TRANSDIAGNOSTIC PSYCHOLOGICAL SYMPTOMS ASSOCIATED WITH TEMPORAL DELAY DISCOUNTING TASKS- MONETARY, SOCIAL, & HEALTH TASKS

by

Morgan DeHart

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Transdiagnostic Psychological Symptoms Associated with Temporal Delay Discounting Tasks – Monetary, Social, & Health Tasks

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Abstract

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This thesis examined transdiagnostic characteristics of psychological symptoms and how they might affect decision making and performance on a behavior inhibition task. Instead of examining individuals diagnosed with distinct psychological disorders, this study examined the influence of transdiagnostic symptoms, similar across different disorders, measured in the general population. Anxious/depressive, compulsive/impulsive, and social withdrawal were the three dimensions examined in the present study, and are anticipated to play a role in decision-making. Decision-making was measured in this paper using delay discounting techniques. Delay discounting measures the likelihood that an individual will choose a smaller, immediate reward or a larger, delayed reward. It is a measure of impulsiveness that was hypothesized to relate to certain symptoms of psychological disorders. This study also examined behavioral inhibition using a Go/No-

Go decision making task. This study used a transdiagnostic dimensions questionnaire, three discounting tasks regarding monetary, social and health rewards, and a behavioral inhibition task. The results showed that age was a good predictor of higher discount rates, with older individuals significantly more likely to choose the smaller, immediate reward. We did not see any significant relationships between the three transdiagnostic dimensions and delay discounting. However, we did see an effect of reaction time and anxious depressive symptoms on the Go/No-Go behavioral inhibition task. Also, age played a role in false positive error, while social withdrawal symptoms played a role in false negative error on the Go/No-Go task. The observed relationship between age and discounting was broadly consistent with previous literature. The lack of an association between transdiagnostic symptoms might reflect the relatively mild levels of symptoms in the small sample used, weaknesses in the symptom measures, and/or this specific measure of decision making.

Introduction

When faced with the choice between equal rewards, but one now or one later in the future, most people would choose the reward now. However, there's a discrepancy in decision-making when faced with an immediate, lesser reward and a future, greater reward (Bickel & Marsch, 2001). An example could be how one might suffer from alcohol withdrawal in the moment, but will experience a healthier life, mentally and physically in the long run. There are many potential factors that would affect a person's choices between an immediate reward and a delayed reward, like age or psychological disorders. Possibly, the severity of the symptoms of psychological disorders can cause a higher discount of the future (Lemper, et. al. 2018).

Excessive discounting of rewards as a function of the delay and reward magnitude, known as delay discounting, is a recurring problem in maladaptive behavior (Odum, 2011). The term is a behavioral economic measure of impulsivity and reflects how rapidly a reward loses value based on temporal distance. That is, the longer the delay (i.e. the distance) between the two rewards, the less likely one would choose the future reward over the immediate reward, even if it is smaller. The tendency to select the immediate and smaller reward is suspected in some pathological or impulsive behavior and observed in many problems such as substance use and health related issues such as

obesity (Epstein, et. al. 2010; Bickel & Marsch, 2001). However, the definition of delay discounting can be seen in different forms. One way that delay discounting has been measured has focus on the magnitude, such as the depreciation in the value of a reward related to the time that it takes to be released (Tesch & Sanfey, 2008) or the depreciated of the subjective value of a consequence when it is delayed (Baker, Johnson, & Bickel, 2003). Thus, many temporal discounting studies show support of how the function of time depreciates the longer delayed reward. In addition, the uncertainty of obtaining the reward also plays a role in discounting behavior. Rationally, the longer the delay until the reward is provided, the higher the probability that something could happen to prevent the delivery of the reward. However, the way delay discounting is measured can also differ. Most of the time, studies use a hyperbolic model to fit the data and this must have multiple delays(e.g. 1 day, 1 week, 1 month, etc). But in this current study, we do not use the usual hyperbolic model for analysis. The discounting task from Seaman and colleagues (2020) did not have but only three delays of two months, four months, and six months. Nonetheless, this study is aimed to support previous research that has found that decision-making with delay discounting is being applied in order to further understand self-control, impulsivity and risk taking in psychological disorders (Lemper et. al. 2018).

