2023

Time is Money: Using Delay Discounting and Reflection to Improve Decision-Making in the Iowa Gambling Task

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By

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2023

Presented in

partial fulfillment of the requirements for

Bachelor's degree in Psychology

Hollins University

Roanoke, Virginia

May 2023

Director of Thesis: Dr. Alex Wooten

Department: Psychology

Acknowledgments

First and foremost, I would like to express my gratitude to my supervisor, Dr. Alex Wooten, for his unwavering support, guidance, humor, and encouragement throughout my undergraduate journey. Additionally, my advisor, Dr. Richard Michalski provided me with encouragement and advice at every hurdle of my undergraduate. Their consistent trust and confidence in me have allowed me to pursue my interests and complete my undergraduate degree. This thesis would not have been possible without their invaluable guidance and support.

I would also like to express my sincere gratitude to my parents for their sacrifices, patience, and encouragement throughout my academic journey. Thankful to my support system: De Faustina Camacho, Zahin Mahbuba, Dionne Torres, Megan Brown, Aqsa Fazal, Lisa Okolo, Kiran Gautam, Sajila Kanwal, and Max Kreutzer for their continuous love and support for me during my time at Hollins University. Without them, a lot of this work could not have been done. I will always cherish the memories we have created together.

Lastly, I want to thank the wonderful participants for my thesis who so generously devoted their time and shared their life stories with me. Without their participation, this thesis would not have been possible.

Abstract

Gambling disorder is described as a persistent and reoccurring behavior that leads to distress and significant impairments in relationships, jobs, or career opportunities in the DSM V (American Psychiatric Association, 2013). With gambling behaviors on the rise, it is crucial to understand what makes one individual more likely than another to develop a gambling disorder. Impaired decision-making has been associated with problematic gambling behaviors, and delay discounting has been related to multiple behaviors such as alcohol use, drug use, and gambling. This study investigates the relationship between delay discounting and performance on the Iowa Gambling Task (IGT), a commonly used decision-making task in the field of psychology. Delay discounting refers to the tendency to devalue rewards as the delay in receiving them increases. The hypothesis is that individuals who exhibit high levels of delay discounting may be more likely to perform poorly on the IGT, which requires participants to make decisions based on long-term outcomes rather than immediate rewards. However, studies have observed reflective feedback can improve decision-making. The participants were assessed for delay discounting using a standard questionnaire and then performed the IGT with or without reflective feedback. The results of the study provide support for the hypothesis, as those with higher levels of delay discounting exhibited poorer performance on the IGT. This study highlights the importance of cognitive operations and feedback during complex tasks such as the IGT.

Keywords: decision-making, gambling, delay discounting, Iowa Gambling Task, feedback, cognition

Using Delay Discounting and Reflection to Improve Decision-Making in the Iowa Gambling Task

In 2020 the global gaming revenue for social casino gambling was around 6.2 billion U.S dollars. This excludes online gambling which amidst the pandemic became much more prevalent (Clement, 2021). With gambling behaviors on the rise, some individuals tend to develop addictive gambling tendencies. Excessive gambling can lead to a gambling disorder which is described as a persistent and reoccurring behavior that leads to distress and significant impairments in relationships, jobs, or career opportunities in the Diagnostic and Statistical Manual of Mental Disorders V (DSM V; American Psychiatric Association, 2013). Many studies have looked at what makes one individual more likely than another to develop a gambling disorder (Ruiter et al. 2009; Mackillop et al. 2014).

Impaired decision-making has been researched intensively in the clinical setting and is associated with problematic gambling behaviors (Mackillop et al., 2014), food consumption (Pignatti et al., 2006), and addiction (Bechara & Martin, 2004). Theories regarding pathological gambling can be narrowed to four specific domains: decision-making, impulsivity, cue reactivity, reward sensitivity. First, impaired decision making can happen when individuals seek the immediate rewards without giving much thought to the long-term consequences (Ciccarelli, et al.,2016). Pathological gamblers have relatively shorter temporal windows into the future. This impairs their decision-making and leads them to discount the future when presented with a more appealing immediate reward and can lead to addiction, obesity, and most relevant for this paper pathological gambling (Epstein et al., 2010; Bickel & Marsch, 2001). The second factor is impulsivity, this is also often called disinhibition. Where a lack of cognitive skills can lead to poorly thought-out decisions. The third factor is cue reactivity or the urge to gamble often

triggered by gambling-related cues much like drug use. Lastly, the factor of reward-punishment sensitivity is also closely associated with Gray's reinforcement sensitivity theory where participants are heavily motivated by rewards or demotivated by punishment (van Holst et al., 2010). However, for this study, I focused on the more prevalent factor of impaired decision-making and its relationship with gambling behavior in college students to better develop effective prevention and treatment strategies. To better understand impaired decision-making and gambling behavior research I will provide the relevant background in the field.

