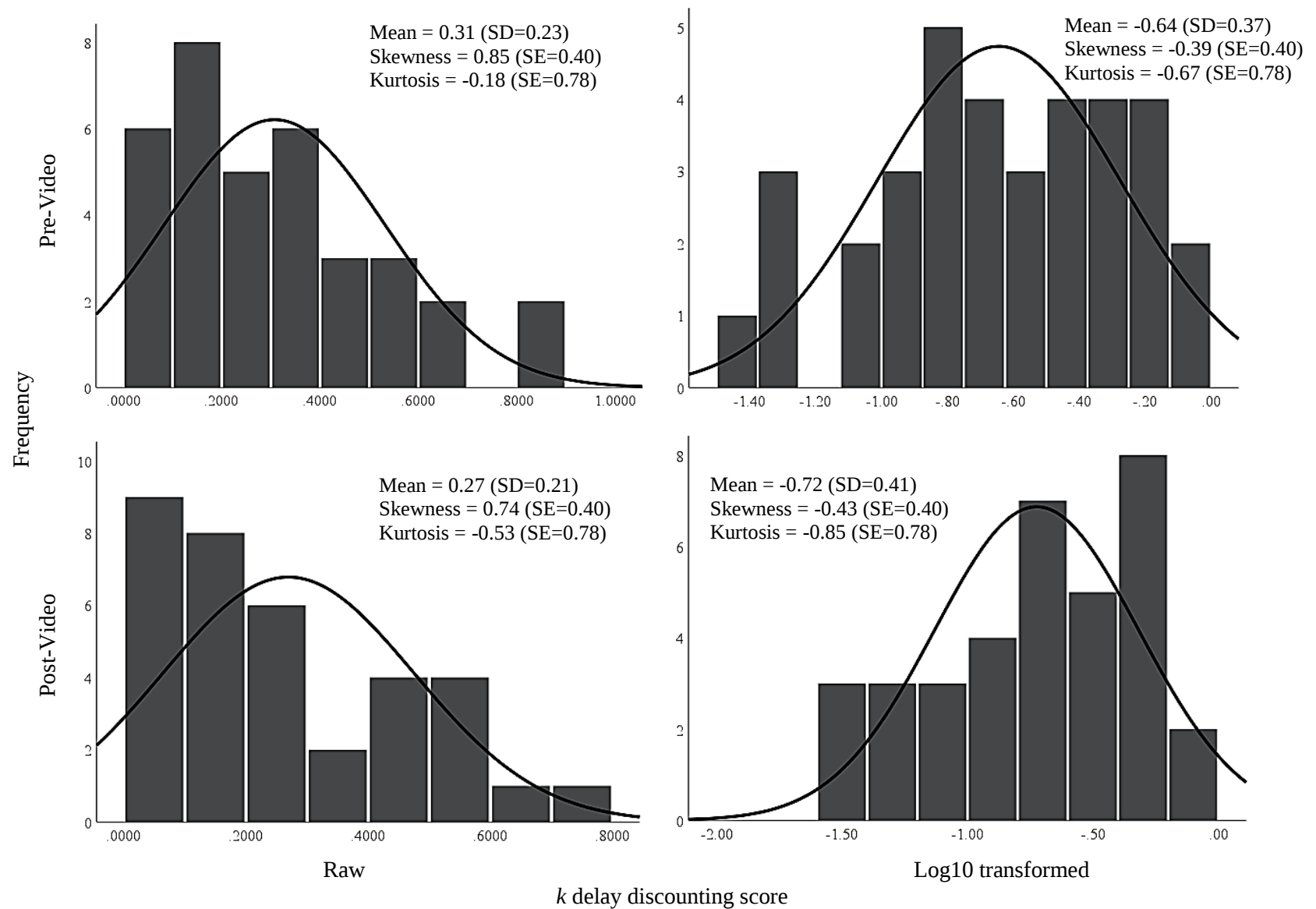
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Figure 3. Pre- and Post-Video Raw and Log10 Reflection Transformed AUC Scores for Monetary Discounting Frequency Histogram



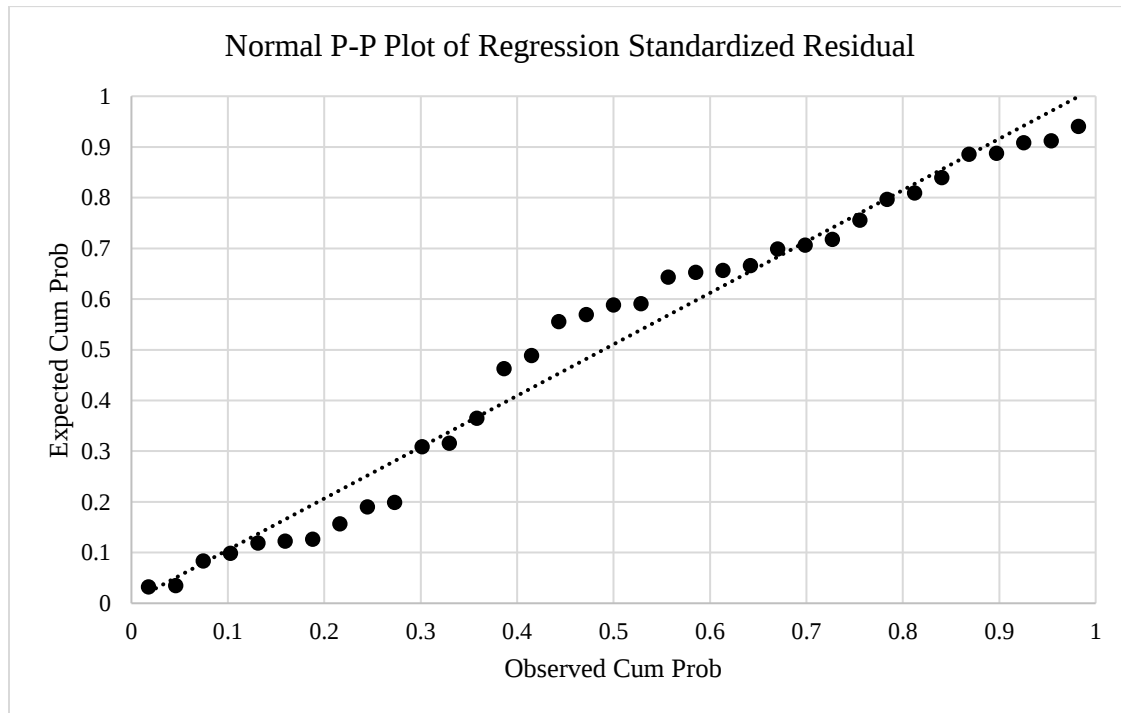
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Figure 4. Pre- and Post-Video Raw and Log10 Transformed AUC Scores for Sexual Activity Discounting Frequency Histogram



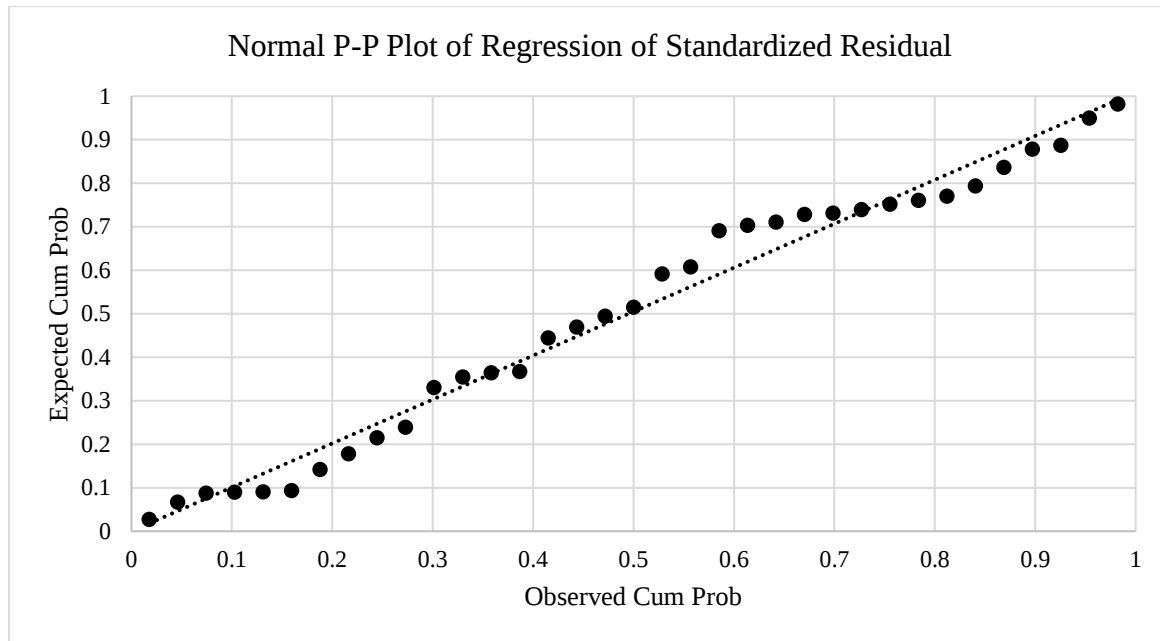
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Figure 5. Normal P-P Plot of Linearity of Predictors Video Group (Independent Variable), Post-Video Sexual Arousal (Mediator), and SBQ Total Score (Covariate) with Outcome Variable (Post-Video $\log_{10} k$ Scores for Sexual Activity Discounting)



