

**Conditions that increase the perceived likelihood of temporary restriction of firearm
access: An investigation in male firearm owners**

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Abstract

This study evaluated hypothetical participation in temporary voluntary removal of firearms from the home to reduce future suicide risk in 408 adult male firearm owners. A reinforcer-based model of choice was applied to evaluate the degree to which these choices were influenced by two dimensions of reinforcer efficacy—Delay and Magnitude. The decision-making task sampled choice behavior across various durations of temporary voluntary removal of firearms (Delay) and differences in the potential risk of suicide (Magnitude) as a result of that choice. Results of mixed-effects modeling indicated that the subjective value of immediate access to a firearm was differentially sensitive to both Delay and Magnitude. Additionally, the scaling of these effects was linked to various other indicators of firearm-specific safety (e.g., use of trigger locks) and suicidality risk (e.g., intolerance of uncertainty). These results provide additional support for reinforcer-based models of choice when evaluating how specific environmental arrangements and framing may support (or potentially discourage) engagement in means safety activities, inclusive of temporary firearms access restriction. These findings suggest that further analysis of the ecological underpinnings of these choices may help to guide more targeted efforts to engage with firearm owners in safety planning when there are concerns about the potential for suicide.

Keywords: delay discounting, firearms, safety planning, suicide, gun violence

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Introduction

Increasing safety with lethal means of suicide is a pivotal aspect of public health suicide prevention initiatives (Office of the Surgeon General, 2012). Firearms are used in over 50% of suicide deaths in the United States annually (Centers for Disease Control and Prevention, 2023). Additionally, no means of suicide is more lethal than firearms. Over 85% of suicide attempts (SAs) made with firearms are lethal (Shenassa et al., 2003). Given this method's availability and lethality, an emphasis has been placed on increasing the ability of healthcare providers to help patients reduce access to firearms during times of risk.

Extant literature demonstrates that brief conversations using motivational interviewing techniques can help National Guard members increase their use of secure firearm storage (Anestis et al., 2021). This research was completed in a sample of National Guard members, few of whom would likely be evaluated as high risk for suicide. Despite a clear need for upstream means of safety efforts such as that of Anestis and colleagues (2021), reducing immediate access to firearms may be needed to ensure the safety of high-risk patients. Given the high rate of suicide in the days following discharge from psychiatric inpatient facilities (Forte et al., 2019), the temporary removal of a firearm may be clinically necessary to ensure safety until patients are evaluated in the outpatient sector.

Despite the clear importance of discussing the option of the removal of immediate access to firearms in high-risk patients, little research has focused on the perceived likelihood of firearms removal in high-risk scenarios. Preconceived notions of patient dissatisfaction with such

an intervention could keep providers from having discussions about the temporary removal of firearms from the home. Thus, understanding the parameters in which at-risk firearm owners are amenable to the temporary removal of firearms would help to inform these important conversations.

Reinforcer-based Models for Firearm Safety Planning Choices

Reinforcer-based models characterize individual choice behavior in terms of the history of the organism, their present context, and the various consequences that follow from such choices. Choice behavior in this view is neither “rational” nor “irrational” and instead viewed in terms of the relative utility to the organism (e.g., amount of reinforcement, given delays; Bickel et al., 2011, 2019). The Reinforcer Pathology model has emerged as a powerful framework for characterizing why certain individuals may persist with various unsafe and/or unhealthy choices, despite substantial and known risks (e.g., substance use, poor dietary choices; Bickel et al., 2011, 2020; Bickel & Vuchinich, 2000).

Two core features in this view are believed to contribute to risky and/or unhealthy patterns of choice. The first feature refers to a relative preference for more immediate but lesser consequences over larger alternatives that involve a delay (Odum, 2011). This phenomenon, delay discounting, is rooted in the basic principles governing behavior rather than cognitive heuristics or biases, which cannot be influenced directly or manipulated. The second feature refers to a preference for certain, *specific* types of reinforcers over other more common and general reinforcers (Bickel et al., 2011). For example, certain subgroups may demonstrate a strong preference for certain reinforcers (e.g., drug reinforcers) over the more common social reinforcers that often compete with them (e.g., social relationships, occupational achievement). This perspective has been applied broadly and successfully to choices such as health and

wellness (Chapman, 1996; Chapman et al., 2001), the decision to vaccinate (Jarmolowicz et al., 2018; Strickland et al., 2022), and engagement with therapeutic practices (Gilroy et al., 2022; Gilroy & Picardo, 2022; Swift & Callahan, 2010).

The decision whether to engage in a therapeutic practice such as firearm means safety can be viewed as a balancing of both immediate and delayed consequences. Most firearm owners endorse carrying firearms for self-protection (Bryan et al., 2022) and maintaining immediate access to a firearm can be viewed as a short-term decision to minimize the immediate, perceived risks to safety in a complex and uncertain world. However, immediate access to firearms has been linked to various other threats to safety, such as potential accidental discharge (e.g., Miller et al., 2005) and risk of suicide (e.g., Bond et al., 2023). In situations where the risk of suicide is clinically determined to be elevated, a reluctance to temporarily limit access to personal firearms can be framed as a ‘suboptimal’ choice, given that any potential value of maintaining access to the firearm as a safeguard against bad actors is overshadowed by the much more statistically likely risk that the individual poses to themselves, intentional or otherwise.

The choice to maintain immediate access to firearms while suicide risk is elevated can be cast into the traditional dichotomy of the discounting framework. The smaller-sooner reward here (SSR) refers to the subjective value associated with the potential for firearm use as a means of self-defense. The emphasis on *smaller* here reflects findings that the use of firearms for self-defense does not appear to significantly reduce overall risk to personal safety and property (e.g., Hemenway & Solnick, 2015). In contrast, the larger-later reward (LLR) refers to the value associated with engaging in temporary firearms removal and the increased likelihood of engaging with and benefiting from outpatient therapy related to suicide risk (Hanratty et al., 2019).

