Delay Discounting and the Cost of Waiting

By

Kendra Thompson-Davies

A thesis

Submitted to the Victoria University of Wellington

In fulfillment of the requirements for the degree of

Master of Science in Psychology

Victoria University of Wellington

2018

Table of Contents

Acknowledgements

I'd like to thank my supervisor, Dr. Anne Macaskill for constantly providing me with the guidance I needed to complete this thesis. I'd also like to thank Dr. Maree Hunt for guiding me as well as helping to keep me on track. I am also very thankful for the warm and supportive environment provided by the Human Learning lab throughout the entire process.

Abstract

If offered $50 now or $100 in a year, many of us will choose $50 now. This occurs because of delay discounting – the idea that reinforcers lose value over time. Individuals tend to display shallower discounting (self-controlled decision-making) in hypothetical discounting tasks, and steeper discounting (impulsive decision-making) in experiential discounting tasks. Hypothetical discounting tasks involve participants making a series of hypothetical monetary decisions (e.g. $50 now versus $100 in a year) over a range of delays. Experiential discounting tasks involve participants experiencing the delays and outcomes of their choices.

A critical difference between hypothetical and experiential discounting tasks is the type of delay they use. Hypothetical discounting task delays typically involve postponing. This involves participants imagining the reward is delivered to them after the delay and that they are free to pursue other activities during the delay. Experiential task delays involve participants waiting out each delay before they receive their reward, (unable access any alternative reinforcement during the delay). Individuals discount more steeply when tested experientially than hypothetically.

Experiment 1 investigated whether waiting and postponing are different discounting constructs. We achieved this via a 2 X 2 within-subjects design where both experiential and hypothetical discounting tasks had both Waiting and Postponing conditions. The hypothetical discounting task involved participants being instructed to imagine waiting for a reward after a delay (Waiting Condition), or imagine the reward would simply be delivered to them after the delay (Postponing Condition). The experiential task involved participants playing a video game that involved having to stop playing and wait for a larger number of points after a delay (Waiting Condition), or playing the game and getting the points delivered after the delay (Postponing Condition). We expected steeper discounting rates when waiting compared to postponing in both the experiential and hypothetical tasks. We found this effect only in the hypothetical task; however, this might be due to our procedure. We randomised the waiting and postponing trials in both tasks and this may have resulted in the participants being unable to discriminate between the interspersed trials.

Experiment 2 investigated whether this methodological feature affected discounting in the experiential task, and we found that blocking the trials resulted in the anticipated

effect. We found steeper discounting in both the experiential and hypothetical tasks for waiting compared to postponing after implementing this change, suggesting that waiting and postponing are different constructs. Experiment 3 investigated what drives the difference between waiting and postponing. We found that waiting has a greater effect on reward value than postponing due to the inability to access alternative reinforcement during the delay.

We also investigated the relationships among our discounting measures and a measure of the consideration of future consequences, and a measure of delayed gratification. We found no correlation among discounting and these measures, and no consistent correlation between waiting and postponing. Overall, our results indicated that waiting and postponing are distinct constructs, and that the inability to access alternative reinforcement during a delay is the key difference between them.

General Introduction

What is Delay Discounting?

Would you prefer $50 now or $100 dollars in 5 months? If given this choice the majority of people will prefer the smaller yet immediate option, because at the time of decision-making it appears more valuable than the delayed alternative. The preference for smaller yet immediate rewards compared to larger yet delayed rewards is captured by a process referred to as delay discounting – the phenomenon that reinforcers lose value over time (Mazur, 1987). We make these types of amount versus delay trade-offs in our everyday decision-making – for example preferring an easy yet unhealthy snack might appear more valuable at the moment of choice compared to the long-term delayed reward of maintaining a healthy body. Selecting the smaller yet immediate rewards is viewed as the impulsive choice in decision-making research involving delay discounting, and selecting the larger yet delayed rewards is considered the self-controlled choice.

How is Delay Discounting Measured?