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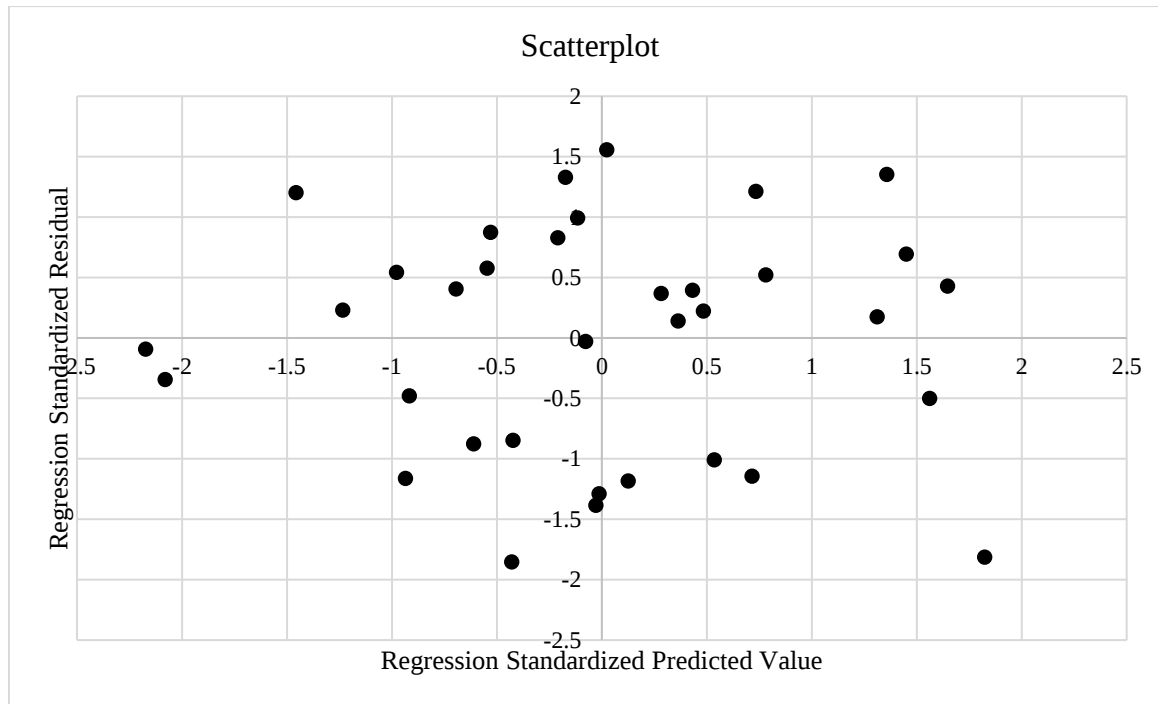
Figure 6. Normal P-P Plot of Linearity of Predictors Video Group (Independent Variable) and Post-Video Sexual Arousal (Mediator) with Outcome Variable (Post-Video Log₁₀ Sexual Activity Discounting AUC Scores)



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Figure 7. Scatterplot of Post-Video $\log_{10} k$ Scores for Sexual Activity Discounting Residuals
(with Video Group, Post-Video Sexual Arousal, and SBQ Total Score entered as Predictors)

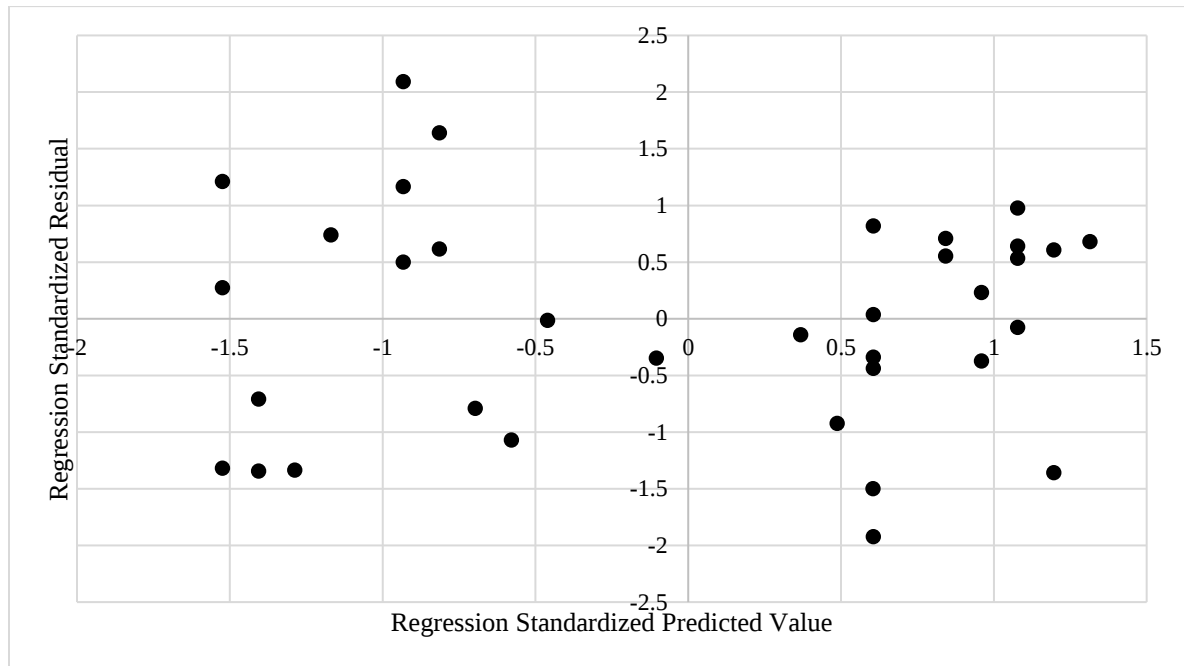
Demonstrating Homoscedasticity of Residuals



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Figure 8. Scatterplot of Post-Video Log₁₀ AUC Scores for Sexual Activity Discounting Residuals (with Video Group and Post-Video Sexual Arousal entered as Predictors)

Demonstrating Homoscedasticity of Residuals



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Appendix M: Supplementary Tables

Table 1.

Sexual Orientation of Participants

Orientation	Number of Participants	Percent
Straight	59	81.9
Gay	6	8.3
Bisexual	5	6.9
Questioning	1	1.4
Other	1	1.4

Table 2.

All Racial Identifications Selected by Participants

Race	Number of Participants	Percent
Black	2	2.8
Latino	11	15.3
White	58	80.6
American Indian	4	5.6
Asian	2	2.8
Multiracial	4	5.6
Other	2	2.8

Table 3.

Collapsed Racial Identification of Participants*

Race	Number of Participants	Percent
Latino	6	8.3
White	51	70.8
Asian	2	2.8
Multiracial	11	15.3
Other	2	2.8

Note. *denotes those participants identifying as 2 or more races were placed into multiracial category

Table 4.

Absolute Sum of Squares Means by Time and Discounting Group

	Discounting Group	Mean	Standard Deviation	Standard Error	Significance
Pre-Video	Money	0.084	0.101	0.017	ns
	Sexual Activity	0.147	0.176	0.030	
Post-Video	Money	0.099	0.135	0.023	ns
	Sexual Activity	0.148	0.130	0.022	

Chapter III: Original Literature Review

Effects of Sexual Arousal on Monetary and Sexual Decision Making in College Men

Decision making is a complex part of life, as everything we do involves a decision that has been made. These consequences of these decisions can vary greatly in severity, extent, and valence (i.e., positive, advantageous, healthy or negative, disadvantageous, harmful). Negative consequences, however, do not necessarily stop an individual from continuing to make the decisions that lead to those consequences. It is important to understand under which circumstances one chooses to make those decisions with negative health consequences (e.g., unprotected sex, intravenous drug use, excessive food intake, tobacco use). More broadly, what influences patterns of decision making? Better understanding the influences under which people make decisions that lead to negative consequences can guide intervention and prevention efforts targeted at reducing behavioral decisions associated with negative health outcomes. Bodily urges or sensations represent one type of influence on decision making. The bodily urge of sexual arousal is of interest, as the extant literature provides evidence of associations between sexual arousal and changes in patterns of decision making. However, it remains unclear upon which types of decisions (e.g., impulse behavioral choice) and which outcomes (e.g., sexual or something more universal) sexual arousal has influence.

Impulsivity

At the surface impulsivity may appear to be an easily defined concept, one that brings distinct actions or traits to mind. There is not, however, a consistent operational definition of what impulsivity actually is or what it represents. Like many psychological concepts, impulsivity is a reified construct that doesn't exist in a tangible sense, but it is used to describe the way we

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make real behavioral choices. Broadly speaking, impulsivity is a multifaceted construct that refers to several different traits or behaviors, including (but not limited to) an inability to delay gratification, acting without forethought of consequences, disinhibition or lack of self-discipline, self-reported abilities to self-regulate (i.e., impulsiveness as a personality trait), and sensation seeking (de Wit, 2008; MacKillop, Weafer, Gray, Oshri, Palmer, & de Wit, 2016; McCrae, 1992; Weafer, Baggot, & de Wit, 2013; Odum, 2011b; Whiteside & Lynam, 2001). Several models and hypotheses have been formulated to conceptualize impulsivity and outcomes associated with impulsive behavior.