Studies of delay discounting have used a variety of outcomes to measure discounting rates. Monetary, social, and health reward domains have been used across a studies to assess decision-making (Seaman et. al. 2020). With monetary discounting, an experimenter asks a participant if they would rather have $50 now or $100 in a month, and the delay in between now and the future would incrementally change (e.g. 1 day, 1

week, 1 month, 3 months, etc.). Given this information, magnitude of the reward plays an important part in the outcome of participants' choices. For example, one study found that discount rates for monetary outcomes decreased as the magnitude of those outcomes increase. (Benzion, Rapoport, & Yagil, 1989). In studies of cigarette smokers, it has been shown that current smokers' delay discounting rates for monetary outcomes were higher than non-smokers. (Bickel, Odum, & Madden, 1999). Social discounting is a more recent technique that is defined in many ways. For the purpose of this paper, we are focusing on whether someone would rather spend a shorter more immediate time with close partner or a longer, but more delayed time with the same person in mind (Seaman et. al. 2016). One study had participants choose between spending a shorter amount of time sooner with a person whom they were close with, but wish they spend more time with, or choose to spend a longer amount of time with them but later in the future. They observed that there was higher discounting for social rewards than monetary rewards (Seaman, et al. 2020). Another type of discounting measure looks at health outcomes. This domain is thought to be more motivational than wealth accumulation for some people, specifically, older adults. Most health reward discounting measures are exploring the effect of age on decision-making. Research has found that older individuals would most likely choose social and health rewards associated with less temporal delays, higher certainty, or lower levels of physical effort (Seaman, et. al. 2016).

Age has been an important factor in metacognition and impulsiveness. There is some evidence that younger children and older adults tend to have higher discount rates (lower self-control) than middle aged groups (Gollner, L. et. al. 2018). Also, when

looking at actual behavior between age groups, studying decision making and behavioral inhibition can be an effective way to measure impulsivity. Behavioral inhibition develops differently as one grows due to various factors including environment, contextual factors, or personality traits (Hornbuckle, S., 2010). Previous research found that children with a high behavioral inhibition do not go on to develop any clinical anxiety problems (Henderson, Pine, & Fox, 2014). For the purpose of this study, we are looking at behavioral inhibition as a way to measure impulsivity and compare it with delay discounting rates. Therefore, we use a Go/No-Go task to measure for impulsive responses as previous research has linked poor inhibition(impulsivity) to having more errors on such task, (Meule, A., 2017). In these tasks, participants are instructed to respond (Go) to a frequently appearing target, and to withhold responses (No-Go) to a less frequently appearing target. Higher error rates would mean behavioral inhibition is worse(more impulsive), than those with less error rates. Research has found evidence that younger children tend to have more errors on Go/No-Go tasks than older children and adults, perhaps as their focus and attention has not fully developed (Bezdjian, S., et. al. 2009). This would be that younger children have worse behavioral inhibition. Moreover, this task has been used to compare self-control in children with ADHD and control groups. These have shown children with ADHD had an increased number of commission errors (false alarms) compared to control children, therefore, leading to problems with behavioral inhibition, (Yong-Liang, et. al. 2000).

Psychiatric research continues exploring new relationships between behavior and decision-making. There are similarities of trends on delay discounting tasks across

multiple psychological disorders. There evidence that those with major depressive disorder hold a negative view of the future, therefore, influencing their decision to invest in their future selves and highly discount the future (Pulcu, et al., 2013). High discount rates have also been found in other disorders like gambling, (Miedl et al., 2015), ADHD (Jackson & MacKillop, 2016), mania (Mason et al., 2012), borderline personality disorder (Barker et al. 2015), bulimia nervosa (McClelland et al., 2016), and binge eating disorder (McClelland et al., 2016), which are all related to impulsivity, (Lempert et al., 2018). Increased delay discounting has also been found in individuals with schizophrenia, (Heery et. al, 2007). Evidence that excessive delay discounting is observed across a range of psychological disorders raises the possibility that it might be a transdiagnostic symptom of psychopathology.

The comorbidity between the discrete mental disorders occurs in higher levels than prevalence rates, indicating that mental disorders are systematically overcategorized. (Pasion & Barbosa, 2019). For example, substance use disorder (SUD) and major depressive disorder (MDD) have a high co-occurrence rate, and SUD also predicted MDD over time (Rao, Daley, & Hammen, 2000). Dimension models are a new structure of psychopathology, such as those using the internalizing-externalizing spectrum, and may be better able to overcome the practical problems of comorbidity. For example, anorexia nervosa (AN) is defined by abnormalities in eating, it also shares clinical features (e.g. avoidance, preoccupations) with anxiety disorders like obsessive compulsive disorder (OCD) and social anxiety disorder (SAD). A study comparing AN, OCD, and SAD found higher trait anxiety tended to choose more delayed rewards

(Steinglass et al. 2017). This suggests that impulsivity is correlated with higher discounting and anxiety may be correlated with lower discounting.

Recent research using samples from the general population has proposed a transdiagnostic model of psychological symptoms, and categorized these symptoms into three dimensions: compulsive/impulsive, anxious/depressive, and social withdrawal (Gillan et al. 2016; Rouault et al. 2016). In one study of the relationship between these three transdiagnostic dimensions and decision-making, Rouault and colleagues (2016) examined the way that metacognition distortions – the (in)ability to think about and evaluating one's own cognition – related to poor mental health (Rouault et. al. 2016). They found that those with more anxious/depressive symptoms had less confidence and improved metacognition, whereas the symptom dimension of compulsive/impulsive behavior was associated with over confidence and blunted metacognition. This finding provides support of a possible association of psychopathology and poor decision-making. When making a decision, individuals typically think about the future (prospection) and think about their thinking (metacognition). The importance of metacognition helps one to be in charge of their own thoughts/memories in order to make good decisions. However, symptoms of psychological disorders can play a role in how much one might care about the future. (Bulley & Schacter, 2020). Therefore, its arguable to assume that problems with metacognition could contribute to poor delay discounting.