To measure the degree to which an individual discounts rewards as a function of delay, researchers measure their change in preference for smaller, sooner (SS) rewards compared to larger, later (LL) rewards as the delay increases. Individuals that prefer SS rewards over LL rewards at shorter delays display more impulsive decision-making and a high rate of discounting. For these individuals a reward loses its perceived value more quickly as the delay to receiving the reward increases. Individuals that continue to prefer LL rewards over SS rewards display more self-controlled decision-making and a low discounting rate, indicating that a reward loses its perceived value more slowly over time to them.

A hypothetical delay discounting procedure is typically used to assess these SS versus LL preferences. This procedure involves the individuals making a series of choices regarding hypothetical rewards (usually monetary) across various delays (Odum, 2011a). A process called the titrating amount procedure is used to calculate the individuals' indifference points (Du, Green, & Myerson, 2002; Rodzon, Berry, & Odum, 2011). This process involves modifying the SS options presented to the individual based on their previous choice in order to find the point at which they are indifferent between the two options.

For example, the individual might first be presented with a (hypothetical) choice between $50 now or $100 in 5 months (the SS option usually starts as half of the LL option). If the individual chooses the SS, then the next choice they would get for the 5-month delay would be then modified to make the LL more appealing. This change involves decreasing the SS by a fixed percentage, for example, 10%, of the LL. For this example the $50 now would then be decreased to $40 now against the $100 in 5 months. If the individual first chose the LL option instead then the SS would be increased by 10% of the LL, and the next choice for the 5-month delay would be $60 now versus $100 in 5 months.

This titrating process is carried out until the indifference point is reached for that delay (5 months) – this is the point at which both options are perceived as equal in value to the individual. For our example, the individual might find that receiving $70 now would be subjectively as valuable to them as receiving the $100 after 5 months. In other words after 5 months $100 has lost 30% of its value. As noted above those for whom the subjective value of the reward decreases more steeply are termed impulsive. A more impulsive individual might find that receiving $30 now would be as subjectively valuable to them as receiving the $100 after 5 months, indicating that after 5 months $100 has lost 70% of its value.

By finding indifference points for a range of delays, they can then be plotted to form a discounting curve with delay on the x-axis and subjective value of the LL (in this example $100) on the y-axis. This curve depicts the decrease of value as the delay increases. The curve is shallower for individuals that are less impulsive (more self-controlled LL choices) and steeper for individuals that are more impulsive (more SS choices).

An individual's rate of discounting is calculated using these indifference points, and there are two main ways to achieve this. One way involves fitting a model - for example the hyperbolic model:

$$V = A/(1 + kD)$$ [Equation 1; Mazur, 1987]

to the indifference points curve. In this equation "V" represents the indifference point (the subjective value of the delayed reward to the individual), "A" represents the full amount of the delayed reward (e.g. in this example $100), "D" represents the delay, and

"*k"* represents the individual's discounting rate. Higher *k* values represent steeper discounting and lower *k* values represent shallower discounting. The hyperbolic model assumes a rapid and steep decline in a reward's perceived value that gradually tapers off as the delay to receiving the reward continues to extend.

A second way involves an atheoretical analysis that instead of assessing how well the discounting curve can be fitted to a particular model involves calculating the area under the curve (AUC). This method is free from all assumptions associated with fitting any given model. The AUC value can then be used to represent the individuals' rate of discounting. AUC is calculated as:

$$\text{AUC} = \sum x_2 - x_1 \left(\frac{y_1 + y_2}{2}\right)$$

[Equation 2; Myerson, Green, & Warusawitharana, 2001]

with "x1" and "x2" representing the consecutive delays and "y1" and "y2" representing the subjective values connected to those delays. The AUC value is a proportion of the total area and therefore AUC values must fall along the range of 0 to 1. An individual showing steep discounting (more impulsive decision-making) would have a lower AUC value than an individual showing shallow discounting (more self-controlled decision-making).

To recap, rewards drop in subjective value more quickly over time for individuals that are described as more impulsive. Such individuals would prefer the SS options to the LL options at shorter delays than those who are less impulsive. Such a pattern of behaviour would result in steeper discounting, higher *k* values and lower AUC values.

Why is Delay Discounting Important?

