

RISKY SEXUAL BEHAVIOR AND PUBLIC HEALTH: ON THE USE OF BEHAVIORAL
ECONOMICS TO INFORM PUBLIC HEALTH POLICY

By

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Abstract

Risky sexual behavior represents an intransigent public health issue in the United States and exists within a complicated web of political, social, cultural, economic, racial, and geographic contexts. The Socio-Ecological Model (SEM) is a public health framework designed to situate behavior in such contexts, allowing for multi-level analysis and amelioration strategies.

Condoms are an effective means of reducing sexually transmitted infections and unwanted pregnancies, but barriers to access in the form of cost and delay to acquisition may substantially impact their use. Behavioral economics provide a means of scientifically investigating these dual barriers, while utilizing research methods that lend themselves to the study of behavior that is not available for direct observation. To this end, I utilized the Condom Purchase Task and Sexual Delay Discounting Task to empirically investigate these two barriers and administered a temporal framing intervention to assess the malleability of sexual discounting and demand. I recruited participants from two STI testing clinics in Eastern Kansas, one in Lawrence and the other in Wyandotte County. Results suggested no effect of the intervention on sexual discounting and demand. When split by willingness to engage in unprotected sex and the frequency of sexual thoughts however, marked differences were observed, providing support for the use of behavioral economic research methods in informing public health policy.

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The Ecology of Behavior and Levels of Intervention

Behavior is the result of a complex, multidirectional relationship between current and historical environments, context, material conditions, antecedent stimuli, reinforcement history, and the behaving individual(s). Each of these elements represent a potential locus for behavioral intervention, but with each of them impacting and being impacted by each of the others, any intervention favoring one of these behavioral constituents at the expense of the others may not have the desired impact. This is especially the case when strict experimental control is not possible as in large scale interventions relating to public health. Several such contemporary efforts have done just this by creating interventions that primarily target the behaving individual. As a primary example, the War on Drugs has relied heavily upon increasing the sentencing requirements for drug-related offenses (a form of delayed positive punishment) in an effort to curb drug use and drug-related deaths (Pearl, 2018). Contrary to the aims of the decades-long effort, the War on Drugs has, “contributed to an increase in drug overdoses and fostered and sustained the creation of powerful drug cartels” (Coyne & Hall, 2017). More relevant to the current research, school-based sex education programs that encourage youth to remain abstinent until marriage (Abstinence Only Until Marriage or AOUM programs) as a primary means of reducing unwanted pregnancies and risk of contracting Sexually Transmitted Infections (STIs) also target the behaving individual. Rather than implementing a positive punishment procedure, AOUM programs purport to change behavior by altering motivation to engage in sexual activity through the provision of information stressing the “social, psychological, and health gains to be realized by abstaining from sexual activity” (Kandasamy, et al., 2018). These programs are, among other things, ineffective and unethical (Elia & Eliason, 2014; Kantor et al., 2008; Society for Adolescent Health and Medicine, 2017; Trenolm et al., 2007). Other, more ethical and

comprehensive sex education programs have shown promise in reducing rates of STIs and unwanted pregnancies, but overall rates still leave much room for improvement (Santelli et al., 2017).

By leaving environmental and contextual factors unexamined and unaltered, these sorts of programs that intervene solely at the level of the individual are ensuring their limited success. It is akin to one person seeking to row upriver in a canoe that fits 6 or 7 people; more success will be had when all hands are on deck and rowing. Intervening solely at the level of the individual can also implicitly promote de facto victim-blaming; by creating a situation wherein it is the sole responsibility of the individual to alter their behavior, a lack of effect can be interpreted as a failure of the individual, rather than an ineffective intervention. This potential scenario highlights the need for behavior to be understood and interventions to be implemented under a more comprehensive framework. Although the individual behaves, a problem of behavior is not necessarily—or solely—a problem with an individual. A more holistic approach that considers the relative contribution of each of the elements or levels of influence is necessary. The prevalence and relative intransigence of risky sexual behavior and its concomitant negative outcomes in the United States (Satterwhite et al., 2013; Sonfield et al., 2014) provides an ideal exemplar for this position.

Risky Sex: Definition and Prevalence of Outcomes

For the purposes of this paper, risky sexual behavior (hereafter referred to as “risky sex” or “unsafe sex”) refers to engaging in sexual behavior (not necessarily penetrative or vaginal sex) with one or more persons without the use of a condom and/or other forms of birth control (e.g., long-acting reversible contraception; LARC). This sort of sexual behavior is considered risky because of the potential for the contraction/spread of STIs and the risk of an unplanned/unwanted

pregnancy (these outcomes hereafter referred to as “negative outcomes”). Each year, there are roughly six million pregnancies in the United States, but fully half of these 6 million pregnancies are unintended (Finer & Zolna, 2014). To put that into context, nearly 5% of all reproductive-age women (15-44 years old) have an unintended pregnancy each year, making this a prevalent phenomenon (Finer & Zolna, 2014). STI prevalence in the United States is similarly high, with estimates placing the number of active infections at 110 million and the number new infections each year at 20 million—10 million of which are contracted by young adults aged 15 to 24 (Satterwhite et al., 2008, 2013). The consequences faced by individuals who experience these negative outcomes are not uniform; existing public and economic policy related to healthcare, contraceptive, and abortion access and sexual education create disparities in who experiences these outcomes and what the ramifications are.

Disparities and Inequities in Negative Outcomes: Class & Race

Significant class- and race-based disparities exist for both negative outcomes of risky sex. Women living in poverty disproportionately contract STIs and experience unplanned pregnancies, even though women from all income brackets have sex at equivalent rates (Finer & Zolna, 2014; Reeves & Venator, 2015). In 2011, women living under the poverty line were five times more likely to experience an unplanned pregnancy as those making at least 200% of the poverty rate (Finer & Zolna, 2016). This can partially be explained by the additional barriers these women face in accessing healthcare and abortion services. Nearly three-quarters (73.7%) of the 30 million uninsured non-elderly adults in the United States report being uninsured because costs are too high, and, predictably, the majority of these adults are also experiencing poverty (Tolbert & Orgera, 2020). This lack of coverage makes accessing more reliable—and expensive—forms of birth control difficult, with affluent women being more likely to use the

most effective forms of birth control (i.e., Intrauterine Devices; IUDs) than those experiencing poverty (Reeves & Venator, 2015). The likelihood of an unplanned pregnancy leading to a birth is also moderated by class due to disparities in abortion access. Women experiencing poverty are three times less likely to have an abortion after an unplanned pregnancy than more affluent women (Reeves & Venator, 2015). It is not altogether clear how religious beliefs may impact this disparity in abortion access. According to a survey by Pew Research Center, higher educational attainment is associated with being less religious in the United States, but this pattern does not necessarily hold for Christianity (Pew, 2017). Those with more education are actually *more* likely to be regular churchgoers than those with less educational attainment and although it is not possible to draw a direct correlation between church attendance and religiosity, this may suggest that religious beliefs may act to curb abortion access for both wealthy and poor women alike, although it is possible that religious beliefs are responsible for a portion of this disparity in abortion access. There also exist geographic-based disparities that remain even when controlling for income, which may point to differences in cultural or religious practices in across the country (Finer & Zolna, 2014; Martin et al., 2017). At any rate, these disparities in abortion access culminate in high numbers of uninsured women giving birth, resulting in large public costs. Roughly half of all annual births paid for through public insurance are unplanned (Sonfield & Kost, 2015), the total cost of which is estimated to be roughly \$21 billion USD—the same amount as NASA’s 2020 budget (Khazan, 2020; NASA, 2020).

Given the racial disparities with regards to rates of poverty, Black, Indigenous, and People of Color (BIPOC) individuals are at greater risk of each of the above class-based outcomes. However, even independent of income, BIPOC women experience elevated rates of both negative outcomes. Compared to White women, BIPOC women experience higher rates of

STIs, explainable at least in part, by systemic, societal, and cultural barriers (Centers for Disease Control, 2018). These women, particularly Black and Hispanic women, also experience higher rates of unintended pregnancies and unintended pregnancies resulting in birth. In 2011, 60% of all pregnancies in Black women were unintended and 33% of these ended in birth and 48% of all pregnancies in Hispanic women were unintended, 31% of which ended in birth, compared to 42% and 17%, respectively, for White women (Troutman et al., 2020).

An additional barrier faced by BIPOC women in the United States, independent of poverty status, that contributes to the existing race disparities lies in the United States' sordid history of forced sterilization procedures by American doctors engaging in explicit eugenics and/or population control efforts (Baggaley, 2020). As recently as the 20th Century, as many as 32 states even had federally funded eugenics boards, "...tasked with ordering the sterilizations of women – and sometimes men – deemed 'undesirable'" (Lennard, 2020). This history is discussed here as it has bearing on the potential efficacy of future efforts to reduce the negative outcomes of unprotected sex. If the reduction or elimination of barriers in the way of accessing birth control is one part of this effort, then another part ought to be increasing the use of birth control, not simply its acquisition. For some women (particularly women of color), even if birth control is readily available and free, this may not be enough to encourage its use, especially if it requires a procedure as some forms of birth control do (Jacobs et al., 2006). Even though a full discussion of the implications this history of forced sterilizations may have on future efforts is beyond the scope of this paper, I believe it is important to discuss here for two reasons: (1) so the audience may understand that the author appreciates the complicated nature of the problem and understands increasing access and reducing barriers is not a silver bullet, and (2) to illustrate the importance of historical environments and context on present behavior.

Risky Sex: An Ecological Perspective

When examined at the level of the individual, it may appear as though risky sexual behavior is a problem that begins, and ends, at that level. It is, after all, individuals who decide to engage or not engage in safe sex. But, as is described above, there are broader issues at play, including educational and economic ones, that render this issue far more complex. What the decision to be safe or unsafe entails is not so simple and can be wildly disparate based on one's environment and context. Economic concerns, educational failures, and means of access can all become barriers that stand between someone and a decision to engage in safe sex. The socio-ecological model (SEM), an oft-cited framework in the public health literature that has been adapted by the Centers for Disease Control (CDC), is a tool for examining behavior from an ecological perspective; that is, understanding a behaving individual to exist within a set of systems expanding out from the individual (Golden & Earp, 2012; Kilankowski, 2017). Some details of the model differ across studies, but generally there are five levels or systems—

intrapersonal (or microsystem), interpersonal (or the mesosystem), community, organizational and institutional (or the exosystem), public policies (the macrosystem), and culture, society, and historical context (the chronosystem) (Golden & Earp, 2012; Kilankowski, 2017). Visual representations of the model depict five nested circles, with the mesosystem at the center and the chronosystem most distal. This representation is meant to illustrate the interdependency of the systems—how the behaving individual impacts and is impacted by each successive system. For clarity, the systems are often referred to as, in order, individual, interpersonal, community, societal, and policy (see Figure 1 for a visual representation of the SEM). For the present study, the SEM nicely summarizes the multiple levels of influence on risky sexual behavior—the political forces shaping how we teach our adolescents and young adults about sex, the

community norms and barriers of access one experiences in a local environment, the relational factors at play in sexual decision-making and, finally, the behavior of the individual. Considering the barriers in this way suggests the high rates of unplanned pregnancies and STIs seen in the United States do not stem from a single cause. However, the fact remains that these negative outcomes can be largely mitigated via the regular and proper use of birth control, presenting one avenue for intervention. Only 5% of annual unplanned pregnancies occur when couples used some form of contraceptive as prescribed (Sonfield, Hasstedt, & Gold, 2014). Part of the problem, as noted above, is that access to contraception is mitigated by socioeconomic status. Although more effective means exist for preventing unwanted pregnancies than condoms (e.g., LARC), condoms provide the added benefit of protecting against STI contraction and represent a low-cost means for addressing both major negative outcomes of risky sex (Food and Drug Administration, 2018). What is more, they do not suffer from the same history as other forms of birth control and are thus positioned to not be as affected by this history as these other forms of birth control.

Condoms, then, provide an ideal basis for intervention to determine to what extent the dual barriers of cost and ease of access (effort expenditure, delay to acquisition, etc.) have on their use. However, given the nature of sexual interactions, interventions in applied settings and/or those that allow for behavioral observation are both unethical and impractical. It is perhaps unsurprising then, that the extant behavioral literature on condom use and risky sexual decisions more broadly is quite limited. Three studies, all from the 1990s (discussed below), modified access to condoms with results that have important implications.

Historical Behavioral Approaches to Curbing Risky Sex

Honnen and Kleinke (1990), sought to increase condom use by providing free condoms and sexual health information in bars. Using an ABAB design, they showed that placing large signs above a bowl of condoms advertising the condoms and replete with sexual health information could increase the number of condoms taken by 47%, relative to their sign-free baseline. Specifically, the signs held information on fatality statistics involving AIDS and that condoms can help to reduce likelihood of spread (as an aside, the information involved AIDS, rather than other STIs or pregnancy information as these interventions took place in known gay bars at the height of the AIDS epidemic). Amass and colleagues (1993), conducting their study in a substance-use outpatient clinic rather than a bar, manipulated location of condoms as well as the type of sign advertising their availability. Researchers placed a glass bowl of condoms alternately in the clinic's bathroom above the toilet or on a shelf in the clinic's public waiting area. The posters were not moved along with the condoms, but rather stayed in each location. The poster above the toilet was bright green and stated simply, "AIDS affects everyone. You can reduce the spread of AIDS by using condoms". The poster in the waiting area was black and white and contained information about the spread of AIDS. Results from this study showed a four-fold increase in number of condoms taken when available in the restroom as opposed to the waiting area and a much more modest increase when poster prompts were present, rather than absent. Interestingly, the number of condoms taken decreased sharply over time. With each successive exposure (per the BCBC design) the percentage of condoms taken dropped in both locations; from the first to last exposure, condoms taken dropped by 30% in the bathroom and by 50% in the waiting room. A similar study was conducted in another substance-use outpatient clinic by Carrigan and colleagues (1995), who also found that manipulating the location of condoms affects the number taken. Rather than using a bowl, Carrigan and colleagues used a free

condom dispenser. They found that when condoms were available in day room, as opposed to a counselor's office, the number of condoms taken was, on average, nine times higher. These results were achieved without any special advertising as to their availability. Several important insights can be drawn from these studies based on their findings and limitations.