Background Literature

Decision-making relies on cognitive operations to choose the better option between choices A and B. The renowned economist, Adam Smith, first mentioned the underlying idea of the rational choice theory stating that individuals act out of self-interest, and this often involves choosing the outcome that yields the greatest returns and fulfills their personal objectives (Smith, 1776). It is relevant to individuals, businesses, consumers, families, and societies. However, behavioral economics has used a psychological approach to refute the rational choice theory stating that people are influenced by emotions, personal beliefs, motivations, socioeconomic status, personality, and other internal and external factors that can often prevent them from making the best rational decision (Thaler, 2017). Such dysfunction in rational thinking leads to cognitive distortions and is also related to maladaptive behaviors like drug use, gambling, eating disorders, adolescents, and even individuals in poverty.

Delay Discounting

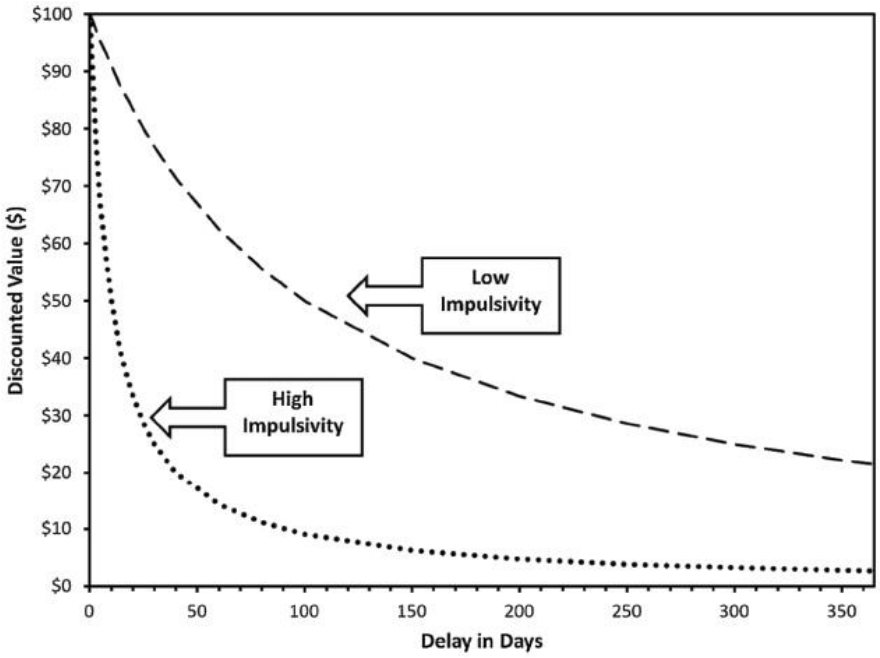
The theory of delayed discounting proposes that individuals are more likely to prefer short-term rewards over delayed rewards because they tend to discount the value of a long-term reward the longer the wait period increases is known as delay discounting (e.g. Radu et al.,

2011). Delay discounting has been related to multiple behaviors like alcohol use, discounting of monetary rewards, cocaine and heroin use, gambling, and smoking (Bickel & Marsch, 2001). There are few studies looking at how delay-discounting may be used to predict certain patterns of impaired decision-making, especially with monetary outcomes in individuals without any pathological gambling addiction. A life-span comparison study found that the discounting tendency of an individual stays reliably consistent over time and is based on certain personality traits as well. However, the tendency to discount the future for immediate gratification decreases over the lifespan (Green et al., 1994).

The most commonly used measure for delay discounting is the Monetary Choice Questionnaire (MCQ), a 27-item self-administered assessment tool. In this measure, the participant chooses between a smaller, immediate monetary reward or a larger, delayed monetary reward. For example, $15 today or $35 in 13 days. The test is scored by calculating where the respondent's answers place amid reference discounting curves measured by a k value for each participant. The k value is a parameter to measure the steepness of the discounting curve. If placement is along the steeper curve, it indicates higher levels of impulsivity and a higher k value that shows a greater preference for immediate rewards over delayed rewards (see Figure 1; Gray et al., 2016).

Figure 1

Delay Discounting curve.