The preference for something small such as an unhealthy snack or choosing to sleep-in and avoid household chores, or even choosing to spend time browsing the internet instead of working on a project may appear relatively harmless at first glance, but pervasive failures of self-control can also have detrimental effects on societal well-being. Delay discounting has been implicated in more harmful decision-making processes such as problem gambling (Dixon, Marley, & Jacobs, 2003; Grecucci, Giorgetta, Rattin, Guerreschi, Sanfey, & Bonini, 2014; Vanderveldt, Green, & Rachlin, 2015); substance abuse (Bickel & Marsh, 2001; Johnson, Herrmann, & Johnson, 2015; Odum, 2011a; Odum & Rainaud, 2003); severe procrastination (Olsen, 2016); and risky

health behaviours (Bickel, MacKillop, Madden, Odum, & Yi, 2015; Johnson et al., 2015; Kaplan, Reed, & Jarmolowicz, 2015). Delay discounting is also affected in individuals with eating disorders, with anorexia being associated with lower rates of discounting (Decker, Figner, & Steinglass, 2015; Steward et al., 2017) and binge eating associated with higher discounting rates (Steward et al., 2017). Lower delay discounting rates are associated with academic success (Acuff, Soltis, Dennhardt, Borsari, Martens, & Murphy, 2017).

The link between impulsive decision-making (captured via delay discounting) and many maladies from cigarette smoking to schizophrenia has resulted in delay discounting potentially being considered a trans-disease process. Understanding more about this process could therefore aid understanding of the diseases that share this common tendency of excessive delay discounting (Bickel & Mueller, 2009). These investigations suggest that there is a strong relationship between discounting rates and serious maladaptive decision-making.

What is Delay Discounting Measuring?

Currently there is considerable variation across methods used to investigate delay discounting and a beneficial step is figuring out whether these procedures measure similar or distinct phenomena. That was the main aim of the current study – to further investigate an argument that different delay discounting procedures measure different decision-making processes. This hypothesis is best captured when discounting is compared across experiential and hypothetical delay discounting tasks.

Unlike the hypothetical task described earlier, experiential discounting tasks involve the individual experiencing both the rewards and the delays involved in their successive choices – not just imagining them. When individuals are tested hypothetically they have lower discounting rates, and display more self-controlled decision-making than when experiential tasks are used (Kirby, 1997; Jimura, Myerson, Hilgard, Braver, & Green, 2009; Jimura, Myerson, Hilgard, Keighley, Braver, & Green, 2011).

There is even concern within the experiential discounting procedures as to whether or not they measure the same discounting behaviours. Reynolds (2006) investigated delay discounting via the experiential discounting task (EDT). The EDT involves participants making a series of monetary choices – if they choose SS for a trial then the cents are immediately delivered, whereas if they choose the LL they must wait out the required number of seconds before the cents are delivered and they can

continue making choices. Whether or not the LL cents would actually be delivered was uncertain in the EDT as it involved probabilistic delay discounting where participants chose between a certain SS an uncertain (35% chance of receiving) LL.

In the study by Reynolds (2006), discounting rates were significantly correlated with a hypothetical delay discounting measure but not a hypothetical probability discounting measure – suggesting that the delay discounting procedures were capturing the same process. However, when Smits, Stein, Johnson, Odum and Madden (2013) investigated delay discounting via the EDT they found that it had poor test-retest reliability and that discounting rates were uncorrelated with those gained from the typical hypothetical task. This suggested that the EDT and the typical hypothetical task measure different constructs, with boredom proneness perhaps having a large influence on EDT decision-making behaviour.

Johnson (2012) investigated a novel experiential discounting procedure - the Quick Discounting Operant Task (QDOT) to assess discounting behaviour, alongside the EDT and hypothetical money tasks. The QDOT was developed as a more efficient and effective experiential delay discounting task compared to the EDT. The QDOT required less time to determine a discounting rate, resulted in fewer ambiguous indifference points, and removed the probabilistic nature in favour of a purely delay based trade-off that involved certain consequence delivery on all trials. Johnson found that the QDOT was correlated only with the EDT and not the hypothetical task. The majority of research investigating hypothetical versus experiential discounting indicates that the hypothetical discounting task that is most typically used to assess discounting behaviour is measuring something different than what experiential discounting tasks measure. This raises the question of what shared and distinct features of hypothetical and experiential delay discounting tasks critically affect discounting behaviour.