Taken together, the findings from the three aforementioned studies suggest that modifying the cost and ease of access (i.e., little or no delay to acquisition) to condoms increases the likelihood that condoms will be taken by individuals. Although these studies do not address the problem of being able to measure the target behavior (i.e., protected vs. unprotected sex), they do provide a means for increasing condom access; there is also research to suggest that increasing access to condoms by making them freely available does increase condom use, although the authors suggest these effects may be more pronounced in more sexually inexperienced adolescents (Schuster et al., 1998). However, the problem remains that, although these studies measured observable behavior, the behavior observed is a proxy, leaving their findings in some doubt. One way to partially account for this would be to include a follow-up survey to better understand if obtaining condoms had any impact of sexual behavior. These studies were also unable to control for the number of condoms taken by any one individual, making it impossible to know the number of *individuals* who obtained condoms, only the *number taken*—an important distinction. Finally, these studies were all conducted at the height of the AIDS pandemic and were targeted at populations specifically at-risk of contracting AIDS (i.e., gay men and intravenous drug users). While these do not constitute limitations in and of themselves, the populations are specific and may have had increased motivation to engage in safe sex given the risk of contracting a deadly virus. Given the foregoing, I see four questions pertinent to the current study that are left unanswered by the extant research: (1) Does increased

condom availability (i.e., free, easy to access) increase *condom use*? (2) If so, does it do so evenly across populations or are some individuals still unlikely to use a condom even if available? (3) How much do the barriers of cost and ease of access affect likelihood of condom use in isolation? (4) What methods exist that allow for a more accurate measurement of behavior we may not be able to observe?

A Behavioral Economic Approach

This fourth question above is perhaps the most important to answer, as the veracity of our assessments of the other questions depend upon accurate measurement. Fortunately, methods of investigation that permit measure of real (or a close replicate of real) decision making without need to introduce participants to real choice scenarios are available. Methods available using a behavioral economic framework are particularly well-suited to these situations. In short, behavioral economics represents a methodology that exists at the intersection of behavioral philosophy and microeconomics (Reed et al., 2013). Behavioral economists study choice behavior under the constraints of access to a given commodity/behavior/outcome in terms of delay, probability, or cost to/of receipt. Behavioral economists understand behavior to be environmentally influenced and thus seek to understand how environmental constraints impact behavior. Behavioral economics, in other words, "...represents a concrete attempt to apply the science of behavior to understand the data of economics" (Hursh, 2014, p. 275). From this lens, there are two main impediments to the use of condoms: (1) delay in accessing condoms and thus safe sexual intercourse, and (2) their cost. Put simply, behavioral economics represents a unique methodology allowing us to ask and seek answers to all four questions listed above.

Discounting

The trio of constraints examined with behavioral economics—delay, probability, and cost—are studied using two separate methodologies, namely, discounting and operant demand (Reed et al., 2013). Discounting examines the impact of delay and/or the probability of an outcome on behavior and operant demand examines the impact of cost (in terms of effort or money) on behavior. *Delay* discounting refers to those methods aimed at examining the impact of delay alone on behavior. It refers to the rate at which rewards are devalued as a function of that delay. In other words, delay discounting is a way to study one's subjective interpretation of reward value as delay to its receipt escalates (see Madden & Bickel, 2010; Odum, 2011). What research in delay discounting has shown is that not only does reward value decrease as delays increase, but also that this decrease in value is hyperbolic, meaning that rewards lose most of their value after the shortest initial delays, with the decrease in value shallowing out as delays increase—a finding that has clear implications for condom use (Green & Myerson, 1996).

As a consequence of discounting functions taking this shape, not only do humans (and non-human animals) generally prefer immediate rewards over delayed ones, they prefer relatively smaller immediate rewards when compared to a larger delayed reward. For instance, when individuals are presented with the choice between some temporally distant outcome (e.g., a grade on a test) and an immediately available, albeit less ultimately reinforcing outcome (e.g., going to the bar), effort can be allocated toward the smaller sooner reward, even when the delayed outcome is ultimately preferred (see Green, Fristoe, & Myerson, 1994; Kirby & Herrnstein, 1995). This preference for immediate rewards, even when of a lesser order than the delayed reward, has been associated with a host of addictive behaviors—from smoking to drug and alcohol abuse, to gambling, and other realms of addiction and non-addiction (Bickel, Odum, & Madden, 1999; Petry, 2001; Madden, Francisco, Brewer, & Stein, 2011).

Research has examined discounting across species (e.g., Evenden & Ryan, 1996; Rachlin & Green, 1972) using several approaches (e.g., Du, Green, & Myerson, 2002). Most typically, human participants complete decision-making trials in which they are asked to choose between an immediately available reward of relatively small magnitude and a delayed reward of larger magnitude across a series of trials (see Rachlin, Raineri, & Cross, 1991). For example, choices are frequently made between *hypothetical* amounts of money (e.g., \$500 now or \$1000 in a year). The discounting task titrates the smaller immediate reward (SIR) across successive trials in order to arrive at an indifference point (i.e., no preference between smaller and larger reward). This indifference point is a metric used to determine the subjective immediate value that is equal to the larger later reward (LLR).

Importantly, delay discounting also allows for an examination of a phenomenon known as preference reversal (Odum, 2011). This involves a reversal, or switch, in behavioral preference as a function of delay. In practice, this phenomenon is exemplified in the inconsistency between what someone says they want to do (Time A) and the behavior they ultimately engage in when the time comes (Time B). Going back to our above example, a college student may say they plan to get straight A's in a given semester and declare their intention to study for each test in order to do so (initial preference at Time A). However, when the week of the first test rolls around, the same student may decide to go to a bar with friends the night before the test, rather than study (preference at Time B, the point of decision). This phenomenon of preference reversal reveals yet another limitation to the studies conducted by Honnen and Kleinke (1990), Amass and colleagues (1993), and Carrigan and colleagues (1995). That is, these studies measured behavior at Time A and rely on a temporally consistent choice at Time B, but leave the possibility for reversal unexamined.

Delay discounting then, and the phenomenon of preference reversal in particular, have clear implications for sexual decision making. To this end, Johnson and Bruner (2012) developed a hypothetical decision-making task (Sexual Delay Discounting Task [SDDT]) for condom use decisions. This initial proof-of-concept study examined the impact of delay to a condom on the reported likelihood of either engaging in immediate unprotected sex or waiting the delay to engage in protected sex. Researchers collected an array of 60 color photographs of various individuals for use as hypothetical sexual partners in the study. Participants were asked to select from the photographs who they would like to have sex with, based on appearance alone, and to imagine the person as having immediate interest in sexual intercourse, with or without protection. Participants were then prompted to indicate their subjective likelihood of waiting for condom access to engage in safe sexual intercourse at each of a series of increasing delays. Consistent with previous delay discounting studies, results showed a rapid decrease in reported likelihood of safe sex. The research also indicated little effect of hierarchization of partner preference (e.g., most preferred partner vs. least preferred partner).

More recent extensions of this work have shown sexual discounting to be modulated by a host of factors, including age of respondents, intoxication level at time of task completion, and probability of contracting an STI, (Berry et al., 2019; Dariotis & Johnson, 2016; Johnson & Bruner, 2012; Johnson et al., 2016; Sweeney et al., 2020). A recent systematic review of delay and probability sexual discounting found delay to condom receipt to cause systematic decreases in the value of condom-protected sex (Johnson et al., 2020). The authors conclude that, “The reviewed research has provided robust support for the notion that sexual behaviors, including sexual risk behaviors, are highly dependent on delay and probability discounting” (Johnson et al., 2020, p. 23).

Thus, the SDDT allows for an examination of one key aspect of condom-use decisions—the delay individuals are willing to wait to engage in safe sex. The second barrier, the impact of cost of condoms on their use, can be examined via operant demand.

Operant Demand

Operant demand represents a framework by which behavioral economists can study cost as a limiter of engagement with a commodity. On a very basic level, operant demand is an analysis of the relationship between cost and consumption, specifically, operant demand analyzes *how consumption decreases with increases in cost*. This relationship forms what is called a “demand curve”, the analysis of which can reveal much about the persistence of behavior in the face of constraints (Hursh, 2014). Essentially, the greater the costs one is willing to meet (e.g., monetary, energy spent, time waited) to maintain access to a given commodity or behavior, the greater the value the commodity or behavior holds. In prototypical demand assessments, individuals are asked to quantify and report their estimated engagement with a commodity with reference to multiple imposed (typically monetary) costs and under specified environmental constraints. In the range of costs typically far exceed market prices in an effort to observe the cost at which responding is extinguished and the environmental constraints serve to increase experimental control. As the cost of the commodity increases, consumption, eventually, decreases. This demand-based approach allows for an in-depth examination of cost/consumption relationship and offers several quantifiable indices with respect to defense of baseline commodity consumption (i.e., that without cost).

The rate at which consumption decreases relative to initial levels is called “elasticity of demand”. Since consumption is measured as a function of price, when decreases in consumption are exceeded by increases in price (i.e., a one unit increase in price is met with less than one unit

decrease in consumption), the demand curve is relatively flat. This portion of the demand curve, referred to as “inelastic demand”, is characterized by increases in rates of responding (e.g., money spent or effort expended), as a maintenance of baseline levels of consumption necessitates ever-greater responding as costs increase. At a certain point in the demand function, this relationship reverses, and the organism moves from exhibiting inelastic demand to exhibiting “elastic demand”. In the elastic portion of the demand curve, decreases in consumption outpace increases in price (i.e., a one unit increase in price is met with a greater than one unit decrease in consumption), resulting in a steepening of the slope of the curve. This relationship between inelastic and elastic demand represents a continuum of responding, with maximal consumption at no cost on one end and minimal consumption at elevated costs on the other and provides a basis for comparing the value of commodities (i.e., reinforcers). The longer an organism’s responding remains inelastic—the longer they persist in baseline or near-baseline consumption as costs increase—the more valuable the commodity (or reinforcer). The rate at which consumption decreases as a function of increasing cost is referred to as “elasticity of demand” or alpha (represented as α formulaically). Alpha is thus a measure of persistence in consumption as it provides a rate of change across the demand function, with a relatively greater alpha indicating a relatively more rapid decrease in consumption as prices increase. The concept of alpha is also related, and inversely proportional, to the Essential Value (EV) of the commodity or behavior. A commodity with a high EV (more necessary commodities e.g., water or gasoline) will result in greater persistence in consumption, and thus a lower alpha, relative to a commodity with a low EV (less necessary commodities e.g., a bookmark). EV can then, in theory, be used as a metric by which reinforcers can be rank ordered by their importance, or value, to an individual or population (Hursh, 2014). The point of transition from inelastic to elastic demand provides

another valuable metric in demand assessments. The precise point at which the curve shifts from inelastic to elastic demand represents a perfect exchange of price and consumption (i.e., where a one unit increase in price is met with a one unit decrease in consumption) and is quantified by a slope of -1. This is the point of maximum expenditure in time, money, or effort across the entire demand function and is referred to as “Price Max” or “ P_{max} ”. This value represents another way to think about the value of a commodity; a greater P_{max} indicates a generally more inelastic demand curve and thus a higher EV. P_{max} is also a “sweet spot” of sorts, as consumption to the left of this point is relatively steady and characterized by increases in responding, while demand to the right begins to decrease exponentially and is characterized by decreases in responding. Eventually, with significant enough increases in price, responding will be extinguished (i.e., no amount of the commodity is accessed). The price just before this, the last price at which the commodity is acquired in any amount, is called Breakpoint (*BP*). *BP* represents yet another metric by which behavioral economists can assess the value of a reinforcer, as it can be used to compare the response requirements endured to access a commodity with relatively greater *BP* values being generally indicative of more inelastic demand.

This cost-consumption relationship (i.e., operant demand analysis) can be readily applied to a wide range of human-environment interactions, from the relatively quotidian and readily assessed to the less common and more private. One paradigmatic example of persistent behavior in the face of increasing costs (i.e., low elasticity of demand) is the consumption (purchase) of gasoline. The “gas shortage” in the 1970’s saw the price per gallon of gasoline triple from around \$0.33 to over \$1, while consumption only decreased by around 10% (Hursh 2014). Similarly, in a study that exhibits the efficacy of modeling and assessing operant demand using hypothetical purchase tasks (HPT), Reed and colleagues (2014) found that consumption of fuel

was highly resistant to increases in price, with some participants indicating a willingness to purchase fuel at prices exceeding \$15/gallon.

Toward the application to difficult-to-simulate circumstances, operant demand too has been successfully employed via hypothetical operation. The HPT embodies a validated approach for examining the influence of effort expenditure (e.g., monetary cost) on decision making in logistically complicated scenarios, including alcohol consumption (Amlung et al., 2012; Kaplan et al., 2017; Kaplan et al., 2018), marijuana use (Aston & Meshesha, 2020; Naudé et al., 2020), as well as other commodities of abuse including tobacco, heroine, and even pornography (Jacobs & Bickel, 1999; Mulhauser et al., 2018; Reed et al., 2020). Further, efforts to validate the findings of HPTs indicates acceptable reliability (Few et al., 2012; Murphy et al., 2009) and validity (Amlung et al., 2012) of modeled choice. The extant research on operant demand via hypothetical purchase tasks also makes clear the multiple dimensions impacting reinforcer potency (i.e., subjective value), perhaps most notably the environmental constraint of cost. The importance of this contribution is difficult to overstate as it is directly analogous to the real-world barriers people face in acquiring reinforcing commodities. Any basic or translational analysis that hopes to model what decisions will look like when they are occurring in the natural environment must account for these constraints, as operant demand (and delay discounting) does.

