The Value of Delayed Gratification

Abstract

Self-control was studied and quantified through the concept of delayed gratification, utilizing economic discounting principles. A survey was used to measure a subject's decision making when faced with a choice between an immediate and a delayed reward. Subjects exhibited delayed discounting, which was used as an independent variable in attempting to find a correlation between higher discounting and better success in life as measured by the subject's grade point average. Subjects that exhibited higher rates of discounting could be described as being more patient and this was found to have a positive linear relationship with success. Subjects with higher rates of discounting also tended to major in physical science over social science but exhibited higher rates of stress.

I.   Introduction

When faced with a choice between a small, instant reward and a larger, delayed reward, an organism displays immediate gratification if it chooses the small reward, while showing delayed gratification if it chooses the bigger reward. Delayed gratification, or self-control, is the ability to resist the temptation of an immediate reward and wait for a bigger, later reward (Carducci, 2009).

The ability to delay gratification correlates with similar skills such as patience, self-regulation and willpower (Doerr, 2011). Thus, there have been studies conducted to investigate the connection between one's delayed gratification and their well-being. These studies suggest that there maybe a positive correlation between the ability to self-control and mental, physical and social health, as well as academic success. If we look around, we can see this playing out almost everywhere:

> If you delay the gratification of entertainment and do your homework instead of watch television, you will receive better grades.

> If you delay the gratification of making money right now with a low-pay job and go through training first, you will be able to land a better pay job.

There are many different factors that contribute to one's level of self-control.

The first primary factor is one's upbringing.

The Stanford 'Marshmallow experiment' was a series of psychological studies starting in the 1960s led by Professor Walter Mischel. Follow up studies suggests that delayed gratification is not a predetermined trait, but rather learned from the experiences and environment (Kidd, 2012).

The second one is delay discounting.

Delay discounting is the decline in the present value of something after a period of time. From an economic point of view, the value of rewards, usually monetary, declines hyperbolically after a delay. This gives one incentives to go for the small but instant reward (Odum, 2011).

The third primary factor is one's own preference.

People who seek immediate gratification have a more present focus. They act impulsively and enjoy having their present wants satisfied. Given a dinner, they are likely to eat whatever they like best first rather than leave it until later. Meanwhile, those who possess delayed gratification look for a more secure future. They resist present temptations and invest in larger, more satisfying long-term benefits.

In my research, I investigate the degree to which self-control affects people and attempt to find out the correlation between one's level of delayed gratification and their success in life. Understanding the effects of delayed gratification would, first and foremost, help us improve the teaching of small children. We can come up with do's and don't's to help guide the young generation. Furthermore, this study will enhance our understanding of human behavior, which will advance firms' management strategy. Knowing how people delay (or not) their rewards will help policies on bonus to achieve maximum efficiency.

II.   Literature Review

For this study, I thoroughly studied two scientific papers and a scholarly article, in which I encountered a series of studies on similar topics.

1.   *An Experimental Analysis of Impulsivity and impulse Control in Humans* by Jay V. Solnick and Catherine H Kannenberg.

This study suggests that the preference of rewards is a function of when the choice is made. Small, immediate reward is often preferred to large reward with delay X, but adding delay T to both variables should shift the preference to large reward. They conducted three experiments, using termination of 90 dba white noise as the reinforcing event (reward).

Participants were 155 voluntary female students in an Introductory Psychology course at the University of North Carolina. All experiments occurred in a 2.3 x 2.3m room, which contained a small desk and a chair for the participants, and a speaker that was connected to a white noise generator. Participants took the experiment individually. They were given math problems to do in the room while a loud hissing noise was being played continuously. Participants can choose to eliminate the noise for a short time, but then it will return. They got choose between 90-second noise off without delay and 120-second noise off after a 60-second delay. The experiments showed that most people preferred the option of noise off immediately (small reward), however, when a 15-second delay (T) was added to both options, preference shifted to the other option (large reward).

2. *Discounting of Delayed Rewards: A Life-Span Comparison* by Leonard Green, Astrid F. Fry, and Joel Myerson.

In this study, researchers experimented on three age groups: children, college-aged adults and older adults. The researchers compared delay discounting on these three groups. Subjects were 36 volunteers from there age groups: 12 sixth graders (M = 12.1 years), 12 college students (M = 20.3 years) and 12 older adults (M = 67.9 years). Each participant had to go through a series of choices, individually in a quiet room, regarding hypothetical amounts of money. The choices are a fixed-amount reward that could be obtained after a varying delay (e.g., 1 week to 5 years) and an instant reward with varying amount (e.g., $1 to $1000). The data received indicated a life-span developmental trend of the rate at which individuals discounted the value of delayed rewards. The sixth-graders reduced the value of delayed rewards at a faster rate than young adults, who, respectively, reduced the value of delayed rewards at a faster rate than older adults.