Delay range. The first difference between the two types of task lies in the range of delays they use. The typical hypothetical discounting task involves large delays - comprised usually of days, weeks, months, or years. Whereas experiential tasks typically use delays of seconds or minutes. It might be that there is something crucial about discounting across short delays and discounting across large delays that results in different discounting behaviour.

Johnson and Bickel (2002) investigated whether or not hypothetical and experiential monetary discounting tasks that used the same range of delays would result in different discounting and found it did not. Participants discounted similarly across the delays in both tasks. This suggests that the delay range itself might be a factor driving the difference in discounting behaviour between experiential and hypothetical discounting tasks, and that using the same delay range might mitigate this difference. However the experiential task used by Johnson and Bickel used a potentially real reward and the impact of this is discussed below.

Reward type. The next difference between the two types of task is the type of rewards they use. The typical hypothetical discounting task involves the use of monetary rewards. Whereas experiential tasks typically use consumable rewards. It might be that there is something crucial about discounting across different types of rewards that results in different discounting behaviour.

Odum and Rainaud (2003) found steeper discounting rates for hypothetical alcohol and food compared to hypothetical money over the same range of delays, and suggested this was due to the difference in commodity type, as the former function as primary and consumable reinforcers compared to a secondary, non-consumable reinforcer. This could support the idea that differences in reward type might underlie the typical difference found between experiential and hypothetical discounting.

Hypothetical versus experiential rewards. In addition to delay or reward type, another difference might be that the reward is actually experienced in the experiential task and not experienced in the hypothetical task. Some studies have suggested that hypothetical rewards are valid substitutes for real rewards in discounting research (Johnson & Bickel, 2002). However, other studies have suggested the opposite (Hinvest & Anderson, 2009).

Jimura et al. (2011) investigated discounting of hypothetical money and real liquid rewards and found no correlation between discounting rates of the two types rewards, and suggested that instead of discounting reflecting a single impulsivity trait it may instead reflect separate stable traits for discounting of experiential consumable rewards and hypothetical monetary rewards. This result, however, might have reflected the commodity or delay effects described above.

The reward being experienced is not limited to experiential tasks alone, one of the common discounting procedures also involves the individual experiencing the reward. Instead of the participant just making a series of hypothetical choices, they are informed that one or more of the choices they will be making will be real – and that their preference (SS or LL) would be delivered to them after the task (if SS was chosen) or after the delay specified (if LL was chosen). This is used to incentivise participants to make each choice as if they were actually real – as they do not know which of the choices will be selected. This is also used in some studies as a way to assess experiential discounting.

Participants discount similarly across purely hypothetical tasks and this type of hybrid hypothetical task where the reward is sometimes experienced (Madden et al., 2004). However, this type of hypothetical discounting task where the reward is sometimes experienced still results in different discounting behaviour compared to experiential discounting tasks where the reward is always experienced (Johnson, 2012).

In the aforementioned delay section, Johnson and Bickel (2002) used this hybrid discounting task to measure and compare experiential discounting and hypothetical discounting. Their results supported the conclusion that delay range might be the crucial difference behind the typical difference between experiential and hypothetical discounting tasks. However the use of this hybrid task weakens its potential given that this type of potentially real hypothetical/experiential hybrid task doesn't correlate with other experiential tasks and is more similar to purely hypothetical discounting tasks.

The conclusion that discounting is similar across the same delay range for both hypothetical and this hybrid task cannot be applied to experiential discounting tasks in general, as experiential discounting and hypothetical/experiential hybrid discounting are not interchangeable. There is another factor consistently present in experiential discounting tasks and absent in hypothetical discounting tasks that results in more impulsive discounting behaviour in the former and self-controlled discounting behaviour in the latter.

