DELAY DISCOUNTING OF DIFFERENT OUTCOMES IN A SAMPLE OF AMERICAN INDIAN AND NON-INDIAN COLLEGE STUDENTS

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Abstract: Delay discounting occurs when an individual prefers a lesser amount of an outcome that is available immediately, rather than waiting for the full amount. The present study was a preliminary investigation into delay discounting in a yet unstudied population, American Indians (AIs). AI college students completed a delay-discounting task that consisted of five different outcomes (e.g., money, retirement income, obtaining the ideal body image). An equal-sized group of Caucasian respondents was then matched to the AI sample in terms of sex, age, and grade point average. Results demonstrated that AI and Caucasian respondents sometimes differed in how they discounted certain outcomes, suggesting that the value of these outcomes may differ across ethnicities. Further, the AI participants displayed different rates of discounting across the different outcomes, indicating that those outcomes may hold different values for the AI respondents. The potential value of delay discounting in understanding cross-cultural and intra-cultural differences is discussed and, because of the preliminary nature of the present study, a call for additional research is made.

It is not unusual for people to choose a lesser amount of something in exchange for getting that something immediately, rather than having to wait to get the full amount. For instance, when individuals win the lottery, it is common for them to choose to receive a smaller "lump sum" of cash immediately, rather than having their full winnings paid out in installments across many years (e.g., Baker, Johnson, & Bickel, 2003). This decision sometimes makes intuitive sense because the future is uncertain. In the case of the lottery, one must depend on the institution responsible for paying out the money over time having the continued ability to pay. Further, one's own future is never certain; by waiting, one runs the risk of not surviving long enough to collect the full amount.

The study of how and why people make decisions between getting a certain amount of an outcome now versus waiting for a greater amount of that outcome later is known as the study of temporal or delay discounting (e.g., see Critchfield & Kollins, 2001, or Madden & Bickel, 2010, for reviews). Delay discounting research has its roots in early delay-of-gratification work (Rotter,

1954). Although the concepts are related, delay discounting involves making multiple choices across a series of delays (see Madden & Bickel, 2010). Delay of gratification, on the other hand, often involves a single, dichotomous choice. In terms of delay discounting, how much the subjective value of an outcome decreases as the full amount is increasingly delayed determines the "rate" at which the individual discounts (i.e., a single rate of discounting is calculated across the multiple delays).

The rate of discounting varies systematically as a function of certain factors. For instance, the greater the value of the outcome, the less discounting is observed (e.g., Chapman, 1996; Smith & Hantula, 2008), a finding known as the magnitude effect. Take the situation in which someone owed you $10 but could not pay you the full amount for two weeks. In such a situation, you might be willing to accept $9 today rather than waiting two weeks. On the other hand, if someone owed you $10,000, you would be unlikely to accept $9,000 today rather than waiting two weeks for the full amount. Thus, over the same delay, the value of the smaller amount has been discounted by at least 10% whereas the value of the larger amount has not.

The study of delay discounting has received a great deal of research interest over the past decade because the rate at which people discount future outcomes has been shown to vary as a function of group membership, psychological characteristics, and/or experience. Such findings are of interest because they provide insight into the decision-making process that helps define those variables, as well as raising the issue of whether those variables change as a function of delay discounting or whether the ways in which people discount delayed outcomes changes as a function of those variables. For example, individuals who are pathological gamblers tend to discount hypothetical monetary rewards more steeply than do individuals who do not gamble pathologically (e.g., Dixon, Marley, & Jacobs, 2003; see Petry, 2005, for a review), raising the question of whether increased discounting leads to pathological behavior, pathology alters discounting, or there are other factors that lead to both. Ostaszewski (1996) showed that extraverted, highly impulsive respondents displayed greater rates of discounting than did their counterparts. Do changes in discounting lead one to be more extraverted? Logue and Anderson (2001) found that experienced university administrators discounted future budgetary amounts more steeply than did less experienced administrators, a finding the authors suggested indicated that experienced administrators have learned not to trust promises of future budget increases. Alternatively, are administrators inherently conservative?