Mental effort is another key variable in which an individual tries to minimize effort during task performance by avoiding decisions with great cognitive demand

(Patzelt et al. 2018). Thinking about the future would require mental effort, so it could be assumed that higher discounting of the future is associated with problems of mental effort. That being said, different clinical symptoms like lack of perseverance and impulsiveness led to increased avoidance of mental effort. OCD symptoms, disordered eating, and the factor of compulsive/intrusive thoughts had less avoided mental effort. (Patzelt, et al. 2018). In short, since dysfunction of metacognition and mental effort has been associated to psychopathology, one might predict that deficits in delay discounting might also be related to psychopathology.

The purpose of this study was to further understand how severity and different symptom dimensions play a role in delay discounting and behavioral inhibition. In the current study, it was predicted that those with more severe compulsive symptoms will tend to have higher discounting rates, choosing the more immediate reward and potentially fast reaction times on the Go/No-Go task but more errors. Another prediction is those with more severe anxious/depressive symptoms might tend to choose the more delayed rewards in all 3 discounting measures (social, health and money) and have worse reaction times on the Go-No/Go task. Lastly, it is predicted based off previous research that potential social withdrawal symptoms could mean participants excessively think about the future and appear less risky, meaning having high discount for the future, (Gillan, et. al. 2016). Social withdrawal symptoms may lead to more increased errors on the Go/No-Go task, (Uzefovsky, Smith, & Baron-Cohen, 2016). Age should also have an effect on discounting rates and behavioral inhibition as previous research has concluded. Potentially, there could be a relationship with high discounting rates and more errors on

the Go/No-Go task as both of those outcomes could be related to impulsivity. Lastly, there is potential to see a relationship of the transdiagnostic dimensions on behavioral inhibition, therefore, the Go/No-Go task performance.

Methods & Materials:

Participants. We used Prolific to recruit participants (n=98, 28 males, 70 females, mean age 31.6). Participant age ranged from 18 – 60 years old. Participants received informed consent and expressed there were no benefits or risks to this study. The whole study lasted about 20-30 minutes and participants were compensated for their time.

Procedure. Each participant completed a condensed version of the psychological symptoms questionnaire that was used in Wise et. al., (2016) measuring the transdiagnostic psychological symptoms. These questions come from previous psychological surveys including the Zhung Depression Scale, State Trait Anxiety Inventory, Obsessive Compulsive Inventory, Liebowitz Social Anxiety Scale, Barratt Impulsivity Scale, Alcohol Use Disorder Identification Test, Eating Attitudes Test, and Apathy Evaluation Scale (Gillan et. al. 2016). Table 1 shows how many questions from each psychological survey were used to form each of the transdiagnostic dimensions.

Table 1:

Transdiagnostic Dimensions	Questionnaires
Anxious/Depressive	Zhung Depression Scale(8), State Trait Anxiety Scale(10), Apathy Evaluation Scale(3), Barrat Impulsivity Scale(7)
Compulsive	State Trait Anxiety Scale(1), Apathy Evaluation Scale(1), Eating Attitudes Test(4), Barrat Impulsivity Scale(6), Obsessive Compulsive Inventory(11)
Social Withdrawal	Alcohol Use Disorder Identification(1), Barrat Impulsivity Scale(1), Liebowitz Social Anxiety Scale(11)

For the delay discounting tasks, we attempted to keep the magnitude to a realistic value to implement in the real world as they are hypothetical questions (Seaman et.al. 2020). To assess decision-making, we measured choices about hypothetical gains on three discounting tasks containing monetary rewards, social rewards, and health related rewards via validated tasks. For each type of task, participants are asked to choose between a smaller, immediate reward (SIR) and a larger delayed reward (LDR). The LDR was either 25%, 50%, 100%, or 150% larger than the SIR. The outcome variable was the proportion of choosing the shorter, immediate reward, (Seaman et. al. 2020). Each participant had the same set of questions but with randomized order.

The monetary task consisted of these instructions:

"You will choose between different amounts of money you can spend. Each option has a different period of waiting until you'll be able to get that money. You must choose which amount you would prefer."

This domain contained the SIR reward being between $10 and $15 (e.g. $15 today and $30 in two months, LDR being 100% larger than SIR).