As it relates to risky sexual behavior and condom use decisions, there exists a relative dearth of demand literature. In 2016, Jarmolowicz and colleagues (Jarmolowicz et al., 2016) published a study wherein participants first completed a Multiple Stimulus Without Replacement (MSWO) procedure for the selection of hypothetical sexual partners from an array of color photographs and then completed a purchase task; the task asked participants how many sexual encounters they would purchase with their chosen hypothetical partner across a wide-range of

prices (\$1-\$1 Million). Dolan and colleagues (Dolan et al., 2020) utilized a Hotel Room Purchase Task as a proxy for the purchase of actual sexual encounters. Rather than indicating how many sexual encounters they would purchase, the task instructed participants to indicate how many nights in a hotel room they would purchase over a one-month period in order to have sex with a hypothetical partner. The only other published study assessing demand for sex was published by Strickland and colleagues in March of 2020 (Strickland et al., 2020). This task is the most similar to the CoPT utilized in the current study. Participants in this study were instructed to indicate how many condoms they would purchase over a one-month period for use with an “ideal” hypothetical sexual partner.

The above studies each represent novel contributions to the demand and behavioral economic literature, but, crucially, they leave unexamined the question of what participants do *after they hit their BP*. In practical terms, these tasks have not been constructed to examine the choices available to individuals after condoms have become too expensive (e.g., will a given individual become abstinent, engage in unprotected sex, etc.). I created the CoPT (Harsin et al., 2021, in press) to address this question, giving it one key advantage over other demand assessments. What happens after *BP* is one of the most important considerations of research on risky sexual behavior as it has a direct bearing on engagement with sexual risk.

Some evidence exists that rates of discounting (primarily monetary discounting) and levels of demand can be modulated via an Episodic Future Thinking (EFT) manipulation (Daniel et al., 2013; Stein et al., 2016; Sze et al., 2017). EFT involves a guided mental simulation of future events (Atance & O’Neill, 2001). In the delay discounting literature, EFT manipulations generally begin with a guided interview process wherein participants are asked to imagine realistic, autobiographical positive events that could occur at or after some specified delay-

usually delays that correspond to the delays in the subsequent discounting task (e.g., 2 days, one week, one year). Participants then rate the imagined event according to four scales: vividness, enjoyment, importance, and excitement. Finally, participants are asked to create a two-three sentence summary of the imagined event(s), which are then played back to the participant (if audio recorded) or presented to the participant (if written) during each delay discounting trial. The process for applying EFT manipulations to HPTs is similar, with the episodic cues being played back or presented to the participant while completing the HPT (Sze et al., 2017). The control condition for these studies involves a very similar process, but instead of imagining a future event, participants are tasked with imagining an event in their own past (Episodic Recent Thinking; ERT).

One of the purposes of the present study was to expand on previous behavioral economic work examining condom use decisions to better understand the factors influencing decision making that are unexplored in historic approaches (Berry & Johnson, 2018; Collado et al., 2017; Dariotis & Johnson, 2015; Johnson & Bruner, 2012, Strickland et al., 2020). Namely, I sought to further investigate how monetary cost as an economic constraint impacts a given individual's reported likelihood of using a condom (i.e., operant demand for safe sex). Additionally, work by Bickel and colleagues (Bickel, et al., 2017a; Bickel, et al., 2017b; Snider et al., 2020) suggests the phenomena of discounting and operant demand to be intimately interrelated. An additional purpose of the study, then, was to continue previous work I have conducted investigating the relationship between demand for and discounting of condom-protected sex using the Condom Purchase Task (CoPT)- a HPT for condom-protected sex. This initial study was the first to seek to answer the question of what participants would do after reaching their *BP* (i.e., the point at which consumption is extinguished). The sample, however, was somewhat homogenous, leaving

the generality of their conclusions in some doubt. Thus, an additional purpose of the study was to recruit a more diverse, representative sample to better support the generality of any results, including restricting participation to participants who have a history of being sexually active, something not controlled for in the earlier study. A final purpose of the study was to attempt to influence participant responding via an EFT intervention.

I hope to build upon our understanding of the choices participants make when monetary budgets have been tapped and when delays exceed patience by allowing participants to indicate their desire to become either abstinent or unprotected after *BP*. Furthermore, I expect our results to be broadly consistent with those from our initial study, with individuals exhibiting a greater price sensitivity to also exhibit a relatively greater sensitivity to delay and a greater willingness to engage in unprotected sex. Drawing such an understanding would greatly expand upon our current understanding of sexual choice and begin to inform subsequent intervention to reduce negative impacts for those most at risk. Finally, I expect a modest effect from the EFT manipulation; still evident, but of a lesser order than seen in previous studies given the current procedure was created to lessen the demand characteristics typically associated with such interventions.

Methods

Participants

I recruited participants from STI testing clinics at both the Lawrence-Douglas County and Wyandotte County Health Departments in Kansas. These two sites were selected as they represented a location that allowed for collection of a community sample of sexually active participants. The initial sample consisted of 40 participants; a larger sample was desired, but restrictions on recruitment during the COVID-19 pandemic limited the researcher's ability to increase the sample size. Participation was limited to individuals between the ages of 18-30; this

age range includes the young adult population at higher risk of STIs and unwanted pregnancies, while allowing for a larger pool of potential participants. The average age of participants was 22.8 years old ($SD = 3.71$). Participants were fairly diverse: 15 identified as White (37.5%), 14 as African American/Black (35%), six as Hispanic/Latino (15%), one as Asian American (2.5%) and four as “Other/more than one” (10%). Nearly three-quarters of participants (29, 73%) reported making an income under \$30,000 and 85% (34) reported making an income under \$60,000. To incentivize participation, all participants received a \$5 Wal-Mart gift card in exchange for a completed survey.

Procedures

I constructed and completed study materials using Qualtrics, an internet survey-hosting service. All participants completed the survey via a tablet (iPad) and Bluetooth keyboard. Participants first answered a series of demographics-oriented questions and then moved on to the remaining survey measures. The survey took between 15-30 minutes to complete. Data were collected from March 12, 2019 to March 1, 2020. The local Human Research Protection Program (HRPP) approved all described tasks and procedures (IRB #00140397; see **Appendix A** for the complete informed consent form).

Episodic Future Thinking and Recent Thinking Manipulations

Participants were randomly assigned to one of two conditions: (1) the control group or (2) the experimental group. Those assigned to the control group were taken through an ERT procedure and those in the experimental group an EFT procedure. The survey gave participants in the EFT group the following instructions:

Please take a moment to imagine one positive event related to your financial, personal, or

career goals that could realistically happen **in one year**. The event should be one that you can **imagine very clearly** and one that is **positive in nature**. Who are you with? Where are you? How are you feeling? What are you seeing? What are you hearing?

Take the next 30 seconds to think about this event in as much detail as possible as though it were actually happening right now.

After reading these instructions, participants responded to the questions “How important was this event to you?”, “How much enjoyment did this event bring to you?”, “How exciting was this event to you?”, and “How vivid is this event in your mind?” on a five-point Likert scale that ranged from 1 (not at all) to 5 (very much). After completing the scale, participants were required to respond textually to questions designed to draw out details of the imagined event (e.g., whom will you be with, where will you be). Upon answering these questions, participants were asked to incorporate these details into a short paragraph. Both a model example and a poor example were included to give participants a clear idea of what their paragraph should look like. The ERT procedure was exactly the same as the EFT procedure except for the time frame for the events participants were asked to imagine (yesterday for the ERT group and within the next year for the EFT group) and the grammatical alterations to reflect this (see **Appendix B** for screenshots showing this portion of the survey).

Hypothetical Partner Selection

To increase the salience of the SDDT and HPT, participants selected a hypothetical sexual partner from an array of color photographs (See **Appendix C** for instructions and a screenshot of the photograph selection page). These photographs were selected from the Chicago Face Database (CFD), a repository of high-resolution, standardized photographs developed by researchers at the University of Chicago (Ma et al., 2015). The database was created for use in scientific research and includes head shots of male and female faces of individuals from various

racial and ethnic backgrounds between the ages of 17-65 years old. These photographs were also subjectively rated by independent judges across a range of attributes (e.g., attractiveness, trustworthiness), as well as physical attributes (e.g., face size). These ratings were used in the selection of participants for the current study. I downloaded all the images from the CFD and filtered according to the subjective rating for attractiveness. Then, I selected the top 30 most attractive females and males, for a total of 60 photographs. I then reviewed the photographs to ensure that there were at least two photographs of each race/ethnicity for both the male and female faces.

When participants reached this point in the survey, they were given the following instructions (bold-faced words appeared as such in survey instructions):

For the following tasks, we will ask you **hypothetical or pretend questions about your willingness to have sex in various situations**. For the purpose of this task, **please pretend that you are not currently in a committed sexual relationship** if you are. In other words, **please pretend that you are single and available** and that **you are not cheating on anybody** if you indicate you would have sex with somebody in this task.

For each of the following photographs, think about how attractive that person is. **Based on physical appearance alone**, please think about whether each person is someone that you would consider having sex with **in the right environment** and if you **liked the person's personality**. Please select the photograph of the person you would **most like to have sex with**.

There are no "right" or "wrong" responses. Please answer all questions honestly, thoughtfully, and to the best of your understanding, as if you were actually in this situation.

The photograph each participant chose as the individual they would most like to have sex with was then displayed to participants while they completed both the CoPT and SDDT, the order of which was randomized.

Condom Demand Assessment

The CoPT was set up nearly identically to that of the previous study in which I employed it, with a few modifications. The CoPT assesses demand for condom-protected sex by instructing participants to report their willingness to purchase and use condoms across a range of 12 prices from \$1-\$233 (the dollar amounts followed the Fibonacci sequence; see **Appendix D** for a complete list of prices). The CoPT instructs participants that at each price they will have three options: (1) *purchase and use the condoms* for sex with their preferred hypothetical partner, (2) not purchase the condoms and *have unprotected sex* instead, or (3) not purchase the condoms and *give up the opportunity* to have sex. Participants were also told to assume that they were not able to purchase condoms at any other location, that the condoms available were their preferred brand and type, the condoms were for this sexual encounter only, and that they had the same income/savings they do now. I included several questions in the survey after the delivery of these instructions to ensure participants were attending to and understood the instructions. Once participant correctly answered the attending questions, I presented them with the following vignette:

Below is the image of the person you have selected as **most wanting to have sex with**. Please imagine that you and this person have met, are getting along great, and are both interested in having sex right now. Please answer the following questions **with this person and the event you imagined in mind**.

Above the vignette the narrative paragraph created by each participant relating to their imagined future or past event was displayed with instructions to read through it and to keep it in mind while completing the task.

By allowing participants to indicate what they would do after hitting *BP* (i.e., become abstinent or engage in unprotected sex), an additional metric termed breakpoint zero (BP_0) can be

calculated (Roma et al., 2016). Based on participant choice at BP_0 , we are able to split participants into either the abstinent (ABS) group (i.e., those who indicated they would give up the opportunity to have sex after hitting BP) or the unprotected (UNP) group (i.e., those who indicated they would engage in unprotected sex after hitting BP).

The CoPT has one other significant departure from more traditional purchase tasks. Rather than asking participants *how many* or *how much* of a given commodity they would purchase at each price (e.g., Becirevic et al., 2017; Hursh et al., 2016, Strickland et al., 2020) the CoPT simply asks participants whether—that is, simply yes or no—they would purchase the same product at a series of increasing prices, making it more akin to a hypothetical version of a progressive ratio schedule (Hodos, 1961).

Sexual Delay Discounting Task

The SDDT used in this study was nearly identical to and modeled off the original SDDT (Johnson & Bruner, 2012), with the only difference being participants were not instructed that there was zero risk of pregnancy. Participants used a sliding visual analog scale (VAS) to indicate at each of a series of 8 delays ranging from a 0-delay or no delay condition to 6 hours (0, 2 min, 5 min, 15 min, 30 min, 1 hr, 3 hr, 6 hr) how likely they would be to wait the delay in order to have protected sex (See **Appendix E** for a screenshot of the sliding VAS). The VAS ranges from 0-100% and is anchored on the right (100%) by the text, “I will definitely wait _____ [that trial’s delay] to have sex with this person with a condom” and on the left (0%) by the text, “I will definitely have sex with this person now without a condom”.

Similar to the CoPT, the narrative paragraph was displayed above the vignette with instructions to read and to consider while answering the following questions. As with the task itself, the vignette was nearly identical to that of Johnson & Bruner (2012). It read:

Below is the image of the person you said you would most like to have sex with. Imagine you have just met this person. You are getting along great and they are interested in having sex with you now. Please answer the following questions with this person and the event you imagined in mind.

Monetary Choice Questionnaire

Upon completion of the SDDT and CoPT, participants next completed the 27-item monetary choice questionnaire (MCQ; Kirby, 1999). This task presents participants with 27 dichotomous choices between a relatively smaller amount of money available immediately (e.g., \$54 today; **See Appendix F**) or a relatively larger amount of money available after a specified delay (e.g., \$55 117 days from now). Again, as with the SDDT and CoPT, the narrative paragraph was presented with instructions to read and keep in mind while answering. Beneath the narrative paragraph were the following instructions:

For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. While you will not actually receive the rewards, pretend you will actually be receiving the amount you indicate and answer honestly.

The MCQ was a strategic inclusion, rather than one directly related to study aims, which I chose for two reasons. First, the 27-item MCQ is a brief and well-validated method for obtaining rates of monetary discounting (Kaplan et al., 2016; Kirby & Petry, 2004; MacKillop et al., 2011) and so could be completed without significantly increasing the amount of time needed to finish the survey. Second, rates of monetary discounting have proven to be susceptible to EFT manipulations (Snider et al., 2016; Stein et al., 2016; Stein et al., 2017). Since no such research base exists for sexual discounting or condom demand, a lack of experimental effect on CoPT and SDDT results could be evidence of insufficient EFT administration or that sexual behavior is more resistant to EFT manipulations. An effect on the MCQ, or lack thereof, could then supply evidence for either of these possibilities. the 27-item MCQ is a brief and well-validated method

for obtaining rates of monetary discounting (Kaplan et al., 2016; Kirby & Petry, 2004; MacKillop et al., 2011; Naudé et al., 2018)

Community Reinforcement Interview Survey (CRIS)

To better understand the relative abundance of available reinforcement available in each participant's lived environment (e.g., home, neighborhood, etc.), I created a novel reinforcement interview survey, termed the Community Reinforcement Interview Survey (CRIS). The CRIS was modeled after similar surveys used to determine the reinforcing capacity of a participant's environment (Adolescent Reinforcement Survey Schedule; Holmes et al., 1987). The Adolescent Reinforcement Survey Schedule (ARSS) is an 89-item scale, created to provide a comprehensive accounting of activities adolescents may engage in and find reinforcing. An amended version of the ARSS was utilized in a study by Bulow and Meller (1998) that attempted to capture the reinforcing capacity of various sexual behaviors and the idea of motherhood. The CRIS included similar items related to sexual activity (e.g., oral sex, having intercourse, thinking about sex), as well as recreational activities (e.g., hiking, engaging in athletic pursuits, gaming), social activities (e.g., spending time with family) and drug/alcohol use (e.g., taking prescription drugs; see **Appendix G** for a complete listing of all 21 items in the CRIS).