MacKillop and colleagues (2016) determined through factor analysis that impulsivity is a multidimensional construct, composed of three broad categories: impulsive choice, impulsive action, and impulsive personality traits. Impulsive choice accounts for a tendency to devalue rewards based upon delay in their receipt. Those making impulsive choices, therefore, choose rewards that are available more immediately, despite being objectively less valuable relative to a reward available after a delay. Impulsive action refers to difficulty inhibiting a motor response when necessary or beneficial. In other words, difficulty controlling one's actions, or acting before thinking, represents impulsive action. Impulsive personality traits, refer to one's self-reported evaluations of his or her ability to self-regulate behavior.

These categories (i.e., impulsive choice, impulsive action, and impulsive personality traits) were largely unrelated to each other, which suggests that impulsivity refers to different behaviors or traits, depending on the dimension of interest. Individuals evidencing impulsivity in one category do not also necessarily evidence impulsivity in the other categories. So, if one has a tendency toward impulsive action, this person isn't necessarily also above average on impulsive personality traits or impulsive choice. Others have found that the strength of relation between

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these three categories of impulsivity varies from no relation at all to moderate associations (Petry, 2001; Baumann & Odum, 2012; Murphy & MacKillop, 2012). Understanding and measuring these categories as separate concepts can be useful in guiding research related to impulsivity.

Impulsive choice has long been interpreted as difficulty in delaying gratification. This is based upon observed behavioral choice preferences to receive an objectively less valuable option rather than a larger or more rewarding outcome (Ainslie, 1975; Logue & King, 1991). Ainslie (1975) inferred that the tendency to choose less valuable choice occurs when it is available sooner than the more valuable choice. This idea is partially based upon deferred gratification (or lack thereof) behavioral patterns (Schneider & Lysgaard, 1953). Delaying receipt of a reward is associated with loss of reward effectiveness or desirability. Some individuals demonstrate higher rates of reward depreciation as a function of time to its receipt. These individuals have a higher affinity for selecting rewards that are available sooner, rather than foregoing that choice in order to receive a larger reward after a delay (Ainslie, 1975).

Impulsive action involves one's inability to inhibit a prepotent behavioral response, or responses that seem to occur without thinking. MacKillop and colleagues (2016) found impulsive action to be evidenced by three behavioral action measures of response inhibition. These measures included a Go/No-go Task (GNG), a Stop Signal Task (SST; Fillmore & Weafer, 2013), and a Continuous Performance Test (CPT; Rosvold, Mirsky, Sarason, Bransome, & Beck; 1956). Across the tasks, impulsive action is demonstrated by someone engaging in a behavioral response when they should have inhibited that action. This inability to stop one's actions becomes of more concern when an individual cannot inhibit inappropriate behaviors.

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In regard to impulsive personality traits, several models have outlined said traits. Although MacKillop and colleagues (2016) did not include the Five-Factor Model (FFM), it deserves brief mention here as it is one of the most prominent models of personality. The five main factors of personality are neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. In the model, impulsivity-related personality traits are found amongst four of the five main factors (i.e., neuroticism, extraversion, openness, conscientiousness). These impulsive traits include a poor ability to inhibit one's behaviors (i.e., low self-discipline), spontaneity or lack of planning (i.e., low deliberation), excitement seeking, and (inherently) impulsiveness (Costa & McCrae, 1992; McCrae & Costa, 1987). MacKillop et al. (2016) included two models of personality traits of impulsiveness from Whiteside, Lynam, Miller, and Reynolds (2005) and Patton, Stanford, and Barratt (1995). Whiteside and colleagues (2005) labeled the various traits of impulsivity as Urgency, lack of Premeditation, lack of Perseverance, and Sensation Seeking (UPPS). Urgency represents a proclivity to behave impulsively during states of negative affectivity, even when detrimental longer-term consequences are possible. Lack of Premeditation refers to difficulties in planning and "impulse control problems," in which individuals engage in behaviors before considering the consequences. The third feature, lack of Perseverance, describes an incapability to maintain attention and effort on a task, especially ones that are tiresome or challenging. Sensation Seeking represents the fourth feature of impulsivity and is comprised of two parts: "(1) a tendency to enjoy and pursue activities that are exciting, and (2) an openness to trying new experiences that may be dangerous" (Whiteside et al, 2005, p. 561).

The other model of impulsive personality traits included by MacKillop et al. (2016) comes from Patton and colleagues' (1995) study on the Barratt Impulsiveness Scale (BIS).

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Within this scale, there are three subtypes of impulsiveness, including attentional (Ia), motor (Im), and non-planning impulsivity (Inp). Attentional impulsivity refers to the inability to sustain attention to a task, which includes the subjectively rated difficulty of doing so and interfering thoughts that may occur while trying to concentrate. Motor impulsivity suggests a tendency to act in a disinhibited fashion (i.e., spur of the moment). Nonplanning impulsivity reflects a lack of ability to plan and dedicate adequate time to think over a decision, as well as avoidance of or displeasure in challenging mental tasks.

Some researchers argue against separating impulsive choice and impulsive personality traits, and consider impulsive choice to be a personality trait (i.e., a pattern of thoughts, feelings, and behaviors that are stable across certain circumstances and time; Roberts, 2009). As a personality trait, individuals should demonstrate related impulsive behavioral choice patterns across a variety of domains. Several researchers have found a significant positive correlation between individual's impulsive choice patterns across consumption or usage of money, food, cigarettes (for current smokers), marijuana (for past and current dependent individuals), and alcohol (Johnson et al, 2010; Odum, 2011b; Odum & Baumann, 2010). This implies that impulsive choice is a personality trait, although it may be distinct from other personality traits of impulsivity (e.g., non-planning, sensation seeking, lack of perseverance).

Impulsivity and Human Problem Behaviors

Impulsive choice is associated with many negative long-term outcomes. In a historic study of the relationship between problems delaying gratification and long-term outcomes, Mischel, Ebbesen, and Zeiss (1972) offered children a small amount of a tasty reward (e.g., a marshmallow) immediately or, if the subject waited some time without consuming the small amount, more of the reward (e.g., two marshmallows). When followed up several years later,

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children who ate the immediate, smaller reward had significantly more behavioral and academic problems, such as poorer social and emotional coping, lower SAT scores, greater cocaine/crack use, and lower educational attainment, than their self-controlled counterparts (Ayduk et al, 2000; Mischel et al, 1972; Mischel, Shoda, & Rodriguez, 1989; Mischel et al, 2011).

Among adolescents and adults, difficulty in delaying gratification is associated with a range of problem health behaviors, including illicit drug use (Anokhin, Golosheykin, Grant, & Heath, 2011; Coffey, Gudleski, Saladin, Brady, 2003; Kirby, Petry, & Bickel, 1999; Petry, 2003), problematic alcohol use (Khurana et al, 2013), tobacco use (Audrain-McGovern et al, 2009; Baker, Johnson, & Bickel, 2003), unprotected sex (Herrmann, Johnson, & Johnson, 2015; Johnson & Bruner, 2012; Lawyer & Mahoney, in press), and weight problems (Rasmussen, Lawyer, & Reilly, 2010). Similar health risk behaviors, such as over-eating, excessive drinking, smoking, risky driving, and violent behaviors are considered markers of impulsive personality traits and are strongly, positively associated with the FFM factor of neuroticism and moderately, negatively associated with conscientiousness (Shanahan, Hill, Roberts, Eccles, & Friedman, 2012; Valero et al, 2014).

Some facets of impulsivity are differentially associated with specific problem behaviors. Positive urgency (but not negative urgency) is associated with engaging in unprotected sex (Zapolski, Cyders, & Smith, 2009) and gambling (Holub, Hodgins, & Peden, 2005), while negative urgency (but not positive urgency) is associated with binge eating and purging behaviors (Smyth et al, 2007). Impulsive behavioral choice patterns differentiated gamblers and non-gamblers. Problematic and pathological gamblers made significantly more impulsive behavioral choices (i.e., choosing smaller rewards available sooner, rather than choosing to wait for larger rewards), as compared to non-gamblers. Impulsive action, rather than impulsive

behavioral choice, differentiated pathological gamblers (greater impulsive action tendencies) from problematic gamblers (Brevers et al, 2012). Various types of impulsivity (e.g., inattentiveness, behavioral impulsivity, non-planning) were positively correlated with problem sexual behaviors in a young adult community sample, including preoccupation with sexuality or being sexually active, inability to control repetitive sexual fantasies, inability to control sexual urges, and out of control repetitive sexual behavior (Leppink, Chamberlain, Redden, & Grant, 2016).

Measuring Impulsivity

Self-Report. Self-report measures of impulsivity pose a series of questions about impulsivity-related behaviors, outcomes, or traits upon which the individual indicates the extent to which the item is relevant to him/her (e.g., “I can resist eating junk food: *totally agree, agree, neutral, disagree, totally disagree*,” Food Scale, Delay of Gratification Inventory, DGI; Hoerger, Quirk, & Weed, 2011) and/or how often it happens (e.g., “I do things without thinking: *never/rarely, occasionally, often, almost always/always*,” BIS). Self-report measures of impulsivity may index general patterns of impulsive choice (e.g., Patton et al, 1995, Whiteside et al, 2005) or may ask participants about patterns of impulsive behavior across specific domains (e.g., Hoerger et al, 2011).