The social task consisted of the following instructions:

"For some of the questions you will be choosing between spending a shorter amount of time with someone today/soon and spending a longer amount of time with that same person later. You will be imagining spending time with one person when answering these questions. Think about someone you don't get to see right now that you wish you got to spend more time with. You will choose between different amounts of time (in minutes) you can spend with the family member, friend or other person. Think about that person while answering these questions. Each option has a different period of waiting (no waiting if Today or you have to wait 2, 4, or 6 months) until you be able to spend those minutes with that person. Imagine if you can only choose one of the two options – either the number of minutes at the sooner time or the number of minutes at the later time."

In this domain: the hypothetical reward was the amount of time a person can spend with a close social partner with whom the participant wishes they spent more time (Seaman et. al. 2020). The SIR ranged between 10 minutes and 70 minutes, (e.g. 20 minutes in two months or 40 minutes in four months, LRD 100% larger than SIR).

The health reward task instructions go as followed:

“A new health improvement pill has been discovered. Higher doses of this pill (a higher milligram content) will have greater positive effect on your health. Positive effects include increased energy, improved sleep quality, and resistance to cold, flu, allergies, and bodily aches and pains. There are no known side effects. You will choose between different doses of the health improvement pill. Each option has a different period of waiting until you’ll be able to get that dose. You must choose the option you prefer.”

For the health domain, this defined rewards as the degree to which (via drug dosage) a new medication improves general physical and mental function, (Seaman et. al. 2020). The SIR ranged between 2mg and 500mg, (e.g. 200mg today and 400mg in four months, LDR 100% larger than SIR).

Included in this study is a Go/No-Go behavioral inhibition task as well used to measure impulsivity. This was a sample task from Gorilla, (Bezdjian, S. et. al. 2009). The task instructions were:

“This task is a Go/No-Go task with two repeated measures conditions of 40 trials and 5-10 practice trials each. The first condition requires a ‘**Go**’ response to the letter **P**, and a ‘**No-Go’** response to the letter **R**, while the second condition requires the reverse. This task should take around 6 minutes to complete.”

Results:

We used Gorilla to collect data and analyzed in R studio**.** Wise et. al., (2019) created a data-driven approach to select the best questions for determining factor scores of the three dimensions developed by Gillan et. al., (2016). This shortened the original 200 questions to 68 questions that best predicted the three dimensions. Predicted factor scores for the three dimensions and for each participant are shown in Figure 1. As mentioned in the methods, certain questions from each of the questionnaires were used to generate the 3 transdiagnostic dimensions and this approach helped created the factor scores for them.

Fig. 1

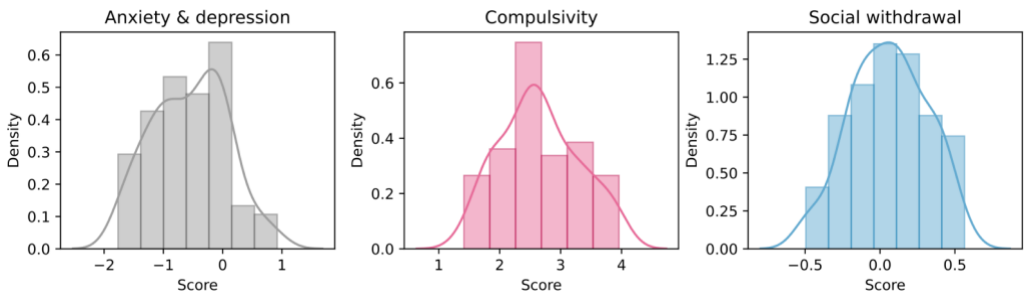

Figure 1. Generated predictive factor scores for anxious/depressive, compulsivity, and social withdrawal transdiagnostic characteristics. X-axis labels reflect the factor score ranges.

We ran linear mixed effects models on the behavioral inhibition task to compare reaction time with anxious/depressive symptoms, compulsiveness, social withdrawal,

gender, and age. The model showed a main effect of anxious/depressive symptoms, p=.0099 and age, p=.0001 (Table 2, Fig. 2). This meant when anxious depressive symptoms increased, reaction time decreased on the Go/No-Go task. As age increased, reaction times had increased overall. We also looked at the false positives and false negatives in the Go/No-Go task. Interestingly, after digging deeper, higher anxious/depressive symptoms may be responding faster, but slightly more likely to false positive. For the false positives, we found that as age decreased, the chance of pressing the button when participant was not supposed to, increased, p=.0002 (Table 3, Fig. 3). As for false negatives, they found those with lower social withdrawal symptoms were more likely to not press the button when supposed to, p=.0214 (Table 4, Fig. 4).

Table 2: Linear mixed effects of reaction time on Go/No-Go task

ANOVA

	numDF	denDF	Std. Error	F-value	p-value
(intercept)	1	90	0.037	237738.35	<.0001
AD	1	90	0.012	6.95	0.0099
Compul	1	90	0.010	1.16	0.29
SW	1	90	0.027	0.41	0.52
Gender	1	90	0.014	0.74	0.39
Age	1	90	0.001	18.10	0.0001

Table 2. Data of the Go/No-Go task with the 3 dimensions of transdiagnostic characteristics, gender, and age. Anxious/depressive symptoms and age have main effects.