Hypothetical versus experiential waiting. The focus so far largely appears to be on whether the reward itself is experienced or not. However, whether the delay is experienced or hypothetical might be a more important factor to consider - that has generally been ignored (Dixon, Mui Ker Lik, Green & Myerson, 2013).

Participants only experience the wait for a reward in the experiential task – never in the hypothetical task. Even when the hypothetical hybrid task involves the chance of a reward being delivered after a delay, there is still a fundamental difference between waiting for that reward and waiting for a reward in an experiential discounting task. Experiential discounting tasks involve participants making choices over short delays that they have to actually wait out before their reward is received. The different discounting procedures may be measuring different types of waiting.

Waiting versus postponing. Paglieri (2013) identified this issue in his review on delay discounting research. The vast majority of discounting studies fail to take into account the effect of delay costs on decision-making behaviour. The major difference between typical experiential and hypothetical discounting procedures is that they deal with two different types of delay that have differing associated costs. There is the type of delay that involves waiting, these involve the individual having to wait for their reward, and endure all the costs associating with that experience (the typical experiential procedure). Compared to waiting, there is a second type of delay that instead involves postponing – this delay allows a reward to be postponed to a later time with fewer costs associated with postponement experienced by the individual (the typical hypothetical procedure).

Paglieri (2013) specifically identified three types of potential costs he believed were linked with delayed rewards. First, the direct cost of the delay itself - i.e. the individual being bored or uncomfortable during the delay. Second, opportunity costs of the delay - which cover all of the other potentially reinforcing activities or behaviours that the individual could be participating in if they weren't experiencing the delay. Lastly, opportunity costs of the reward – which cover all of the reinforcement the individual would be receiving if they had access to the reward immediately available. The only delay cost that is equally present in both typical hypothetical discounting tasks and experiential tasks is this last cost associated with the reward. The first two costs are present only under experiential conditions, and not under hypothetical conditions. It is thus unclear whether the two types of task can be treated as the same.

Discounting studies that use the typical hypothetical procedure (as the majority tend to do) are assessing the preference to postpone and not the preference to wait. It is important to investigate whether waiting and postponing should be treated as

interchangeable constructs in decision-making research (Paglieri, 2013). It appears likely that a crucial aspect responsible for the differences found between the typical hypothetical discounting procedure and typical experiential discounting procedure is whether the task is measuring waiting or postponing. It also seems plausible that different discounting tasks capture different discounting behaviours.

Johnson et al. (2015) carried on from the concern raised by Paglieri (2013) and were the first to investigate the effect of delay costs in delay discounting using a novel hypothetical task and procedure that aimed to assess whether or not the concern of waiting versus postponing was a valid one. They raised issues with the three differing types of delay costs detailed by Paglieri (2013), particularly whether or not the three costs where actually distinct from each other. Johnson et al. instead decided to merge the second and third costs into the overall idea of opportunity costs associated with restricted access to reinforcement and consider the first cost as the subjective experience of these opportunity costs.

In order to investigate the effect of these opportunity costs, Johnson et al. (2015) used both a hypothetical money discounting task as well as a hypothetical cigarette discounting task among participants that smoked. They created four different hypothetical framing conditions that were designed to represent increasingly restrictive levels of reinforcement availability during various delays. At the most restricted end of the four conditions was the “wait” condition; this was designed to hypothetically mimic a typical experiential waiting procedure. This involved participants having to imagine that they had to sit in front of the computer and watch a non-stimulating waiting screen until the delay was up and being unable to seek out any reinforcement during the delay except to quickly eat or use the bathroom.

The second condition Johnson et al. (2015) included was a “browse” condition that was less restrictive in that participants still had to imagine waiting at the computer but were allowed to seek out reinforcement during the delay via the computer, e.g. browsing the internet during the delay. The third condition was the “return” condition and was even less restrictive – they had to imagine they were free to leave the computer/room but had to return to the computer after the delay or they would not receive the reward. They also were not allowed access to any timepiece during the delay in this hypothetical

scenario. This was to mimic more closely how difficult it is for individuals in experiential tasks that have to use their own strategies to keep track of the time.