Note: Hyperbolic delayed reward discounting curves reflecting the discounted subjective value of $100 delayed from 1 day to 1 year. Figure from MacKillop (2013)

The mechanisms behind delay discounting are poorly understood. However, certain traits associated with discounting behaviors are related to better cognitive processes like increased self-control abilities, patience, and calculated risk-taking (Burst et., al 2009). Researchers have also examined whether certain personality traits such as extraversion was a predictor of greater discounting rates while emotional stability predicted lower discounting rates (Hirsh et., al 2008). This highlights that certain traits can be used to calculate an individual's predisposition to develop gambling or addictive behaviors.

Interventions

Despite the large amount of research demonstrating the temptation to pick immediate rewards over the long term, there has been little research investigating attempts to reflect and activate a more deliberate, calculated thinking approach to prefer long-term rewards over the short term. Therefore, I also plan to test an intervention to observe possible changes in decision-making for participants that allow them to prefer long-term rewards over short-term rewards. Rung et al. (2019) focused on some aspects that might help reduce delayed discounting and found framing effects to be effective. Framing effects focus on how the alternatives of a decision are described. They examined approaches to rephrase questions and focus more on the forgone benefit of the option. For example, emphasizing on choosing $15 today and $0 in 13 days, or $35 in 13 days and $0 today. Introducing the $0 condition highlights the lack of a reward in the future and lowers long-term discounting by improving the importance of the long-term reward. Another intervention is the temporal attention shift which consists of shifting the participant's attention to a different time point, to adopt a more long-term perspective. This can involve past events or future projections by the participant to self-reflect or self-project and modify their perspective on time and expectantly their discounting rates. Radu et al.,(2011) tested how drawing away attention from the now and focusing their attention on the past or future could help reduce preference for immediate rewards. They found the temporal attention shift intervention to be more effective than framing effects

Another intervention to improving decision-making is Episodic Future Thinking (EFT). This focuses on having participants think about events that might be happening a year from now when the reward occurs. For example, participants could be told to imagine they will be spending time with their 5-year-old son or celebrating their anniversary, going on vacation. They are then asked to imagine specific details of these events as well, to generate a positive thinking

cue that makes them feel happy. Though episodic future thinking is a new avenue in research it can be a valuable tool for better decision-making. By mentally simulating possible future events, individuals can consider the potential outcomes of their choices, weigh the risks and benefits of different options, and make decisions that are more likely to lead to positive outcomes. However, not everyone may equally profit from EFT such as individuals with disorders like anxiety or depression. These populations often find it more difficult to conjure positive images of the future (Gamble et al., 2019)

In Daniel Kahneman's book "Thinking Fast and Slow" (2011). Kahneman talks about two schools of cognitive thinking. The first one is called System 1, which is described as the more intuitive and automatic system. For example, instinctive actions like knowing how to tie your shoelaces, or pulling one's hand away from a hot stove. While the second one System 2 is a more analytical and reflective system. For example, solving complex calculus problems, or parallel parking. Kahneman states that system 1 is automatically involved in decision-making but it can require assistance from system 2. However, individuals don't always activate system 2 for complicated decisions, and may need to be activated for optimal decision-making. By reflecting and thinking more deeply about our decisions instead of allowing system 1 to solely decide. In order to activate system 2 tasks like engaging feedback and active reflection questions are employed which help initiate a more analytical thinking process.

An effective way to amend gambling behavior and exert a reflective mindset or system 2 as stated by Kahneman is to provide feedback. There are different feedback techniques that have been used to improve and change participants' maladaptive behaviors. Some types of feedback that can be helpful are informational feedback where individuals are provided with personalized feedback to help adjust their behaviors. For example, presenting participants with the time and

money they have spent at their gambling session can allow individuals to make better-informed decisions and encourages greater monitoring of their behavior. Similarly, Wood and Wohl (2015) executed a study where participants were given informational feedback based on color-coded gambling risk levels with Green (no-risk decision-making), yellow (at-risk decision-making), and Red (problematic play) categories. Individuals participating in gambling tasks would be provided with information about the level of risk involved in their decision-making, enabling them to adjust their behavior accordingly. Ideally, green was the safe zone and yellow and red signified that a change in decision-making behavior was needed. They found that upon informational feedback about behavior in online gambling tasks the yellow(at-risk) group individuals most significantly improved their gambling decisions by depositing and gambling less money over a 24-month period compared to those who received no personalized feedback. Another feedback example includes social feedback from close friends, families, and acquaintances that help individuals be held accountable for their actions while also providing motivation for rehabilitation. Research has seen the negative impacts gambling behaviors can have on familial relationships and social ties. However, it has been observed that individuals with greater family support and involvement have beneficial coping skills for problematic gambling behaviors even when individuals may not be in treatment (Kourgiantakis et al., 2013). Other interventions may involve voluntary limit set by the participant that allows them to be updated on how much of their limit they have already lost. However, studies didn't always find this to be an effective intervention. Ivanova et al. (2019) observed no differences in expenditure frequency and gambling deposits despite having a set limit. It is also important to note that not all individuals develop problematic addictive behaviors. For example, a study looking at the behavioral intentions of alcohol consumers observed that when individuals had set goals and