Fig. 2:

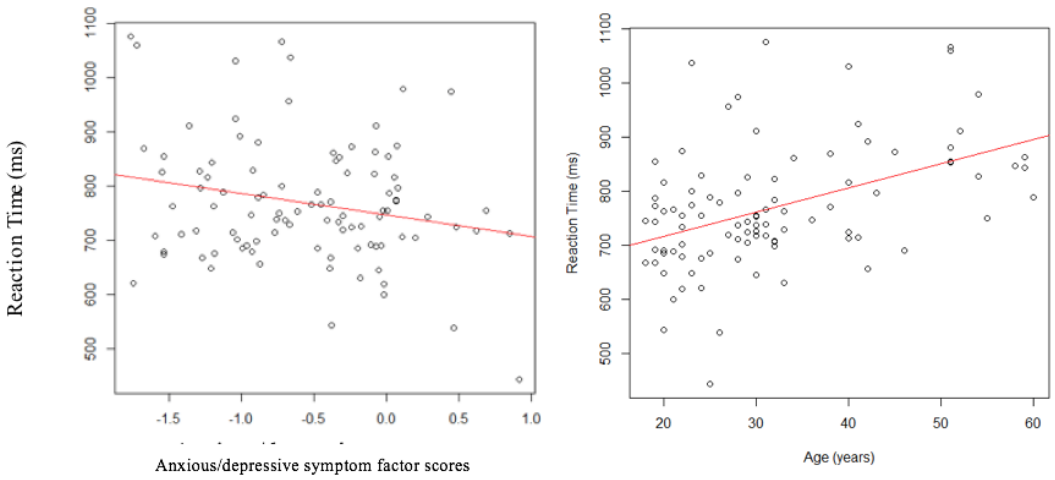

Figure 2. Data of Go/No-Go task with overall reaction time on the Go-No/Go Task. As anxious depressive symptoms increase, reaction time decreases. As age increases, reaction time increased.

Table 3: Linear mixed effects model of false positives

ANOVA

	numDF	denDF	Std. Error	F-value	p-value
(intercept)	1	90	0.016	128.69	<.0001
AD	1	90	0.005	4.99	0.0279
Compul	1	90	0.005	0.53	0.47
SW	1	90	0.012	0.42	0.52
Gender	1	90	0.006	0.53	0.47
Age	1	90	0.000	14.78	0.0002

Table 3. ANOVA of "false positives." False positives are when participant pressed the button when they should not have. Those lower in age were more likely to have a false positive.

Fig. 3:

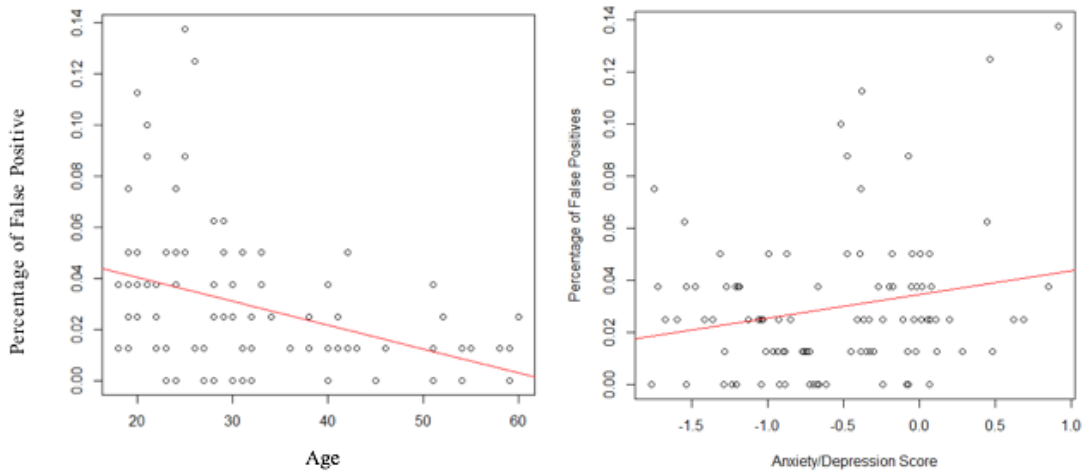

Figure 3. Data from Go/No-Go task of percentage of false positive errors. As age decreased, false positive errors increased. As anxious depressive symptoms increased, false positives errors increase

Table 4: Linear mixed effects model of false negatives

ANOVA

	numDF	denDF	Std. Error	F-value	p-value
(intercept)	1	90	0.015	8.63	0.0042
Anxious/Depressive	1	90	0.005	0.03	0.8643
Compulsive	1	90	0.004	2.85	0.095
Social Withdrawal	1	90	0.011	5.48	0.0214
Gender	1	90	0.006	0.10	0.7539
Age	1	90	0.0002	0.17	0.6777

Table 4. ANOVA of "false negatives." False negatives are when the participant does not press the button, but should have. Those with low social withdrawal symptoms tend to have more false negatives.