There are too many self-report measures of impulsivity to exhaustively cover each here. Some measures assess impulsivity in a broad sense (e.g., NEO-PI; Costa & McCrae, 1992), which capture many facets of impulsivity without specifying what those facets are. Broad measures are better at capturing impulsivity in a general sense, and will identify most individuals who possess some trait or behavioral pattern of impulsivity. On the other hand, these measures lack specificity, which makes finding associations with specific problem behaviors difficult.

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Other instruments recognize the multifaceted nature of impulsivity and measure a specific facet or facets (e.g., DGI; UPPS). These measures better capture what types of impulsive traits one possesses, which allows for greater specificity than broad measures. Specific measures, however, can miss individuals who are impulsive in ways other than the facets that the measure captures. Individuals' behaviors can vary not only in which facets of impulsivity they fall, but can also vary across behavioral domains. Certain individuals, for example, might be very impulsive in the domain of food consumption, such that they cannot resist eating large amounts of unhealthy food when available, but have no difficulty using alcohol responsibly. Accounting for the behavioral domains in which one is impulsive can help in better understanding the extent of one's impulsivity and patterns of decision making. Self-report instruments aren't the only option for understanding and measuring multiple dimensions of impulsivity.

Behavioral Methods. Observation of overt impulsive behavioral actions or choices can be used to study impulsivity. Researchers could observe individual's rate of engaging in impulsive behaviors (e.g., uninhibited behaviors, acting without apparent forethought), preceding factors or environmental influences occurring prior to an impulsive action, consequences of impulsive actions, etc. These observations can occur in laboratory settings or in-vivo. In-vivo observation, or naturalistic observation, involves assessment of naturally occurring behaviors. In the case of naturally observing impulsivity, one could discreetly monitor the public for rates of certain impulsive behaviors or actions and peripheral events. This would create issues in controlling for environmental factors (e.g., setting used, selection bias, inability to obtain accurate, specific demographic information of those observed). Laboratory observation helps to control for environmental factors, but suffers from participants no longer truly behaving as they naturally would. Both forms of observation are also inefficient, prone to observer bias or measurement

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errors, observer effects, and economic difficulties (Hammer, du Prel, & Blettner, 2009). Because of these issues, many laboratory tasks were created to measure behavioral impulsiveness.

Laboratory behavioral measures can assess different facets of impulsivity in a temporally and economically efficient fashion. Impulsive action can be assessed through laboratory tasks that focus upon one's ability to inhibit an action. The action to inhibit could be the verbalization of certain words (e.g., *Color-Word Interference Test*, Delis-Kaplan Executive Function System, DKEFS, Delis, Kaplan, & Kramer, 2001), connection of certain visual targets on paper (e.g., *Trail Making Test*, DKEFS, Delis et al, 2001), or a keystroke or mouse-click during certain computer targets (e.g., CPT; Go/No go; Stop Signal Task, Verbruggen & Logan, 2008; Test of Variables of Attention, TOVA, Greenberg, 2011), to name a few examples.

Other laboratory tasks assess impulsive choice, usually through tasks that focus upon one's ability to delay gratification. Some impulsive choice tasks ask participants to decide between various rewards. Some of these tasks use real rewards, or rewards actually received by the participant. The well-known marshmallow study, mentioned above, asked children to choose between eating a single marshmallow immediately or withholding for a few minutes in order to receive two marshmallows (Mischel, Ebbesen, & Zeiss, 1972). Other, similar measures of impulsive behavioral choice, called delay discounting, often use hypothetical outcomes (e.g., would you rather have \$978 now or \$1000 in one week) posed on paper, computer, or orally, as real rewards (e.g., sex, large quantities of food, or high amounts of money) are much too impractical to utilize in a laboratory (Amlung et al, 2013; Rachlin, Raineri, & Cross, 1991; Kirby, Petry, & Bickel, 1999; Richards, Zhang, Mitchell, & de Wit, 1999).

Self-Report and Behavioral Measure Differences

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There are important distinctions between self-reported traits of impulsivity as compared to behavioral measures of impulsiveness. Self-report questionnaires are easy to administer, usually completed quickly, and are cost-effective. These questionnaires can easily be distributed across large groups of participants through a number of means (e.g., in laboratory, online, by mail, over the phone, in participant's home). One drawback to relying on self-report measurements is the issue of social desirability, even on non-deviant behavior questions.

Galbraith, Strauss, Jordan-Viola, and Cross (1974) completed an analysis on a sexual behavior inventory involving men and women rating each item on how much the item evokes socially desirable responding and correlating those ratings with the items rate of true response (i.e., how often individuals answered true to the question). The authors found a strong, positive correlation between social desirability and true response ratings ($r=.70$, women; $.71$, men). This suggests that the more socially desirable an item's content is, the more likely one will rate that item as true for his or herself. This is particularly problematic for inappropriate or pathological behaviors, as those behaviors typically have very low social desirability and may therefore be underrated as true. In addition to social desirability or demand characteristic issues, self-report measures of impulsivity are subject to the individual's level of insight toward their patterns of thoughts, feelings, and behaviors. There is some evidence to suggest that individuals have limited insight regarding their decision making processes (Nisbett & Wilson, 1977).

Behavioral measures of impulsivity counteract many of the weaknesses of self-report measures (see Emery & Levine, 2017). In contrast to self-report questionnaires that rely on accurate self-reflection of decisions an individual has made, behavioral methods more objectively capture decisions an individual actually makes in real-time. Behavioral tasks, unlike self-reports, can measure one's decisions or behaviors occurring under certain present states

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(e.g., sexual aroused, hungry, tired), while not requiring one to accurately remember and honestly report previous behaviors associated with these states. Behavioral measures of impulsivity have their limitations as well. Some behavioral measures can only be administered in a laboratory with the use of a research assistant, which may confound responding by social desirability, demand characteristics, or experimenter bias. Of course, some behavioral tasks can be administered through a computer program to ensure privacy and increase anonymity. Behavioral measures can lack agreement as to which concept(s) of impulsivity they assess. Many measures assess multiple concepts, including various facets of impulsivity, but also working memory and sustained attention (Dougherty, Marsh, & Mathias, 2002). This can make it difficult to determine exactly which behavioral (or cognitive) constructs the task measures.

Aside from the strengths and limitations of self-report and behavioral measures of impulsivity, a growing research literature suggests that these approaches may actually index different aspects of the impulsivity construct. Lange and Eggert (2015) found an overall low correlation between trait and behavioral measures of impulsivity, meaning these two measures could be capturing different concepts. The authors used the BIS as the self-report measure. The behavioral measures of impulsivity included delay discounting (described below) of monetary rewards (Rachlin et al, 1991) and a customized go/no-go task. The go/no-go task, described by Eigsti and colleagues (2006), assesses one's ability to quickly respond to a target stimulus (i.e., a frequently appearing red circle on a computer screen) and inhibit response to an incorrect stimulus (i.e., an infrequently appearing green circle). The authors found the behavioral tasks (i.e., delay discounting and go/no-go) to be uncorrelated with each other, which supports distinct dimensions of behavioral impulsiveness. The go/no-go task was associated with the attentional impulsiveness (Ia) and motor impulsiveness (Im) factors of the BIS, but not the non-planning

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impulsiveness (Inp) factor. The delay discounting task was unrelated to any of the BIS factors. This indicates that the relationship between the behavioral and self-report measures of impulsiveness is more specific, rather than generalized. Although, delay discounting and the Inp factor of the BIS were significantly, positively correlated in a different study (Swann, Bjork, Moeller, & Dougherty, 2002).

In contrast, Reynolds, Ortengren, Richards, and de Wit (2006) found no association between similar self-report and behavioral measures of impulsivity. The authors found two significant factors between their four measures of behavioral impulsivity, “impulsive inhibition” and “impulsive behavioral choice.” The Stop Task (Logan, Schachar, & Tannock, 1997) and Go/No-go Task represented impulsive disinhibition, while delay discounting and the Balloon Analogue Risk Task (BART; Lejuez et al, 2002) represented impulsive behavioral choice. Therefore, behavioral tasks differ in the facet of impulsivity measured, and the tasks have mixed associations with self-report constructs.

Significant associations between self-report and behavioral measures tend to occur when both types of measures assess similar facets of impulsivity. Meda and colleagues (2009) found impulsivity to be a multifaceted structure comprised of five domains, including “Self-Reported Behavioral Activation,” “Self-Reported Compulsivity and Reward/Punishment Sensitivity,” “Self-Reported Impulsivity,” “Behavioral Temporal Discounting,” and “Behavioral Risk-Taking.” There were some significant associations between self-report and behavioral measures when examining specific impulsivity components. Self-reported difficulties with inhibition and sensation seeking (i.e., personality traits) were significantly related to behavioral impulsivity tasks (i.e., Experiential Delay Task, EDT; Reynolds & Schiffbauer, 2004). A behavioral risk

taking task (i.e., BART) was unrelated to self-reported traits of impulsivity, as well as the behavioral discounting task (EDT).

There is evidence to suggest that self-report and behavioral methods are differentially related to the outcome of interest. In a meta-analysis of different measures of impulsivity and obesity outcomes, behavioral measures had significantly greater, positive effect sizes associated with body mass index (BMI), than did self-report questionnaires (Emery & Levine, 2017). The authors explained that self-report measures are also susceptible to varying conceptualizations of impulsivity and lack proper assessment of state influences on impulsive decision making. All considered, laboratory tasks that measure impulsive behavioral choice best capture the behavioral decisions one actually makes, rather than relying on accurate self-perceptions of past behaviors or inefficient observation of behaviors.