desire to achieve abstinence they were influenced by motivational and cognitive intentions to work towards the goal and change their behavior just 2 weeks later. Similar theories can be applied to addictive behaviors like gambling, obesity, and addiction (Prestwich et al., 2008). This brings us to realize that there are other factors like individual motivation and varied personality traits that may be contributing to a lack of cognitive functioning and poor decision-making.

Predictions

Using Kahneman's theories and Informational feedback interventions I designed the study to allow participants to participate in the Iowa Gambling Task (IGT; Bechara et al., 1994) and used a delay discounting k value to predict their behavior. It is used to study decision-making and impulsive behavior. The IGT has been used to study substance abuse, gambling, and risk-taking behaviors among other variables (Mackillop et al., 2014)

It is a good identifier for various maladaptive behaviors (Bechara & Martin, 2004). I also looked at different factors like GPA, socioeconomic status, political affiliation, and age to observe patterns in gambling behavior. As some studies found that high risk players had lower reported GPA (Latvala et al., 2019) and often external factors like poverty may influence gambling problems (van der Maas, 2016). Based on these studies I hypothesized that a) individuals who score a very high k value on the delay discounting MCQ will be more likely to display risky behavior and display worse decision-making during the IGT, b) reflective feedback will help improve long-term behavior and help participants amend their behavior. Lastly, I hoped to observe an exploratory effect between progress and behavior, k value, GPA, democratic/republican affiliation, and socioeconomic status.

Method

Participants

Participants were recruited from a college campus through classes, mass email, flyers around campus, and a link posted on the university's social media in exchange for extra credit. Participants were also entered in a raffle for a $25 Amazon gift card. Basic demographic information was collected including age, grade point average, socioeconomic status, and political affiliations. The demographics included age (Mean age = 20.5, SD = 1.80), gender, class year, and campus leadership positions.

Design

I used a 2x2 mixed-subjects design. There were 2 independent variables. Feedback was manipulated between subjects and progress was manipulated within subjects. The first independent variable Feedback (Present or Absent) was presented to participants on the 50th trial .Our second independent variable was progress over 100 trials in the IGT. We separated 100 trials into blocks of 20 to analyze progress and changes in behavior. The dependent variables were discounting rates measured by the MCQ, and impaired decision-making severity measured by the IGT. Greater risk-taking and gambling severity were operationalized by the mean advantageous choices and disadvantageous decisions a participant made. Progress over 100 trials was also measured by advantageous decisions made over time. The experiment took approximately 20 minutes to complete and Hollins Research Review Committee (HRRC) approval was obtained.

Measures

The 27 Monetary-Choice Questionnaire (MCQ; Kirby et. al,1999) is a self-administered assessment tool used to assess discounting rates in participants. Participants are presented with

choices between smaller, immediate rewards and larger, delayed rewards (e.g., “Would you prefer $54 today or $80 in 30 days?) (Kirby et al., 1999). Using the participant's answers, we can calculate the discounting constant ‘k’. k values are calculated as a hyperbolic discounting curve with the following discount function equation: $V_{immediate} = V_{delayed} / (1 + kD)$, in which V is the reward value in dollars and D is a delay in days (Mazur, 1984). Values of k range from 0.00016 to 0.25 and higher scores indicate a greater discounting rate, and a steeper curve, hence a greater preference for smaller short-term rewards. This k value can be used to calculate consistency scores, proportion scores, correlations, and more. We used an automated Scoring of Delay Discounting to calculate the k value (Kaplan et., 2016).

The IGT is a computerized hypothetical gambling task. It has been used to understand decision-making (Bechara et al., 1994). Participants begin with $2000 in hypothetical money and are presented with 4 decks of cards and must select a card for each trial. Some decks are more advantageous and incur more gains while some are disadvantageous and incur greater losses over 100 trials. We can analyze the risk-taking behavior of participants and financial outcomes over a number of trials.