Participants scored each item according to its reinforcing capacities (i.e., "How pleasurable is this behavior?") on a 5-point scale ranging from "unpleasant/neutral" to "extremely pleasant". They also rated each behavior or activity in terms of their frequency of engagement with it (i.e., "How often do you engage in this behavior/activity?") according to a similar 5-point scale ranging from "0 times over the past 30 days" to "more than once per day" (see Appendix X for a screenshot of the complete 5-point scale). Scoring for the CRIS was similar to that employed by Bulow and Meller (1998); in order to be considered a reinforcer, the participant would need to indicate a high degree of derived pleasure from the activity or behavior

(a score of 4 or 5). However, in a departure from the scoring employed by Bulow and Meller (1998), I chose not to incorporate the frequency of engagement as a factor in determining if a particular activity or behavior was considered a reinforcer. In an environment relatively bereft of potential reinforcers (or behaviors/activities one knows to be reinforcing but is prevented from engagement due to environmental constraints), the frequency of engagement may not necessarily correspond to the reinforcing capacity of a given behavior or activity—rather, it may simply be more reinforcing than the alternative(s). In fact, this exact sort of situation was part of the reason for including the CRIS in this study; not only was I hoping to determine whether a relation between frequency of sexual engagement or sexual thoughts and rates of discounting and demand for condom protected sex exist, but also to determine whether the richness of one’s environment had any impact on one’s reported intentions at BP_0 (i.e., if a greater disparity between what is reinforcing and what is available impacts becoming abstinent or unprotected on the CoPT).

Data Analysis

Data Orderliness

All exclusionary criteria were applied listwise and based on data quality and/or suitability for analysis. For the SDDT, I used Johnson and Bickel’s (2008) algorithm for identifying non-systematic data. This algorithm employs two screens for identifying data to exclude: (1) if any indifference point is greater than the preceding indifference point by a magnitude of 20% of the larger later reward (LLR; in the current context, a 100% likelihood of waiting the delay for a condom) and/or (2) if the last indifference point is not less than the first by a magnitude of at least 10% of the LLR (i.e., a magnitude of 10% given the LLR is 100%). Six sets of data violated these criteria (3 violated criteria 1 and 3 violated criteria 2) and were subsequently excluded from all analyses (15%). The exclusionary criterion for the CoPT was answering “yes” to all

prices, as indicating a desire to purchase a condom for \$233 is considered unrealistic and likely an indication that participants are not attending to the task. No participants met this exclusionary criterion.

For the Monetary Choice Questionnaire, participants with consistency scores below 60% were excluded. Previous research indicates that participants with consistency scores below 75% should have their individual-level choices examined closely (Kaplan et al., 2016). Two participants had consistency scores between 60-75%, but their response patterns were not necessarily indicative of non-attending and were retained. After the six participants who met exclusionary criteria for the SDDT were removed, no participants had consistency scores below 60%. An additional two participants (5%) submitted incomplete data sets and were also subsequently excluded from all analyses, leaving 32 participants in the final sample.

Discounting Data Analysis

Prior to analyzing the discounting data outright, I first normalized it by taking each reported value as a proportion of the initial zero-delay condition; that is, for every participant, their reported likelihood of waiting for a condom was divided by their reported likelihood of waiting in the no-delay condition. This is a standard method for analyzing sexual discounting data (Johnson & Bruner, 2012) and serves to isolate the effect of delay, thus allowing for an examination of how delay alone impacts one's willingness to wait a delay to have condom-protected sex. I then split the sample in two ways, first by experimental condition (i.e., ERT or EFT) and second by BP_0 status (UNP or ABS), regardless of experimental condition. I then plotted each of the resulting normalized values and fit these data with a discounting function. Myerson and Green's (1995) hyperboloid discounting equation was fit to all discounting data after determining data fit using Gilroy and colleagues' discounting model selector (2017). Myerson and Green's (1995) hyperboloid discounting equation states:

$$V = \frac{A}{(1+kD)^s} \quad \text{Equation 2}$$

where V is the subjective value of the reinforcer, A is the objective amount of the reinforcer (entered as a 1 given the use of normalized data), D the imposed delay (i.e., time), k is a free parameter describing the overall rate of reinforcer devaluation, and s is a modulating parameter that factors in the nonlinear scaling of amount and/or time (Green & Myerson, 2004).

Participants reported their likelihood of waiting at each delay using a VAS (as described earlier); these reported likelihoods are then used as indifference points. I then calculated area under the curve (AUC) for each set of indifference points using standard methods, (i.e., the ordinal method; as described by Borges et al., 2016). AUC is an index based on the proportion of graphic space between the x-axis and the discounting curve, thus providing an intuitive, quantifiable index for use in comparison of rates of discounting (see Odum, 2011). In most cases, AUC is capped at 1.00 (i.e., 100% of possible area under the curve [as would be seen in a discounting function where delay has no effect on subjective value and would be represented by a straight line]), but because I calculated indifference points as a proportion of reported likelihood of using a condom at no delay, there is potential for indifference points to be greater than 1.0, which would then result in AUC values greater than 1.0 (this would occur when a reported likelihood is greater than the preceding reported likelihood, but was not large enough to meet the exclusionary criteria described above; we observed such instances in only 2 participants).

Operant Demand Data Analysis

Following the analysis of the discounting data, I next examined the demand data from the CoPT at the individual level to identify each participants' BP values (both BP and BP_0). BP —the index typically used in operant demand analyses—was defined as the first price at which

consumption ceased and the participant switched responding to either becoming abstinent or engaging in unprotected sex. Each participant's choice to become either abstinent or unprotected after hitting BP is quantified as their BP_0 .

Using these individual-level data, I analyzed for group differences based on control (ERT) or experimental (EFT) group status. To do this I conducted a Mann-Whitney non-parametric two-sample U -test using the BP dollar-values of each participant. This test served as an initial comparison of the groups based on their demand for condom-protected sex. Next, to analyze for group differences their willingness to engage in unprotected sex, I conducted a second Mann-Whitney non-parametric two-sample U -test using BP_0 values.

After this individual-level analysis, I then analyzed at the "population"-level by examining the percent consumption (i.e., purchase and use of condoms) for based on both experimental and control group status as well as ABS or UNP group status (collapsed across experimental condition). Given the nature of the CoPT, elasticity of condom use served as my primary demand index and was calculated by taking the proportion of each group that would purchase and use a condom at each price. To calculate this index, I used Hursh and Silberberg's (2008) exponential model of demand, which states:

$$\log Q = \log Q_0 + k (e^{-\alpha(Q_0 * C)} - 1) \quad \text{Equation 1}$$

Here Q is percent market consumption of condoms at cost C (price per pack), Q_0 is maximum market consumption at no cost or free (for the present study, Q_0 was a fitted parameter constrained to values between 0 and 1 as I used proportion of consumption as the DV), k is conceptualized as the range of Q in logarithmic units (for the present study, I fixed k at 2 given that our analyses examined the proportion of respondents indicating condom use and no likelihoods below .01 were indicated at high prices (i.e., there was a maximum Q_0 of 1.00 and

minimum consumption at the aggregate level did not sink below .01), and α is the rate of change in elasticity across the demand curve (i.e., rate of change in market proportion consumption/purchasing). I also calculated P_{max} values for both groupings (i.e., experimental condition and BP_0 value). To calculate P_{max} I generated 1000 prices and the corresponding choice likelihoods using Equation 1 to find a slope of exactly -1.0 (Gilroy et al., 2019). This high-resolution method allows for the calculation of the slope between the predicted (i.e., model-derived) likelihood at a given price and the predicted likelihood at the subsequent price. This method is both more transparent and more accurate than calculating P_{max} formulaically (Gelino et al., 2018).

Monetary Choice Questionnaire

I analyzed monetary discounting data from the MCQ using an automated scorer (Kaplan et al., 2014; see Kaplan et al., 2016 for instructions on how to use the scorer). The scorer provides overall k values for each participant as well as consistency scores (a reflection of the proportion of choices that align with a participant's assigned k value). The scorer calculates consistency scores by summing the number of smaller sooner reward (SSR) choices prior to the assigned k value and the number of larger later reward (LLR) choices after the assigned k value and then divides this sum by the total number of possible choices (Kaplan et al., 2016). Once obtained, I natural log transformed overall k values to better approximate a Gaussian, or normal, distribution (Kirby et al., 1999). I then again grouped participants by experimental condition and conducted another round of Mann-Whitney non-parametric two-sample U -test to examine for group differences. I repeated the t-tests based on BP_0 status, without regard for experimental condition.

Community Reinforcement Interview Survey

I analyzed responses to the CRIS in a number of ways, the first two being consistent with that of Bulow and Meller (1998). First, as I mentioned above, any behavior or activity that received a rating of a 4 (pleasant) or 5 (extremely pleasant) was counted as a “reinforcer”. Each participant received a score of 1 for every reinforcer; total reinforcement scores were then calculated by simply summing these scores. I then calculated sexual reinforcement scores ($R_{\text{contingent}}$) by adding up the scores for questions related to sex or sexual activity and extraneous reinforcement scores ($R_{\text{extraneous}}$) by summing the scores for each of the remaining questions.

In a departure from the scoring of Bulow and Meller (1998), I adapted the $R_{\text{contingent}}$ scoring to further isolate the reinforcing capacity and frequency of sexual thoughts. I did this in keeping with the logic I described above relating to the frequency of a behavior not necessarily being linked to the subjective reinforcing capacities of that behavior due to environmental constraints or realities; that is, sexual intercourse is an activity between two or more people that requires not only another party, but a consenting other party. Given that one’s ability to find a consenting party(ies) has no direct bearing on how reinforcing one finds sexual intercourse, I decided to isolate the frequency and reinforcing capacity of sexual thoughts as no such constraints exist. I coded responses and grouped participants as either a 1 (yes) or 0 (no) for each the reinforcing capacity and frequency of sexual thoughts. Those who rated the reinforcing capacity of sexual thoughts with a 4 or 5 were coded as 1’s and those who rated sexual thoughts with a 3 or lower were coded as 0’s. Similarly, those who rated the frequency of sexual thoughts as either a 3 (most days), 4 (every day), or 5 (more than once per day) were coded as 1’s, with all others coded as 0’s. Upon grouping participants in this fashion, I again analyzed their SDDT, CoPT, and MCQ data.

General Statistical Comparisons

To further analyze for an experimental effect and to assess for any confounds or group differences not reducible to experimental condition, I conducted a series Mann-Whitney non-parametric two-sample *U*-test in addition to those already described. And as a final effort to detect the existence of experimental effect I analyzed the AUC and *k* values using SDDT data based on EFT/ERT group status.

To rule out the possibility of pre-existing group differences confounding the experimental manipulation, I conducted several more t-tests using CRIS data as responding here was likely to be unaffected by any EFT manipulation; one based on total reinforcement score, one isolating only the $R_{\text{contingent}}$ score, one isolating only the $R_{\text{extraneous}}$ score, and one based on the frequency of sexual thoughts (absent from this list is a t-test based on the reinforcing capacity of sexual thoughts, all but two participants rated these as reinforcing rendering any formal analysis unnecessary).

I also conducted several correlation analyses (Pearson's *r*) to examine the relationship between the discounting, demand, and reinforcer assessments. Specifically, I conducted correlation analyses for AUC and MCQ *k* values, AUC and *BP*, MCQ *k* values and *BP*, and *BP* and income.

Results

Results showed no significant effects of the EFT manipulation across the SDDT, CoPT, and MCQ. The Mann-Whitney *U*-tests revealed no significant differences between groups in terms of AUC ($p = .219$), log-transformed *k* values from the SDDT ($p = .441$), *BP* ($p = .921$), BP_0 ($p = .472$), nor the natural log-transformed *k* values from the MCQ ($p = .259$). The decision to either become abstinent or unprotected after hitting *BP*, perhaps the main thrust of the EFT intervention, was also similar across groups; 10 of the 17 participants in the experimental

condition (59%) became UNP and 10 of the 15 participants in the control condition (67%) became UNP.

I next conducted a series of Mann-Whitney *U*-tests using CRIS scores (total available, contingent, and extraneous reinforcement), age, gender, and income to test for any confounds in group composition. No significant differences were found. Overall reinforcement ($p = .541$), $R_{\text{contingent}}$ ($p = .175$), $R_{\text{extraneous}}$ ($p = .541$), and frequency of sexual thoughts ($p = .144$) were found to be similar across groups. Additionally, no significant differences between groups were found for age ($p = .415$), gender ($p = .720$), or income ($p > .999$). See Table 2 for a complete listing of the results for all Mann-Whitney *U*-tests.

Given the lack of any significant effects from the EFT intervention and the lack of any significant differences between groups based on other scales and demographic variables, I collapsed data across EFT/ERT group status for all remaining analyses.

Although no differences were found when participants were split based upon experimental condition, differences did become apparent when participants were grouped in other ways. When grouped by BP_0 status, differences in rates of discounting and levels of demand can be seen between the UNP ($n = 20$) and ABS ($n = 12$) groups by using simple visual inspection. Depicted in Figure 2 are the indifference points (normalized as a proportion of each group's reported likelihood of using a condom in the no-delay condition). In Figure 3 are the demand data grouped by BP_0 status, which shows the proportion of each group's participants purchasing and using the condom at each price. Data in both graphs show a monotonic decrease, indicating largely systematic data that conform with what is expected.