Delay Discounting

Discounting paradigms are behavioral choice laboratory tasks designed to measure various aspects of impulsivity. One commonly used discounting task involves delay in receipt of a reward. Delay (or temporal) discounting is the devaluing of a reward based upon delay in its receipt and represents a behavioral indicator of impulsive choice (Ainslie, 1975; Rachlin et al, 1991). In other words, the longer one must wait to receive a reward, the less that person tends to subjectively value that reward. Individuals vary in their rates of delay discounting, which means that some individuals are more sensitive to delayed rewards. As such, these individuals who are more sensitive to delayed rewards tend to opt for more immediate, albeit of less value (e.g., quantity, quality), rewards rather than having to wait for a larger reward. Based on these observed behavioral tendencies, some researchers have inferred that individuals highly sensitive to delayed rewards have difficulty delaying gratification (Ainslie, 1975).

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This behavioral phenomenon was first studied in laboratories using operant conditioning principles in non-human animals (Logan, 1965). Rats and pigeons were often used in these animal studies and were trained to choose between food (or water) choices available immediately or after a delay using adjusting delay and adjusting amount procedures (Mazur, 1997; Richards, Mitchell, de Wit, & Seiden, 1997). These procedures have found that non-human animals discount delayed rewards in a way that can be described in a hyperbolic function (Mazur, 1987), which is the same pattern of discounting found in humans.

In delay discounting tasks involving humans, individuals to choose between a smaller reward available immediately and a larger reward available after a delay (e.g., \$3.50 now or \$10 in one week, with \$10 representing the highest possible reward) to obtain one's subjective value of that reward at that delay. Individuals generally select the larger-later reward when the more immediate reward is very small, but eventually select the smaller-sooner reward as it increases in value across the series of choices. The point at which the individual reverses their choice from the larger, later reward to the smaller, sooner reward is called the indifference point, which indicates the individual's subjective value of the larger-later reward at that delay. Typically, the mean difference between the two values at which the individual changes their preference represents the indifference point (i.e., subjective value of the reward). If, for a \$10 reward available after one week, the individual chose the larger-later reward over \$5 now, \$6 now, \$7 now, but finally selected \$8 now, then the individual's indifference point would equal \$7.50. Thus, the individual subjectively values \$10 available after one week as \$7.50 currently.

Discounting procedures obtain multiple indifference points per individual based upon the number of delays within the particular discounting task (i.e., how many different time points one uses as an option for receipt of the larger, later reward). Discounting patterns can be

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characterized by plotting individual (or group median) indifference points graphically to represent a pattern of behavioral choices. These patterns can be described using a hyperbolic function, wherein time, or delay in receipt, is plotted along the x-axis and the subjective value of the reward is plotted along the y-axis. Mazur (1987) created a hyperbolic function to mathematically describe this pattern (Eq. 1):

$$V = \frac{A}{1+kD}$$

in which V represents the individual's subjective value of the reward (A) at the specified delay (D) and k serves as a free parameter designed to capture the rate at which an individual discounts rewards over several delays. The larger k is the more steeply one is said to discount rewards based on their delayed receipt (i.e., a proclivity toward selecting smaller sooner, rather than larger later rewards). Therefore, the steeper the discounting rate is, the more impulsive are the individual's behavioral choices.

Establishing a rate of discounting using the k parameter is based upon economic theories of exponential discounting (i.e., Loewenstein, 1992 and Samuelson, 1937, as cited by Myerson, Green, & Warusawitharana, 2001). Myerson and colleagues (2001) created an atheoretical alternative to the use of k parameter. Their alternative estimate of discounting rates calculates the area under the curve (AUC). AUC is calculated by plotting indifference points along a graph, the same as when using k (except delay is expressed across the x-axis in proportion of largest delay, rather than in days), and “drawing” straight lines to connect each indifference point. Straight lines are drawn vertically from the indifference point to the x-axis, which creates a series of trapezoids. The area of the trapezoids are calculated by using the formula $(x_2 - x_1) * [(y_1 + y_2)/2]$, where x_1 and x_2 represent consecutive delay proportions and y_1 and y_2 represent subjective value proportions associated with the respective delays. The area of the trapezoids are

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then added together to yield a total AUC score. In contrast to k scores, larger AUC scores indicate less impulsivity or devaluing of a reward due to delay in its receipt.

There are several different delay discounting procedures. Some utilize mathematical procedures that result in lengthy tasks (Amlung et al, 2013; Richards et al, 1999), which require the participant to make many choices before reaching an indifference point. Indifference point values for each delay are found by incrementally adjusting (i.e., titrating) the smaller, immediately available reward up or down depending on participant responses to dozens of previous questions in the task. The adjustments are made such that each question narrows the range of values on successive choice trials until an indifference point is established. Procedures also vary in the number of indifference points they require, which depends upon how many time delays are desired. Thus, procedures that require many delays (e.g., eight delays) and use a titration procedure can be very time consuming, relative to procedures with fewer delays or a different algorithm used to obtain indifference points.

Some newer discounting computerized tasks use mathematical algorithms that achieve indifference points more rapidly and accurately. Baker and colleagues (2003) developed a discounting program, adapted from the Richards and colleagues (1999) task, that uses a double limit procedure (i.e., having a lower and upper limit on the range of choices for the smaller, sooner choice that narrows dependent upon participant choices). This procedure obtains a faster, more accurate estimate of discounting rates because the limits will reset if a participant makes an “erroneous” choice (e.g., choosing \$100 in one month over \$50 now, when one has previously chosen \$30 now over \$100 in one month).

Other procedures use fixed sets of choices that all participants view, which facilitates faster (relative to titration procedures) and consistent task completion time amongst participants

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(e.g., monetary choice questionnaire, Kirby et al, 1999). The monetary choice questionnaire (MCQ) consists of a series of nine choices between a varying smaller reward and fixed larger reward. There are three different larger rewards (i.e., \$10, \$100, and \$1,000). This means that this procedure has, at most, 27 choices, while titration tasks can have as much as four times as many choices. Rather than determining indifference points, the MCQ has predetermined k values associated with each choice. The individual's series of choices determine their estimated k value for the task, as well as the degree of fitness of that k value to the individual's choices. This procedure takes much less time than titration procedures. However, titration procedures can obtain a more specific estimate of one's discounting pattern (i.e., k score), as the choices in the task change according to the individual's previous choices. Using a titration procedure with a sufficient, not excessive or lacking, number of delays (e.g., five delays) and rapid titration process (i.e., fast-working algorithm to obtain indifference points) will obtain a better estimate of individual's degree of behavioral choice impulsivity.

Discounting Task Considerations

In laboratory research, money commonly serves as the reward or outcome to be discounted as it has an objective, quantifiable, dollar-amount value. Money typically has the same current value to all individuals, meaning almost everyone would choose \$10 now over \$10 tomorrow and \$10 now over \$5 now (Johnson & Bruner, 2012). Hypothetical rewards are not actually given to the participant, but the participant is usually prompted to imagine that they will be given the reward. Potentially real rewards procedures give the participant a chance at actually receiving one or more of their choices. One procedure randomly selects several choice trials within a participant's discounting task and the participant receives the respective amount of money based on their choices (Johnson & Bickel, 2002). Real monetary rewards procedures are

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less common and have several limitations (e.g., costly, logistically difficult to deliver a delayed reward, ethically questionable to give cigarettes or alcohol if those be the discounted commodity, legally impossible to give illicit substances), as participants are given the money or other discounted commodity they choose for each choice trial at the corresponding time delay.

There is evidence to suggest that using hypothetical rewards yields similar results (i.e., discounting patterns) to potentially real (Johnson & Bickel, 2002; Lawyer, Schoepflin, Green, & Jenks, 2011) and real rewards (Lagorio & Madden, 2005). There is also evidence to suggest the contrary that hypothetical rewards are discounted less steeply than real rewards (Hinvest & Anderson, 2010), although the amount of money for the real rewards are much less (e.g., less than \$1) than what hypothetical tasks typically use (\$10-\$1,000; Stewart, Reimers, & Harris, 2015). Hinvest and Anderson (2010) used similar hypothetical and real reward amounts (.10 and .20 British pounds) and found a discrepancy between hypothetical and real delay discounting. However, the generalizability of this finding is questionable, given that most hypothetical tasks use much greater monetary values (e.g., \$10-\$1,000), and greater values result in differential discounting patterns (see the magnitude effect described below; Stewart et al, 2015). For practical, ethical, and statistical reasons, hypothetical discounting tasks are a sound choice for measuring discounting patterns.

When using delay discounting tasks with money, the dollar amount of the rewards and time between delays matters for several reasons. To begin, there is a concept known as the magnitude effect, in which high amounts of money (e.g., \$10,000) are discounted less steeply (i.e., have greater subjective value over time) as compared to smaller amounts (e.g., \$10 or \$100; Kirby, Petry, & Bickel, 1999; Green, Myerson, & McFadden, 1997). The magnitude effect was evident in a study that involved discounting of points earned in a computerized game by making

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either certain or risky decisions for fewer or more points, respectively (Greenberg, Hunt, Macaskill, & Harper, 2015). Therefore, to see more evident patterns of discounting it is better to use smaller or medium-sized rewards, compared to relatively large rewards.