3. *40 Years of Stanford Research Found That People With This One Quality Are More Likely to Succeed* by James Clear.

In the 1960s, Stanford professor Walter Mischel began conducting a series of psychological studies on children of around 5 years old, and then kept track of them as they grew up. Mischel's study is referred to as the famous "marshmallow experiment". Basically, a child was offered one marshmallow (small reward), and if they waited for 15 minutes during which the

testers left the room, they would get a second marshmallow (bigger reward). Years later, the researchers conducted follow up studies and tracked each child's progress in certain areas, which they thought would indicate level of well-being. Results showed that children who waited to get the large reward ended up experiencing more competent adolesence, scoring higher in measurements such as acedemic achievements, physical and mental health as well as social skills (Mischel, 1988).

The series of studies by Mischel gave me the idea for my project, but in what way is my project different?

In 2012, researchers at the University of Rochester recreated the 'marshmallow experiment' with a critical difference in the method. Prior to being faced with a choice of rewards, the children were randomly assigned into two groups. One group was exposed to unreliable experiences: the testers promised each child a box of crayons and a sticker, but never gave the child anything. The other group went through reliable experiences, being that the testers kept their promise. The same 'marshmallow experiment' was conducted, but this time the researchers analyzed the wait time. Results showed that youngsters who had reliable interactions waited significantly longer than those who were lied to (Kidd, 2012).

Due to their simple thought process, children in the reliable group were trained to think that waiting was worth it, while children in the unreliable group had no reason to trust the testers and wait. This experiment raised the question of whether waiting illustrates delayed gratification, or strategic thinking. Mischel's studies did not take into account the reliability of the environment, which greatly affected the child's decision making.

In my experiment: the participants are young adults who receive a college level education, thus should be able to make relatively rational decisions regarding monetary rewards. Additionally, the rewards are hypothetical, and therefore the concern of reliability can be dismissed.

III.   Relevant Background Theory

The primary behavioral economic concept that I explored in this study is the theory of exponential discounting and hyperbolic discounting. When given two similar rewards, humans show the tendency to pick the one that arrives sooner. Logical thinking and personal experiences allow us to understand the superior benefits of the earlier reward, namely, the satisfaction of instantly having our needs/wants fulfilled, the reduced opportunity cost and the present value of the reward. In short, we discount the value of the later reward, or our valuations decrease.

In behavioral economics, *exponential discounting* is a time-consistent model of discounting, which means that the discount rate is constant throughout the whole delay period, no matter how long it is. In contrast, the *hyperbolic discounting* model is time-inconsistent, being that valuations drop sharply for small delays, but then slowly decline for longer delays (Green, Myerson, 1996).

Economists that study human choice behavior favor an exponential discounting model that follows the form (Green, Myerson, 1996),

$$V = Ae^{-kD}$$

While Psychologists that study choice behavior within humans and animals rely on hyperbolic discounting of the form (Green, Myerson, 1996),

$$V = A/(1 + kD)$$

Hyperbolic discounting is based on exponential discounting, and is considered to be more advanced, in the sense that it explores actual human behavior. However, for my study, I will use the exponential discounting model because of its simplicity and consistency.

IV.   Experimental Design

I sent out an online survey to a large population of Ohio Wesleyan University students. Then, from the pool of responses I picked out 40 subjects who met the following simple requirement. 20 subjects had to be social science majors, such as economics, psychology, sociology, while the other 20 had to be physical science majors, such as physics, chemistry and astronomy.

The procedure was quite simple. Each participant had to take an online survey, which is as followed.

1. What is your major?

2. What is your cumulative GPA?

3. You earned a bonus of $500, but your employer has cash-flow problems and is hoping to pay you a larger sum in a month. What is the minimum amount you will accept to be paid 1 month late?

4. Same scenario, but the bonus is $1000 and the delay is 3 months.

5. Same scenario, but the bonus is $750 and the delay is 1 year.

6. You earned a bonus of $500, to be paid at the end of performance period in 2 weeks. However, you have planned a family vacation because the weather is nice, so you are thinking to negotiate with your employer to be paid immediately, a smaller sum. What is the minimum amount you will accept to be paid 2 weeks early?