Gilroy and colleagues (2021) presented a framework for evaluating the likelihood that an individual would choose to engage in hypothetical firearms means safety, specifically temporary firearms removal from the home. This framework, an extension of the delay discounting paradigm, emphasized the impact of both delays (i.e., duration of time in which firearms are temporarily inaccessible) and magnitude (i.e., the degree to which safety practices are likely to reduce risk). The Hypothetical Firearm Decision Task (HFDT) was constructed to explore the conditions under which high-risk individuals would consider the temporary, voluntary removal of firearms from their possession and their storage with a trusted other. Specifically, choices in this framework were cast in terms of delay (i.e., amount of time until firearm access is regained) and magnitude (i.e., differences in the amount of risk with and without removal). The administration of the HFDT consists of individuals responding to questions (i.e., ‘Yes’, ‘No’) emulating those that would be asked by a provider with concerns that a patient was at a high risk of self-inflicted harm.

Research Questions

Steep discounting of delayed outcomes has been associated with various clinical populations, and more broadly, high levels of discounting have been considered to be a transdiagnostic indicator of various disorders (Amlung et al., 2019; Levitt et al., 2022; Mitchell, 2019). Although suicidal thoughts and behaviors and decisions related to engaging in treatment related to those needs are amenable to such a framework, reinforcer-based explorations of these choices are not well-represented in this literature. The purpose of this investigation was to extend and apply earlier expansions of this model presented by Gilroy et al. (2021) with a sample of firearm owners. The methodology, analytical strategy, and overall framework were consistent

with those outlined in the earlier Gilroy et al. (2021) work. The specific research questions are listed below:

RQ1: It is hypothesized that the choice to voluntarily and temporarily remove firearms from the home will scale with the traditional dimensions of reinforcer efficacy. That is, there is an expected *decreasing* trend predicted for the likelihood of engagement in response to temporally delayed choices and an *increasing* trend for relative differences in terms of the magnitude of benefit associated with engagement.

RQ2: We hypothesize that relationships exist between contemporary measures related to suicide risk and nonsecure firearms storage practices (i.e., suicide ideation [SI] and intolerance of uncertainty [IU]; Anestis et al., 2023) and practices related to firearm storage (e.g., staging firearms loaded and/or in a secure location). Thus, it is expected that these concepts moderate may moderate relationships found in testing RQ1.

Method

Participants

The sample consisted of 408 self-identified adult males who endorsed the ownership of at least one firearm. A full listing of the sample characteristics is provided in [Table 1](#). There was no restriction on the type of firearm. The average age of the sample was 43.57 years ($SD = 16.25$, $Mdn = 40$, $Q1-Q3 = 33-53$). The sample overwhelmingly self-identified as White ($N=342$; 83%) and endorsed self-protection as their primary reason for owning a firearm ($N=288$, 70%). On average, participants reported owning 6.93 firearms ($SD = 5.31$, $Mdn = 8$, $Q1-Q3 = 1-11$), and approximately one-third of the sample identified as veterans ($N = 126$, 31%). Nearly one half of participants ($N=188$, 46.07%) endorsed experiencing some level of SI in the past year.

Materials

Hypothetical Firearm Decision-making Task (HFDT)

The HFDT (Appendix) represents a procedure that frames firearm-related choices in terms of decisions between the short- (SSR) and long-term (LLR) consequences resulting from those choices (Gilroy et al., 2021). Specifically, a preference for the SSR would consist of the individual selecting a smaller, perceived benefit to their safety (i.e., safety from others) over the larger, more probability risk of safety from themselves (i.e., risk of self-harm considered high). Alternatively, a choice in favor of the LLR would represent a choice favoring the larger, long-term benefits associated with addressing suicide risk, despite a delay in which access to firearms is voluntarily limited. The decision-making task consisted of a total of 30 forced choice Yes/No questions that varied across Delays ($n = 6$) and Magnitudes ($n = 5$). The delays associated with the temporary storage of firearms from the home and with a trusted other consisted of 1, 7 (1

week), 14 (2 weeks), 30 (1 month), 60 (2 months), and 120 days (3 months). Risk levels were presented as ratios, in which choices featured a ratio of 1, 2 or $\frac{1}{2}$, or 4 or $\frac{1}{4}$.

Characteristics of Firearms Ownership

Questions related to the characteristics of firearm ownership were derived from a self-report measure related to firearms ownership (Bryan et al., 2022). Specifically, questions included in the measure queried the number of firearms owned, current storage practices, and the belief that storage practices are related to suicide risk. Using a free-response format, participants were asked to report how many firearms they owned. Current storage practices were assessed using three questions. The first asked participants if they stored their firearms in a secure location (e.g., locked safe) with yes or no response options. The other two items also used the same option format but assessed if firearms are secured with a locking device (e.g., cable lock) and if firearms are stored loaded. For all three items, if at least one firearm was stored sub-optimally (i.e., loaded versus unloaded or without a locking device compared to with one) participants were instructed to select the less secure option (i.e., loaded but not locked in a secure location or not stored with a locking device).

Suicide Ideation

Suicide Ideation (SI) was assessed using two items from the self-report version of the Self-Injurious Thoughts and Behaviors Interview-Revised (SITBI-R; Fox et al., 2020). The first item asked, “Have you ever had thoughts of killing yourself” with yes or no response options. Those who selected yes to this question completed the following item, “When did you most recently have thoughts of killing yourself” with the following response options, “more than one year ago”, “within the past year”, and “within the past month.” The recency of SI variable used in analyses was derived from the participant’s response to this question.

Intolerance of Uncertainty

The Intolerance of Uncertainty Scale - Short Form (IUS-SF; Carleton et al., 2010) was used to assess the general tendency to be intolerant of an uncertain future. The self-report measure includes 12 items with response options scored on a 5-point Likert-type scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). Sample items include, “A small unforeseen event can spoil everything, even with the best of planning” and “Unforeseen events upset me greatly.” Higher scores on the measure represent a higher Intolerance of Uncertainty (IU). The IUS-SF demonstrated strong internal consistency in the current study ($\alpha = .912$).

Procedure

Quota sampling through Qualtrics Panels was used to recruit study participants. Qualtrics Panels maintains a database of millions of individuals interested in study participation and screens these participants for eligibility in various studies. For the current study, inclusion criteria included being fluent in English, able to provide consent, above the age of 17, and owning one or more firearms. Given that this study explored choices related to temporary removal of firearms from the home to reduce suicide risk, an additional quota was added to sample this population more thoroughly. Specifically, at least $n=100$ of the $n=400$ adult male firearm owners were recruited based on their endorsement for historical SI.