When using a variety of reward amounts, it is important to consider the differences between the reward amounts (e.g., \$10, \$100, \$1000), as well as the differences in delays in receiving the rewards (e.g., one day, one week, one year). Stewart and colleagues (2015) found that altering when hypothetical rewards are received, the probability of their receipt (pertinent to probability discounting), and their amount changed discounting patterns (i.e., the shape of the discounting rate curve). The authors found that the discounting pattern was steepest when the delays were most dense (i.e., having less time between delays, such as one day to one week versus one day to one year) and when using smaller amounts, as found in the magnitude effect. When larger amounts were used across widespread delays, discounting patterns evidenced a flatter slope (2015), which would make comparisons amongst participants more difficult. Using one reward amount across a previously established and validated set of delays circumvents the problems associated with choosing the density or distribution of delays and reward values.

Domain-specific Discounting

Delay discounting tasks have used other rewards besides money, such as tobacco (Baker et al, 2003), alcohol (Petry, 2001; Vuchinich & Simpson, 1998), illicit drugs (Kirby & Petry, 2004), food (Rasmussen et al, 2010), erotica (Lawyer, 2008), and sex (e.g., Lawyer, Williams, Prihodova, Rollins, & Lester, 2010). Selecting an appropriate type of reward, or domain, is important as domains differentially correlate to certain discounting patterns. Individuals discount certain domains more steeply than others, especially when rewards within that domain are tempting to them. Specifically, when participants found a reward, such as chips, particularly

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enjoyable they evidenced steeper delay discounting patterns than others who did not have such a temptation to chips. These participants also devalued the tempting reward when delayed more steeply than other, non-tempting rewards, meaning individuals demonstrate domain-specific discounting patterns (Tsukayama & Duckworth, 2010).

Rasmussen and colleagues (2010) also found domain-specific discounting in a study on delay and probability discounting of food and money. Their results revealed that percent body fat (PBF) was associated with delay and probability discounting of food, but not money. This suggested that those with higher PBF were more impulsive in their decision making for hypothetical food (i.e., steeper delay discounting), as compared to individuals with lower PBF. This finding indicates that those with higher PBF were willing to choose a smaller, but immediately available, amount of hypothetical food over a larger, but delayed, amount. The higher PBF group also demonstrated less risk-taking or risk-sensitivity (i.e., steeper probability discounting) for hypothetical food, as compared to the lower PBF group. This suggests that those with higher PBF preferred to choose amounts of hypothetical food that were guaranteed, albeit smaller, rather than risking receipt of a larger amount of hypothetical food. Those with higher PBF were no more impulsive or risk-sensitive than those with lower PBF in their decision making for money, which reflects domain-specific discounting.

In comparison to discounting of money, discounting of other domains usually presents much steeper (i.e., more impulsive) delay discounting rates. In healthy populations, alcohol (Lemley, Kaplan, Reed, Darden, & Jarmolowicz, 2016), cigarettes (for smokers only; Baker et al, 2003; Odum, 2011a), and food (Odum, Baumann, & Rimington, 2006), are discounted at steeper rates than money. These comparisons are confounded by differences in unit price (i.e., the price one is willing to pay in terms of money, time, and effort to obtain the good) between

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money and the comparison commodity (even when attempting to equate monetary value of both commodities). In substance abusing populations, the substance of choice is sometimes discounted more steeply than money, such as heroin (which was standardized to be equal in unit price with money; Kirby et al, 1999; Madden, Petry, Badger, & Bickel, 1997) and cocaine (Coffey et al, 2003). Unless equating unit price of both commodities, it is nonsensical to directly compare one group's discounting rate for money and another commodity. We can, however, look at the relative change across unequal commodities by comparing the ratio of change between two or more groups.

It is important to thoughtfully choose the domain to be discounted. As mentioned above, obesity outcomes were associated with delay discounting of food, but not discounting of money (Rasmussen et al, 2010). Other research suggests that patterns of delay discounting for sexual activity are differentially associated with sexual outcomes, as compared to non-sexual outcomes (Lawyer & Schoepflin, 2013). The authors found that sexual activity delay discounting rates were associated with sexual outcomes, such as sexual excitability (i.e., how one reacts to sexual stimuli). Monetary discounting, however, was unrelated to any sexual outcome measure. Therefore, when investigating impulsivity related to specific outcomes it is most useful to use a decision making paradigm that involves factors associated with that outcome.

Factors that Influence Decision Making

“Visceral” Factors

Visceral factors include negative emotions (e.g., anger or fear), drive states (e.g., sexual desire, hunger), and feeling states (e.g., pain; Loewenstein, 2000) that can influence behavior (Peters, Västfjäll, Gärling, & Slovic, 2006). The visceral influences hypothesis (Loewenstein, 1996) holds that internal states associated with deprivation (e.g., thirst, pain, sexual desire) can

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significantly influence the behavioral decisions an individual makes (e.g., drinking, consuming pain relief medication, having sex). Loewenstein outlines seven research-supported propositions within his visceral influences hypothesis (1996).

Table 1. Visceral Influences Hypothesis Propositions (1996, p278)

Prop.	Description	Behavioral Interpretation
1.	“The discrepancy between the actual and desired value placed on a particular good or activity increases with the intensity of the immediate good-relevant visceral factor”	One’s potential behavioral efforts to obtain a good increase as the intensity of visceral sensations related to that good increase
2.	“Future visceral factors produce little discrepancy between the value we plan to place on goods in the future and the value we view as desirable”	Present visceral sensations have greater influence on behavior than visceral sensations expected to occur in the future
3.	“Increasing the level of an immediate and delayed visceral factor simultaneously enhances the actual valuation of immediate relative to delayed consumption of the associated good”	Increasing intensity of visceral sensations increase one’s sensitivity to delayed consumption of the related good
4.	“Currently experienced visceral factors have a mild effect on decisions for the future, even when those factors will not be operative in the future”	Present visceral sensations influence present behaviors that have delayed outcomes
5.	“People underestimate the impact of visceral factors on their own future behavior”	People underestimate the impact of future visceral sensations on future behavior, which can influence present behaviors that have implications on those future behaviors
6.	“As time passes, people forget the degree of influence of visceral factors will increasingly be forgotten, or will seem perplexing to the individual”	Past experiences of visceral sensations diminish in their effect on present behaviors over time
7.	“The first six propositions apply to interpersonal as well as intrapersonal comparisons, where the other people play the same role vis a vis the self as the delayed self plays relative to the current self: i. We tend to become less altruistic than we would like to be when visceral factors intensify; ii. When making decisions for another person, we tend to ignore or give little weight to visceral factors they are experiencing; iii. Increasing the intensity of a visceral factor for ourselves and another person in parallel leads to a decline in altruism; iv. When we experience a particular visceral factor, we tend to imagine others experiencing	Visceral sensations increase one’s sensitivity to self-serving consumption of goods, rather than other-serving

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	it as well, regardless of whether they actually are; v. & vi. People underestimate the impact of visceral factors on other people's behavior"	
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The first proposition holds that the “actual value” of a stimulus (i.e., the subjective value of a stimulus implied by the individual’s price willing to be paid through time, effort, and resources) becomes increasingly distanced from the stimulus’s “desired value” (i.e., the subjective value of a stimulus that the individual views as in his or her own self-interest) as the intensity of the visceral factor relevant to the stimulus increases (e.g., stomach growling and feeling hungry for food, feeling sexually aroused for sex). In other words, the individual’s behaviors implemented to obtain the stimulus (e.g., food) implies the individual’s actual value for that stimulus. One could assume a higher actual value of food for one individual who is willing to spend 5% of their disposable income and walk two miles to obtain cookies, as compared to an individual willing to spend 5% of their disposable income but only walk one mile to do so. The desired value for cookies would be low for both individuals, as these cookies would not be viewed as something for their best interests, relative to healthier foods. The impact on behavior (i.e., what one chooses to do) increases as the visceral factor’s intensity (i.e., physiological and psychological changes due to deprivation) increases, which sets the stage for self-destructive patterns of decisions (e.g., overeating, sexual misconduct or sexual risk taking). So, as an individual becomes hungrier, the desired value of cookies (i.e., relatively low desired value) becomes increasingly distant from the actual value of cookies (i.e., behaviors implemented to obtain the food).

Second, current visceral factors have more influence on behavior than visceral factors expected to occur in the future. To exemplify, not feeling sexually aroused now, but knowing one will be in the future, may result in a person obtaining condoms or planning to use a condom

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during their next sexual encounter. In the absence of the visceral influence of sexual arousal, the individual has a preference for using condoms during sexual activity. In contrast, feeling sexually aroused in the present could shift that individual's preference from obtaining a condom to obtaining sex as quickly as possible, even if no condom is available (Ariely & Loewenstein, 2006).

The third proposition refers to the influence of the visceral factors on the individual's time preference in receiving the desired stimulus. When a stimulus is immediately available (i.e., within an individual's physical proximity or the individual becomes aware that the stimulus will be readily available), visceral factors increase and the individual will prefer to receive the stimulus more immediately, rather than after a delay (relative to their preference prior to realizing the stimulus's availability). Seeing one's kitchen would elicit an appetitive response, like salivation and feeling hungry. The feeling of hunger would be more intense for someone more greatly deprived of food, as compared to someone who has recently eaten. The proximity (i.e., imminently receiving food) and visceral sensations increase the likelihood of that individual consuming food immediately (relative to their desire to eat a bite of food prior to walking their kitchen).

