Predicting domain-specific outcomes using delay and probability discounting for sexual versus monetary outcomes

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A B S T R A C T
Discounting, the tendency to devalue an outcome as a function of its delay or probability, is emerging as a fundamental process that underlies a broad range of impulsive-choice behaviors. Recent research suggests that people discount the value of sexual outcomes and individual differences in rate of discounting of sexual outcomes may represent an important behavioral process that underlies sexual risk behavior. However, it is not clear that discounting the value of domain-specific sexual outcomes (e.g., sexual activity) is a better predictor of sexual behaviors than is discounting for domain non-specific outcomes (e.g., money). Adult undergraduates (n = 103) completed delay and probability discounting procedures in relation to money and sexual activity and a series of self-report measures concerning sexual and non-sexual outcomes. Results revealed domain-specific relationships such that (1) discounting for sexual and monetary outcomes were significantly correlated; (2) discounting for sexual activity was significantly associated with sexual excitability, but not with non-sexual outcomes; and (3) discounting for money was not related to the sexual outcomes. A consistent gender effect across measures suggests that gender may moderate the relationships between discounting and sexual and non-sexual outcomes. The relevance of these findings for domain-specific discounting is discussed.

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1. Introduction
1.1. Delay and probability discounting

Delay and probability discounting refer to the tendency for individuals to devalue a reward as a function of its delay or likelihood (Ainslie, 1975; Green and Myerson, 2004; Rachlin et al., 1991). Patterns of delay discounting are established in human participants by asking them to choose between a relatively large reward available after one of several delays and a smaller, adjusting, amount available immediately (e.g., “Would you prefer $10 now or $100 in one day?”). Similar procedures are used in probability discounting, where participants make a series of choices between a large, probabilistic outcome (e.g., $10 with a 25% chance) and a smaller, adjusting, amount of money available “for sure.” Delay discounting patterns can be characterized using a hyperbola-like mathematical model (Green et al., 1994): \[ V = \frac{A}{(1 + kD)^p} \]. In this model, V represents the subjective value of the large outcome, A represents the amount of the large outcome, D represents the delay to receiving the large outcome, and k represents a free parameter that indexes the rate of discounting (higher values indicate a preference for smaller–sooner outcomes and more impulsivity). In probability discounting, a similar model is used: \[ V = \frac{A}{(1 + kD)^p} \]. In this model, the parameters are the same as for delay discounting, except that \( p \) represents the odds against receiving the large outcome \((1/p) − 1\), where \( p \) is the probability of receiving the outcome), and \( h \) indexes the rate of discounting (lower values indicate a preference for large, probabilistic outcomes).

Individual differences in the rates at which individuals discount the value of delayed and probabilistic outcomes correspond well with behavioral theories of impulsive-choice (Ainslie, 1975) and underlie a variety of problem health behaviors, including substance use and abuse (e.g., MacKillop et al., 2011; Yi et al., 2007, 2010), gambling (Petry, 2001b), obesity (Epstein et al., 2010; Fields et al., 2011; Rasmussen et al., 2010; Weller et al., 2008), and sexual risk-taking (Chesson et al., 2006). The breadth of health outcomes that are tied to the de-valuing of delayed rewards has led Bickel and Mueller (2009) to argue that discounting is a “trans-disease” process that underlies a broad range of intersecting phenomena.

1.2. Discounting sexual outcomes

Researchers commonly assess discounting patterns by posing participants with questions regarding their preference for immediate versus delayed money (e.g., Rachlin et al., 1991), but also assess discounting of other (typically hypothetical) outcomes, including...
drugs (e.g., Bickel et al., 1999; Coffey et al., 2003; Madden et al., 1997), alcohol (e.g., Odum and Rainaud, 2003), and food (Estle et al., 2007; Odum and Rainaud, 2003; Rasmussen et al., 2010), among others. Several recent studies report that the discounting paradigm can also be used to characterize decisions regarding sexual outcomes. Lawyer (2008) found that erotic users discounted the value of erotica outcomes in a hyperbolic manner and Lawyer et al. (2010) found that college students discount the value of hypothetical sexual activity in a manner similar to that for money. More recently, Johnson and Bruner (2012) found that discounting for sexual outcomes in several of their tasks significantly predicted self-reported sexual risk behavior (SRB).