7. Same scenario, but the bonus is $1000 and you want to be paid 2 months early.

8. Same scenario, but the bonus is $750 and you want to be paid 6 months early.

9. On the scale of 1 to 5, how well do you think you handle stress? (1 being stress does not bother me at all and 5 being I have a very hard time dealing with stress)

Explanation of the survey questions:

- The measurements that I chose for success in life are the GPA and the ability to handle stress. Since the subjects are college students, I figured that academic performance and mental health are two of the main indicators of their well-being.

- 40 subjects had to be 20 social science majors and 20 physical science majors. The idea was to dismiss a popular belief that some majors regarding physical science such as physics or micro-biology are considered to be more 'difficult' or 'stressful' than others. This way the two indicators of life success can achieve their maximum accuracy.

- For the six scenarios, some people who did the survey had the question of why not make it simpler by using the same reward and ask them to wait different amount of time, such as $500 after 1 month, then 2 months, then 6 months. This is because people tend to anchor their answers based on their previous answers. Therefore, mixing up the monetary rewards and amounts of time would be more representative of the participants' true preferences.

- How do the scenarios serve as measurements of delayed gratification?

    In the first scenario, participants will get a bigger reward after a delay. Someone who lacks self-control will demand a higher reward to compensate for their wait. Participants who give higher answers are less patient.

    In the second scenario, participants are requesting an instant, smaller amount than what they earned, to go on a vacation. People who lack delayed gratification will settle for smaller amounts because their want for the trip, right now, is so high. Participants who give smaller answers are less patient.

V.   Data Analysis

The data from the survey was recorded and sorted in a table such as below

Respondent	Major	GPA	Ability to handle stress	Scenario 1a	Scenario 1b	Scenario 1c	Scenario 2
1	Physical science	3.2	4	750	1600	2250	300
2	Physical science	3.4	2	500	1100	1000	400
3	Physical science	3.7	2	500	1000	1000	400

Scenarios 1a, 1b, 1c and 2a, 2b, 2c are the six scenario questions from the survey respectively.

Scenario 2a asked the participant to settle for a smaller amount, two weeks prior to their reward of $500. Scenarios 2b and 2c are two slightly altered versions of 2a.

We use discount rate analysis to determine the *present value* of a delayed reward, which can be modeled with the following equation:

$$x = \frac{x_0}{d^k}$$

Where x is the *present* value, x_0 is the value of the delayed reward, d is the rate of discounting, and k is the wait time (in months).

We can manipulate these equations to isolate the discounting rate as follows:

$$d^k = \frac{x_0}{x}$$

$$k \ln d = \ln \frac{x_0}{x}$$

$$\ln d = \frac{1}{k} \ln \frac{x_0}{x}$$

Where (ln(d)) is the discount factor and ultimately we use this to determine the representative discounting, discount rate d overall, by taking the exponential of the average discount factor.

We use the above formula to find the discount factor, ln(d), for each participant in every scenario, then find the average, and finally take the exponential of the average discount factor to yield the representative discounting, or representative discount rate, for each participant.

We can also infer that a higher discounting rate, closer to 1, correlates to higher patience since the delayed reward won't have to be much larger relative to the immediate offered amount in order to incentivize the subject to wait. I.e. less incentive is needed to make a subject wait, which can be defined as more patient.

We can now plot the average discount rate with our dependent variables, gpa and ability to handle stress, to find out their correlation, as well as regress gpa against average discounting rate and the dummy variable, major.

Example of manipulated data using the equations previously stated

delta2a	delta2b	delta2c	Mean Discounting factor	Median Discounting factor	Representative discouting (avg discount rate)
-1.02165125	-0.17833747	-0.06757752	-0.320208374	-0.167502674	0.725997742
-0.4462871	-0.45814537	-0.10476811	-0.177490691	-0.068269085	0.837368795
-0.4462871	-0.11157178	-0.06757752	-0.108234984	-0.045775512	0.897416693

We ran a regression on gpa vs avg discount rate and a dummy variable, major:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.968	.524		5.664	.000
	average	-.134	.707	-.027	-.190	.850
	major	.635	.145	.610	4.362	.000

a. Dependent Variable: GPA

$$Gpa = -0.134d_{avg} + 0.635M + 2.968$$

We see a negative correlation between gpa and avg discount rate but this term is dominated by error as can be seen on the table. Major seems to have quite a large impact on overall GPA. We can see that in this case average rate is statistically insignificant.