As noted above, finding that rates of delay discounting vary across groups is interesting, but the results are correlational in nature. What is potentially more interesting is the finding that measures of delay discounting may predict actual behavior in certain situations (e.g., Weatherly, Marino, Ferraro, & Slagle, 2008). If that is the case, then knowing how an individual discounts delayed outcomes could potentially be used in a preventative fashion by allowing therapists or

counselors to address issues before they become problematic for the individual. That is, knowing how a student discounts a certain outcome may inform school counselors as to whether the student may be at risk for engaging in problem behavior (e.g., experimenting with drugs or sex). Furthermore, measures of delay discounting could be used as dependent measures that might indicate whether or not a particular treatment is working. For example, if delay discounting contributes to pathological gambling, then a successful gambling treatment should produce changes in the individual's rate of discounting.

To our knowledge, no investigations have yet attempted to study delay discounting in AIs, although some (e.g., Granzberg, 1973) have attempted to study delay of gratification. Studying delay discounting among AIs would seem inherently warranted, if not socially compelling, for several reasons. One reason is theoretical. That is, does delay discounting vary as function of culture or ethnicity? Although very few studies have attempted to address this question, results from one cross-cultural study (Du, Green, & Myerson, 2002) would suggest it does. Du et al. found differences in the rate that American, Chinese, and Japanese graduate students temporally discounted hypothetical monetary amounts. Finding differences in delay discounting across different cultures and ethnicities would be of interest because the study of those differences could potentially provide a metric of the values held by different cultures.

A second reason for studying delay discounting in AIs is a practical one. AIs differ from the non-AI majority population in regards to a number of (mental-) health-related factors, including substance abuse, pathological gambling, and psychopathology (e.g., McDonald & Chaney, 2003; Wardman, el-Gueblay, & Hodgins, 2001). Given that research has shown that delay discounting differs as a function of disorders such as pathological gambling (e.g., Dixon et al., 2003) and substance abuse (Petry, 2001; Petry & Casarella, 1999), one might expect to find that AIs differ in their delay discounting relative to their majority-population counterparts. On the other hand, if similar rates of delay discounting were to be found between AIs and non Indians, then such results would suggest that the higher rates of disordered behavior among AI populations are likely the outcome of other factors not directly related to decision-making characteristics (e.g., socioeconomic status, educational opportunities, degree of acculturation).

A third reason to pursue the study of delay discounting in AI populations is that it may ultimately shed light on cultural differences between tribes. Although the full pursuit of this reason was beyond the scope of the present preliminary investigation, it may be the case that tribes in more impoverished areas may show differences in discounting of monetary outcomes relative to tribes in less impoverished areas. Similarly, differences may be found in how members of different tribes discount outcomes related to their own health, personal well-being, or government policies. Thus, knowing how members of certain tribes discount delayed outcomes could be informative for

policy makers at both the local and national levels. For example, if one knew how tribal members discounted particular outcomes (e.g., the building of a new fire station), then policy makers would have a better idea about how much the members might be willing to pay now to get those outcomes at some date in the future.

The present study was a preliminary investigation into measuring delay discounting in a sample of AI university students. Two different groups of AI students completed discounting tasks on a different set of five outcomes and the results were then compared to an equal-sized group of Caucasian students matched to the AI sample in terms of sex, age, and grade point average. Two issues were of particular interest in this preliminary investigation. First, would AI and Caucasian students differ in how they discounted the different outcomes? Second, what differences would be observed within the AI samples in how the respondents discounted the different types of outcomes? Because of the exploratory nature of this study, we did not have *a priori* hypotheses about the answers to these questions.

METHOD

Participants

The participants were undergraduate college students enrolled in an abnormal, developmental, educational, introductory, or personality psychology class at the University of North Dakota. In all, a total of 791 participants were surveyed. A total of 26 of these students self-identified as AI. From the pool of respondents who self-identified as Caucasian, 26 were matched to the sample of AI respondents by three factors: sex, age, and self-reported grade point average. This process involved matching each individual AI participant with a Caucasian participant based on the above characteristics. Participants were matched on grade point average so as to help ensure similar academic performance between the individuals. Thus, the data from 52 respondents are reported in the present preliminary investigation.

Materials and Procedure

Participants completed a questionnaire packet in their particular psychology course. Each questionnaire packet contained three items. The first was an informed consent cover sheet outlining the research as approved by the Institution Review Board at the University of North Dakota. The second was a demographic form that asked participants about their sex, age, grade point average, and ethnicity, as well as a number of additional pieces of information (e.g., political affiliation, smoking habits, gambling frequency). The third was a series of delay-discounting questions that pertained to five different outcomes.