These studies suggest that discounting-related decisions for sexual outcomes can be described using mathematical models that have proven important in a range of other contexts, and also point to impulsive choice for sexual outcomes as a potentially important behavioral mechanism that may underlie sexual risk behaviors, such as having unprotected sexual intercourse. These findings are consistent with research making a clear connection between SRBs and self-reported impulsive choice (Deckman and DeWall, 2011) and money delay discounting (Chesson et al., 2006).

1.3. Domain effects in discounting

One important question is whether domain-specific discounting procedures are better predictors of domain-specific behaviors than are domain non-specific procedures (e.g., preferences for monetary outcomes). In this context, domain specificity refers to patterns of impulsive choice that vary as a function of the commodity. In other words, does someone who is impulsive when making a decision about drugs also impulsive regarding decisions for other outcomes, such as money? On the one hand, individual discounting rates tend to be significantly correlated across different types of outcomes (Odum, 2011) and discounting for money (a non-specific outcome) is associated with a broad range of health–related outcomes cited already (but also see Madden and Bickel, 2010), which suggests that discounting for one outcome should predict a behavior as well as discounting for other outcomes. On the other hand, a consistent “domain effect” is emerging in which some types of outcomes tend to be discounted at different rates than others (even if the two rates are correlated at the group level). For example, drug users discount the standardized value of drugs at a steeper rate than money (Bickel et al., 1999; Coffey et al., 2003; Madden et al., 1997; Petry, 2001a) and human participants in general tend to discount the value of consumable outcomes, such as food, at higher rates than money (e.g., Charlton and Fantino, 2008; Estle et al., 2007; Odum et al., 2006; Odum and Rainaud, 2003; Tsukayama and Duckworth, 2010).

While individuals tend to discount outcomes differently as a function of their domain, it is not clear whether discounting for a specific commodity differentially predicts behavior associated with that commodity. However, some recent studies suggest that discounting for domain-specific outcomes may predict some behaviors better than others. Johnson and Bruner (2012) reported that discounting for sexual outcomes, but not for money, was associated with SRBs and Lawyer (in press) reported domain specificity in a laboratory measure of risk-taking behavior, finding that risk-taking for sexual outcomes was more strongly related to self-report measures of sexuality-related constructs than was risk-taking for money. Some research in the context of food discounting highlight domain-specific outcomes (Hendrickson and Rasmussen, in press; Rasmussen et al., 2010), though one study (Best et al., 2012) found that delay discounting for money, but not food, was associated with a positive treatment response in overweight children. These studies (with one exception) suggest that domain-specific measures of impulsive or risky choice predict domain-specific outcomes better than decision-making for generic (monetary) outcomes. However, the research literature focusing on domain-specific versus generic outcomes in discounting remains relatively small, making confident empirical statements about the predictive utility of generic (monetary) versus domain-specific discounting difficult to make.

The purpose of the present study was to examine whether discounting for sexual outcomes would differentially predict outcomes drawn from sexual versus non-sexual self-report measures. Delay and probability discounting for sexual activity and money were measured using procedures used in previous research (Lawyer et al., 2010; Richards et al., 1999) to establish their relative relationships with self-report measurements of impulsivity-related outcomes that were decidedly sexual (e.g., sexual desire) and non-sexual (e.g., gambling behavior). Drawing from extant findings indicating significant relationships between discounting for different domains, we hypothesized that (1) discounting for money and sexual activity would be significantly related; (2) discounting for sexual activity would be more strongly related to sexual outcomes than non-sexual outcomes; and (3) discounting for sexual activity would be more strongly related to sexual outcomes than would discounting for money.

2. Materials and method

2.1. Participants

Participants were sexually active undergraduate students (n = 103) recruited from psychology courses at Idaho State University. The majority of the sample was female (64.1%), European-American (78.6%); Hispanic = 12.1%, and heterosexual (94.2%). The mean age of the sample was 26.1 years (SD = 8.9; Range = 18–56). All participants received research credit toward their undergraduate courses for their participation in this study.