To supplement visual inspection, I applied an Akaike Information Criterion (AIC) analysis; this test describes the probability that that UNP and ABS group curves differ and shows

a greater than 78.4% chance the two curves are independent. The rate of change in elasticity across the demand function (α) also differs between the groups with a greater rate of change (i.e., less persistence in purchasing of condoms) for the UNP group (.044) than the ABS group (.025). Another way of examining for differences in demand is to compare P_{max} values; here again we see differences between groups with the ABS group exhibiting a P_{max} of \$7.42 and the UNP group of \$11.96. Additionally, a Mann-Whitney two-sample U -test revealed these two groups to significantly differ in terms of their BP ($U = 63.5$, UNP $n = 20$, ABS $n = 12$, $p = .026$).

No significant differences were found between the ABS and UNP groups based on AUC (Mann-Whitney $U = 94.5$, $p = .331$, two-tailed), but given the shape of the curves (ABS group initially discounting more steeply at early delays and UNP group discounting more steeply at longer delays), this is unsurprising. These findings are broadly consistent with that of Harsin and colleagues (2021, in press).

I also split participants by the frequency of sexual thoughts, which revealed clear differences in rates of sexual discounting observable using visual inspection. Figure 4 depicts the sexual discounting data for participants who engage in frequent sexual thoughts (FREQ; $n = 12$) and those who engage in less frequent sexual thoughts (INFREQ; $n = 20$), with those engaging in more frequent sexual thoughts displaying a greater degree of discounting (i.e., less willingness to wait for a condom). Differences between groups in terms of demand for condom-protected sex are less clear; an AIC analysis revealed these groups to have a 69% chance of sharing a single curve, but the rate of change across the demand function as represented by α shows the FREQ group exhibiting less persistent purchasing ($\alpha = .34$) than the INFREQ group ($\alpha = .24$) based upon frequency of sexual thoughts, with those reporting less frequent sexual thoughts displaying relatively greater levels of demand (see Figure 3). Examining P_{max} values reveals a

difference of several dollars between the *FREQ* ($P_{max} = \$7.83$) and *INFREQ* ($P_{max} = \10.16) groups (values quite similar to the *ABS* and *UNP* groups).

Correlation analyses were less dynamic. No significant correlations were found between *AUC* and $\ln k$ *MCQ* values, *AUC* and *BP*, *BP* and $\ln k$ *MCQ* values. See Figure 6 for the scatter-dot plots based on these correlation analyses. The lack of significant correlations between monetary and sexual discounting has been reported elsewhere in the literature (Johnson et al., 2015) and the small sample size is also likely a factor here.

Discussion

Rates of STIs are at all-time highs in the United States (Centers for Disease Control, 2019) and the numbers of unwanted pregnancies far outpace those in other similarly developed nations (Guttmacher, 2019). Our government continues to fund and our schools continue to teach *AOUM* programs, which have been found to be scientifically unsupported, in violation of adolescents' rights, and harmful towards *LGBTQI+* youth (Santelli et al., 2017). These trends suggest alternative methods of education and new policies must be employed if progress in ameliorating these negative outcomes is to be made. If empirically based, these new programs and policies increase their chances of success. The main purposes of this study were to engage in the first step of empirical foundation building, to showcase the potential for contributions from the field of behavioral economics in that effort, to situate this research within a socio-ecological philosophy (e.g., individual, interpersonal, community, institutional, and sociological/political influences on sexual decision-making) and to attempt to intervene on risk engagement through a temporal framing exercise.

Behavioral economics offers researchers an ethical and validated approach to studying risky sexual behavior. Although participants are engaging with hypothetical scenarios, previous

research has shown a high say-do correspondence between responses on the CoPT and SDDT and past sexual behavior (Harsin et al., 2021, in press). This study was an initial effort in extending previous translational behavioral economic research investigating risky sexual behavior to a novel, community-based participant pool. To date, I am aware of no other studies that have investigated demand for and discounting of condom-protected sex with such a sample and, although recruitment and ultimately the final sample size were limited due to the COVID-19 pandemic, the study produced several novel results that contribute to the existing literature as well as some findings that merit further investigation.

Both the CoPT and SDDT produced systematic data on par with other studies utilizing HPTs to measure operant demand (e.g., Aston et al., 2015; Harsin 2021 et al., in press; Murphy & MacKillop, 2006; Reed et al., 2016) and the SDDT to measure sexual discounting (e.g., Johnson & Bruner, 2012; Johnson et al., 2015; Johnson et al., 2016). The majority of this previous research employing behavioral economic methods to study risk sex have engaged college students, Amazon's Mechanical Turk (mTurk) workers—an internet-based crowd-sourcing survey platform wherein participants are paid a nominal fee in exchange for completed surveys (e.g., Mellis & Bickel, 2020; Strickland & Stoops, 2019)—or clinical samples (e.g., populations with a drug dependency) as participants. What is common to each of these populations is that they are all frequently targeted in scientific research. Results from studies employing participants recruited from mTurk, for example, have shown these participants to be capable of producing highly systematic discounting and demand data. One concern about the use of these participants, however, is their extensive history of completing surveys. Some mTurk studies require potential participants to meet certain criteria, including completing a specified number of human intelligence tasks (HITs; e.g., 1000) and to have an approval rating above 90%

(e.g., Henley et al., 2016, Roma et al., 2016). Use of these criteria help to ensure that researchers' limited funds are not wasted and provide a high proportion of usable survey responses. One question raised by use of such proficient responders is that they may be more attenuated to demand characteristics and thus better able to respond "correctly" (similar arguments can be made when recruiting college students and/or clinical samples). An advantage of behavioral economic assessments in the form of HPTs and discounting assays is there are no "right" or "wrong" responses which guards against results being tainted from participants "gaming" the survey. There does exist a certain logic to these assessments, however, and whether similarly systematic data can be generated from more novice responders was a point of inquiry. The R^2 values (a measure of the how well the discounting and demand equations fit the data and often used as a method of determining how systematic data are) in the present study consistently being above .95 for both the SDDT and CoPT data supply some evidence that community samples can also produce highly systematic discounting and demand data. The relatively low number of participant exclusions based on non-systematic data is further evidence of this. Only six data sets in total (15%) were removed based upon exclusionary criteria; in a previous study I conducted employing the CoPT and SDDT with students recruited from an introductory college course required, twice the proportion of data sets (30%) met exclusionary criteria (Harsin et al., 2021, in press). Achieving such systematic results with a novel participant pool suggests these methods may have utility in more applied research.

Service as further evidence of the data quality supplied by participants is the high degree of consistency in choices they displayed on the MCQ (Mean = 93.3%). As with the CoPT and SDDT, there are no "correct" responses with the MCQ, but again as with the CoPT and SDDT, a method of parsing out non-systematic responding exists, here in the form of consistency scores.

Consistency scores are calculated by analyzing response patterns both before and after participants switch from choosing the SSR to the LLR (Kaplan et al., 2016). Put simply, this score reflects the consistency of participant choices between SSR and LLR and indicates attending to the task and thus the provision of legitimate responses. A high consistency score can be reflective of a significant preference for either immediate or delayed money, so long as the participant is consistent in that preference throughout the questionnaire. The MCQ was the second-to-last assessment completed by all participants, potentially indicating participants were attending to tasks throughout the survey.

The overall quality of the data raises questions as to why participants in the experimental group showed no clear effects of the EFT manipulation—I found no significant effects of the manipulation across all three behavioral economic measures. The lack of effect is discouraging, but I do have several hypotheses as to why the intervention was ineffective. One possibility is that sexual discounting and demand may simply not be amenable to such an intervention or that a stronger “dose” is necessary to see any effect. This possibility does leave the question as to why monetary discounting—a form of discounting that does seem malleable given an EFT intervention (Stein et al., 2016; Stein et al., 2017; Stein et al., 2018; Sze et al., 2017)—was not affected. If sexual discounting and demand are more resistant to effects of temporal framing, there are two possible reasons for the lack of effect on the MCQ, both of which have bearing on the potential effectiveness of EFT interventions on sexual discounting and demand. One is that completion of the MCQ was too far removed from the intervention. Although the narrative paragraph created by participants was displayed on screen and was paired with instructions to read it and bear it in mind while completing each assessment, the effects of the manipulation may be more pronounced immediately after the initial imagining of the event and lose potency

with time. If this is the case, and effects would have been apparent had the MCQ been nearer the initial manipulation, then it would indicate that sexual discounting and demand are less malleable than monetary discounting as they showed no effects even though they were completed immediately after the manipulation. Evidence does exist that sexual discounting is malleable; a systematic review by Johnson and colleagues (2020) found number of studies that show sexual delay discounting to increase when participants are in an altered state due to administration of drugs or alcohol (e.g., cocaine, alcohol; Johnson et al., 2020). This review also found sexual and monetary discounting to be only marginally correlated, which could suggest that an intervention effective in manipulating monetary discounting (i.e., EFT) may have no such effect on sexual discounting. At any rate, future research should investigate if a greater “dose” of an EFT intervention would be sufficient to manipulate levels of sexual discounting and demand.

A second possibility is that the EFT manipulation was insufficiently administered. Where it has been successful, the administration has been slightly more involved than in the present study. For example, work by Stein and colleagues (Stein et al., 2016; Stein et al., 2018; Sze et al., 2017) found EFT manipulations to be effective in reducing monetary discounting when participants generated three future events that were roughly matched to the delays in the discounting assessment (e.g., 1 month, 2-3 months, 4-6 months) and research by Daniel and Epstein (2013) found significant effects when participants generated seven future events. A study by Stein and colleagues (2017) lends further evidence for this possibility, they found significant effects when participants generated three future events, but, when participants generated only a single event like in the current study, the effects disappeared. Each of these studies also anchored the temporal distance of imagined events to the delays used in the discounting assessments. For the present study, I chose to use a single imagined event given time constraints—participants had

just completed a medical appointment and to increase their likelihood of agreeing to participate, I strove to make the survey as short as possible—and did not anchor the event to any delays because the delays in the SDDT and MCQ are quite disparate (the longest delay in the SDDT is only 6 hours whereas it is 186 days in the MCQ). At any rate, the foregoing evidence may help to explain the lack of effect here when using only a single positive future event. These possibilities should be investigated in future research as they have bearing on the potential effectiveness of any large-scale application of EFT as a clinical intervention.

After ensuring no significant effects from the intervention, I collapsed all data and re-grouped participants in two ways: (1) by UNP or ABS status as determined by the CoPT and (2) by the frequency of sexual thoughts as determined by the CRIS. In a prior study I conducted with college students in which I employed the CoPT and SDDT (Harsin et al., 2021, in press), I found significant differences in both demand for and discounting of condom-protected sex when splitting participants into UNP and ABS groups. Results from that study showed participants in the UNP group to have both decreased levels of demand and higher rates of discounting than those in the ABS group. That is, participants in the UNP group were exhibiting a risky sexual behavior in that they showed less persistence in purchasing condoms as prices increased (i.e., greater elasticity indicating less demand) *and* less willingness to wait for a condom to engage in protected sex (i.e., greater discounting) than participants in the ABS group. They indicated, in other words, that they would engage in unprotected sex if either monetary cost or delay became a barrier. Given the relative homogeneity of that sample (77% White, 80% female), the diversity in the current sample represents an opportunity to assess the generality of the earlier results with a more representative sample. As for grouping participants by the frequency of their sexual

thoughts, no study to date has examined whether the frequency of sexual thoughts has any impact on sexual discounting or demand.

In an interesting reversal from the previous study, the UNP group in the present study exhibited greater levels of demand for condom-protected sex relative to the ABS group. The UNP group had higher rates of condom purchase even at low prices (e.g., \$1), exhibited greater persistence in purchasing as evidenced by alpha being nearly double that of the ABS group (i.e., less elasticity), had a higher P_{\max} (\$11.95 vs. \$7.42), and exhibited significantly greater BP values ($U = 63.5$, UNP $n = 20$, ABS $n = 12$, $p = .026$). Additionally, the AIC analysis I conducted revealed the demand from these two groups to be better fit by two separate curves, rather than one, indicating a significant difference between them. These results strongly suggest that one's willingness to engage in unprotected sex impacts their demand for condoms.

Given the strength of the results from the previous study, that these two groups would significantly differ is somewhat unsurprising, what was unexpected though, was that greater demand would be exhibited by the UNP group, rather than the ABS group. In the same way that the UNP group exhibited increased levels of demand across all indices in this study, the ABS group exhibited increased levels of demand across indices in the previous study (Harsin et al., 2021, in press). Since the CoPT does not assess demand for sex per se, but rather demand for condom-protected sex, caution should be employed when speculating about the differences in demand for sex between the two groups. However, this pattern of responding seems to suggest that the UNP group likely has a greater EV for sex than does the ABS group. That is, their willingness to engage in unprotected sex, despite the increased risk of moving from protected to unprotected at $BP0$, may indicate a greater EV for sex in general, not just condom-protected sex. Continuing with this logic, the ABS group, despite their relatively lower levels of demand, were

displaying a somewhat risk-averse pattern of responding. This group was willing to purchase and use condoms at lower prices, but when condoms neared market value (roughly \$4-\$5), participants were more willing to become abstinent.

Continuing the divergence in results from the previous study, the UNP and ABS groups differed in their rates of sexual discounting in an unexpected fashion. At relatively short delays (under 1 hr), the UNP group exhibited shallower discounting (i.e., more willingness to wait for a condom) than the ABS group. Then, at the 1 hr delay, the curves cross each other, and at all subsequent delays the UNP group exhibited steeper discounting. This result seems to be in accordance with results from the CoPT data in that the UNP group was willing to engage in safe sex to a point, before becoming more likely to engage in unprotected sex. If we take their decision to become abstinent on the CoPT as an indication that the ABS group would instead become abstinent at low reported likelihoods on the SDDT, then the ABS group is again displaying a relatively safe pattern of responding; they are willing to use a condom when available readily but will forgo the opportunity when delays become a barrier.

One plausible reason for the reversal relative to the previous study lies in the experimental setting used in the present study. Participants completed the survey—one asking them about risky sexual behavior—immediately following an appointment with a health professional, the topic of which was their sexual health. The temporal proximity of the assessment to the appointment could very well have impacted the responding of both groups towards safer levels of responding. For those who sex has a high EV and are willing to engage in unprotected sex, the appointment may have increased their demand and decreased their discounting, a safer pattern of responding. And for those who sex has a lower EV and are not willing to engage in unprotected sex, the appointment may have decreased their demand and

increased their discounting, also a safer pattern of responding. More research is needed to draw any firm conclusions, but a health appointment—or the reasons for making the health appointment in the first place—functioning as an intervention could have implications for sexual education programs.