The delay-discounting questions were in the form of "fill in the blank" (Chapman, 1996; and see Smith & Hantula, 2008). Each set of questions had five different types of outcomes. Because no research on delay discounting in AIs exists, the outcomes tested in the present investigation were wide ranging (i.e., not limited to one specific outcome such as a hypothetical amount of money). Set A asked participants about $1,000 they had won, $100,000 they had won, 100 free packs of cigarettes[1], finding the perfect partner through a dating service[2], and obtaining the ideal body image through diet and exercise. Set B asked participants about $1,000 they were owed, $100,000 they were owed, medical treatment for a "serious" disease they were suffering from, their annual retirement income relative to $100,000 per year, and a Federal legislation policy reforming the American educational system. The hypothetical monetary outcomes were chosen because money is the typical outcome that is investigated in studies of delay discounting (see Madden & Bickel, 2010). Two different monetary amounts were included as a manipulation check. That is, previous research has demonstrated that people display less delay discounting as the magnitude of the outcome is increased (e.g., Chapman, 1996). Thus, one would expect to see less discounting for the $100,000 than for the $1,000. Cigarettes were chosen because previous research has linked the discounting of cigarettes to that of money (e.g., see Yi, Mitchell, & Bickel, 2010). The outcomes of dating partner, ideal body image, medical treatment, and retirement income were chosen because they potentially addressed aspects of people's well-being, and one might expect them to be treated differently than tangible outcomes (e.g., a sum of money). Federal legislation was chosen because, although it might indirectly affect the respondents, it represented an outcome that might be experienced by others. The exact wording of these questions can be found in Weatherly, Terrell, and Derenne (2010).

Each question was asked eight different times, with the wording of the question only varying as a function of the delay the person would have to wait to receive the full amount of the outcome. The eight delays were one week, two weeks, one month, three months, six months, one year, five years, or ten years. For each question, the respondent was required to provide an amount or percentage of the outcome he or she would accept today rather than waiting the specified period of time. Thus, each packet of delay-discounting questions contained 40 total questions (5 outcomes X 8 delays). The order of the questions was then randomized, and all participants who completed a certain set of questions did so in the same random order. Each section of a particular class completed the same set of questions (e.g., one section of students enrolled in developmental psychology completed Set A, while another section of students in developmental psychology completed Set B). Because we did not have *a priori* knowledge of the ethnicity of the students in the different classes, it was not possible to ensure that an equal number of AI students completed Set A and Set B of questions.

[1]For this particular outcome, respondents were asked to "suppose" they smoked cigarettes.
[2]For this particular outcome, respondents were asked to "suppose" they were single.

Data Analysis

There are several different ways to analyze data from delay-discounting tasks such as the ones used in the present study (see Madden & Bickel, 2010, for a thorough discussion). Each involves analyzing the data for each outcome across all the delays tested and determining a single discounting "rate." This approach is taken because delay discounting is conceptualized as a process, rather than individual decision points, and the "rate" of discounting theoretically encompasses the decision-making process for that particular respondent for that particular outcome.

One way to analyze delay-discounting data is to calculate the area under the curve (AUC) created by the indifference points across the different delays using the following equation (Myerson, Green, & Warusawitharana, 2001):

$$x_2 - x_1 [(y_1 + y_2)/2] \quad \text{(Equation 1)}$$

The measure of temporal discounting in Equation 1 is the result of summing the AUC across the trapezoids calculated across the different delays. The result is a proportion than can vary between 0.0 and 1.0. Small AUC values represent steep discounting of that outcome (i.e., a willingness to take a small amount of the outcome rather than waiting); large AUC values represent little discounting of that outcome (i.e., a willingness to wait for the full amount). Again, it is important to note that AUC measures discounting across all of the tested delays and summarizes discounting as a single value. As noted above, this conversion is typical within the field because delay discounting is considered a process, not a single decision at any given delay.

Another popular technique for analyzing delay-discounting data is fitting the indifference points across the delays with the following hyperbolic equation (e.g., Mazur, 1987):

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

In Equation 2, V stands for the subjective value of the delayed outcome, A stands for the amount of that particular outcome, D stands for the delay to the full amount of the outcome, and *k* is a free parameter. The value of *k* describes the rate at which discounting occurs and, when this type of analysis is employed, serves as the dependent measure of discounting. In Equation 2, the higher the value of *k*, the more the respondent is discounting that particular outcome.