2.2. Discounting tasks

2.2.1. Delay and probability discounting for money

Rates of delay and probability discounting for money were established using a computerized discounting program and procedure similar to that used in previous studies (Lawyer et al., 2010; Richards et al., 1999). A research assistant read the following script before data collection began [with delay/probability discounting language in brackets]:

“I’m going to ask you to make some decision about which of two rewards you would prefer. One of the rewards will be available [right now] [for sure], and the other will only be available [after you have waited for some period of time] [with some probability].

For example, I might ask you to choose between $550 delivered [right now] [for sure] and $800 delivered [in two years] [with an 80% chance]. 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.”

For delay discounting questions, participants chose between $10 to be received after five different delays (1 day, 1 week, 1 month, 6 months, 1 year) and a smaller amount of money available immediately. For probability discounting questions, participants chose between $10 to be received with one of several different probabilities (95%, 75%, 50%, 25%, 10%) and a smaller amount of money available immediately.

In this procedure, participants are posed with a delayed or probabilistic standard amount of money ($10) and a smaller, adjusted amount of money. The adjusted amount was selected randomly from the pool of possible amounts (in $0.50 increments) that fell
between top and bottom limits, which changed as a function of the participant’s choices across the session. For example, if a participant, posed with a choice between $2 now and $10 in 1 week, then the computer program would randomly selected from a pool of increasing adjusting amounts (e.g., $2.50, $4.00) on subsequent questions. However, if the participant chose the delayed $10, then the program chose from a pool of decreasing adjusting amounts (e.g., $1.50, $5.00) until an indifference point was established for that delay (or probability). The random selection of questions helped mask the adjusting procedure the program used (see Richards et al., 1999, for details regarding this procedure). Indifference point values were used to fit discounting functions to individual and group median indifference point data.

2.2.2. Delay and probability discounting for sexual activity
Delay and probability discounting for sexual activity was measured using a modified version of the task used by Lawyer et al. (2010). In both tasks, the large outcome was set at 30 min (increased from 10 min in the original task). For delay discounting, the delays were shortened to 1–180 days (from 1 to 365 days in the original task). These modifications were made to better represent a meaningful reward outcome and to better capture variability in responding at shorter time-periods than assessed in the earlier paper. Prior to data collection, a research assistant read the following script [with delay/probability discounting language in brackets]:

“In the task that follows, you will have the opportunity to choose between different amounts of sexual activity available [after different delays] [with different probabilities]. The test consists of questions such as the following: [“Which do you prefer?: 3 min of sexual activity right now or 10 min of sexual activity in 1 week?”] [“Which do you prefer?: 2 min of sexual activity for sure or 10 min with a 50% chance.”]. “Sexual activity” 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. 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.”

After participants indicated they understood the task, they completed the task in a private setting. For delay discounting questions, participants chose between 30 min of sexual activity after five different delays (1 day, 2 days, 1 week, 1 month, 6 months) and a smaller amount of sexual activity available immediately. For probability discounting questions, participants chose between 30 min of sexual activity with one of several different probabilities (95%, 75%, 50%, 25%, 10%) and a smaller amount of sexual activity available immediately. The computer program established indifference points for all delays using the same procedure as the money task, though adjusting increments were set at ±2 min. Indifference point values were used to calculate discounting rates and to fit discounting functions to individual and group median indifference point data.