As a final comparison between the current and prior study I plotted the demand data from each in the same graph. Since overall levels of demand in the current study seemed to be lower than that of the previous study, I plotted the combined data from the current study against that of the ABS group from the prior study (See Figure 7). The data points from both studies are nearly indistinguishable at lower prices and remain similar across all prices assessed. Alpha and P_{max} , are also nearly identical and an AIC analysis indicates there is a 98.6% chance these data are best represented with a single curve (i.e., the combined participants in the current study exhibited nearly identical demand as the UNP group from the previous study). The result of this comparison underscores the value of the BP_0 component of the CoPT. Absent the ability to split participants by their willingness to engage in unprotected sex, if these data were gathered using a task without this feature, the conclusion from such a comparison would be that these two groups have similar demand and thus similar levels of risk of negative outcomes. Because we are able to understand what participants will do after BP however, the CoPT allows for a higher resolution analysis that reveals very different behavior. Such an analysis could be invaluable in assessing the effectiveness of a sexual education program. Demand could appear the same both before and after completion of a program, indicating a lack of effect, but if BP_0 shows differences, the program could then be seen as quite effective.

I also compared participants by the frequency of their sexual thoughts. When split this way we again see good model fits as well as differences between groups. Those engaging in

frequent sexual thoughts (FREQ) exhibit both steeper discounting and lower levels of demand for condom-protected sex than those who engage in less frequent sexual thoughts (INFREQ). Visual inspection of the discounting data shows clear differences between the groups; the FREQ group exhibits steeper discounting across all delays and the R^2 values for both curves are above .98 (see Figure 4). Though still apparent using visual inspection, the differences in demand data between groups are less clear and not statistically significant (see Figure 5). However, the respective P_{max} and alpha values for these groups show some disparity that, though not statistically significant, may indeed be clinically significant (e.g., the difference of a few dollars in P_{max} could be the difference between purchase and subsequent safe sex or unprotected sex). This is the first study to examine sexual discounting and demand by the frequency of sexual thoughts and the results seem to merit further research which could investigate the utility of splitting participants in this fashion with a larger sample size.

This study also carries with it a number of limitations. Two novel assessments were employed in the present study and, although both the CoPT and CRIS are modeled after assessments used in the literature, their validity and reliability remain unknown. A second limitation lies in the uncertainty regarding the intervention's ineffectiveness; it may be that more than a single imagined future event is necessary, that the temporal distance of any imagined events must be more clearly anchored to the assessments, that sexual discounting and demand are less impacted by EFT interventions, or some combination of the three. Another limitation concerns the lack of within subject comparisons. Such comparisons may have shed more light on intervention (in) effectiveness and would have been informative as to the test-retest reliability of the SDDT and CoPT in such a sample. Fourth, the discounting and demand assessments were all hypothetical in nature. Although evidence exists concerning the correspondence between real

and hypothetical rewards in both discounting (e.g., Johnson & Bickel, 2002; Lagorio & Madden, 2005; Madden et al., 2003; Madden et al., 2004) and demand assessments (e.g., Amlung et al., 2012; Amlung et al., 2015; Wilson et al., 2016) no such direct correspondence is possible in an ethical study of risky sexual behavior. Moreover, given the potency of the reinforcer, there exists the possibility of preference reversal between a hypothetical assessment (Time A) and an actual sexual encounter (Time B). However, Harsin and colleagues (2021, in press) did find a significant correlation between BP_0 status and the number of reported unprotected sexual encounters and number of sexual partners over the previous three months. Future research should include such comparisons to further investigate CoPT and SDDT validity. Fifth, the language of the survey materials was not examined for readability for a general, community-based audience. Materials were largely adapted from those used in prior SDT, EFT, and CoPT studies (Harsin et al., 2021; Johnson & Bruner, 2012; Stein et al., 2016) and were kept consistent with those materials so as to not add potential confounds to the current study. However, the possibility remains that some responses were affected if participants were not able to read and understand task instructions. One means of controlling for this possibility was the inclusion of attending questions that prevent the completion of survey tasks before answering basic questions about task instructions. Regardless, this remains an area for future research and should be investigated further. A sixth and final limitation of the present study is the small sample size which limits statistical power. I recruited participants for nearly 12 full months before being required to halt recruitment due to the COVID-19 pandemic and in this time, I was only able to recruit 40 participants, a very slow rate of recruitment. There are some reasons for this that can inform future such research efforts in community settings. The setting, while convenient and providing a reliable method for ensuring recruitment of participants with a sexual history, also had

drawbacks. Namely, participants had just completed an appointment that they likely had to take off work or find a sitter to attend. Staying an extra 15 or 20 minutes after their appointment to complete the survey was simply too inconvenient for some participants. I was also, given other demands, only able to recruit participants a couple of days a week. To guard against this, future research in community settings could recruit from a higher traffic area or, if possible, work with a research team that can supply a researcher at the site during all hours of operation.

Risky sexual behavior is impacted by every level of the SEM, from individual attitudes towards safe sex to public policy that can create or eliminate barriers to acquiring reliable birth control. To have a hope at curbing the trends in STI and unwanted pregnancy rates, interventions at every, or at least multiple, levels of the SEM may be necessary. I see two such interventions that can potentially be informed by this line of study. First, behavioral economic investigations into risky sexual behavior can inform public policy regarding the potential effectiveness of interventions designed to reduce barriers to reliable methods of birth control and STI prevention. The results from this study clearly show that both cost and delays in access to a condom severely impact one's intention to practice safe sex. While this may seem to be an obvious point, behavioral economic methods such as the CoPT and SDDT can help to answer the questions of (a) how much cost is too much and (b) how long of a delay is too long. The results from this study (as well as the previous study mentioned) indicate that any amount of cost and even slight delays are enough to impact condom use, thus providing support for policies that make birth control freely and readily available. The results also show that freely and immediately available condoms alone are not a silver bullet; participants still indicated a willingness to engage in unprotected sex even in these conditions, supporting the conclusion that interventions at multiple levels of the SEM are necessary. Second, this line of research can inform sex education programs

or other interventions (e.g., EFT); assessing sexual discounting and demand before and after program completion could provide a critical means of feedback regarding program effectiveness. Before that happens, more research must be done.

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Table 1*Participant Demographic Characteristics*

Demographic	n
Gender	
Male	11
Female	20
Nonbinary/Third Gender	1
Sexual Orientation	
Straight/Heterosexual	26
Gay or Lesbian	2
Bisexual	4
Reported Annual Income	
Rather Not Say	3
Under \$30,000	25
\$30,000-\$59,000	3
\$60,000-\$89,000	1
Race/Ethnicity	
Asian	1
African American/Black	13
Hispanic/Latino	2
Other/More than one	4
White	12
Age	
Mean	22.71
Median	22

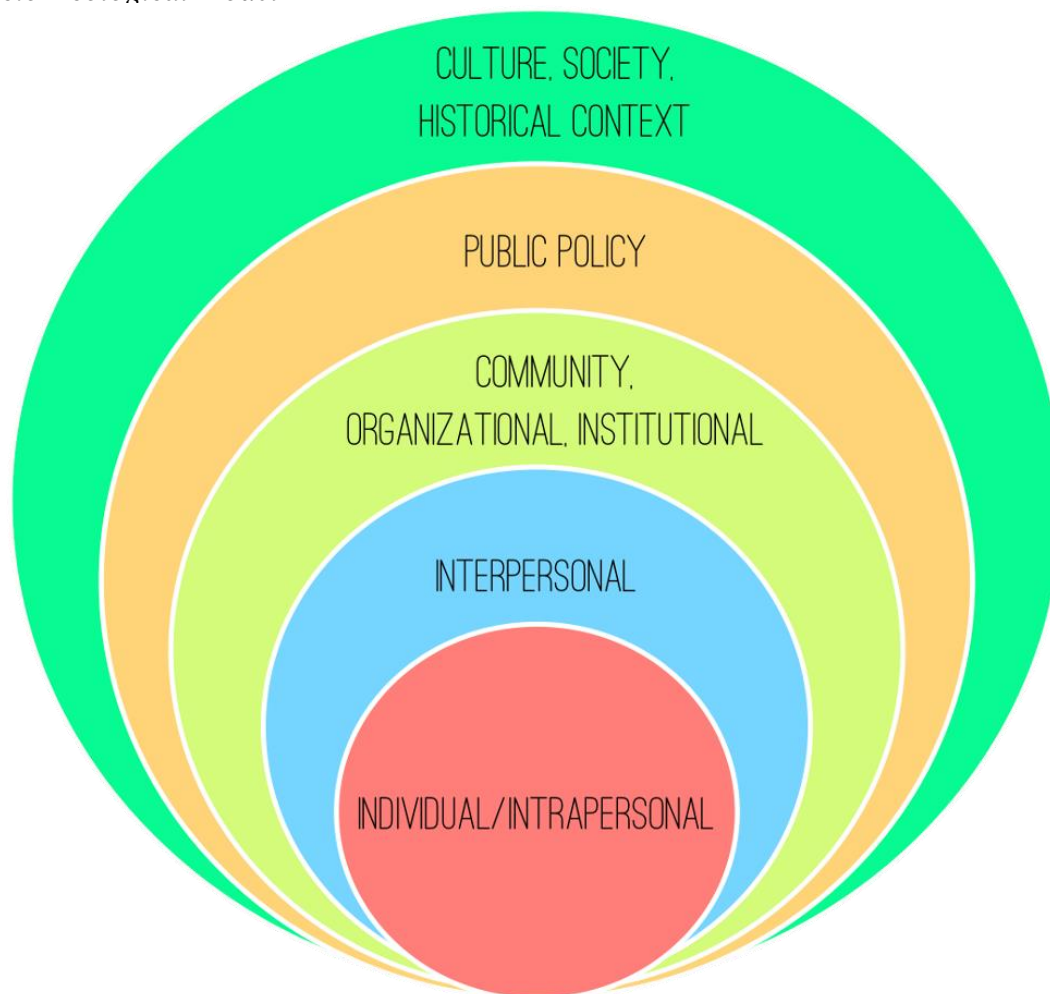
Table 2*Mann-Whitney U-test Results from EFT/ERT Comparison*

	EFT		ERT		<i>U</i>	<i>p</i>
	Median	<i>n</i>	Median	<i>n</i>		
Area Under the Curve	0.63	17	0.80	15	94.5	0.22
SDDT ln <i>k</i>	-1.45	16	-1.85	14	93	0.44
<i>BP</i>	8	17	8	15	124.5	0.92
<i>BP</i> ₀	1	17	1	15	109	0.47
MCQ ln <i>k</i>	-2.75	17	-3.19	15	97.5	0.26
CRIS	7	17	6	15	111.5	0.54
<i>R</i> _{contingent}	1	17	1	15	92	0.178
<i>R</i> _{extraneous}	6	17	5	15	111.5	0.54
Frequency of Sexual Thoughts	0	17	1	15	89.5	0.14
Age	21	17	22	15	105.5	0.42
Gender	0	16	0	15	109.5	0.72
Income	1	14	1	15	105	>.999

The significance level is 0.05 (two-tailed)

Figure 1

The Socio-Ecological Model



Note. This figure represents a version of the Socio-Ecological Model with five levels, or spheres, of influence. Other iterations of this model may only display or include four levels.

Figure 2
Sexual Discounting Plot for ABS and UNP Grouping

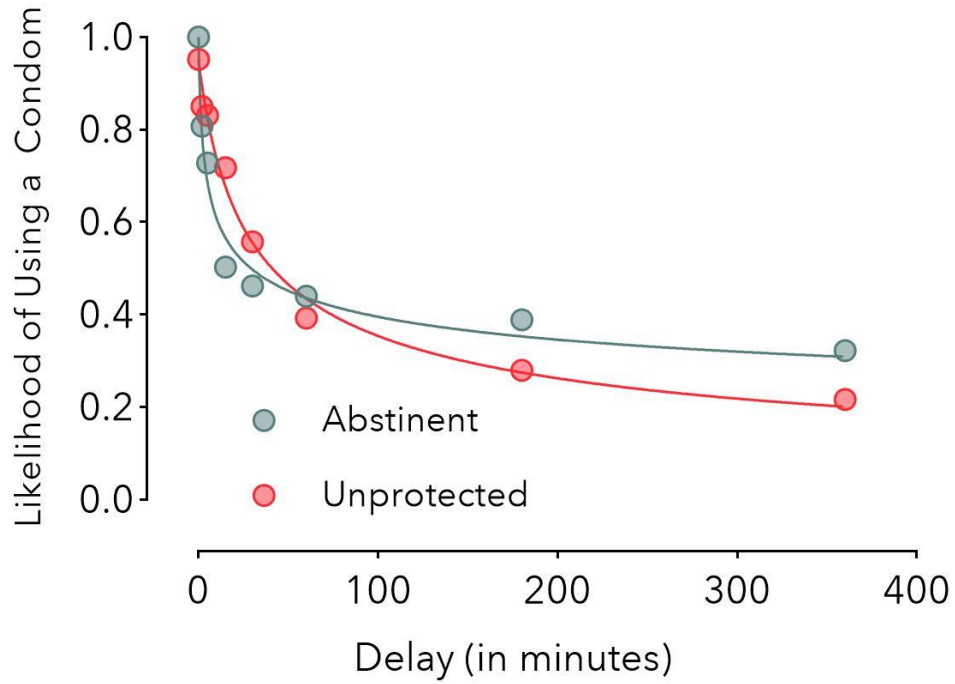
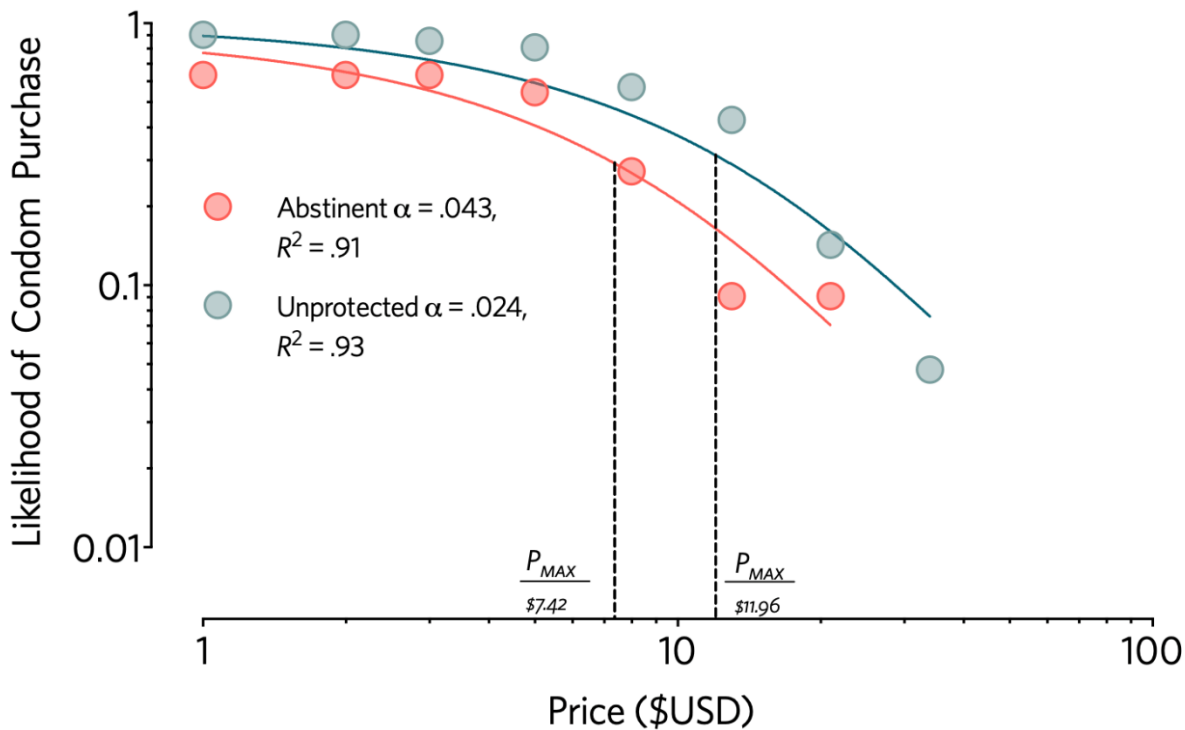