We also ran a regression on gpa vs median discount rate and a dummy variable, major:
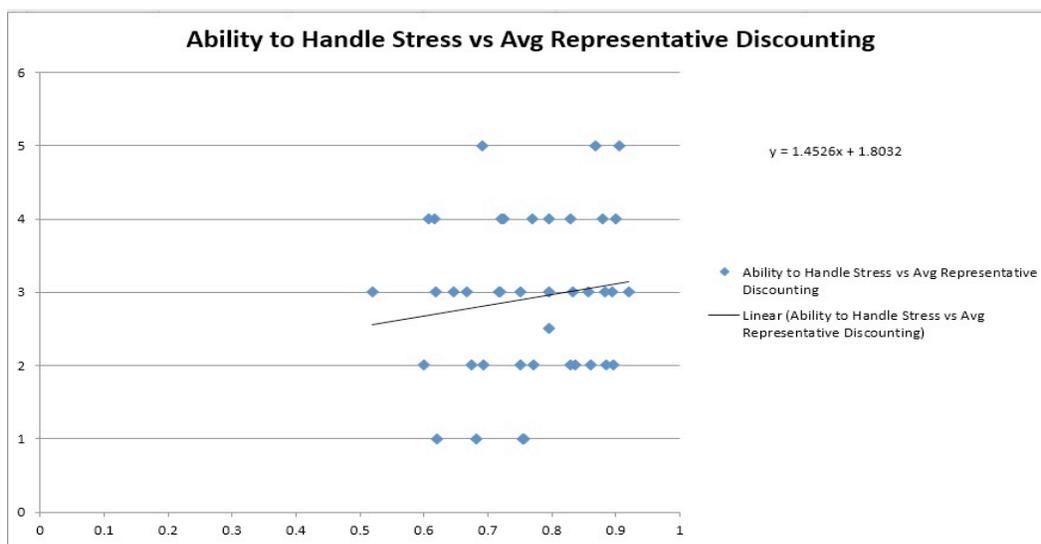
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.813	.697		4.035	.000
	Median	.071	.858	.012	.083	.934
	major	.621	.145	.597	4.276	.000

a. Dependent Variable: GPA

$$Gpa = 0.071d_{median} + 0.621M + 2.813$$

We see a positive correlation between gpa and median discount rate but this term is also dominated by error. Major seems to have quite a large impact on overall GPA. Median discount rate is also seen as insignificant here.
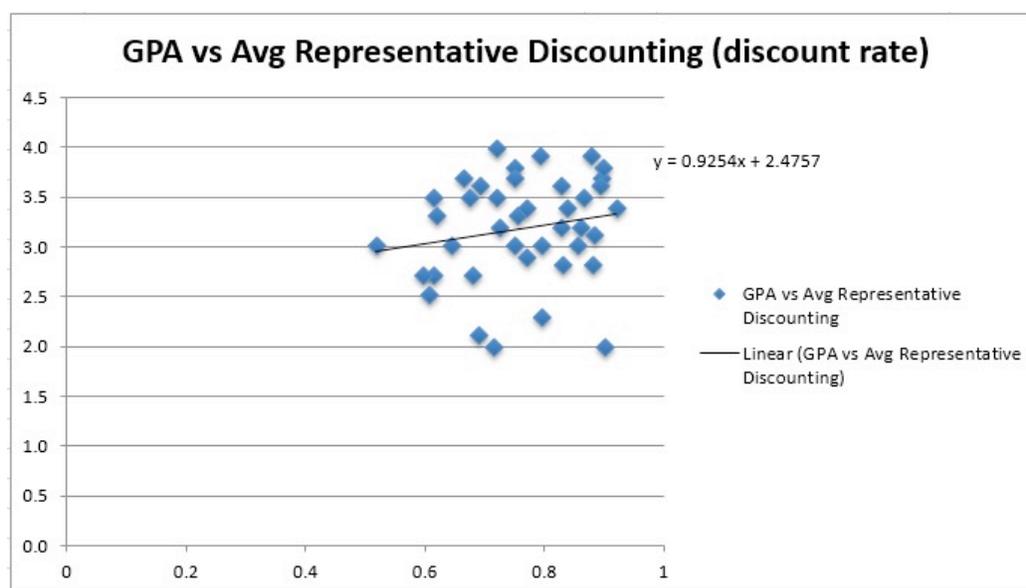
Results:

Ability to Handle Stress vs Avg Representative Discounting

y = 1.4526x + 1.8032

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.803	1.304		1.383	.175
	averagerate	1.453	1.692	.138	.858	.396

a. Dependent Variable: stress

A higher discount rate implies more patience and we see a positive correlation between discount rate and inability to handle stress (1 is best and 5 is worst). This implies that those that are more patient are less able to handle stress, which disagrees with our expectations

GPA vs Avg Representative Discounting (discount rate)

$y = 0.9254x + 2.4757$

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.476	.621		3.984	.000
	averagerate	.925	.806	.183	1.148	.258

a. Dependent Variable: gpa

We see a positive correlation between representative discount rate and GPA. This implies that those with a higher discount rate, more patient, end up with higher GPAs. This does agree with our initial expectations.