2.3. Self-report measures

2.3.1. Non-sexual outcomes
A number of impulsivity-related outcomes not directly tied to sexual behaviors were used in this study, all of which are related to discounting behavior in past research. The Alcohol Use Disorders Identification Test (Saunders et al., 1993) was used to assess alcohol use and abuse. It is a 10-item measure recommended by the World Health Organization as a brief screening instrument for the detection of harmful alcohol consumption and assesses drinking frequency, intensity, symptoms of tolerance and dependence, and alcohol-related negative consequences over the past 12 months. A single item from The Gambling Quality and Perceived Norms Questionnaire (Neighbors et al., 2002) was used to assesses frequency of gambling behavior. Participants were asked, “Approximately how often do you gamble?” and answered using a 10-point scale ranging from 1 (never) to 10 (every day). The Fagerstrom Test for Nicotine Dependence (FTND; Fagerstrom and Schneider, 1989) measured nicotine use and dependence. It is a 6-item measure that is a standard tool for assessing the physical intensity of addiction to nicotine. Polysubstance Use was measured using seven questions about the extent to which participants used a variety of drugs over the past 12 months. Participants were asked “How frequently have you tried the following types of drugs over the past 12 months (without a prescription)?” and were given several options (e.g., marijuana, cocaine). They answered on a 4-point Likert scale ranging from 0 (never) to 3 (11 or more times).

2.3.2. Sexual outcomes
Several sexuality-related measures were used to assess a broad range of sex-related outcomes. All measures used here are well-established and frequently used in sexuality-related research. The Sexual Sensation Seeking Scale measured individual interest in a variety of sexual experiences. It is an 11-item measure that has acceptable test-retest reliability and discriminant validity and is associated with a variety of high-risk sexual behaviors (Kalichman and Cain, 2004; Kalichman and Rompa, 1995). The Sexual Desire Inventory (SDI; Spector et al., 1996), a 14-item measure that assessed, the individual’s interest in both solitary (e.g., “How strong is your desire to engage in sexual behavior by yourself?”) and dyadic (e.g., “When you spend time with your partner, how strong is your sexual desire?”) sexual activity. The SDI total score (range = 60–123) was used to index greater interest in, and valuing of, sexual activity. The Sexual Inhibition and Excitation Scales (SIS/SES; Janssen et al., 2002) measured sensitivity to cues that promote (sexual excitability) and diminish (sexual inhibition) sexual arousal. One sexual inhibition scale (SIS1) measures how participants would respond sexually to situations that would threaten performance failure, such as losing arousal easily, while the other (SIS2) assesses how participants respond sexually to situations involving risk, such as being caught, getting a sexually transmitted infection, or experiencing pain. The sexual excitability scale (SES) assesses how participants react to several provocative sexual situations, including social interactions, visual stimuli, and fantasies. Participants rate all items on a four-point scale (1 = strongly agree to 4 = strongly disagree).

2.4. Procedure
After consenting to participate, participants provided basic demographic information and completed all psychometric and behavioral measures in a private screened-off section of the laboratory. All questionnaires were completed using a computer program to ask questions and record data into a database. This procedure enhances confidentiality of participant responses, which is important in light of the sensitive subject matter assessed by the various measures. Half of the participants completed the self-report measures before the behavioral measures; the other half completed the behavioral measures first. The order of the behavioral measures (money discounting versus sexual activity discounting) and the order of delay and probability tasks within domain types also were counterbalanced to control for order effects.
Table 1
Descriptive statistics for discount rate (k/h), time scaling (s), area under the curve (AUC), and residual sum of squares (RSS) across discounting tasks.

<table>
<thead>
<tr>
<th></th>
<th>Delay discounting</th>
<th>Probability discounting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Money</td>
<td>Sexual activity</td>
</tr>
<tr>
<td>k/h*</td>
<td>.009 (.003, .032)</td>
<td>.027 (.005, .083)</td>
</tr>
<tr>
<td>s&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.43 (2.71)</td>
<td>.39 (.60)</td>
</tr>
<tr>
<td>AUC&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.391 (.241)</td>
<td>.380 (.219)</td>
</tr>
<tr>
<td>RSS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.029 (.010, .044)</td>
<td>.027 (.010, .064)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Represented as median (interquartile intervals) due to positive skewness.
<sup>b</sup> Mean (SD).

2.5. Analyses

2.5.1. Estimating discounting parameters

To establish how well the hyperbola-like decay function (Green et al., 1994) fit the data gathered here, the model was applied to individual and group-median indifference point data using nonlinear regression in GraphPad Prism<sup>©</sup>. The residual sum of squares (RSS) was used as an indication of how well the model fit the data. RSS was used in place of $R^2$, since $R^2$ sometimes produces uninterpretable values (e.g., negative numbers) due to the nature of nonlinear regression (Johnson and Bickel, 2008).