Fig. 4:

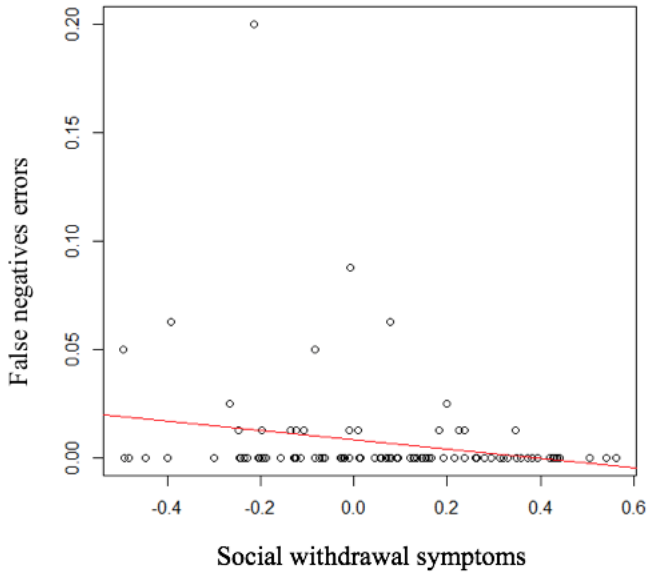

Figure 4. Data from Go/No-Go task shows when social withdrawal symptoms increase, false negative errors decrease.

For the delay discounting task, we calculated the amount difference (e.g. $20 now vs. $40 in two months = $20) for each of the questions and the difference between the time (e.g. now vs. two months = 2) as the delay. Using those difference values, we extracted the shorter immediate reward(SIR) and the longer delayed reward (LDR). From that, we were able to calculate when the probability of choosing the SIR when the delay was 2 months, 4 months, or 6 months. We made a table of each participants' probability of choosing the SIR for each delay and all 3 discounting tasks. Participants

average between the 3 delays (2,4,6) were calculated and used that to have a mean discounting rate for each task(monetary average, social average and health average). Those averages of the 3 discounting tasks were used to compare discounting performance with each other the 3 transdiagnostic characteristics (Anxious/Depressive, Compulsive, Social Withdrawal), gender and age demographics. We ran a linear mixed effects model and ANOVA of the three discounting tasks. We found a main effect for social discounting and age, p =.0043 (Table 5, Fig. 5). This means that discounting the future increased as age increased. Monetary discounting and age also had a main effect, p=.0338. This means as age increased, so did monetary discounting. Health discounting had no main effects, p=.38.

Table 5:

ANOVA

	numDF	denDF	Std. Error	F-value	p-value
Social discounting & Age	1	90	0.003	8.60	0.0043
Monetary discounting & Age	1	90	0.003	4.64	0.0338
Health discounting & Age	1	90	0.003	0.76	0.38

Table 5. ANOVA of main effects for the discounting measures and age.

Fig. 5:

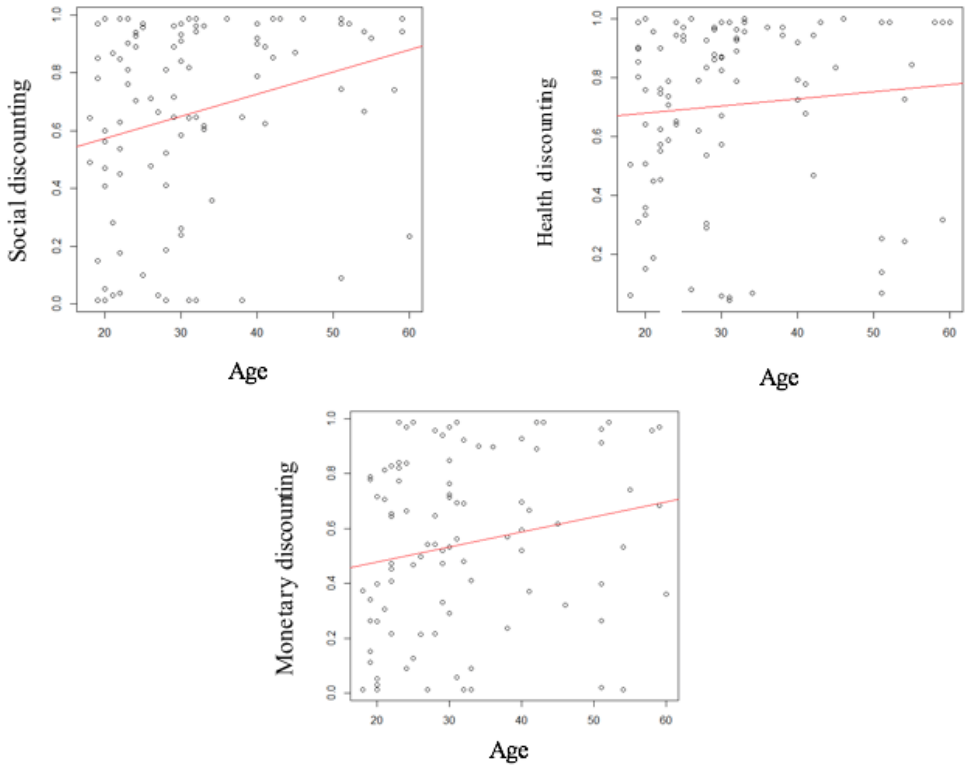

Figure 5. Scatterplot looking at the relationship of age and each discounting task. Age had an effect on social and monetary discounting, not health discounting.

We hypothesized that there would could potentially be a relationship with discounting and behavioral inhibition. Therefore, we ran a regression to see if there was any relationship with delay discounting on the different tasks and performance on the Go/No-Go task. Unfortunately, there was no effect of the 3 discounting tasks on false positive errors, false negative errors, and reaction time (Table 6a, 6b, 6c).

Table 6a: Social Discounting

Social Discounting	Value	Std. Error	t-value	p-value
(Intercept)	1.952	2.179	0.896	0.37
False Negative error	-1.614	1.601	-1.008	0.32
False Positive error	-2.764	1.759	-1.572	0.12
Reaction time	-0.413	0.746	-0.555	0.58

Table 6b: Monetary Discounting

Monetary Discounting	Value	Std. Error	t-value	p-value
(Intercept)	-1.248	2.156	-0.579	0.56
False Negative error	2.072	1.584	1.308	0.19
False Positive error	-1.082	1.74	-0.622	0.54
Reaction time	0.627	0.738	0.85	0.4

Table 6c: Health Discounting

Health Discounting	Value	Std. Error	t-value	p-value
(Intercept)	1.04	2.033	0.511	0.61
False Negative error	-0.897	1.494	-0.601	0.55
False Positive error	-0.872	1.641	-0.531	0.6
Reaction time	-0.103	0.696	-0.148	0.88

The next model used a different set of data to look for interactions between the different discounting measures and transdiagnostic symptoms.. We shortened the data frame with less variables. We were then able to look at the probability of choosing the

shorter immediate reward (SIR) and each discounting measure, transdiagnostic symptom category, gender, and age. Discounting and age did have a main effect, $p = .0045$.

Table 7: No interactions

ANOVA

	numDF	denDF	Std. error	F-value	p-value
(intercept)	1	190	0.14	863.97	<.0001
Discounting	2	190	0.04	9.47	0.0001
Anxious/depressive	1	90	0.04	0.01	0.93
Compulsive	1	90	0.04	0.01	0.93
Social Withdrawal	1	90	0.10	1.83	0.18
Gender	1	90	0.05	2.34	0.13
Age	1	90	0.001	8.44	0.0046

Table 7. Data from running a LME no interaction model and found age had a main effect.

Before the last data analysis, we changed the data frame in order to better find interaction effects for probability of choosing the SIR. Table 8 shows interactions between all the discounting measures, transdiagnostic symptom categories, gender and age. There was no significant interaction between the three discounting tasks (monetary, social, & health). The effect age on discounting was not different between the three

discounting tasks and symptoms. There was a significant difference between the discounting measures, *p=.0001*, with discounting higher for health discounting than monetary or social discounting. There was no effect of age between the discounting measures, $p = 0.21$, (Table 8).

Table 8: Interactions

ANOVA

	numDF	denDF	Std. error	F-value	p-value
(Intercept)	1	182	0.2	863.97	<.0001
Discounting	2	182	0.24	9.64	0.0001
Anxious/Depressive	1	90	0.06	0.01	0.93
Compulsive	1	90	0.05	0.01	0.93
Social Withdrawal	1	90	0.14	1.83	0.18
Gender	1	90	0.05	2.34	0.13
Age	1	90	0.0028	8.44	0.0046
Discounting & Anxious/Depressive	2	182	0.08	0.42	0.66
Discounting & Compulsive	2	182	0.07	1.82	0.16
Discounting & Social Withdrawal	2	182	0.17	1.99	0.14
Discounting & Age	2	182	0.00358	1.56	0.21

Table 8. ANOVA of the interactions between discounting, transdiagnostic dimensions, age, and gender.

Discussion:

This study examined the dimensional approach of transdiagnostic characteristics of psychological symptoms and decision-making. The three dimensions that were used, anxious/depressive, compulsive, and social withdrawal, are newly defined and still being explored. In the past, psychological disorders like substance use disorder (Bickel & Marsch, 2001) or OCD, (Steinglass et al., 2017) have led to higher discounting rates. These two disorders have compulsive/impulsive symptoms that overlap, therefore, leading to the hypothesis that there could be a relationship with these symptoms and high discount rates. Unfortunately, there was no relationship between the transdiagnostic dimensions and the delay discounting measures observed in the present study.