Because of the lack of statistical significance between our dependent and independent variables we indexed subjects into a high stress category, can't manage stress well and thus wrote a value greater than 3 on the 1 to 5 scale) and a low stress category, those able to manage stress well (less than 3 on the 1 to 5 scale). We then compared their relative mean discounting rates and yielded,

Low stress index:
Mean Discounting rate: 0.761
High stress index:
Mean Discounting rate: 0.776
Overall average discounting rate: 0.764

Thus we see that those with a lower average discounting rate are better at managing stress while those with higher rates of discounting, and thus, more patient tended to be worse at managing stress.

We also indexed the data by the subject's major in hopes of finding a difference in the average discounting rate of a physical science major versus that of a social science major.

Physical Science Major:
Average Discounting Rate: 0.799
Social Science Major:
Average Discounting Rate: 0.728
Overall average discounting rate: 0.764

As we can see from the data above physical science majors tended to have higher discounting rates, meaning that they could be seen as more patient but this also means that they were more likely to describe themselves as more stressed, or worse at handling stress as can be seen in the Stress vs Discounting Rate plot above. We can also conclude that more patient people tended to choose a major in the physical sciences, which is notably interesting.

VI.   Conclusion

❖ Findings:

- Those that were seen as more patient tended to be worse at handling stress (not expected)
- Those that were seen as *more* patient tended to have higher GPAs (expected)
- Ability to handle stress also had a measureable linear relationship with GPA, as seen below, implying that those that are better able to manage stress also will have higher GPAs
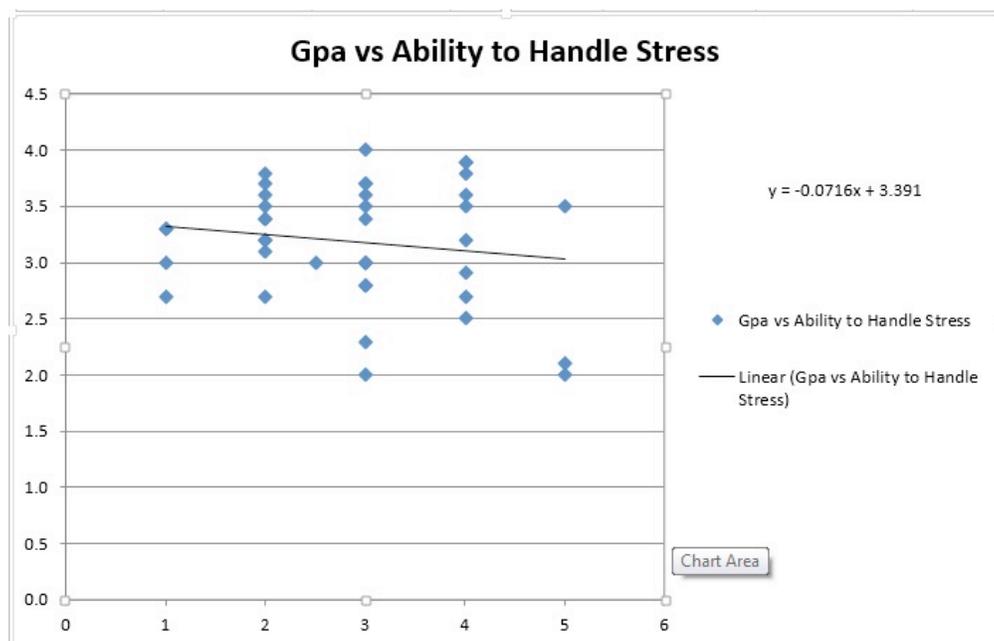
I believe these findings are highly valuable.

The positive correlation between Gpa and delayed gratification upholds the hypothesis of several previous studies such as Mischel's.

However, the negative correlation between the ability to handle stress and delayed gratification challenges our expectation. This finding raises the question of what people define to be their success in life. It could be inferred that people who have a higher level of delayed gratification

focus more in a secure future, rather than on their instant wants/needs, and thus have a high level of stress and inability to manage stress.

❖ Directions for Future Work

For further studies, we should conduct experiments where we first ask participants what they think is success. Then we have two ways to manage and test the data: either assign subjects who have similar goals in life in to the same group, then test the data of each group, or create a scale where the subjects rank their own well-being (e.g., 1 to 10), then do the same analysis as in above.

Also, our results show that GPA is affected by much more than just patience because of patience's statistically insignificant contributions. In the future we can attempt to find a measure of other variables that could affect success rather than just patience, such as work ethic.

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