Eligible participants were emailed a survey link from Qualtrics Panels. An informed consent sheet for the study was presented and participants provided consent through the survey instrument. After completing the study measures, participants read a debriefing sheet and were given the option to download a list of national resources for suicide prevention. Participants were financially compensated after completing the study at a rate that they agreed upon when joining

Qualtrics Panels as a potential survey participant. All procedures were approved by a local Institutional Review Board.

Analytical Strategy

This study evaluated individual choice consistent with the methods outlined in Gilroy et al. (2021). Specifically, this study applied a generalized linear mixed model to evaluate the choice of whether to engage with hypothetical firearm safety practices (0, 1). Generalized linear mixed modeling was applied using the *lme4* library (Bates et al., 2014) in the R Statistical Program (R Core Team, 2017). The evaluation of individual choice in this manner has been found to provide more precise, more powerful, and more robust estimates in comparable delay discounting tasks (Young, 2018).

The evaluation of RQ1 and RQ2 followed the same approach and model building and evaluation varied minimally apart from the specific factors entered into the initial model. The general strategy applied in these analyses consisted of first determining the optimal random effects structure and then performing subsequent comparisons of the fixed effects. Originating from the maximal model, the individual fixed effects and interactions were evaluated using Likelihood Ratio Tests (LRTs). LRTs were used to determine which model the data was most likely to emerge from. The best-performing model was selected for use in analyzing the data set.

Results

RQ1: Evaluation of Delay and Magnitude

The goal of RQ1 was to evaluate the degree to which choices related to temporary firearms removal from the home corresponded with the dimensions of reinforcer efficacy (i.e., Delay, Magnitude). The results from RQ1 are illustrated in [Figure 1](#) and the level of indifference (i.e., 50/50) is illustrated using a solid horizontal line at 50% likelihood. Model evaluation

revealed that the data was best characterized when slopes for Delay and Magnitude were permitted to vary across individuals and LRTs supported the inclusion of both Delay and Magnitude factors in the model.

Results indicated that overall patterns of choice were significantly associated with both the length of time without access to firearms ($b[Delay] = -0.6998$; $Z = -4.943$; $p < .0001$) and the relative differences in risk reduction ($b[Magnitude] = -1.2609$; $Z = -10.29$; $p < .0001$). Regarding delays, modeling indicated that the probability of endorsing the likelihood of temporary firearms removal overall decreased across the sample as the duration of removal increased (Delay). Similarly, results revealed that the probability of removal tracked with risk levels (Magnitude), whereby larger reductions in risk level corresponded with greater probabilities of hypothetical temporary firearms removal. Specifically, the likelihood of voluntary firearm removal decayed to a level of ambivalence (i.e., 50/50) at delays of 11.5 and 2.25 days when the magnitude of risk reductions were 1/4 and 1/2, respectively.

RQ2: Moderators of Temporary Firearm Restriction and Delay/Magnitude

The second research question explored the degree to which dimensions of reinforcer efficacy were related to various other factors relevant to firearms safety and suicidal thoughts. Specifically, RQ2 explored to what degree Delay and Magnitude were associated with firearm safety practices (Practices; e.g., secure storage, trigger locks) and suicidal thinking (i.e., IU, recently of SI). Results from RQ2 are illustrated in [Figure 2](#) and all models estimates are listed in [Table 2](#). The maximal model structure was used to explore multiple random-effects structures, and consistent with RQ1, model performance was superior when slopes and intercepts varied for Delay and Magnitude across individuals. Multiple LRTs were used to evaluate specific

interactions between dimensions of reinforcer efficacy and relevant covariates and explore which model arrangement the obtained data was most likely to have emerged from.

The final model included supported interactions with SI and Delay as well as Magnitude as well as Delay-specific interactions with Storage Practices and IU. Interactions between SI and Delay revealed an orderly relationship whereby more recent SI corresponded with lower probabilities of potential temporary firearm removal, with significantly lower likelihood when endorsing SI in the past month ($b = -1.23, Z = -2.88, p < .001$) or year ($b = -0.95, Z = -2.53, p < .05$). A similar pattern emerged for storage practices, whereby larger Delays and more secure storage practices tracked with a higher likelihood of temporary firearms removal ($b[\text{Delay:Locked/Secured}] = 1.08, Z = 2.83, p < .01$). Lastly, a significant interaction was found for Delay and IU ($b[\text{Delay:IU}] = 0.37, Z = 2.60, p < .01$) whereby higher levels of IU were associated with a greater likelihood of temporarily restricting access to firearms as Delay increased.

Discussion

This study evaluated a reinforcer-based model of choice in the context of temporary and voluntary firearm restriction with male firearm owners. This work builds incrementally on prior work translating basic behavioral principles to choices related to firearm storage practices in those at risk for suicide (Gilroy et al., 2021) and aligns with proposed methods of building stronger theories in psychology (Borsboom et al., 2021). This work is of particular importance as men account for over two-thirds of suicides in a given year in the US (Curtin et al., 2022), in part because the use of firearms in suicide attempts result in death far more frequently compared to other methods (Elnour & Harrison, 2008). An improved understanding of how individual preferences related to delays and perceived suicide risk influence could also guide more

individualized and culturally competent approaches to firearms safety initiatives (Houtsma et al., 2018).

The findings from this study are consistent with patterns of suboptimal choice often explored using the Reinforcer Pathology model. First and foremost, choices related to immediate access to a firearm were linked to the duration of temporary removal (Delay) throughout the sample, whereby firearm owners sharply discounted safety from themselves as a function of the duration of that temporary restriction. Even under the most optimal conditions (i.e., very high levels of risk reduction), the overall sample was approximately ambivalent to their options at a duration of 11.5 days. Furthermore, this point of ambivalence was estimated at 2.25 days when conditions were slightly less than very highly optimal in terms of risk reduction (Magnitude). Overall trends observed revealed that delays and duration of temporary removal appear highly related to the likelihood of hypothetical engagement with voluntary firearm restriction initiatives.