Although Equation 2 is perhaps the most popular technique for analyzing discounting data, we employed Equation 1 for the present preliminary investigation. This decision was made for several reasons. First, Equation 2 was developed using a specific type of discounting task (i.e., a binary-choice procedure). The present study used the fill-in-the-blank method, not a binary-choice procedure (see Smith & Hantula, 2008, for a discussion). Second, as outlined by Myerson et al. (2001), Equation 2 assumes that delay discounting follows a particular form (i.e., a hyperbola). Discounting may or may not take this form, but we had no theoretical reason to expect that to be

true. Equation 1, on the other hand, is atheoretical in terms of the form the resulting discounting curve takes. Third, Equation 2 produces a skewed distribution because *k* has a lower bound (i.e., 0), but no upper bound. Thus, data transformations are required before parametric statistics are employed. Equation 1 does not suffer from this difficulty. Fourth, and perhaps most importantly, the AUC produced by Equation 1 is standardized across outcomes, whereas the value of *k* in Equation 2 depends on the scale. Because the present preliminary investigation asked respondents about outcomes that differed along a number of different factors (e.g., domain, scale), the use of Equation 1 was deemed most appropriate.

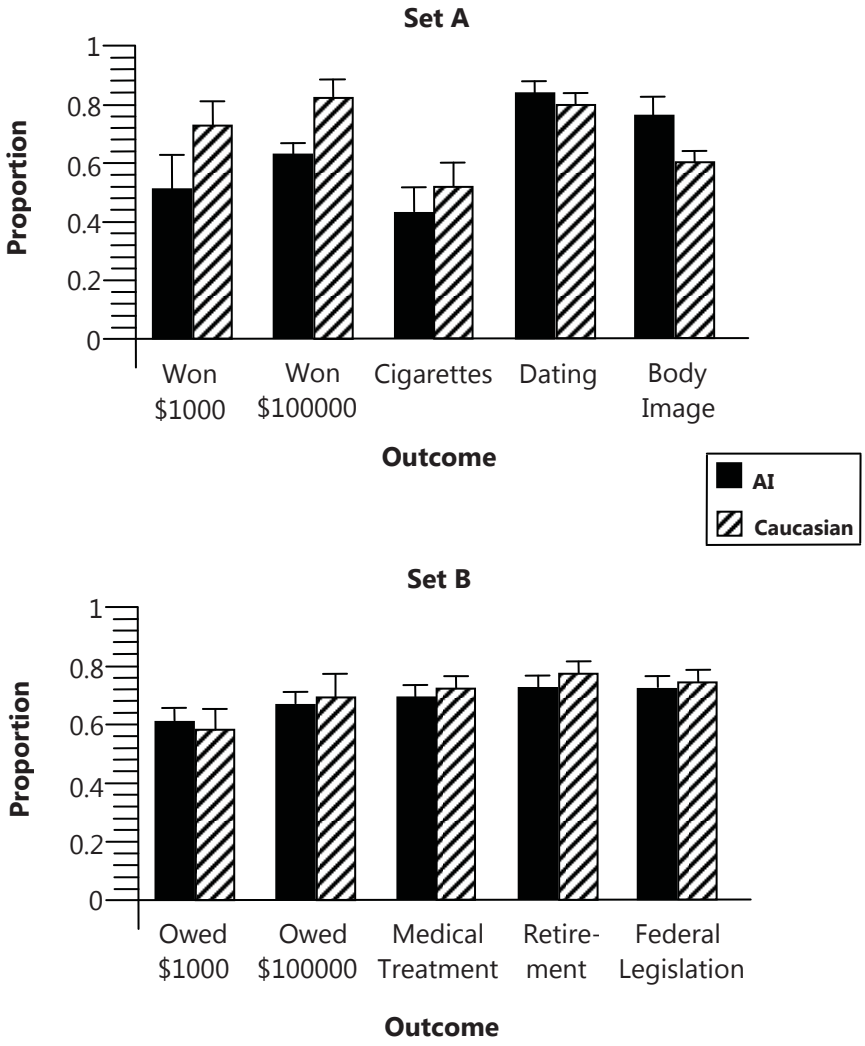
RESULTS

Set A

A total of eight respondents (6 females, 2 males) who completed Set A of delay-discounting questions self-identified as AIs. Eight respondents who self-identified as Caucasian were then individually matched to each of the AI respondents in terms of sex (6 females, 2 males), age, and grade point average. Statistical analyses indicated that the groups did not differ in terms of age (AI = 19.63 years; Cauc = 20.5 years; $F(1, 14) < 1$, $\eta^2 = .014$) or grade point average (AI = 2.20 out of 4.0; Cauc = 2.24 out of 4.0; $F(1, 14) < 1$, $\eta^2 = .002$). An alpha level of .05 was used to judge statistical significance for all analyses.