Figure 3
Demand Curves by ABS and UNP Grouping



Note. Demand curves depicted by continuous best-fit lines. Vertical dashed lines depict P_{max} .

Figure 4

Sexual Discounting Plot for FREQ and INFREQ Grouping

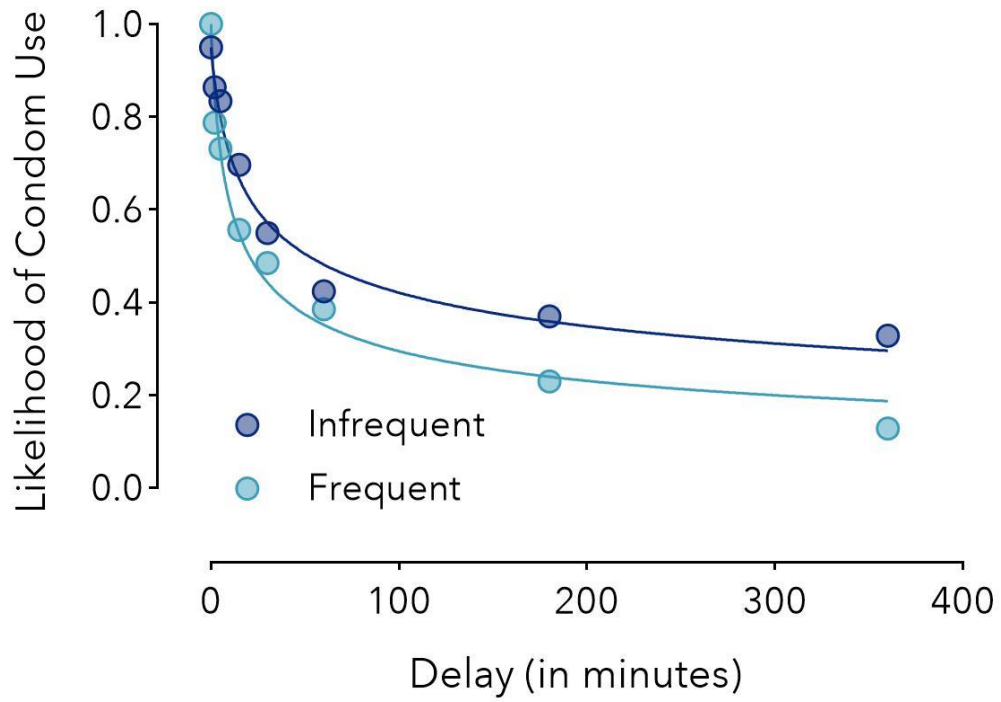
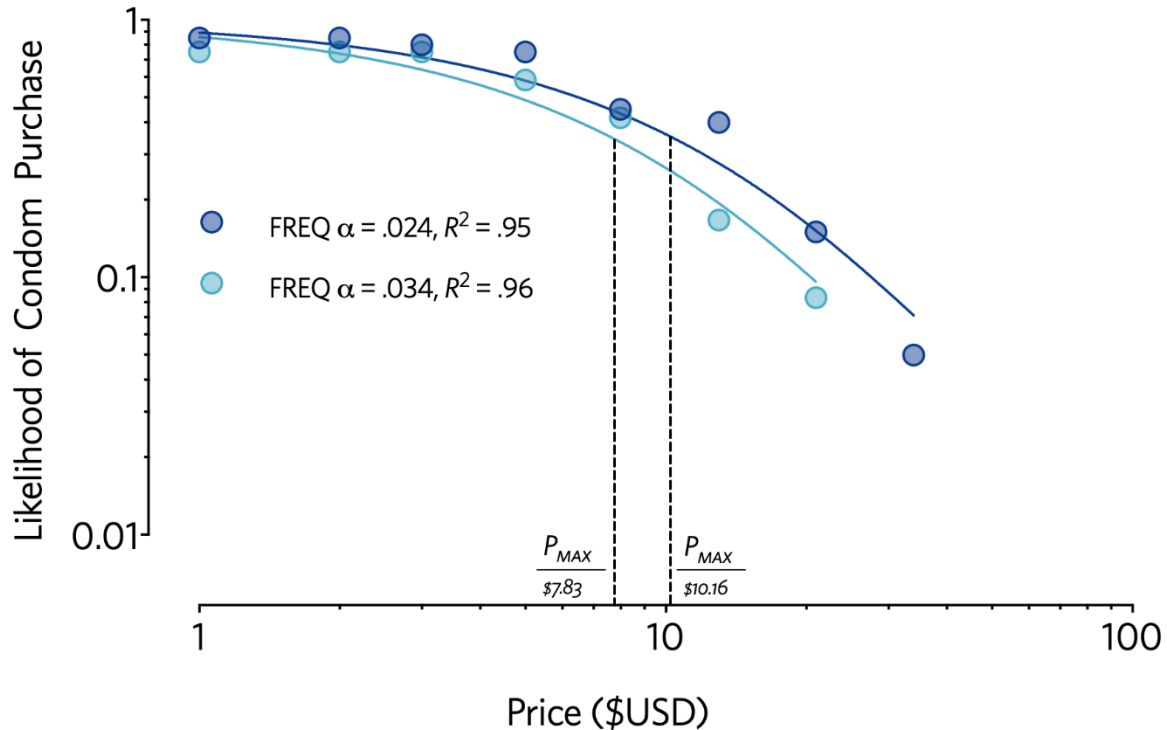


Figure 5

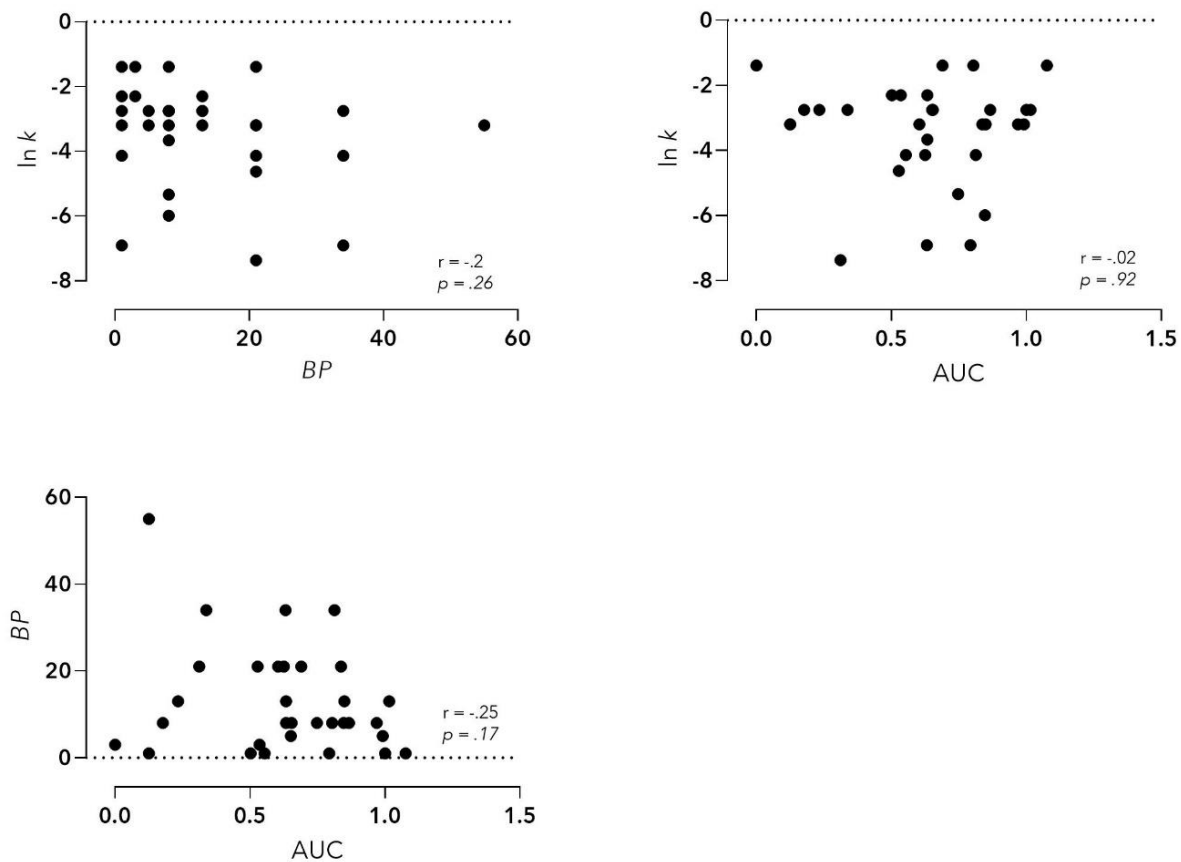
Demand Curves by FREQ and INFREQ Grouping



Note. Demand curves depicted by continuous best-fit lines. Vertical dashed lines depict P_{max} .

Figure 6

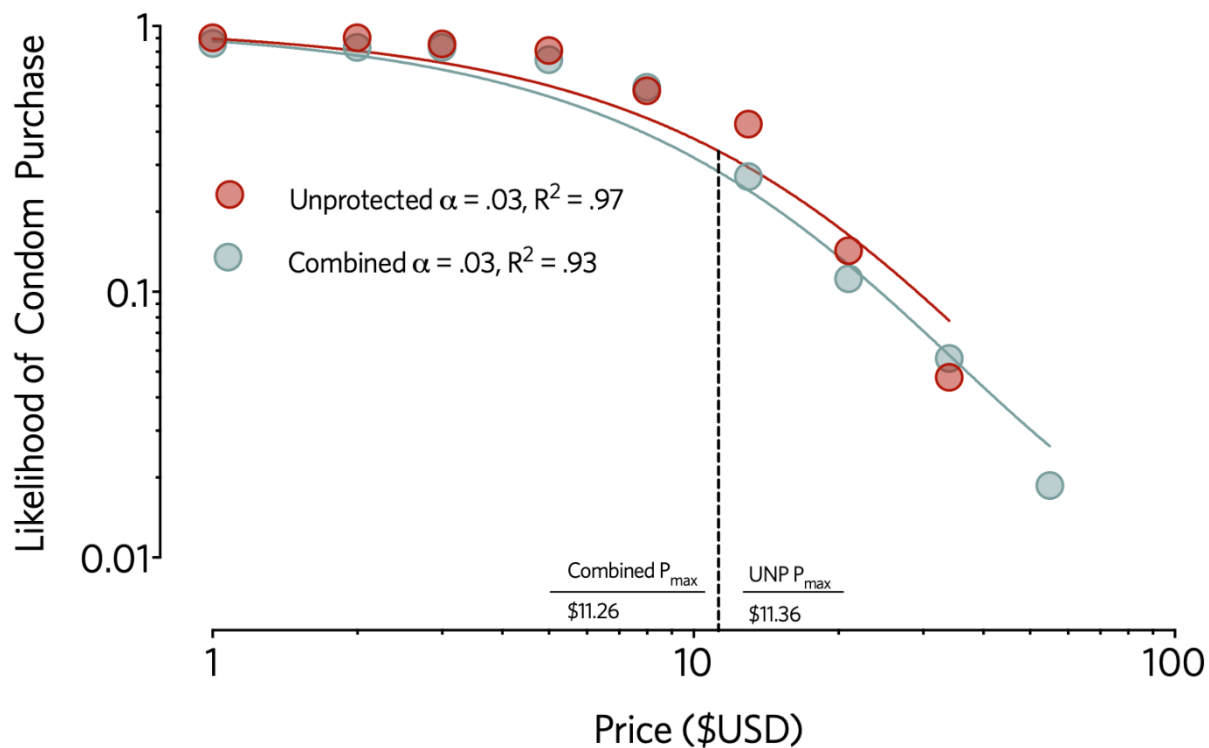
Correlation Analyses of Participant-Level Discounting and Demand Indices



Note. Each plot represents a Pearson correlation analysis; r values represent correlation coefficients.