Procedure

Participants read the consent and agreed to participate in the study. Participants were recruited through posters from an undergraduate liberal arts college. They completed the 27 Monetary-Choice Questionnaire (MCQ; Kirby et. al,1999; Appendix A). Then participants were randomly assigned to either the control group or the cognitive reflection group. Participants will begin the Iowa gambling task (IGT, Bechara et al., 1994). However, the participants are unaware of the fact that cards A and B can win $100 but also lose a greater amount of money and are riskier in the long run(disadvantageous deck). While cards C and D only win $50 but also had

lower losses over the long term (advantageous deck). Participants were instructed that the goal of the experiment is to have the most amount of money in order to get a chance to win an additional $50 as an incentive. The no-reflection cohort (control group) underwent 100 trials of the IGT with no interruption. While the Cognitive Reflection cohort (experimental group) paused halfway at 50 attempts and was asked to reflect on their earnings and encouraged to pick more advantageous cards for long-term success. This is the informational feedback pause that encourages activation of system 2 thinking after which the task resumed for the remaining 50 attempts.

Lastly, all participants were asked to respond on their stress levels on a 5-point Likert scale with the question 'How stressed were you during the completion of the task?' as higher levels of stress can worsen decision-making (Simonovic et al., 2017). Finally, participants completed demographic information on age, GPA, conservative/liberal, and socioeconomic status. They were debriefed and entered a contest to evaluate if they made the most money during the task and be rewarded with an additional gift card if they did. Additionally, all participants were also entered into a raffle for another gift card for participation.

Results

A mixed analysis of variance (ANOVA) was conducted to assess the impact of two different interventions (Feedback - no feedback) on participants' scores on the mean advantageous decision-making, across five-time blocks (Blocks 1-20, 21-40, 41-60, 61-80, 81-100). There was no significant interaction between Progress blocks and the mean proportion of advantageous choices, Wilks' Lambda = .93, F (4, 18) = 0.353, p = .838, partial eta squared = .073. There was a substantial main effect for Progress, Wilks' Lambda = .597, F (4, 18) = 3.03, p

= .045 partial eta squared = .40, with both groups showing a change in mean proportion advantageous scores across the five time periods and a large effect size (see Figure 2). The main effect comparing the two types of intervention was not significant, F (1, 21) = .233, p = .634, partial eta squared = .011, suggesting no difference in the effectiveness of the two feedback conditions. The relationship between K values of delay discounting and disadvantageous decision-making frequency was investigated using Pearson correlation coefficient. There was a weak positive correlation between the two variable, r = 0.22, n = 23, p = 0.311.

On average individuals reported a 40% stress level on a scale of 0-100 % which was not deemed too high to interfere with decision-making. Political affiliations reported by participants included the largest group of individuals who identified as Democratic, with a total of 13 individuals. Independent, with 5 individuals. Republican group, with only 1 individual. In addition, there are 4 individuals who identified as Other. Our sample size consisted of White/Caucasian= 10, Native Hawaiian or Pacific Islander = 1, Black or African American = 4, Asian:6, Hispanic or Latinx = 2 participants. Participants had an average GPA score of 3.47. 8 of our participants reported an average yearly income of Under $20,000, 3 reported $20,001 – $40,000, 3 for $40,001 – $60,000, 3 for $80,001 – $100,000, and lastly 3 for $100,001 or over. We had a range of students from different races, socioeconomic statuses, and political affiliations. However, in our analysis, we found no significant correlations between demographics and discount values.

Table 1

Test of between-subjects Effects

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta squared
Intercept	1.105	1	1.105	167.442	0.000	0.889
Group	0.002	1	0.002	0.233	0.634	0.11
Error	0.139	21	0.007			

Note. Between subject design: Control and experimental groups' effect on the mean value of advantageous decisions was not significant. $p > 0.05$