The goals of the present study were to determine if delay discounting differed between AI and non-AI participants, whether such a difference varied across different outcomes, and whether AI participants differentially discounted the different outcomes. Toward that end, the top graph in Figure 1 presents the amount of discounting observed for both groups of respondents across the five different type of outcomes. Higher AUC proportions in Figure 1 represent less delay discounting. The data suggest that differences in discounting existed both between groups and across outcomes. The data used to construct the top graph of Figure 1 were subjected to a two-way (Ethnic group X Type of outcome) mixed-model analysis of variance (ANOVA). In this ANOVA, ethnic group served as the between-groups variable and type of outcome was a repeated measure. Results showed that the main effect of ethnic group was not significant, $F(1, 14) < 1$, $\eta^2 = .065$, indicating that, across the five different outcomes, levels of discounting did not differ between the AI and Caucasian respondents. The main effect of type of outcome was significant, $F(4, 56) = 8.28$, $p < .001$, $\eta^2 = .372$, indicating that different rates of discounting were observed across the five different outcomes. The interaction between ethnic group and outcome was also significant, $F(4, 56) = 3.04$, $p = .024$, $\eta^2 = .179$., indicating that the changes in discounting rates across the different outcomes differed as a function of ethnic group.

Figure 1
Discounting Rates



Discounting Rates Observed for Both Sets of Outcomes. Presented is the proportion of the area under the discounting curve for the mean of all AI and Caucasian respondents for each of the outcomes completed by the different groups. The top graph presents results from respondents who completed Set A (*n* = 8) of delay-discounting questions. The difference in discounting of body image between AI and non-AI participants was significant. The bottom graph presents results from respondents who completed Set B (*n* = 18). No significant between-group differences in discounting were observed. In both graphs, high proportions represent low rates of delay discounting. The error bars represent one standard error of the mean across participants for that particular outcome.

Follow-up analyses were conducted due to the significant interaction. Comparison of the different groups on each outcome showed that AI and Caucasian respondents did not differ in their discounting of cigarettes, $F(1, 14) < 1$, $\eta^2 = .035$, or dating partner, $F(1, 14) < 1$, $\eta^2 = .029$. The differences approached statistical significance for the monetary amounts of winning $1,000, $F(1, 14) = 4.11$, $p = .062$, $\eta^2 = .227$, and $100,000, $F(1, 14) = 4.49$, $p = .052$, $\eta^2 = .243$. The difference between groups was significant for body image, $F(1, 14) = 4.92$, $p = .044$, $\eta^2 = .260$, with Caucasian respondents discounting body image to a greater degree than the AI respondents.

A one-way repeated-measures ANOVA was conducted on the discounting of the five different outcomes by the AI respondents. Results showed that discounting differed significantly across the outcomes, $F(4, 28) = 6.59$, $p = .001$, $\eta^2 = .485$. *Post hoc* Tukey HSD comparisons indicated that the AI respondents discounted cigarettes significantly more than they did a dating partner and their own body image. Further, they discounted winning $1,000 significantly more than they did a dating partner.

Set B

A total of 18 respondents (15 females, 3 males) who completed Set B of delay-discounting questions self-identified as AIs. Eighteen respondents who self-identified as Caucasian were then individually matched to the AI respondents in terms of sex (15 females, 3 males), age, and grade point average. Statistical analyses indicated that the groups did not differ in terms of age (AI = 22.89 years; Cauc = 22.17 years; $F(1, 34) < 1$, $\eta^2 = .003$) or grade point average (AI = 2.92 out of 4.0; Cauc = 2.92 out of 4.0; $F(1, 34) < 1$, $\eta^2 = .000$).