The last condition Johnson et al. (2015) included was the freest of the four, aptly named the "free" condition, which mimicked the typical hypothetical procedure preferred in discounting research that involved postponing and not waiting. The individuals had to imagine they were free to leave the room/computer and were free to pursue any reinforcement during the delay and did not have to return to the room/computer to receive the reward afterward.

Not surprisingly, Johnson et al. (2015) found that as the associated opportunity costs increased, so did the rates of discounting. Participants showed the steepest discounting in the most restrictive "wait" condition, followed by the "browse" condition, the "return" condition and lastly showed the shallowest discounting in the least restrictive "free" condition. Their results supported Paglieri's (2013) hypothesis that waiting and postponing are different constructs. They concluded that future studies on the full impact of opportunity costs associated with hypothetical and experiential delays are necessary for more accurate theory and more appropriate application of delay discounting research.

Waiting and postponing appear to be different constructs that result in different discounting patterns and therefore caution must be taken when considering the conclusions drawn from studies that differ in whether they require participants to wait or postpone, or that have used only postponing to make judgements about the preference to wait.

The obvious difference between waiting and postponing found in Johnson et al.'s (2015) hypothetical discounting procedure was a good first step in further shedding light on the role of opportunity costs. The current study aimed to continue on from this and provide further evidence for the distinction between waiting and postponing by replicating the hypothetical discounting effect and also demonstrating the same effect in an experiential discounting procedure.

Delay Discounting and the Consideration of Future Consequences

Delay discounting has been examined alongside other measures related to decision-making, temporal judgements, and impulsivity. One such measure is the Consideration of Future Consequences (CFC). The CFC scale (CFCS) was a 12 item scale

designed to measure the degree to which individuals focused on future and immediate consequences (Strathman, Gleicher, Boninger, & Edwards, 1994). High scores on the CFCS indicate a tendency to focus more on future consequences, and low scores indicate a tendency to focus more on immediate consequences.

This measure is conceptually related to delay discounting in that both CFC and delay discounting involve a pitting of immediate consequences against future consequences. Due to this potential link, it seemed of interest for research to investigate the relationship between discounting rates and CFCS scores.

Similar to delay discounting, the CFCS has been used in many socially important research areas. Particularly, areas that involve concern for future outcomes such as health behaviour; financial decision-making; work-related behaviour; ethical decision-making; and environmental behaviour (Joireman & King, 2016). The results of such studies conclude that higher CFCS scores are linked to healthier lifestyles; better financial management; more positive work behaviour and outcomes; stronger moral and ethical reasoning; and greater concern for the environment (Joireman & King, 2016).

Research on the best way to measure CFC has concluded that it should be treated as a multidimensional construct with two distinct yet related subscales at play – CFC-Immediate (CFC-I) and CFC-Future (CFC-F) (Joireman, Balliet, Sprott, Spangenburg, & Schultz, 2008; McKay, Perry, Percy, and Cole, 2016). The CFC-F subscale provided an overall score of concern for future consequences, and the CFC-I subscale provided an overall score of concern for immediate consequences (note that CFC-T refers to the combined F and I subscales). Research also suggests the use of the newer version - the CFCS-14 (that includes an additional two items) over the original CFCS-12 for the increased reliability of the scale. (Joireman, Shaffer, Balliet, & Strathman, 2012, McKay et al., 2016). Examining CFC alongside potentially similar measures such as delay discounting may help clarify which applications of CFC are appropriate in certain settings. If the separate CFC-F and CFC-I subscales are differently related to delay discounting, that could provide further support for viewing and treating these two subscales as distinct constructs.

Cosenza and Nigro (2015) investigated the relationship among impulsivity, delay discounting, CFC and adolescent gambling. They found that gambling severity was significantly related with delay discounting, CFC-T, and CFC-I. Higher discounting rates,

higher CFC-I scores, and lower CFC-T scores were related to higher gambling severity. Higher discounting rates were related to higher CFC-I scores, and lower CFC-T scores and CFC-F scores.