Others have found that feelings of hunger, elicited by seeing and smelling a chocolate chip cookie, led to greater risk taking (i.e., agreeing to a game with a low probability chance of winning a cookie (10%) and a high probability (90%) of having to spend an extra 30 minutes in the study completing mathematical problems), compared to those who only heard a description of chocolate chip cookies (Ditto, Pizzaro, Epstein, Jacobson, & MacDonald, 2006). It becomes harder to delay receipt of a stimulus, when the stimulus is within reach and eliciting visceral responses. As such, ready availability of a stimulus and related visceral responses increase the

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likelihood of one shifting their typical behavioral choices toward riskier or more impulsive choices.

The fourth proposition states that visceral factors not only have a strong influence on immediate decisions, but also decisions for the future. This could include purchasing an excess of groceries when shopping while hungry (Nisbett & Kanouse, 1968 as cited by Loewenstein, 1996). The visceral factors not only influence immediate decisions, but also guide present decisions that have an impact on choices one will face in the future. Similarly, the fifth proposition asserts that individuals underestimate the impact of visceral factors on their behavior in the future. Although individuals understand they will feel hungry, amorous, or craving drugs (if addicted) in the future, they underestimate the influence those visceral sensations will have on their behavior later, despite having faced those sensations in the past. For example, women who have faced the pain of childbirth previously underestimated their desire for pain-dulling medication when planning for their next childbirth (i.e., discussing birth plans prior to the onset of labor) and reversed their decision (i.e., wanted the pain-dulling medication) once beginning to experience labor pains (Christensen-Szalanski, 1984).

According to the sixth proposition, individuals forget the extent of the influence visceral factors had on their past behaviors as more time passes. As such, individuals forget the association between an unpleasant state due to visceral sensations and maladaptive behaviors previously used to alleviate such state. The seventh proposition conveys the self-focusing effect that visceral factors elicit. As the intensity of visceral sensations increases, one becomes more focused upon satisfying his or her own needs, rather than the needs of others (relative to their focus during low levels of visceral sensations). For example, an increased focus on bodily sensations (e.g., excited, alert) due to viewing erotic pictures of women was related to an

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increased focus on one's own needs and decreased feeling of connectedness with others (Li & Zhang, 2014).

Aside from Loewenstein's seven propositions, visceral factors have also been found to narrow attention and behaviors onto cues and activities related to the visceral factor (e.g., hunger directs attention toward food cues and increases motivation to engage in behaviors that lead to eating; Easterbrook, 1959). The visceral factors (e.g., hunger, drug craving) not only direct attention toward cues that would lead to satiation, but also away from cues unrelated to the visceral factor (Loewenstein, 1996). For example, individuals addicted to illicit substances (e.g., cocaine, heroin) direct attention (as measured by eye movement) toward cues related to the drug they crave (e.g., pictures of the drug, paraphernalia) and away from unrelated cues (e.g., food, money; Field, Mogg, & Bradley, 2006).

Taken together, these visceral, or bodily, influences focus attention on cues that are related to the stimulus of which one is currently deprived or craving (e.g., cocaine if addicted and withdrawing) and away from unrelated cues (e.g., food; Easterbrook, 1959). Left ungratified, these visceral states are associated with increases in one's likelihood of engaging in behaviors that either obtain what is desired or reduce the visceral sensations in another way. Visceral factors turn one's preferences toward immediate outcomes associated with reducing the visceral factor, despite possible negative consequences of ignoring the future. This hypothesis predicts that a person who is hungry is likely to choose to consume an immediate supply of food, rather than consider saving it for a time they may be hungrier later. However, this sense of immediacy doesn't transfer to other choices or rewards that are unrelated to the visceral factor. So, the person who is hungry would not be inclined any more than usual to choose money or sex immediately, given that those choices could not be simultaneously traded for food. These

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visceral influences also turn one's focus inward onto one's own needs, rather than considering external or societal consequences. The hungry person would have a stronger temptation to feed his or herself, rather than feed another individual or give the food away to a charity (Loewenstein, 1996).

From an evolutionary standpoint, these visceral factors are generally adaptive. For example, it is important to eat when hungry and food is available, as people must feed themselves in order to be healthy enough to take care of oneself and others (Loewenstein, 1996). Still, strong visceral influences can prompt one to engage in behaviors that lead to harmful consequences to oneself or others. To exemplify, individuals usually engage in reasonable behaviors to satiate their desires when the visceral influences are at low levels. One who is experiencing a relatively low-level of sleepiness (i.e., the visceral influence) while driving will take safe and reasonable actions to address their fatigue (e.g., pull over to rest), while someone with a high-level of sleepiness will more likely take unsafe actions (e.g., continue driving and risk falling asleep at the wheel; 1996).

Sexual Arousal as a Visceral Influence

Returning to the visceral factor of interest, intensifying sexual arousal elicits increased attention toward cues that lead to immediate (or sooner, rather than later) sexual gratification, similar to the way in which hunger draws attention toward present, food-related cues (Ariely & Loewenstein, 2006; Loewenstein, 1996). It should also divert attention away from other rewards not related to sexual gratification (i.e., money, food, health; 2006). Individuals who experience high levels of sexual arousal have a greater temptation to engage in risky behaviors (e.g., unprotected sex) to more quickly obtain sexual gratification, as compared to less aroused individuals (Ariely & Loewenstein, 2006; Loewenstein, 1996). Being in a state of sexual arousal

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was also related to increases in the endorsement of verbal coercion tactics one would hypothetically use to obtain sexual activity (i.e., sexual assault behaviors), despite risk of legal consequences (Bouffard, 2015).

Skakoon-Sparling, Cramer, and Shuper (2016) tested the visceral influences hypothesis with men and women by eliciting sexual arousal via exposure to videos of consensual, non-violent erotica and measuring sexual decision making. Participants made behavioral decisions in hypothetical sexual scenarios in which they rated their likelihood of engaging in immediately available but unprotected sex. They found that these sexually aroused men and women tended to focus upon immediately available, but unsafe, sexual gratification in their responses, rather than protected-sex practices, as compared to non-aroused participants. These sexually aroused participants also demonstrated “general risk-taking” decisions in a modified game of Blackjack. Both sexually aroused men and women chose riskier plays in this Blackjack game, as compared to non-aroused participants, which indicated sexual arousal not only impacted sexual risk taking but risk taking in a monetary-based game as well. With these findings taken together, manipulation of sexual arousal led to increased risky decision making related to unprotected, but immediate, sexual activity and monetary gain. It remains unknown whether sexual arousal or simply viewing erotica influences impulsive decision making related to the delay in receipt of sexual activity, rather than risk of contracting a sexually transmitted infection (STI).

Sexual Arousal and its Measurement

Sexual arousal is considered a multidimensional construct consisting of a sexual response involving psychological (e.g., cognitions, emotions) and physiological processes (Chivers et al, 2010; Janssen, 2002). In men, physiological processes of sexual arousal typically result in penile erection, in which blood flow is directed toward the sponge-like bodies (i.e., two corpora

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cavernosa bodies and one corpus spongiosum) in the erectile tissue of the penis. An erection is the most recognizable and common marker of physiological sexual arousal, even though there are other changes in the parasympathetic and sympathetic nervous systems (Janssen, 2002).

Psychological factors, sometimes called subjective sexual arousal, include cognitions and emotions related to the arousal (e.g., awareness of the arousal, demand for sexual activity, appraisal of the arousal and one's ability to gratify it). These cognitions and emotions serve as a positive or negative feedback loop (i.e., enhancing or reducing the arousal; Barlow, 1986).

Measuring sexual arousal is complicated in that sexual arousal comprises physiological and psychological processes, which are not always correlated (Chivers et al, 2010). Sexual concordance refers to the degree to which one's physiological processes (e.g., genital changes) correspond to one's subjective experience (e.g., thoughts and emotions) of sexual arousal. Low sexual concordance indicates a low correlation between physiological processes and subjective experience during sexual arousal, while high sexual concordance indicates a high correlation between those factors. There is evidence of low sexual concordance in the empirical literature on sexual arousal, such as men reporting "feeling sexual arousal" but not experiencing physiological changes in their genitals (Heiman & Hatch, 1980; Rieger, Chivers, & Bailey, 2005), or vice versa with women experiencing genital indications of arousal but not psychological indications (Chivers & Bailey, 2005). A meta-analysis by Chivers and colleagues (2009) found a significant disparity in the sexual concordance of men as compared to women. The authors found an overall concordance between genital and self-reported subject experience of sexual arousal in women ($r=.26$) to be lower than that of men ($r=.66$). Neither genital nor self-reported measurements of sexual arousal fully account for all components of sexual arousal.

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Measuring sexual arousal mechanically via genital changes (e.g., penile plethysmograph, volumetric gauge) is useful at times, especially when socially desirable responding is likely or purely objective data is needed. Research that investigates sexual arousal to deviant stimuli (e.g., sexual aggression, children) is one such instance where social desirability may greatly interfere and mechanical measures of sexual response is warranted (Chivers et al, 2009). Research using mechanical measurements of genital responses found that exposure to erotica (i.e., a video of a naked woman) disinhibited sexual arousal to rape cues in men, including non-perpetrating men. More specifically, these men demonstrated significantly more sexual arousal via physiological measurement (i.e., plethysmograph) and subjective sexual arousal via self-report when viewing video of a naked woman and hearing a narration of a woman being raped, as compared to men who heard the same narration and were shown a clothed woman (Fairweather, Kingston, & Lalumière, 2016).