The bottom graph in Figure 1 presents the amount of discounting observed for both groups of respondents across the five different outcomes. Like Set A, differences in discounting are apparent across the different outcomes. However, the differences between groups were not large. The data used to construct the bottom graph of Figure 1 were subjected to a two-way (Ethnic group X Type of outcome) mixed-model ANOVA identical to that used to analyze the data from Set A. Results showed that the main effect of ethnic group was not significant, $F(1, 34) < 1$, $\eta^2 = .003$, indicating that, across the five different outcomes, levels of discounting did not differ between the AI and Caucasian respondents. The main effect of type of outcome was significant, $F(4, 136) = 7.03$, $p < .001$, $\eta^2 = .171$, indicating that discounting differed across the five outcomes. In this analysis, the interaction between ethnic group and type of outcome was not significant, $F(4, 136) < 1$, $\eta^2 = .008$.

The discounting data of the AIs across the five different outcomes in Set B were analyzed by conducting a one-way repeated-measures ANOVA. Results showed that discounting differed significantly across the different outcomes, $F(4, 68) = 2.64$, $p = .041$, $\eta^2 = .134$. *Post hoc* Tukey

HSD comparisons indicated that the AI respondents discounted being owed $1,000 significantly more than they did their annual retirement income. Differences between all the other outcomes did not reach statistical significance.

DISCUSSION

The present study was intended as a preliminary investigation to better understand the complex process of delay discounting in a cross-cultural context. Several intriguing findings resulted. First, AI respondents discounted an ideal body image significantly *less* than did a matched Caucasian sample, suggesting that this outcome had a *greater* value for the AI respondents than for the Caucasian respondents. Cross-ethnic differences in discounting approached, but did not reach, significance for several other outcomes. Despite the lack of statistical significance, the effect sizes for these differences were large (Cohen, 1988). Thus, it seems likely that future studies that employ larger sample sizes may find additional cross-cultural differences in rates of delay discounting of different outcomes.

Differences in rates of delay discounting also were observed across the different outcomes for the AI participants, indicating that the respondents may have placed different values on the different outcomes. For instance, respondents who completed Set A discounted cigarettes at a significantly greater rate than they did a dating partner or their own ideal body image. They discounted money more than they did a dating partner. Respondents who completed Set B discounted $1,000 at a significantly greater rate than their annual retirement income. These differences suggest that the outcomes of a dating partner, body image, and retirement income held great value for the AI respondents while outcomes such as cigarettes did not. These differences potentially represent a novel way to assess intra-cultural values. Future research may want to focus on expanding the number and type of outcomes studied, as well as diversifying the sample of AI respondents so that generational, tribal, or other factors (e.g., living on or off the reservation) can be assessed.

With that said, we readily recognize that the present study had many shortfalls which limit the generalizability of the results. First, an increased sample size would obviously lend greater power and flexibility to statistical examinations. Second, the representative aspects of the sample could be more sophisticated as well. More specifically, all of the participants in the present study were enrolled in a four-year university. Future research efforts could certainly focus on reservation and urban Indian participants. Additionally, consideration of the degree of biculturalism and the extent to which it may influence delay-discounting behaviors might prove worthy if not fascinating. Finally, examination of potential differences between younger and older participants, and participants with varying levels of education, would also be strongly suggested.

Further manipulations of study methodology could also include more detailed consideration of the outcomes being discounted. For example, what—if any—differences may be observed between objective and tangible outcomes such as clean drinking water or money, as opposed to more subjective outcomes such as adherence to tribal values, customs, and ceremonies? Future researchers might also creatively consider ways to incorporate sociocultural variables that have a significant impact on many Native communities, such as obesity, alcohol abuse, poverty, diabetes, and depressive disorders.

It is our hope that this preliminary investigation serves to generate research on delay discounting in AI populations. A recent book published by the American Psychological Association (Madden & Bickel, 2010) was devoted to the study of delay discounting. Completely absent from that text, however, was the potential influence of cultural variables in the process of discounting. Given that delay discounting has been linked to many mental health issues (e.g., substance abuse, pathological gambling, health decision making; see Madden & Bickel, 2010) that impact AI populations, understanding discounting in AIs would seem a worthwhile pursuit. It would be especially interesting to determine whether the disparities in mental health issues observed between AI and non-AI populations will also be observed in measures of delay discounting. Although one cannot generalize the present results with excessive confidence, the preliminary data in this study suggest that the answer will be "no."

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