Study participants demonstrated high sensitivity to Delay and this can be contextualized given the phenomenology of suicide risk. The removal of a firearm for even a day may be lifesaving as SI intensity can vacillate quickly and acute risk windows are likely temporary (Bryan et al., 2020); however, most evidence-based clinical interventions that result in sustained reductions in suicidal behavior are provided over months and sessions occur weekly (e.g., Rudd et al., 2015). Thus, although some, when deemed highly likely to die by suicide may be willing to restrict access to firearms, this willingness is unlikely when asked for more than a day or potentially a week at a time. Additionally, men who use firearms during suicide attempts are unlikely to present to mental health services when at high risk for suicide (Bond et al., 2022); thus, additional public health strategies are needed in addition to relying solely on clinical appointments to reduce access to firearms. The rapid growth in availability of statewide firearm

storage maps provides a useful resource for firearm owners in crisis seeking trusted, safe, and legal paths for out-of-home storage (Betz et al., 2023); however, in some states, individuals who temporarily transfer their firearms to firearm retailers must undergo background checks to regain access to their firearms. In this sense, state level restrictions on the speed of temporary firearm transfers may cause delays that exceed acceptable levels for firearm owners, thereby substantially lowering the odds that firearm owners will utilize this tool.

The dimension of reinforcer Magnitude, framed here in terms of risk reduction, also appeared highly associated with hypothetical engagement in temporary firearms removal. The sensitivity underscores the importance of public health approaches to firearms safety that do not rely on a male firearm owner to be in crisis and thus reasonably see temporary removal as meaningful (e.g., Anestis et al., 2022). Said another way, it may be “too late” to engage in suicide prevention initiatives with male firearm owners at a point in which they see their risk as high enough to warrant removal and thus a large reduction in risk. This interpretation is certainly in line with data that demonstrates that suicide prevention cannot only be initiated upon first enactment of non-lethal suicidal behavior as firearm suicide decedents demonstrate less historical suicide attempts than those who died by suicide using another method (Anestis, 2016). Relatedly, approaches such as culturally competent messaging may be necessary to more effectively communicate the risks and benefits associated with firearm access when discussing suicide risk (Stanley et al., 2017).

This work was novel in that multiple factors considered to be associated with the risk of suicide (e.g., SI, firearm storage practices) were included as covariates in a delay discounting framework. First, current secure storage (e.g., securing firearms unloaded and with a locking device or in a secure location) was associated with increased engagement with temporary

firearms restriction at high levels of Delay. This result suggests that men already engaging in some level of secure storage may be more amenable to reducing access to firearms for longer periods of time in efforts to reduce suicide risk. This result certainly supports the use of a culturally competent, non-judgmental stance when providers discuss firearms means safety with male firearm owners as those who already securely store firearms in some way may be more open to total access restriction if discussed without shame or fear (Anestis et al., 2022). Similarly, this result may point to an important population to target in precision messaging campaigns to reduce suicide risk. Messages targeting the increase of secure storage practices and potentially temporary removal in those already engaging in some degree of secure storage could be fruitful and worth experimental investigations (Reed, Strickland, et al., 2022)

The recency of SI, particularly within the last month, exerted a profound influence on the likelihood that a participant would engage in voluntary temporary firearms removal. This adds to a growing body of literature demonstrating a previously unreported link between the perceived likelihood of future suicidal behavior and non-secure firearm storage (Anestis et al., 2020). These findings highlight that, in general, male firearm owners are highly sensitive to the time in which firearms would be removed from the home; an effect that is even more pronounced in those recently thinking about suicide. The reluctance to reduce access to firearms can certainly be seen from a functional lens. Firearms restriction limits the ability of a person who is thinking about suicide to kill themselves in the face of unacceptable loss thresholds (Capron et al., 2022) or other stressors in which they see suicide as an option for dealing with them (Tucker et al., 2015).

Additionally, IU was found to interact positively with Delay and the likelihood of engagement in overall temporary firearms removal. A degree of association between IU and Delay is expected, given that each captures the individual's perspective on delayed and,

ultimately, probabilistic events. Phenomenologically, this result adds complexity to the relationship between IU and suicide. IU may increase the likelihood of suicide via increased distress associated with anxiety (Allan et al., 2023) and increased likelihood of purchasing firearms (Anestis & Bryan, 2021). However, the moderation result found in this study reveals that those high in IU may be more likely to temporarily restrict firearm access to reduce suicide risk. Those high in IU may be more open to the idea that suicide is possible for them in the future, regardless of their desire for suicide, and thus simply more amenable to potentially life-saving restriction efforts being used for longer periods given the uncertainty of the future. Certainly, this interpretation is posed cautiously as IU has been studied in relation to SI and firearms ownership practices, but not for one's own probabilistic belief that suicide could occur in the future. The moderation result found in the current study could simply be a function of the oversampling of male firearm owners experiencing recent SI, a sampling strategy that likely resulted in higher IU in the sample compared to the general population of firearm owners. It may also be possible that other important characteristics of SI could impact these relationships. Those high in IU and experiencing SI may be more open to an intervention such as firearms removal *if* they are high in a desire to stay alive (i.e., as opposed to life ambivalence; Brown et al., 2005) as removal of a firearm would proverbially "shut the door" on the uncertainty of whether someone will succumb to SI in the future.

Methodological Extensions for Suicide Research

Methods and strategies derived from behavioral economic research have found widespread adoption across fields and have led to many novel applications. Hypothetical decision-making tasks such as the one employed in this investigation are common in applied behavioral economic research that aims to inform policy decisions (e.g., Hursh, 1991; Reed,

Gelino, et al., 2022; Roma et al., 2016). For example, A hypothetical decision-making task was developed to study the health messaging conditions in which participants would forgo attending a social event during the COVID-19 pandemic (Strickland et al., 2022). In this task, participants indicated their yes/no probability of attending a party if one or more of their community members were likely to be experiencing manipulated symptom clusters (e.g., “a mild” cluster of dry cough, fever, headache versus a “severe” cluster of difficulty breathing) as well as if the symptoms clusters were or were not messaged with a severity label. Variants of this task were used to study other COVID-19 preventative behaviors such as mask-wearing to test which types of messaging strategies may increase the probability of positive health behaviors. The use of hypothetical decision-making tasks within a behavioral economic framework has clear implications for the use of effective messaging to promote the use of specific firearm-related safety strategies (e.g., storing a firearm unloaded) under specific manipulated conditions (e.g., magnitude of risk reduction, sources of information).