Figure 7

Demand Curves by Combined Participants and UNP Participants from Previous Study



Note. Unprotected participants in this data plot are from a previous study employing the CoPT (Harsin et al., 2021, in press). The Combined data path represents all participants from the present study. The dashed vertical line represents the P_{max} for both groups given how close together they are.

Appendix A

Informed Consent Page

Motivations for Condom Use

Information Statement for Internet Study via Amazon Mechanical Turk

Key Information:

Your participation in this research project is completely voluntary. Your participation will take approximately 15–30 minutes to complete. You will be asked to complete an array of surveys, including questions regarding your sexual history and hypothetical questions about your willingness to have sex in various situations. More information on the procedures can be found below. There are no anticipated risks associated with this study, but some brief discomfort may be felt as you will be asked to answer questions about your sexual history. This research will aid in creating a clinical model aimed at disease prevention. Your alternative to participating in this research study is not to participate.

The Department of Applied Behavioral Science at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

We are conducting this study to better understand adults' motivations for condom use. This will entail your completion of several surveys. Your participation is expected to take between approximately 15-30 minutes to complete. The content of the survey is targeted towards sexually history, and may be associated with some brief discomfort.

Although participation may not benefit you directly, we believe that the information obtained from this study will help us gain a better understanding of better ways to survey individuals' motivations for condom use. Your participation is solicited, although strictly voluntary. **Your name will not be associated in any way with the research findings.** Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. All data collected will be anonymous. Your responses will be stored in the researchers locked filing cabinet in a locked office space and on password-protected encrypted hard drives. **It is possible, however, with internet communications, that through intent or accident someone other than the intended recipient may see your response.**

Your participation in this study is completely voluntary; however, if you enrolled through the Amazon Mechanical Turk system, you will be compensated with \$0.60 in exchange for 15-30 minutes for a complete and valid survey if approved by the researchers. This is not market research; thus, we are paying less than what is typically provided in market research – we want to ensure that your participation is voluntary and not coercive. If you enrolled via the Lawrence-Douglas County STI Testing Clinic, you will be compensated with a \$5-10 gift card. In academic research, we believe some of the benefit comes from helping science – not just financial remuneration. The information you provide may help sexuality researchers develop methods to better understand the processes associated with motivation to use condoms.

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail.

Completion of the surveys indicates your willingness to take part in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu

Sincerely,

Derek D. Reed, Ph.D., BCBA-D Principal
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Appendix B

EFT & ERT Instructions and Procedure



Please take a moment to imagine one positive event related to your financial, personal, or career goals that could realistically happen in **one year**. The event should be one that you can **imagine very clearly** and one that is **positive in nature**. Who are you with? Where are you? How are you feeling? What are you seeing? What are you hearing?

Take the next 30 seconds to think about this event in as much detail as possible as though it were actually happening right now.

Note: Button to progress to the next page will appear roughly 30 seconds from now.





Please rate the event you have imagined on the following scales. A rating of 1 indicates 'not at all' and a rating of 5 indicates 'very much'.

Not at all 1 Slightly 2 Somewhat 3 Moderately 4 Very much 5

How important was this event to you?

How much enjoyment did this event bring to you?

How exciting was this event to you?

How vivid is this event in your mind?

Please answer the following questions related to the event you've just imagined. Answers need not be in complete sentences, but should give enough detail to answer the question.

Whom were you with?	<input type="text" value="my boyfriend and cousin"/>
Where were you?	<input type="text" value="at a new job I applied for"/>
How were you feeling?	<input type="text" value="accomplished and more financially stable"/>
What were you seeing?	<input type="text" value="a different atmosphere than where I work now"/>
What were you hearing?	<input type="text" value="phone calls and keyboards"/>





For the event you have imagined, you said that you were:
with my boyfriend and cousin
at/on/in at a new job I applied for
feeling accomplished and more financially stable
seeing a different atmosphere than where I work now
hearing phone calls and keyboards

Please incorporate these details into a short paragraph (i.e., at least 100 characters) describing the event you are imagining in the space below. Write the event as though it is currently happening to you.

In the following **good** example, please note the detail and positivity of the event: I am on a ski trip with my friends Cal and Ashley in Colorado. I'm extremely happy because we have tried to go on a trip like this for the last couple of years and we're finally here. I can feel the wind on my face and the weight of my skis below me. My nose and fingers are slightly cold. I'm sitting on the ski lift taking me up to the top of the run and I can see the mountain peaks all around me. I hear my friends talking and the birds singing.

In the following **bad** example, please note the lack of detail and positivity of the event: I am at home with friends watching a movie. I feel kind of happy because I like this movie. I can see and hear the movie.

I am arriving to my new job that I applied for a few weeks ago and my boyfriend is dropping me off. I am feeling a sense of accomplishment and success for motivating myself to find a better paying job. This will allow me to be more financially stable and allow me to buy a home. I can hear the phone calls and keyboards ringing and typing away my new future.



Please take a moment to imagine one positive event related to your financial, personal, or career goals that happened yesterday. The event should be one that you can imagine very clearly and one that is positive in nature. Who were you with? Where were you? How were you feeling? What were you seeing? What were you hearing?

Take the next 30 seconds to think about this event in as much detail as possible as though it were actually happening right now.

Note: Button to progress to the next page will appear roughly 30 seconds from now.





Please rate the event you have imagined on the following scales. A rating of 1 indicates 'not at all' and a rating of 5 indicates 'very much'.

Not at all Slightly Somewhat Moderately Very much
1 2 3 4 5

How important is this event to you?



How much enjoyment would this event bring to you?



How exciting is this event to you?



How vivid is this event in your mind?



Please answer the following questions related to the event you've just imagined. Answers need not be in complete sentences, but should give enough detail to answer the question.

Whom will you be with?	<input type="text" value="roommate"/>
Where will you be?	<input type="text" value="home"/>
How will you be feeling?	<input type="text" value="happy excited"/>
What will you be seeing?	<input type="text" value="nothing"/>
What will you be hearing?	<input type="text" value="boss talking on the phone about work"/>





For the event you have imagined, you said that you will:

be with roommate

be at/on/in home

be feeling happy excited

be seeing nothing

and be hearing boss talking on the phone about work

Please incorporate these details into a short paragraph (i.e., at least 100 characters) describing the event you are imagining in the space below. Write the event as though it is currently happening to you.

In the following **good** example, please note the detail and positivity of the event: I am on a ski trip with my friends Cal and Ashley in Colorado. I'm extremely happy because we have tried to go on a trip like this for the last couple of years and we're finally here. I can feel the wind on my face and the weight of my skis below me. My nose and fingers are slightly cold. I'm sitting on the ski lift taking me up to the top of the run and I can see the mountain peaks all around me. I hear my friends talking and the birds singing.

In the following **bad** example, please note the lack of detail and positivity of the event: I am at home with friends watching a movie. I feel kind of happy because I like this movie. I can see and hear the movie.

i was at home with my roommate watching grey's anatomy and my boss called to tell me how good a job i was doing at work and i was pretty happy that she took the time to do that.



Appendix C

Hypothetical Partner Selection Instructions & Sample of Photographs



For the following tasks, we will ask you **hypothetical or pretend questions about your willingness to have sex in various situations**. For the purpose of this task, **please pretend that you are not currently in a committed sexual relationship if you are**. In other words, **please pretend that you are single and available and that you are not cheating on anybody** if you indicate you would have sex with somebody in this task.

For each of the following photographs, think about how attractive that person is. **Based on physical appearance alone**, please think about whether each person is someone that you would consider having sex with **in the right environment** and if you **liked the person's personality**. Please select the photograph of the person you would **most like to have sex with**.

There are no "right" or "wrong" responses. Please answer all questions honestly, thoughtfully, and to the best of your understanding, as if you were actually in this situation.

In this section you are to select a photograph of a person you would most like to have sex with.

True

False



KU

Please select the image of the person you would most like to have sex with.



Appendix D

Condom Purchase Task Instructions & Task



Below is the event that you described earlier. Please read through it and answer the following questions with this event in mind.

I am arriving to my new job that I applied for a few weeks ago and my boyfriend is dropping me off. I am feeling a sense of accomplishment and success for motivating myself to find a better paying job. This will allow me to be more financially stable and allow me to buy a home. I can hear the phone calls and keyboards ringing and typing away my new future.

Below is the image of the person you have selected as **most wanting to have sex with**. Please imagine that you and this person have met, are getting along great, and are both interested in having sex right now. Please answer the following questions **with this person and the event you imagined in mind**.



Please indicate whether or not you would purchase a box of condoms at the following prices.
Remember, treat each price as its own purchasing scenario.

	Yes, I would buy a box of condoms at this price and use them to have sex with my partner.	No, I would not buy a box of condoms at this price and would have unprotected sex instead.	No, I would not buy a box of condoms at this price and would give up the opportunity to have sex.
\$0.05	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$0.10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$0.25	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$0.50	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$0.75	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$21	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$34	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$55	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$89	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$144	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
\$233	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Appendix E

Sexual Delay Discounting Task Visual Analog Scale

Below is the image of the person you said you would most like to have sex with. Imagine you have just met this person. You are getting along great and they are interested in having sex with you now. Please answer the following questions with this person and the event you imagined in mind.



Imagine that there is a condom readily and immediately available. Please rate how likely you would be to immediately have sex with a condom vs. have sex without a condom.

0% I will definitely have sex with this person now without a condom. 100% I will definitely have sex with this person now with a condom



Appendix F

Monetary Choice Questionnaire

For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. While you will not actually receive the rewards, pretend you will actually be receiving the amount you indicate and answer honestly.

Which would you rather have?

- \$54, today
- \$55, 117 days from now

Which would you rather have?

- \$55, today
- \$75, 61 days from now

Which would you rather have?

- \$19, today
- \$25, 53 days from now

Which would you rather have?

- \$31, today
- \$85, 7 days from now

Which would you rather have?

- \$14, today
- \$25, 19 days from now

Which would you rather have?

- \$47, today
- \$50, 160 days from now

Which would you rather have?

- \$15, today
- \$35, 13 days from now

Which would you rather have?

- \$25, today
- \$60, 14 days from now
- Which would you rather have?

- \$78, today
- \$80, 162 days from now

Which would you rather have?

- \$40, today
- \$55, 62 days from now

Which would you rather have?

- \$11, today
- \$30, 7 days from now

Which would you rather have?

- \$67, today
- \$75, 119 days from now

Which would you rather have?

- \$34, today
- \$35, 186 days from now

Which would you rather have?

- \$27, today
 - \$50, 21 days from now
- Which would you rather have?

- \$69, today
- \$85, 91 days from now

Which would you rather have?

- \$49, today
- \$60, 89 days from now

Which would you rather have?

- \$80, today
- \$85, 157 days from now

Which would you rather have?

- \$24, today
- \$35, 29 days from now

Which would you rather have?

- \$33, today
- \$80, 14 days from now

Which would you rather have?

- \$28, today
- \$30, 179 days from now

Which would you rather have?

- \$34, today
- \$50, 30 days from now

Which would you rather have?

- \$25, today
- \$30, 80 days from now

Which would you rather have?

- \$41, today
- \$75, 20 days from now

Which would you rather have?

- \$54, today
- \$60, 111 days from now

Which would you rather have?

- \$54, today
- \$80, 30 days from now

Which would you rather have?

- \$22, today
- \$25, 136 days from now

Which would you rather have?

- \$20, today
- \$55, 7 days from now

Appendix G

Community Reinforcement Interview Survey Items



The items in this questionnaire refer to things and experiences that may give joy or other pleasurable feelings. Please indicate on the dropdown menu how much pleasure you receive from each of the following. A rating of 1 indicates that you find the activity unpleasant or neutral and a 5 indicates you find the activity extremely pleasant. Additionally, please indicate how frequently you experience each of these things. A rating of 1 indicates that you have not experienced the activity in the past 30 days and a 5 indicates you experience these things more than once per day.

	How pleasurable is this behavior?	How often do you engage in this behavior/activity?
Spending time with family	5. Extremely pleasant ▼	5. More than once per day ▼
Spending time with desired sexual partners	4. Pleasant ▼	4. Every day ▼
Spending time with friends	3. Somewhat pleasant ▼	3. Most days ▼
Drinking alcohol (e.g., at a bar/club, at home, etc.)	2. Rarely pleasant ▼	2. Some days ▼
Taking prescription drugs (e.g., opioids, xanax, etc.)	1. Unpleasant/Neutral ▼	1. 0 times over the past 30 days ▼
Smoking/Consuming marijuana/marijuana products (e.g., smoking a joint, ingesting edibles, etc.)	5. Extremely pleasant ▼	5. More than once per day ▼
Using methamphetamine or heroine	4. Pleasant ▼	4. Every day ▼
Using nicotine products (e.g., cigarettes, e-cigs, etc.)	3. Somewhat pleasant ▼	3. Most days ▼
Watching TV or a streaming service (e.g., Netflix, Hulu, etc.)	2. Rarely pleasant ▼	2. Some days ▼
Using social media (e.g., Twitter, Instagram, Facebook, etc.)	1. Unpleasant/Neutral ▼	1. 0 times over the past 30 days ▼
Reading (e.g., Fiction, news, Non-Fiction, etc.)	5. Extremely pleasant ▼	5. More than once per day ▼

Gaming (e.g., PC, PlayStation, XBOX, etc.)	<input type="text"/>	<input type="text"/>
Playing and/or listening to music	<input type="text"/>	<input type="text"/>
Texting/Messaging	<input type="text"/>	<input type="text"/>
Thinking about sexual activity (e.g., sexual intercourse, oral sex)	<input type="text"/>	<input type="text"/>
Having intercourse (vaginal and/or anal)	<input type="text"/>	<input type="text"/>
Oral Sex (giving or receiving)	<input type="text"/>	<input type="text"/>
Thinking about being a parent	<input type="text"/>	<input type="text"/>
Talking about being a parent	<input type="text"/>	<input type="text"/>
Engaging in exercise (e.g., running, biking, hiking, yoga, dancing, etc.)	<input type="text"/>	<input type="text"/>
Engaging in athletics (e.g., basketball, softball, tennis, etc.) either as a hobby or competitively	<input type="text"/>	<input type="text"/>