2.5.2. Area under the curve

For purposes of drawing statistical relationships among behavioral and self-report measures, we calculated individual area under the curve (AUC; Myerson et al., 2001) estimates. AUC provides an atheoretical index of the extent of an individual’s discounting that is appropriate for parametric statistical analyses, since it tends to produce relatively normal distributions of scores (discount rates estimated from model-fit data tend to be skewed). AUC estimates range from 0 to 1 and small numbers indicate more impulsive choice in delay discounting and less risky choice in probability discounting.

2.5.3. Establishing latent variables

To reduce the probability of a Type I error due to correlating each of the behavioral measures with multiple self-report measures, and to increase the variability in sexual and non-sexual outcomes, total scores for self-report measures were subjected to an exploratory principle components factor analysis with a varimax rotation. The factors drawn from this analysis were calculated and used for testing study hypotheses.

3. Results

3.1. Discounting outcomes

Individual model fit parameters (Table 1) across the tasks revealed that the hyperbola-like model fit individual data for each task relatively well. A Wilcoxon sign-ranks test comparing the RSS values across sexual activity and monetary outcomes revealed no differences in the fit of the hyperbola-like model to money and sexual activity discounting in both the delay ($Z = -1.17, p > .05$)
the outcomes measured, a series of measures. These findings made it clear that gender needed to be gender-related outcomes. When gender was considered as a covariate, the only significant monetary discounting relationship was between probability discounting and sexual inhibition such that higher AUC scores (indicating a preference for probabilistic outcomes) predicted higher sexual inhibition scores. On the other hand, there were consistently significant relationships between the sexual excitability factor and delay and probability discounting for

3.3. Relationships among behavioral and self-report outcomes

Table 4 shows the regression coefficients associated with the behavioral measures and the self-report variables after controlling for gender. Gender was a significant covariate in each one of the regression analyses, suggesting that it may represent an important moderator of the relationships between discounting and impulsivity-related outcomes. When gender was considered as a covariate, the only significant monetary discounting relationship was between probability discounting and sexual inhibition such that higher AUC scores (indicating a preference for probabilistic outcomes) predicted higher sexual inhibition scores. On the other hand, there were consistently significant relationships between the sexual excitability factor and delay and probability discounting for