This suggests that individuals that focus more on immediate outcomes are less likely to choose delayed rewards over immediate rewards. The result of this study further suggests that delay discounting and CFC can be useful to examine together in problematic behaviours, and strengthens the link between the two measures and the benefit of further research into their relationship. This study also provides further support for the treatment of CFC-F and CFC-I as distinct measurements in research. Similarly, Joireman et al. (2008) investigated CFC and delay discounting and found that overall CFC-F was negatively related to discounting rates, and overall CFC-I was positively related to discounting rates. This also provided a useful insight into the delay discounting and CFC relationship - particularly how the CFC-I and CFC-F subscales can differently relate to delay discounting.

Charlton, Gossett and Charlton (2011) also investigated delay discounting and CFC. They found that discounting rates were more strongly related with the CFC-I subscale and that self-efficacy was more strongly related with the CFC-F subscale. This suggests that delay discounting involves making immediate decisions (this includes evaluating future outcomes of said immediate decisions), while self-efficacy involves focusing more on future possibilities and outcomes. This result further strengthens the potential link between CFC-I and delay discounting in particular, and again demonstrates how the two subscales can relate to measures differently.

The abovementioned CFC research used variations of the typical hypothetical discounting procedure, and therefore their conclusions about delay discounting and CFC are appropriate only for this type of discounting procedure. The relationship between CFC and discounting procedures that measure waiting and not postponing are still unknown. It might be that CFC differs in how it relates to hypothetical waiting and postponing. The current study aimed to investigate this possibility.

The Current Study – Experiment 1

The main aim of Experiment 1 was to investigate the effect of waiting in both hypothetical and experiential discounting tasks. This was achieved by designing both tasks to include and exclude waiting. As the typical hypothetical money discounting task

only assesses postponing, we included a Waiting Condition that specifically instructs participants to imagine waiting, alongside a Postponing Condition that instructs participants they do not have to hypothetically wait, just postpone (imagine they are free to go about their lives and reward is delivered after the delay). We mirrored this change in the experiential discounting task so that the Waiting Condition specifically involved participants having to wait out each choice, and the Postponing Condition involved participants having their rewards simply postponed. This experiential discounting procedure was in the form of a computer-game based choice task (where the individual plays through a game with choices embedded and rewards are given and taken in the form of points) that has been shown to be an effective way to assess experiential discounting (Greenhow, Hunt, Macaskill, & Harper, 2015).

We expected that participants would show steeper discounting (more impulsive decision-making) in the conditions where they have to wait in both the experiential and hypothetical discounting tasks, and that they would show shallower discounting (more self-controlled decision-making) in the conditions where they do not have to wait, perhaps to ceiling level. A secondary goal was to further investigate the relationship between delay discounting and CFC. The main interest being how the CFC-I, CFC-F, and CFC-T are related to discounting rates, both hypothetical and experiential waiting and postponing. However, as CFC has never been (to our knowledge) investigated in terms of waiting versus postponing or experiential and hypothetical discounting conditions we were unsure as to what the relationships would be among the CFC-T, CFC-F, and CFC-I scores, and this would be largely exploratory.

Experiment 1 – Waiting Versus Postponing

Method

Participants

Participants were 47 first-year psychology students from Victoria University of Wellington who were recruited via a research participation programme as a course requirement. All participants provided informed consent before any data were collected, and all received written and verbal debriefing after the experiment. The procedure was reviewed and approved by School of Psychology Human Ethics Committee.

Materials / Tasks

The discounting tasks used Microsoft Visual Basic® 2013 software. Participants completed the tasks in the laboratory using Dell computers with 19-inch screens that had a resolution of 1920 x 1050.

CFC Scale. The CFC scale used was the CFCS-14 (Joireman et al., 2012). It contains seven positively worded items (CFC-F items) and seven negatively worded items (CFC-I items). An example CFC-F item is: "My behavior is generally influenced by future consequences.". An example CFC-I item is: "I only act to satisfy immediate concerns, figuring the future will take care of itself*.".*

Participants responded via a 7-point Likert scale ranging from 1 (very unlike me) to 7 (very like me). The scale contains two highly reliable factors: one pertaining to future considerations (CFC-F) and one pertaining to immediate considerations (CFC-I). Scores for items in both of these factors were averaged to provide each participant's score for CFC-F and CFC-I. In order to get each participant's overall CFCs score, the seven CFC-I items were reverse scored and scores on the total 14 items were averaged (See Appendix C for the full CFCS-14).