Table 2

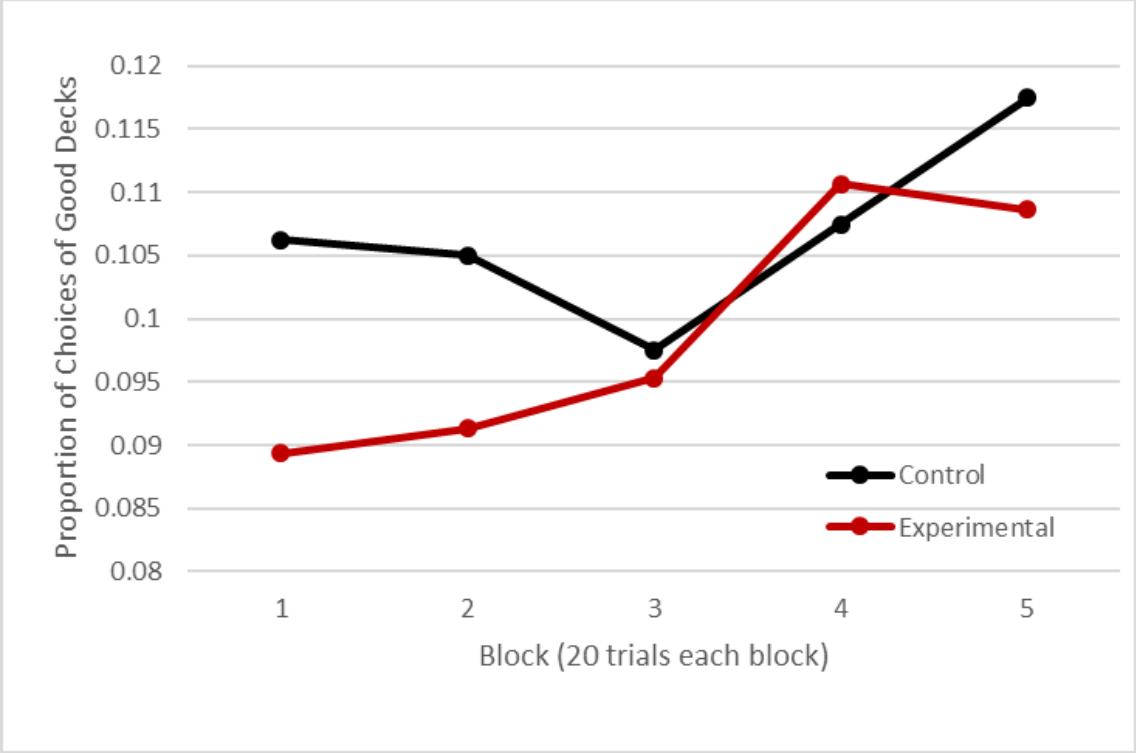
Multivariate ANOVA tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared
Progress	Pillai's Trace	0.403	3.033	4.00	18.00	0.045	0.403
	Wilks' lambda	0.597	3.033	4.00	18.00	0.045	0.403
	Hotelling's trace	0.674	3.033	4.00	18.00	0.045	0.403
	Roy's largest root	0.674	3.033	4.00	18.00	0.045	0.403
Progress *Group	Pillai's Trace	0.073	0.353	4.00	18.00	0.838	0.073
	Wilks' lambda	0.927	0.353	4.00	18.00	0.838	0.073
	Hotelling's trace	0.079	0.353	4.00	18.00	0.838	0.073
	Roy's largest root	0.079	0.353	4.00	18.00	0.838	0.073

Note. Main effect of progress (100 trials) on mean advantageous decisions were significant. p= 0.045 but no interaction effects were found.