Findings from this study suggest that tools such as the HFDT could become an important element of future suicide research. For example, a complete restriction of access to firearms is but one of many potential avenues to reducing the risk of lethal suicidal behavior. The use of alternatives such as locking devices and storing firearms separate from ammunition are also strategies that could reduce the risk of firearm-related injuries (Violano et al., 2018). The task used in the current manuscript focused exclusively on the temporary restriction of access to firearms and thus represents a fragment of what might be learned about how firearm owner behavior related to safety strategies. Methods within the delay discounting framework are flexible and the conditions featured in this task are easily modified to replace restriction with nearly any other form of safety behavior (e.g., storing a firearm with a locking device) and could

likewise be useful in exploring the circumstances under which firearm owners would or would not engage in suggested practices. For example, honor ideology, an individual-level factor not assessed in the current study, relates to firearms ownership and storage behaviors (Bock et al., 2021) and may influence not only the likelihood of voluntarily restricting access to firearms but also safety-related behavior when firearms access is not restricted. Additional evaluation of methods derived from applied behavioral economics, such as the HFDT, may provide useful insight in this regard.

Limitations and Future Directions

Although this work successfully evaluated prior work evaluated through simulation, several points warrant qualification. First, the actual firearm removal of a firearm was not assessed, and it is not known to what degree the estimates revealed in this study correspond to clinical safety efforts. Although the selective sampling strategy increased the prevalence of recent SI than would be anticipated in studies using random sampling, generalizability to the broader male firearm-owning population remains unclear. Results also may not generalize to cisgender female firearm owners or transgender/gender diverse populations as only cisgender men participated in this study. Results may also only represent the experience of White cisgender men as well as less than 20% of the sample self-identified as racially diverse. The study's cross-sectional methodology also precludes assertions about causal and temporal relationships between the acceptability of temporary firearm restriction and firearm ownership characteristics, IU, and SI.

References

- Allan, N. P., Gorka, S. M., Saulnier, K. G., & Bryan, C. J. (2023). Anxiety sensitivity and intolerance of uncertainty: Transdiagnostic risk factors for anxiety as targets to reduce risk of suicide. *Current Psychiatry Reports, 25*(4), 139–147.
- Amlung, M. T., Marsden, E., Holshausen, K., Morris, V., Patel, H., Vedelago, L., Naish, K. R., Reed, D. D., & McCabe, R. E. (2019). Delay Discounting as a Transdiagnostic Process in Psychiatric Disorders: A Meta-analysis. *JAMA Psychiatry*.
- Anestis, M. D. (2016). Prior suicide attempts are less common in suicide decedents who died by firearms relative to those who died by other means. *Journal of Affective Disorders, 189*, 106–109.
- Anestis, M. D., Bandel, S. L., Bond, A. E., & Bryan, C. J. (2023). Threat sensitivity, intolerance of uncertainty, and firearm purchasing during a firearm purchasing surge. *Journal of Psychiatric Research, 162*, 200–206. <https://doi.org/10.1016/j.jpsychires.2023.05.038>
- Anestis, M. D., Bandel, S. L., Butterworth, S. E., Bond, A. E., Daruwala, S. E., & Bryan, C. J. (2020). Suicide risk and firearm ownership and storage behavior in a large military sample. *Psychiatry Research, 291*, 113277.
- Anestis, M. D., & Bryan, C. J. (2021). Threat perceptions and the intention to acquire firearms. *Journal of Psychiatric Research, 133*, 113–118.
- Anestis, M. D., Bryan, C. J., Capron, D. W., & Bryan, A. O. (2021). Lethal Means Counseling, Distribution of Cable Locks, and Safe Firearm Storage Practices Among the Mississippi National Guard: A Factorial Randomized Controlled Trial, 2018–2020. *American Journal of Public Health, 111*(2), 309–317. <https://doi.org/10.2105/AJPH.2020.306019>

- Anestis, M. D., Bryan, C. J., Capron, D. W., & Bryan, A. O. (2022). Evaluation of safe firearm storage messaging in a sample of firearm-owning US military service members. *JAMA Network Open*, *5*(10), e2235984–e2235984.
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. *arXiv Preprint arXiv:1406.5823*.
- Betz, M. E., Barnard, L. M., Knoepke, C. E., Rivara, F. P., & Rowhani-Rahbar, A. (2023). Creation of online maps for voluntary out-of-home firearm storage: Experiences and opportunities. *Preventive Medicine Reports*, *32*.
<https://doi.org/10.1016/j.pmedr.2023.102167>
- Bickel, W. K., Athamneh, L. N., Basso, J. C., Mellis, A. M., DeHart, W. B., Craft, W. H., & Pope, D. (2019). Excessive discounting of delayed reinforcers as a trans-disease process. *Current Opinion in Psychology*. <https://doi.org/10.1016/j.copsyc.2019.01.005>
- Bickel, W. K., Athamneh, L. N., Snider, S. E., Craft, W. H., DeHart, W. B., Kaplan, B. A., & Basso, J. C. (2020). Reinforcer Pathology: Implications for Substance Abuse Intervention. *Current Topics in Behavioral Neurosciences*, *47*, 139–162.
https://doi.org/10.1007/7854_2020_145
- Bickel, W. K., Jarmolowicz, D. P., Mueller, E. T., & Gatchalian, K. M. (2011). The Behavioral Economics and Neuroeconomics of Reinforcer Pathologies: Implications for Etiology and Treatment of Addiction. *Current Psychiatry Reports*, *13*(5), 406.
<https://doi.org/10.1007/s11920-011-0215-1>
- Bickel, W. K., & Vuchinich, R. E. (2000). *Reframing health behavior change with behavioral economics*. Psychology Press.