Table 2
Means (SD) and gender comparisons across study variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (n = 103)</th>
<th>Males (n = 37)</th>
<th>Females (n = 66)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discounting tasks AUC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay discounting money</td>
<td>.39 (.24)</td>
<td>.37 (.22)</td>
<td>.40 (.25)</td>
<td>-.77</td>
<td>ns</td>
</tr>
<tr>
<td>Probability discounting money</td>
<td>.24 (.15)</td>
<td>.27 (.18)</td>
<td>.23 (.13)</td>
<td>1.06</td>
<td>ns</td>
</tr>
<tr>
<td>Delay discounting sex</td>
<td>.38 (.22)</td>
<td>.33 (.21)</td>
<td>.41 (.22)</td>
<td>-1.91</td>
<td>.06</td>
</tr>
<tr>
<td>Probability discounting sex</td>
<td>.25 (.18)</td>
<td>.20 (.16)</td>
<td>.27 (.18)</td>
<td>-1.94</td>
<td>.06</td>
</tr>
<tr>
<td><strong>Non-sexual self-report measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUDIT</td>
<td>4.03 (4.16)</td>
<td>5.03 (5.37)</td>
<td>3.48 (3.20)</td>
<td>-1.6</td>
<td>ns</td>
</tr>
<tr>
<td>Drug use</td>
<td>8.73 (3.14)</td>
<td>9.78 (4.54)</td>
<td>8.14 (1.75)</td>
<td>-2.12</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Gambling frequency</td>
<td>2.18 (1.53)</td>
<td>2.59 (1.7)</td>
<td>1.94 (1.4)</td>
<td>-2.12</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>FTND</td>
<td>1.05 (2.24)</td>
<td>1.05 (2.2)</td>
<td>1.04 (2.3)</td>
<td>-.019</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Sexual self-report measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSSS</td>
<td>20.39 (5.26)</td>
<td>23.73 (5.3)</td>
<td>18.52 (4.3)</td>
<td>-5.47</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>SDI</td>
<td>69.3 (17.09)</td>
<td>76.5 (15.1)</td>
<td>65.3 (16.9)</td>
<td>-3.35</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>SES</td>
<td>49.87 (9.57)</td>
<td>55.0 (16.3)</td>
<td>47.0 (7.9)</td>
<td>-4.42</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>SSS1</td>
<td>29.5 (6.04)</td>
<td>26.6 (6.6)</td>
<td>31.5 (1.1)</td>
<td>3.825</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>SSS2</td>
<td>30.8 (5.18)</td>
<td>27.2 (4.9)</td>
<td>32.8 (4.2)</td>
<td>6.06</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Table 3
Results of the exploratory principle components factor analysis (with varimax rotation) establishing latent variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUDIT</td>
<td>.092</td>
<td>.760</td>
<td>-.105</td>
</tr>
<tr>
<td>Drug use</td>
<td>.146</td>
<td>.787</td>
<td>-.119</td>
</tr>
<tr>
<td>FTND</td>
<td>.12</td>
<td>.631</td>
<td>.418</td>
</tr>
<tr>
<td>GQPN</td>
<td>.005</td>
<td>.451</td>
<td>-.126</td>
</tr>
<tr>
<td>SSSS</td>
<td>.824</td>
<td>.203</td>
<td>-.251</td>
</tr>
<tr>
<td>SDI</td>
<td>.880</td>
<td>.060</td>
<td>-.090</td>
</tr>
<tr>
<td>SES</td>
<td>.898</td>
<td>.060</td>
<td>-.010</td>
</tr>
<tr>
<td>SSS1</td>
<td>-.113</td>
<td>-.025</td>
<td>.787</td>
</tr>
<tr>
<td>SSS2</td>
<td>-.165</td>
<td>-.229</td>
<td>.762</td>
</tr>
</tbody>
</table>

and probability (Z = -.25, p > .05) discounting tasks. Examination of discounting patterns at the group level indicated excellent fit of the model to group median indifference values for both money and sexual activity (Fig. 1) discounting tasks. Delay and probability discounting were significantly correlated for both money (r = .26; p = .01) and sexual activity (r = .46; p < .01). In addition, discounting for money and sexual activity also were significantly correlated for both delay (r = .29, p < .01) and probability (r = .35, p < .01) discounting.

To determine whether there were gender differences in any of the outcomes measured, a series of t-tests were conducted comparing males and females across all behavioral and self-report measures (see Table 2). These analyses yielded numerous significant differences across each of the sexual discounting AUC outcomes (but not the money AUC outcomes), drug use and gambling frequency, and across all of the sex-related self-report measures. These findings made it clear that gender needed to be considered as a covariate in subsequent analyses. Age was not significantly correlated with AUC on any discounting measure.

3.2. Latent factors

The principle components factor analysis (Table 3) yielded a consistent factor structure consisting of one non-sexual latent factor (drug use and gambling) and two sexual latent factors (sexual excitability and sexual inhibition). The non-sexual factor included the AUDIT, the polydrug use questionnaire, the FTND, and gambling frequency. The sexual excitability factor included the Sexual Sensation Seeking Scale, the Sexual Desire Inventory, and the Sexual Excitability Scale. The sexual inhibition factor included both sexual inhibition subscales of the Sexual Inhibition and Excitation Scales. Factor scores were calculated by summing the Z-scores of the scales associated with each factor to form three different factors to be used in data analysis.