The measures of transdiagnostic symptoms used in the present study were previously used to compare different dependent factors like goal directed behavior (Gillan et. al. 2016), or used for learning more about metacognition (Rouault et. al. 2018). Based on these previous findings, it was predicted there would be some relationship of the three dimensions on delay discounting, as there is evidence of relationships between discrete mental disorders and delay discounting. The lack of an effect in the present study could be due to the sample chosen. Choosing a sample that have reported a diagnosis with a type of anxiety disorder or compulsive disorder and comparing that could lead to

different results based on symptom severity. We chose a general population sample that may or may not have a diagnosed psychological disorder. It is possible that a sample with more severe symptoms might have shown deficits on the measures of delay discounting and behavioral inhibition used in the present study.

Across the sample, it was observed that age was a good predictor in of higher discount rates and choosing the smaller, more immediate reward. It was interesting that age played a significant role in monetary and social discounting but less so for health in this study. The present study showed that as age increased, so did discounting the future. Previous research showed a similar age effect in two studies (Seaman et. al. 2016; Seaman et. al. 2020), with high discount rates in older people on social and health discounting tasks, but no relationship with monetary discounting. Studies with age and delay discounting have been consistent in showing that the older age groups and younger children both have higher discounting than middle aged groups. For children, this could be due to cognitive developmental processes (Gollner, L. et al. 2018). For older groups, this could be due to the smaller, immediate reward being more certain or require less physical effort. (Seaman et. al. 2016).

Anxious/depressive symptoms did have an effect on the Go/No-Go task that interpreted as when anxious/depressive symptoms increased, reaction time decreased overall. It was observed that although they were responding quicker, they were more likely to make a false positive error, suggesting a speed versus accuracy trade-off. Not much research has been conducted using this particular Go/No-Go task and anxiety/depression. Interestingly age also had an effect, so when age increased, so did

reaction time on the Go/No-Go task. This could be due to older people having slower reaction time. One study found similar results that older age had slower reaction time and more errors (Gaal & Czigler, 2015). For inhibition, there was an increase in pressing the button when not supposed to (false positive) in those with lower age and lower anxious/depressive symptom dimension. More interestingly, there was also an increased behavior of those with lower social withdrawal symptoms not pressing the button when supposed to (false negative). However, after looking more into the data, most participants actually had no error, but there were some outliers that affected the main effect of social withdrawal and false negatives. When accounting for that, there would probably not be a main effect of social withdrawal and false negatives in this study. For further support, a study conducted found opposing results, showing greater false negative responding in Autism Spectrum Disorder, which has a main symptom of social withdrawal. Therefore, the significant association with both false negative and false positive responses in those with Autism Spectrum Disorder, could lead one to believe there might be deficits with inhibition with higher social withdrawal symptoms, (Uzefovsky, Smith, & Baron-Cohen, 2016).

There were some limitations to this study. The discounting measures from Seaman et. al. (2020) were newer and not as validated as older researched discounting scales. Most delay discounting data is analyzed a bit different than the way this study did it. In this study, discounting is not measured like it usually would be fitting to a hyperbolic model because when looking at each participant, there was not enough delays to make a hyperbolic model, but could make a linear one. Therefore, having more delays

or a different delay discounting task could also have given us more significant results. Most discounting scales also use an economic background with it as well (social economic) and not just physical, like the social and health one we used. An example of a social economic task would look how likely one might be to give a certain amount of money (e.g. $75) to another person either really close to them (good friend/family) or someone that is not as close to them (acquaintance) (Rachlin, H. & Jones, B., 2007). More consistency in the methods of social delay discounting paradigms might help lead to more comparable results between studies.

In addition, the sample in this study was one that didn't specify if there was any history of diagnosed mental disorders. Previous research looking at transdiagnostic dimensions also used a much larger sample population compared to the small sample in this current study (Gillan et. al. 2016, Wise et. al. 2018). There has been a few other studies that use the same dimensions, but not a great deal of research supporting the data driven approach that Gillan et. al. 2016 and Wise et. al. 2018 used to create these dimensions.

In conclusion, future research should continue to explore a transdiagnostic approach and cognitive processes like decision-making. Problems with metacognition are relevant in mental disorders. Research exploring not necessarily the specific mental disorder, but the symptoms that are most severe and related across multiple disorders, could help further knowledge of the disorders, help lead to new therapy techniques, and lead even further support of metacognition distortions in maladaptive behaviors.

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Biography

Morgan DeHart graduated from Basset High School, Bassett, Virginia in 2016 with her Associate's degree. She received her Bachelor of Science from James Madison University in 2019. She received her Master of Arts in Psychology in 2021.