- Bock, J. E., Tucker, R. P., Brown, R. P., Harrington, E. E., Bauer, B. W., Daruwala, S. E., Capron, D. W., & Anestis, M. D. (2021). Factors contributing to honor-endorsing men's suicide capability: Firearm ownership, practical capability, and exposure to painful and provocative events. *Suicide and Life-Threatening Behavior, 51*(6), 1247–1258.
- Bond, A. E., Bandel, S. L., Rodriguez, T. R., Anestis, J. C., & Anestis, M. D. (2022). Mental health treatment seeking and history of suicidal thoughts among suicide decedents by mechanism, 2003-2018. *JAMA Network Open, 5*(3), e222101–e222101.
- Bond, A. E., Karnick, A. T., Bandel, S. L., Capron, D. W., & Anestis, M. D. (2023). Demographic differences in the type of firearm and location of bodily injury in firearm suicide decedents. *Death Studies, 47*(8), 948–956.
<https://doi.org/10.1080/07481187.2022.2144547>
- Borsboom, D., van der Maas, H. L. J., Dalege, J., Kievit, R. A., & Haig, B. D. (2021). Theory Construction Methodology: A Practical Framework for Building Theories in Psychology. *Perspectives on Psychological Science, 16*(4), 756–766.
<https://doi.org/10.1177/1745691620969647>
- Brown, G. K., Steer, R. A., Henriques, G. R., & Beck, A. T. (2005). The internal struggle between the wish to die and the wish to live: A risk factor for suicide. *American Journal of Psychiatry, 162*(10), 1977–1979.
- Bryan, C. J., Bryan, A. O., & Anestis, M. D. (2022). Rates of Preparatory Suicidal Behaviors across Subgroups of Protective Firearm Owners. *Archives of Suicide Research, 26*(2), 948–960. <https://doi.org/10.1080/13811118.2020.1848672>
- Bryan, C. J., Butner, J. E., May, A. M., Rugo, K. F., Harris, J. A., Oakey, D. N., Rozek, D. C., & Bryan, A. O. (2020). Nonlinear change processes and the emergence of suicidal behavior:

- A conceptual model based on the fluid vulnerability theory of suicide. *New Ideas in Psychology*, 57, 100758.
- Capron, D. W., Bauer, B. W., & Bryan, C. J. (2022). When people die by suicide: Introducing unacceptable loss thresholds as a potential missing link between suicide readiness states and actively suicidal clinical states. *Suicide and Life-Threatening Behavior*, 52(2), 280–288.
- Carleton, R. N., Gosselin, P., & Asmundson, G. J. (2010). The intolerance of uncertainty index: Replication and extension with an English sample. *Psychological Assessment*, 22(2), 396. <https://doi.org/10.1037/a0019230>
- Centers for Disease Control and Prevention. (2023, December 4). *Suicide Data and Statistics | Suicide Prevention | CDC*. <https://www.cdc.gov/suicide/suicide-data-statistics.html>
- Chapman, G. B. (1996). Temporal discounting and utility for health and money. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22(3), 771–791. <https://doi.org/10.1037/0278-7393.22.3.771>
- Chapman, G. B., Brewer, N. T., Coups, E. J., Brownlee, S., Leventhal, H., & Levanthal, E. A. (2001). Value for the future and preventive health behavior. *Journal of Experimental Psychology: Applied*, 7(3), 235–250. <https://doi.org/10.1037/1076-898x.7.3.235>
- Curtin, S., Garnett, M., & Ahmad, F. (2022). *Provisional Numbers and Rates of Suicide by Month and Demographic Characteristics: United States, 2021*. National Center for Health Statistics (U.S.). <https://doi.org/10.15620/cdc:120830>
- Elnour, A. A., & Harrison, J. (2008). Lethality of suicide methods. *Injury Prevention*, 14(1), 39–45. <https://doi.org/10.1136/ip.2007.016246>

- Forte, A., Buscajoni, A., Fiorillo, A., Pompili, M., & Baldessarini, R. J. (2019). Suicidal Risk Following Hospital Discharge: A Review. *Harvard Review of Psychiatry, 27*(4), 209–216. <https://doi.org/10.1097/HRP.0000000000000222>
- Fox, K. R., Harris, J. A., Wang, S. B., Millner, A. J., Deming, C. A., & Nock, M. K. (2020). Self-Injurious Thoughts and Behaviors Interview—Revised: Development, reliability, and validity. *Psychological Assessment, 32*(7), 677. <https://doi.org/10.1037/pas0000819>
- Gilroy, S. P., & Picardo, R. (2022). Applications of operant demand to treatment selection III: Consumer behavior analysis of treatment choice. *Journal of the Experimental Analysis of Behavior, 118*(1), 46–58. <https://doi.org/10.1002/jeab.758>
- Gilroy, S. P., Tucker, R. P., Bauer, B. W., & Patros, C. H. (2021). Contemporary methods in delayed discounting: Applications for suicidology with simulation. *Suicide and Life-Threatening Behavior, 51*(1), 19–26. <https://doi.org/10.1111/sltb.12666>
- Gilroy, S. P., Waits, J. A., & Kaplan, B. A. (2022). Applications of operant demand to treatment selection I: Characterizing demand for evidence-based practices. *Journal of the Experimental Analysis of Behavior, 117*(1), 20–35. <https://doi.org/10.1002/jeab.731>
- Hanratty, D., Kilicaslan, J., Wilding, H., & Castle, D. (2019). A systematic review of efficacy of Collaborative Assessment and Management of Suicidality (CAMS) in managing suicide risk and deliberate self-harm in adult populations. *Australasian Psychiatry, 27*(6), 559–564. <https://doi.org/10.1177/1039856219848832>
- Hemenway, D., & Solnick, S. J. (2015). The epidemiology of self-defense gun use: Evidence from the National Crime Victimization Surveys 2007–2011. *Preventive Medicine, 79*, 22–27. <https://doi.org/10.1016/j.ypmed.2015.03.029>