Figure 2

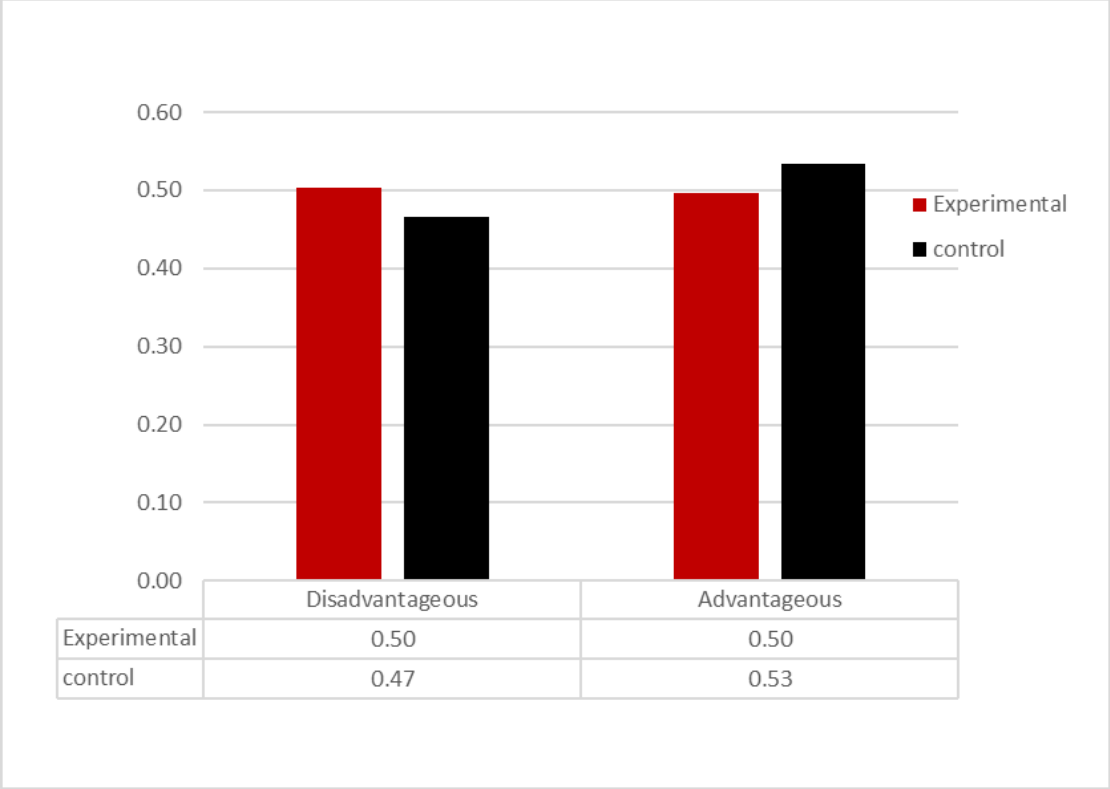
Proportion of good decks picked over 100 trials(Each block represents 20 trials).



Note. As time progresses there is significant improvement in the choice of good decks for both groups.

Figure 3

Mean proportion of good decks between our experimental and control groups.



Note. No significant difference between our feedback and no-feedback condition was found.

Discussion

Given the prevalence of decision-making problems among college students, interventions aimed at improving decision-making skills may have important implications for their academic and personal success. I examined the impact of studying the IGT and delay discounting on decision-making abilities in a college setting. Specifically, if college students can be given

valuable feedback to impact their decision-making abilities. The study looked at the ability of participants to distinguish between the disadvantageous ($100 with higher losses) cards as opposed to the advantageous ($50 with lower losses) cards over a period of 100 trials. Participants who could not learn this distinction are considered to have a decision-making impairment (Bull et., al 2015). I hypothesized that reflective feedback will help improve long-term behavior and help participants amend their behavior. Our results showed a significant improvement in advantageous decision-making with time delay (Fig 1). Concluding that a significant number of individuals did learn the distinction between long-term advantageous decision-making and short-term disadvantageous decision-making disregarding feedback condition. This is evidence that individuals are capable of learning how to activate their system 2 mechanism with time which involves a more analytical and reflective state of thinking and a shift away from the more impulsive system 1. Studies have observed that individuals with pathological gambling disorder or substance abuse are less likely to learn the analytical approach and avoid disadvantageous decks (Brevers et al., 2013). Perhaps due to the immediate gratification, these individuals develop a preference for the disadvantageous decks and fail to see the long-term consequences of their actions.

Our feedback group that looked at changes in advantageous behavior based on the feedback that required them to activate deeper cognitive thinking and reflect on their decision-making at the halfway point (trial 50). Table 1 shows we found no significant differences between our control (no feedback) and experimental group (feedback). This is a surprising outcome as studies have found that participants can identify the disadvantageous decks after hints about the IGT are provided (Fernie & Tunney, 2006). We argue that our study may have had limitations that may have prevented a change in behavior and realization from participants.

These could include low sample size, unclear instructions, and lack of attention by participants. Figure 3 shows the means of advantageous and disadvantageous decision-making. Our mean proportion of disadvantageous and advantageous decisions between participants replicate previous study using IGT in undergraduates (Fernie & Tunney, 2006). However, Caroselli et al. (2006) found that the results of their undergraduate decision-making were similar to the results of patients with frontal temporal lobe damage than to normal controls. This may be due to the fact that the development of the frontal lobe and hence mature decision-making, emotional processing, and risk-taking behaviors all complete development at the age of 25 (Casey et al., 2008). Our sample size was limited to undergraduates at an all-women college with a mean age of 20.5. This creates gender differences and is affected by a more risk-prone participant sample that would explain the impaired learning and decision-making.