Accounting for physiological changes in the genitals, however, is unnecessary when one is merely interested in the urges (i.e., psychological factors) related to sexual arousal induced by non-deviant sexual stimuli. Men's self-reported sexual arousal may already include genital changes in their response, as their genital changes are typically obvious (e.g., fullness in the penis, tightening of supportive ligaments; Pennebaker & Roberts, 1992; Chivers et al, 2009). Sexual discordance issues suggest that using physiological measurements may mislead results, such that men who are physiologically aroused sometimes deny feeling subjectively or psychologically aroused and some men who report subjective or psychological markers of sexual arousal do not evidence physiological markers (Rieger et al, 2005). Other difficulties of physiological measures include sensitivity to participant movements, such that the equipment may produce distorted recordings due to the participant moving in their chair or moving while

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standing. The cost of equipment and lab space necessary for sufficient participant privacy is another problematic aspect of physiological measurement of sexual arousal. Finally, proper placement or setup of equipment can occur due to participant or researcher error and would like contaminate results (Janssen, 2002). Self-report measures of subjective (i.e., psychological) sexual arousal do not suffer from these issues.

Physiological and psychological sexual arousal can be assessed by self-report measures. Of course, if one is only interested in the actual (not estimated) physiological markers of sexual arousal, then physiological measurements are best. If one is only interested in the psychological markers of sexual arousal, then self-report measures are the better option. There is a type of continuous measure of subjective sexual arousal, in which participants continuously (or at certain increments, if desired), shift a computer mouse back and forth across an “arousometer” in accordance with how sexually aroused they are feeling from not at all or “turned off” through extremely sexually aroused. This continuous measure was developed by the Female Sexual Psychophysiology Lab at the University of Texas at Austin (Rellini, McCall, Randall, & Meston, 2005).

Other self-report methods ask participants to rate their sexual arousal at a fixed time point or time points (usually after exposure to an erotic stimulus). Some of these measures estimate subjective sexual arousal in a broad sense by asking participants to rate their “level of sexual arousal” on a Likert scale (Fairweather et al, 2016; Skakoon-Sparling et al, 2016), which offers a minimally time consuming method for capturing subjective sexual arousal. Other measures ask more pointed questions or evaluate specific topics such as sexual desire, concurrent emotions (e.g., nervous, frustrated, excited), readiness to engage in certain sexual activities, or sense of urgency regarding a need for sexual gratification (Althof, Perelman, & Rosen, 2011; Heiman &

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Hatch, 1980; Heiman & Rowland, 1983; Toledano & Pfaus, 2006). As sexual arousal is comprised of many facets, using a self-report item or few items to measure the specific facet of interest (e.g., subjective, psychological sexual arousal) evaluates one's subjective rating of that facet in a timely manner.

Priming

When testing the influence of sexual arousal or sexual attraction on decision making, researchers often expose participants to erotica (i.e., video clips or pictures of sexual activity or nudity) to generate sexual arousal, which is associated with a change in decision making patterns. Ariely and Loewenstein (2006) manipulated sexual arousal by asking college men to view erotic images and self-stimulate (i.e., masturbate) until they neared orgasm, but were able to inhibit orgasming, and then participants rated their attraction to certain objects and people, agreement with morally questionable sexual activities, and willingness to engage in risky sexual activities. The participants answered the same questions in a non-aroused state as well. Compared to the control condition, men in the aroused condition endorsed significantly more sexually deviant feelings/desires (e.g., sexual attraction to women's shoes, sex with someone they hated, sex with a 40-60 year old woman), sexually aggressive behaviors (e.g., willingness to encourage date to drink to increase likelihood of having sex, keep trying to have sex after date says "no," slip date a drug in drink to increase chance of having sex), and sexual risk taking behaviors (e.g., not using condom with partner with unknown sexual history, not using a condom because the woman might change her mind about sex when getting the condom; 2006).

Sexual arousal is often highlighted as the factor most closely associated with the change in decision-making, but that is not the only possible explanation for the findings. Although the experience of sexual arousal may influence individual decisions, it is also possible that simply

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‘priming’ participants by showing them sexual stimuli affects behavior aside from their experience of sexual arousal. Priming results in a change of one’s ability to identify or label a stimulus (e.g., identifying something as sexual, harmful, beneficial, etc.), as a result of having been exposed to a similar stimulus. Exposure to a sexual stimulus (e.g, erotic images or videos) would therefore increase one’s attention toward other sexual stimuli or increase one’s identification of stimuli as sexual. This priming effect does not necessitate sexual desire nor metacognitive awareness of one’s state of arousal in order to influence stimulus identification (Spiering, Everaerd, & Janssen, 2003).

In one example of priming, Spiering and colleagues (2003) asked participants to classify pictures into one of two categories (i.e., sex or plant) after being exposed to a priming image. The priming images were sexual (e.g., nude females, heterosexual couples engaged in oral sex), plant-related (e.g., plants, bushes), or threatening (e.g., mutilated corpses, angry persons). Participants were given instruction to either focus upon the priming image or to ignore it. When told to ignore the priming image, participants classified sexual images significantly slower than plant images, when preceded by a sexual or threatening prime. In contrast, when participants were told to focus upon the priming image, they classified sexual images significantly faster than plant images, only when preceded by a sexual prime. This priming effect is believed to draw attention to cues related to the focused-upon prime, which facilitates faster classification or identification of that cue (Spiering, Everaerd, & Elzinga, 2002). Primes, erotic or otherwise, are related to a variety of effects, including changes in behavioral decision making.

Primes need not be related to the task that they precede, such as sexual image primes preceding sexual decision tasks. Primes can be unrelated to the task, as found in a study with participants viewing images of nature demonstrated different rates of delay discounting of money

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compared to participants viewing other images. Those participants that viewed images of mountains, rather than those viewing buildings or triangles (i.e., control condition), discounted money less steeply (Berry, Sweeney, Morath, Odum, & Jordan, 2014). This suggests that priming individuals with nature images leads to less impulsive monetary decision making (i.e., greater willingness to wait for a larger sum of money) in the short-term. In a similar task of delay discounting of money, priming participants to focus on future outcomes, rather than past or present outcomes, was associated with significantly less discounting of money (i.e., less impulsivity; Sheffer et al, 2016). A focus on one's future-self mediated the relationship between participants primed with a hypothetical position of power (i.e., manager of resources and team leader) and delay discounting of hypothetical monetary outcomes and hypothetical air quality control decisions (Joshi & Fast, 2013).

Wilson and Daly (2004) investigated the effect of attractive faces on delay discounting of money. They found a significant effect of exposure to attractive women's faces on men's rates of monetary discounting, such that men discounted money received at a later date more steeply than their baseline discounting rates. However, there was no such effect for men exposed to unattractive women's faces. There was no effect for women exposed to attractive or unattractive men's faces. This suggests, for men, exposure to women alone doesn't necessarily result in behavioral changes, but rather exposure to attractive women yields a shift in one's behavioral decision making (2004). Because sexual arousal was not measured, it remains unknown whether the exposure to attractive women primed men's change in decision making or another mechanism (e.g., sexual arousal, sexual desire) accounted for the change.

Taken together, using erotica and assuming sexual arousal has occurred is problematic due to not actually measuring sexual arousal. In those cases, sexual arousal cannot be assumed as

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a mechanism of change in the outcome variable. In contrast, only using sexual arousal in analyses does not account for possible priming effects that may occur due to viewing erotica. A mediation model would account for the effects of priming an individual through erotica exposure and determine whether sexual arousal was actually responsible as the mechanism of change. As of yet, a mediation model has not been used to determine the effects of erotica exposure and sexual arousal on delay discounting of sexual outcomes.

Present Study

This study seeks to address gaps within behavioral choice impulsivity literature. Specifically, this will address one possible influence (i.e., subjective sexual arousal) on impulsivity-related decision making for monetary and sexual outcomes. Previous studies have used certain types of sexual health risk outcomes, such as condom availability in hypothetical sex scenarios (Johnson & Brunner, 2012; Skakoon-Sparling et al, 2016) or percent chance of contracting an STI (Schoepflin & Lawyer, *in progress*), but these serve as measures of risk sensitivity, rather than impulsivity. As the effects of sexual arousal on sexual activity by itself are unknown, the sexual outcome in this study is free of health risks and serves more purely as a measure of impulsivity. Impulsivity is such a complex phenomenon that it is essential to specify to which traits, behaviors, or facets of impulsivity one is referring. For this novel study, temporal discounting is used to investigate sexual arousal's effect on impulsive behavioral choice across two domains (i.e., money and sexual activity) in college men.

The following hypotheses were formulated based upon the aforementioned literature:

Hypotheses

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Hypothesis 1: There will be a main effect of video condition on discounting rates for sexual activity, such that the group viewing the erotic video group will have significantly higher k scores, than the control video group.

Hypothesis 2: There will be a domain-specific effect of viewing erotica on discounting task outcomes, such that:

2.1: k scores for delay discounting of money will be similar between the erotic video group and the control video group, and

2.2: k scores for delay discounting of sexual activity will be significantly greater in the erotic video group than the control video group.

Hypothesis 3: Sexual arousal will mediate the relationship between video condition and delay discounting k scores for sexual activity, such that higher sexual arousal is positively associated with steeper delay discounting as indicated by larger respective k scores.

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