Table 4
Regression coefficients associated with AUC estimates and gender predicting latent variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-sexual</th>
<th>Sexual excitability</th>
<th>Sexual inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay discounting money</td>
<td>.72 (.108)</td>
<td>1.84 (.97)</td>
<td>.45 (.59)</td>
</tr>
<tr>
<td>Gender</td>
<td>.13 (.54)</td>
<td>.44**</td>
<td>-.180 (.29)</td>
</tr>
<tr>
<td>Probability discounting money</td>
<td>.14 (.76)</td>
<td>-2.66 (.15)</td>
<td>2.14 (.93)</td>
</tr>
<tr>
<td>Gender</td>
<td>.13 (.55)</td>
<td>-.15</td>
<td>-.189 (.29)</td>
</tr>
<tr>
<td>Delay discounting sex</td>
<td>-.30 (.21)</td>
<td>-.23</td>
<td>-.12 (67)</td>
</tr>
<tr>
<td>Gender</td>
<td>.13 (.55)</td>
<td>-.24</td>
<td>-.02</td>
</tr>
<tr>
<td>Probability discounting sex</td>
<td>-.68 (1.54)</td>
<td>-4.07 (1.34)</td>
<td>1.05 (.83)</td>
</tr>
<tr>
<td>Gender</td>
<td>.12 (.56)</td>
<td>-.44</td>
<td>-.173 (.30)</td>
</tr>
</tbody>
</table>

*p < .05.
**p < .01.
Consistent with Lawyer et al. (2010), a hyperbola-like decay model that people discount the value of sex in much the same way they discount for sexual activity and money.

4. Discussion

4.1. Discounting for sexual activity and money

The results of this study replicate previous research indicating that people discount the value of sex in much the same way they do other rewards (Johnson and Bruner, 2012; Lawyer et al., 2010). Consistent with Lawyer et al. (2010), a hyperbola-like decay model provided a good fit to individual and group discounting patterns in the context of sexual activity. Consistent with study hypotheses, discounting for monetary and sexual outcomes was significantly correlated for both delay and probability discounting. These findings are consistent with Odum’s (2011) conclusion that discounting for one outcome tends to be correlated with discounting for other outcomes.

Delay and probability discounting for money and for sexual activity were positively significantly correlated for both money and sexual activity. This is potentially relevant for improved understanding about the relationship between delay and probability discounting, especially in light of research reporting mixed findings that delay and probability discounting either are (e.g., Mitchell, 1999; Richards et al., 1999) or are not (e.g., Omura et al., 2005; Reynolds et al., 2004) correlated. Although delay and probability discounting overlap procedurally and conceptually, there is ample reason to believe that they represent two meaningfully distinct processes (see Green and Myerson, 2010). Though it is beyond the scope of this paper, future examination of how delay and probability discounting related in the context of domain-specific outcomes is warranted.

4.2. Relationships between sexual activity discounting and sexual and non-sexual outcomes

Our hypothesis that discounting for sexual outcomes would be more strongly related to self-reported sexual outcomes than to self-reported non-sexual outcomes was partially supported. Delay and probability discounting for sexual activity were related to the Sexual Excitation latent factor, but not to the non-sexual factor. This suggests a potentially important aspect of domain-specific discounting in which some sexual outcomes (e.g., sexual excitability) are better predicted by discounting procedures that include decisions for sexual outcomes rather than discounting procedures that use monetary outcomes. It is worth noting that the three self-report measures that made up this (SSSS, SDI, SES) broadly describe approach-related sexual outcomes that predict a range of health-problem outcomes, including risky sex (Kalichman & Rompa, 1995; Turchik et al., 2010).

However, sexual activity discounting was not related to the Sexual Inhibition latent factor, after controlling for gender. One possible reason for the absence of a significant relationship is that the sexual inhibition factor measured here describes how an individual’s sexual arousal is affected by either a threat to performance failure (e.g., an under-aroused partner) or a threat associated with the consequences of sexual behavior (e.g., risk of a sexual transmitted infection). The sexual discounting task used here had no threat-related elements, which may explain the lack of a relationship to the sexual inhibition measures. It is possible that the addition of a threat dimension (e.g., risk if STI exposure) would improve the connection between sexual discounting and sexual inhibition as measured by the SIS/SES (c.f., Johnson and Bruner, 2012). Another issue to consider in the future is the specific measurement of sexual risk behaviors (SRBs). While we assessed sexuality-related constructs that predict SRBs, we did not ask participants to report specifically on the frequency with which they engage in various SRBs.