Research has looked more deeply at the frequency of choices from each deck and the variability for each deck. However, it is important to mention that the IGT has received criticism despite being used mainly for individuals with pathological gambling problems. One of the main criticisms of the IGT is that healthy participants often do poorly on the task because they do not develop a preference for both good options in 100 trials. According to the original assumptions of Bechara et al. (1994), a healthy person should prefer good decks (low total reward but low loss) while avoiding bad decks (high total reward but high loss).

However, research suggests that many healthy participants do not develop this preference and may perform worse on tasks than those with certain types of brain injury (Caroselli et al., 2006). I would also suggest that the design of the task may be the reason why healthy participants do not like good decks. For example, tasks are often presented in a way that does not

mimic real-world decision-making situations. This can make it difficult for participants to pick good decks.

Other researchers have suggested that the reason healthy participants perform poorly on tasks may be due to individual differences in decision-making ability or cognitive style (Toplak et al., 2010). People are more likely to pick bad decks even if they understand the overall risk-reward structure of the task. Despite these criticisms, the IGT remains a popular tool for assessing decision-making capacity, with many studies examining different aspects of decision-making, such as risk-taking behavior, addiction, and emotional processing (Bickel and Marsch, 2001). However, researchers should be aware of task limitations and potential drawbacks when interpreting results. We found no significant correlations between other demographics like gpa, political affiliations, and race.

Lastly, we looked at delay discounting in which the value of a reward decreases as the delay in receiving it increases. It has been associated with addiction, gambling, and impulsivity. However, some studies have found a significant correlation between Iowa gambling task and delay discounting measures, suggesting that individuals who perform well on the IGT are also less likely to discount delayed rewards (Madden et al., 1997). Other studies, however, have failed to find a significant correlation between delay discounting and IGT performance. For our study, I hypothesized that individuals who scored a very high k value on the delay discounting MCQ would make more disadvantageous decisions during the IGT. However, I found a weak positive correlation coefficient of 0.22 (p=0.311), concluding that higher delay discounting rates could suggest more disadvantageous decision-making patterns, but the correlation was not significant and very weak. We suggest that perhaps delay discounting and IGT measure different aspects of cognitive thinking and hence aren't correlated strongly. Overall, the study highlights

the potential impact of feedback interventions and the importance of considering limitations and potential drawbacks when interpreting IGT results. Devaluing future rewards or just avoiding losses may be associated with different personality traits as well. More research is needed to understand the relationship between these variables.

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Appendix A

Kirby's Monetary-Choice Questionnaire

For each of the next 27 choices, please indicate which reward you would prefer: the smaller reward today, or the larger reward in the specified number of days.

1. Would you prefer $54 today, or $55 in 117 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

2. Would you prefer $55 today, or $75 in 61 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

3. Would you prefer $19 today, or $25 in 53 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

4. Would you prefer $31 today, or $85 in 7 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

5. Would you prefer $14 today, or $25 in 19 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

6. Would you prefer $47 today, or $50 in 160 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

7. Would you prefer $15 today, or $35 in 13 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

8. Would you prefer $25 today, or $60 in 14 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

9. Would you prefer $78 today, or $80 in 162 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

10. Would you prefer $40 today, or $55 in 62 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

11. Would you prefer $11 today, or $30 in 7 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

12. Would you prefer $67 today, or $75 in 119 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

13. Would you prefer $34 today, or $35 in 186 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

14. Would you prefer $27 today, or $50 in 21 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

15. Would you prefer $69 today, or $85 in 91 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

16. Would you prefer $49 today, or $60 in 89 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

17. Would you prefer $80 today, or $85 in 157 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

18. Would you prefer $24 today, or $35 in 29 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

19. Would you prefer $33 today, or $80 in 14 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

20. Would you prefer $28 today, or $30 in 179 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

21. Would you prefer $34 today, or $50 in 30 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

22. Would you prefer $25 today, or $30 in 80 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

23. Would you prefer $41 today, or $75 in 20 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

24. Would you prefer $54 today, or $60 in 111 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

25. Would you prefer $54 today, or $80 in 30 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

26. Would you prefer $22 today, or $25 in 136 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

27. Would you prefer $20 today, or $55 in 7 days?

[ ] smaller reward today

[ ] larger reward in the specified number of days

Scoring

A participant's discounting curve may be calculated according to the following function:

$V = A/(1+kD)$

V is the present value of the delayed reward A at delay D, and k is the rate of discounting. k typically falls between 0.0 and 0.5, with smaller values indicating a lack of discounting and preference for delayed rewards and higher values indicating strong discounting and a preference for immediate rewards. Thus higher values of k are indicative of high levels of impulsivity.