- Houtsma, C., Butterworth, S. E., & Anestis, M. D. (2018). Firearm suicide: Pathways to risk and methods of prevention. *Current Opinion in Psychology, 22*, 7–11.
- Hursh, S. R. (1991). Behavioral economics of drug self-administration and drug abuse policy. *J Exp Anal Behav, 56*(2), 377–393. CrossRef. <https://doi.org/10.1901/jeab.1991.56-377>
- Jarmolowicz, D. P., Reed, D. D., Francisco, A. J., Bruce, J. M., Lemley, S. M., & Bruce, A. S. (2018). Modeling effects of risk and social distance on vaccination choice. *Journal of the Experimental Analysis of Behavior, 110*(1), 39–53.
- Levitt, E. E., Oshri, A., Amlung, M., Ray, L. A., Sanchez-Roige, S., Palmer, A. A., & MacKillop, J. (2022). Evaluation of delay discounting as a transdiagnostic research domain criteria indicator in 1388 general community adults. *Psychological Medicine, 1–9*. <https://doi.org/10.1017/S0033291721005110>
- Miller, M., Azrael, D., Hemenway, D., & Vriniotis, M. (2005). Firearm storage practices and rates of unintentional firearm deaths in the United States. *Accident Analysis & Prevention, 37*(4), 661–667. <https://doi.org/10.1016/j.aap.2005.02.003>
- Mitchell, S. H. (2019). Linking Delay Discounting and Substance Use Disorders: Genotypes and Phenotypes. *Perspectives on Behavior Science, 42*(3), 419–432. <https://doi.org/10.1007/s40614-019-00218-x>
- Odum, A. L. (2011). Delay discounting: Trait variable? *Behav Processes, 87*(1), 1–9. <https://doi.org/10.1016/j.beproc.2011.02.007>
- Office of the Surgeon General. (2012). *2012 National Strategy for Suicide Prevention: Goals and Objectives for Action*. US Department of Health & Human Services (US). <https://www.ncbi.nlm.nih.gov/books/NBK109917/>

- Reed, D. D., Gelino, B. W., & Strickland, J. C. (2022). Behavioral Economic Demand: How Simulated Behavioral Tasks Can Inform Health Policy. *Policy Insights from the Behavioral and Brain Sciences*, 9(2), 171–178.
<https://doi.org/10.1177/23727322221118668>
- Reed, D. D., Strickland, J. C., Gelino, B. W., Hursh, S. R., Jarmolowicz, D. P., Kaplan, B. A., & Amlung, M. T. (2022). Applied behavioral economics and public health policies: Historical precedence and translational promise. *Behavioural Processes*, 198, 104640.
<https://doi.org/10.1016/j.beproc.2022.104640>
- Roma, P. G., Hursh, S. R., & Hudja, S. (2016). Hypothetical Purchase Task Questionnaires for Behavioral Economic Assessments of Value and Motivation. *Managerial and Decision Economics*, 37(4–5), 306–323. CrossRef. <https://doi.org/10.1002/mde.2718>
- Rudd, M. D., Bryan, C. J., Wertenberger, E. G., Peterson, A. L., Young-McCaughan, S., Mintz, J., Williams, S. R., Arne, K. A., Breitbach, J., & Delano, K. (2015). Brief cognitive-behavioral therapy effects on post-treatment suicide attempts in a military sample: Results of a randomized clinical trial with 2-year follow-up. *American Journal of Psychiatry*, 172(5), 441–449.
- Shenassa, E. D., Catlin, S. N., & Buka, S. L. (2003). Lethality of firearms relative to other suicide methods: A population based study. *Journal of Epidemiology & Community Health*, 57(2), 120–124. <https://doi.org/10.1136/jech.57.2.120>
- Stanley, I. H., Hom, M. A., Rogers, M. L., Anestis, M. D., & Joiner, T. E. (2017). Discussing firearm ownership and access as part of suicide risk assessment and prevention: “means safety” versus “means restriction.” *Archives of Suicide Research*, 21(2), 237–253.

- Strickland, J. C., Reed, D. D., Hursh, S. R., Schwartz, L. P., Foster, R. N. S., Gelino, B. W., LeComte, R. S., Oda, F. S., Salzer, A. R., Schneider, T. D., Dayton, L., Latkin, C., & Johnson, M. W. (2022). Behavioral economic methods to inform infectious disease response: Prevention, testing, and vaccination in the COVID-19 pandemic. *PLOS ONE*, *17*(1), e0258828. <https://doi.org/10.1371/journal.pone.0258828>
- Swift, J. K., & Callahan, J. L. (2010). A delay discounting model of psychotherapy termination. *International Journal of Behavioral Consultation and Therapy*, *5*(3–4), 278–293. <https://doi.org/10.1037/h0100889>
- Tucker, R. P., Crowley, K. J., Davidson, C. L., & Gutierrez, P. M. (2015). Risk factors, warning signs, and drivers of suicide: What are they, how do they differ, and why does it matter? *Suicide and Life-Threatening Behavior*, *45*(6), 679–689.
- Violano, P., Bonne, S., Duncan, T., Pappas, P., Christmas, A. B., Dennis, A., Goldberg, S., Greene, W., Hirsh, M., & Shillinglaw, W. (2018). Prevention of firearm injuries with gun safety devices and safe storage: An Eastern Association for the Surgery of Trauma Systematic Review. *Journal of Trauma and Acute Care Surgery*, *84*(6), 1003–1011.
- Young, M. E. (2018). Discounting: A practical guide to multilevel analysis of choice data. *J Exp Anal Behav*, *109*(2), 293–312. <https://doi.org/10.1002/jeab.316>

Appendix

Vignette for Hypothetical Firearm Decision-making Task

“The prediction of suicide is extremely difficult, but advances in mathematics and technology have helped make major advancements. For example, a large medical center at Vanderbilt University has developed an algorithm using patient health information that predicts who will attempt suicide in the next year with almost 90% accuracy. The following questions ask you to make a decision about what you would do with your firearm(s) if you were told there was a chance you would kill yourself with one of them. For each question, please select the decision you would likely make if you were ever placed in this situation.”