Our hypothesis that discounting for sexual outcomes would be more strongly related to self-reported sexual outcomes than discounting for money also was partially supported. Both probability and delay discounting for sexual activity were related to the Sexual Excitation factor, which supports the hypothesis. Interestingly, probability discounting for money was significantly related to sexual inhibition, even after controlling for gender. The relationship was relatively weak ($\beta = .19$), but suggests a potential connection between sexual inhibition and sensitivity to probabilistic outcomes in general (though, the lack of a similar relationship to probability discounting for sexual activity suggests that this relationship may be spurious).

Surprisingly, none of the discounting tasks was related to the non-sexual latent factors. One possible reason for this is that a restricted range of scores on the measured outcomes may have prevented the identification of a clear relationship between discounting and drug-use outcomes reported in previous studies. For example, average scores on the FTND suggest that there were very few smokers in this sample.

4.3. Role of gender in sexual activity discounting

One consistent factor that influenced the results of this study was gender. Women scored differently from men in almost every self-report variable, which is consistent with several other studies examining these phenomena (Carpenter et al., 2008; Gaither and Sellbom, 2003). Although there were no gender differences in discounting for money, there was a trend ($p = .06$) for men to have lower AUC estimates for both delay and probability discounting for sexual activity. This suggests that men are less willing to delay gratification for sexual activity and are more risk-averse when it comes to choosing certain vs. probabilistic sexual outcomes. This is consistent with data indicating that men have higher overall sex drives than do women (Baumeister et al., 2001) and also is consistent with evolutionary perspectives that men may value immediate or certain sexual outcomes over delayed or probabilistic sexual outcome, even when the immediate or certain outcomes are relatively small (Haselton and Buss, 2000).

The role of gender in discounting research is not clear and research reports conflicting data indicating that men are steeper discounters than women (Kirby and Maraković, 1996; Wilson and Daly, 2004), women are steeper discounters than men (Beck and Triplett, 2009), or that there are no gender differences in discounting (Epstein et al., 2003). However, the findings reported here are consistent with several other studies suggesting that gender may moderate the relationship between discounting and various outcomes, meaning that relationships between discounting and some other outcomes may be gender-specific. For example, Stoltenberg et al. (2008) found that gender moderated the relationship between impulsivity (measured using the stop signal paradigm) and alcohol problems. Mitchell and Wilson (2012) reported two experiments with male and female smokers and found, in one experiment, that male smokers were steeper discounters than female smokers. This effect was not replicated in the second experiment, perhaps due to a smaller sample size, which limits the power to find an effect. Jones et al., 2009 found a gender x smoking status interaction in which female smokers were especially likely to discount delayed outcome and exhibit shortened time horizons. The potential role that gender plays in understanding the relationships between impulsive choice and health-related outcomes is important and future research should consider addressing this issue more comprehensively.
4.4. Limitations

The findings reported here are relevant to empirical efforts to better understand the role of domain specificity in the context of delay and probability discounting, but should be considered in light of its potential limitations. One potential issue to consider is that the delay discounting tasks for money and sexual activity used different large commodity amounts ($10 and 30 min, respectively) and delays (1–365 days and 1–180 days, respectively) when establishing discounting patterns. It is possible that these different procedures introduced a procedural confound, since area under the curve tends to be sensitive to variability at the longer delays. Although the difference in the nature of the commodities may make this issue less important, future research might consider replicating the methods reported here, but with standardized values across commodities. Another possible issue to consider is whether the gender effect observed across most of the variables measured here might be confounded by contextual factors, such as emotional responding to some cues (e.g., sexual ones), which could explain the gender-discounting relationships reported here.

4.5. Summary

The findings reported here suggest that domain-specific discounting procedures may provide better predictive information than do money-related discounting procedures for some outcomes. The present findings are limited to statements regarding sexual outcomes and replicate related research in this domain (Johnson and Bruner, 2012; Lawyer, in press). However, these findings are consistent also with Rasmussen et al.'s (2010) findings that discounting for food outcomes better predicted percent body fat than did discounting for money. Taken together, these findings suggest that further research on the role of domain-specific discounting and its relationship to domain-specific outcomes is warranted.

References