Table 1

Characterization of Study Sample

Participant Characterization (n = 410)			
Age (years)			
Mean (SD)	43.57 (16.25)	Education	
Median (Q1-Q3)	40 (33-53)	Some High School	4 (1%)
Veteran Status		GED	5 (1%)
Yes	126 (31%)	High School Diploma	45 (11%)
No	284 (69%)	Some college but no degree	79 (19%)
Income		Associate degree	39 (10%)
Q1	48,134 USD	Bachelor's degree	124 (30%)
Median	80,790 USD	Some Graduate Education	12 (3%)
Q3	139,397 USD	Graduate Degree	102 (25%)
Gun Counts		Past Suicide Attempt	
Mean (SD)	6.93 (5.31)	Yes	311 (76%)
Median (Q1-Q3)	8 (1-11)	No	99 (24%)
Perceived Home Safety		Secured Firearm Storage	
Very Safe	105 (26%)	Yes	89 (22%)
Somewhat safer than average	127 (31%)	No	321 (78%)
Average	124 (30%)	Firearm Stored with Lock	
Somewhat less safe than average	43 (10%)	Yes	174 (42%)
Very Unsafe	11 (3%)	No	236 (58%)
Race/Ethnicity		Firearm Stored Loaded	
Asian/ Asian-American	10 (2%)	Yes	193 (47%)
Biracial (please describe)	4 (1%)	No	217 (53%)
Black/ African-American	38 (9%)	Intolerance of Uncertainty	
Black/ African-American, Biracial	1 (0%)	Mean (SD)	36.35 (11.01)
Native Indian/ Native American/ Alaskan Native	1 (0%)	Median (Q1-Q3)	37 (28-43)
Not listed	6 (1%)		
Not listed, Biracial	1 (0%)		
White/ Caucasian	342 (83%)		
White/ Caucasian, Asian/ Asian- American	1 (0%)		
White/ Caucasian, Biracial	1 (0%)		
White/ Caucasian, Native Hawaiian, or other Pacific Islander	1 (0%)		
White/ Caucasian, Native Indian/ Native American/ Alaskan Native	3 (1%)		

Table 2

Results of RQ2 Model Fitting

Factor	Estimate	Error	Wald Z	P
Magnitude	-1.376088067	0.280694	-4.90245	9.46E-07
Delay	-1.00633593	0.358423	-2.80767	0.00499
Magnitude: No SI	0.102226316	0.321562	0.317906	0.750556
Magnitude: SI Within the past month	0.927774839	0.420925	2.204136	0.027515
Magnitude: SI More than one year ago	-0.397754526	0.415312	-0.95772	0.338202
Delay: SI Within the past month	-1.231339377	0.426467	-2.8873	0.003886
Delay: SI Within the past year	-0.956078285	0.377673	-2.53149	0.011358
Delay: SI More than one year ago	-0.294750918	0.387998	-0.75967	0.447452
Delay: Some Secure Storage	0.355138479	0.410283	0.865595	0.386712
Delay: Highly Secured Storage	1.077239205	0.380411	2.831774	0.004629
Delay: IU	0.374160457	0.143742	2.603006	0.009241

Note: Contrasts consisted of Magnitude ["Within the past Year"] and Delay ["No Secure Storage"].

Figure 1. Reinforcer-based modeling of perceived likelihood of temporary firearm removal

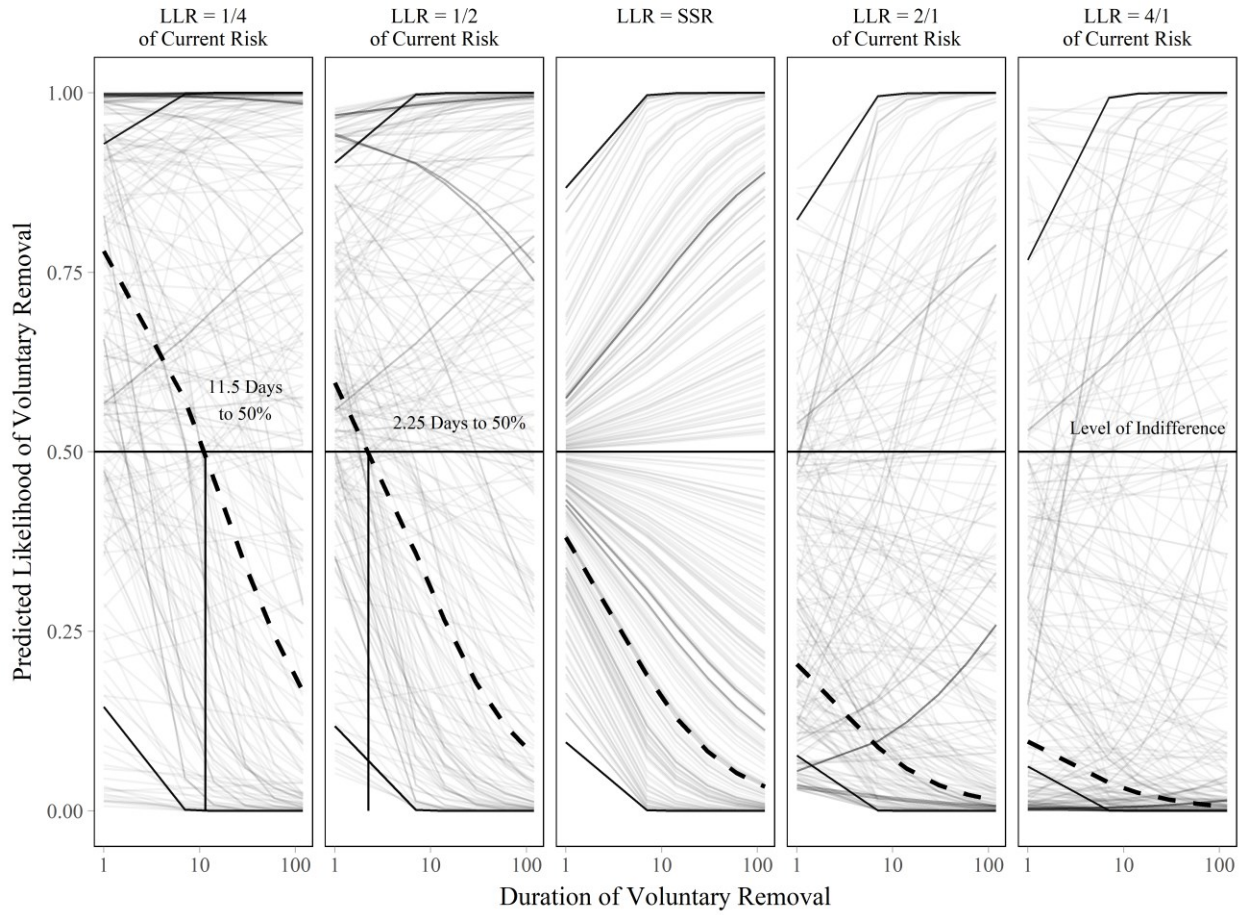


Figure 2. Moderators of perceived likelihood of temporary firearms removal