Experiential discounting task – Waiting Condition. Participants completed the discounting task choices as part of a skiing game. The aim of the game was to earn as many points as possible by navigating around obstacles (where if hit they would lose 2 points) and making jumps to earn 5 points. After a variable number of seconds they would approach a large jump to be asked to choose between a smaller, immediate number of points and a larger number of points after a delay.

Participants first read these instructions:

"You are a 'ski boarder' competing for points. The object of the task is to gain as many points as possible. You gain points for each jump you make over 'moguls', which look like [image of a mogul shown here]. You lose points for running into trees or rocks. Every so often you get to make a 'free run' at a jump platform. Before making such a jump you must choose ONE of TWO possible jump scenarios … One option results in maximum points for the jump but it will take longer to do because it takes a while for the judges to award the points. The other option will give you fewer points but will be quicker to do. Sometimes you have to wait while the judges award their points while other times the judges allow you to ski during this time. Use the mouse to click on the option you wish to choose. You move the

player around using the DOWN, LEFT, and RIGHT arrows. You can only move left or right, straight down, or at an angle downwards (make sure you spend some time at the start trying out the keys in order to become familiar with movement). Please wear the headphones attached to the computer during this task."

Participants then began playing the game – navigating their skiing character down the slope avoiding the rocks and trees and making the jumps. This game portion of the task acted as the inter-trial interval (ITI) separating the choices. The choice alternatives task embedded in the game involved five delays (4, 7, 14, 22, and 32 seconds), with each being presented five times in a randomised order (totaling 25 trials).

A titrating amount procedure was used to calculate each participant's indifference point for each of the five delays. In this procedure, participants' prior choices determined the next smaller, immediate option for each delay. The larger, delayed option was always 60 points, and the smaller, immediate option started off as half of the larger, delayed option (30 points) and titrated from there. The smaller, immediate options for each delay were either increased or decreased by 10% of the larger, delayed option to make the option not previously selected more appealing. For example, if the participant chose in the first trial of delay 1 the smaller, immediate option (30 points), then the smaller, immediate option for the next trial in that delay was decreased to 24 points (thus making it less appealing) and shown against the larger, delayed reward amount (always 60 points). If the participant chose the larger, delayed option in the first trial of delay 1 instead, then the smaller, immediate option will be increased to 36 points in the next trial (thus making this option more appealing).

If participants chose the smaller, immediate option, they were presented with an animation of the skier making the jump and read the (example) text: "You get 30 more points". They were then put back into the game where they could continue skiing down the slope, avoiding collisions and earning points via jumps. If participants chose the larger, delayed option, they were presented with an image of the skier and the delayed option they chose on-screen for the duration of the delay – indicating they would have to wait. Just before the delay was over they were presented with the jump animation and the text "You get 60 more points", after which they were allowed to keep playing the game. Their total score was displayed and continually updated in a box in the top

right corner of the screen and they played this skiing game between the choices until the task was finished.

Experiential discounting task – Postponing Condition. The task in this condition is the same as in the Waiting Condition, except participants did not have to wait during the delays if they chose the larger, delayed option. They were immediately put back into the game and allowed to keep playing, and after the specified delay was up, a small window would pop up and the participant would then be able to click to receive their points.

Experiential discounting task – condition / trial setup. Participants experienced both the Waiting Condition and the Postponing Condition during the experiential discounting task in a randomised pattern. As they played the game, the participants were randomly presented with discounting choices for both the Waiting and Postponing conditions for each of the five delays (the text presented to the participants aim to help them distinguish between the two). Participants experienced a single trial for each of the delays within both conditions before they experienced the next (titrated) trial for each of the delays within both conditions. This process continued until all five trials for each of the five delays within both the Postponing and Waiting conditions were completed (total 50 trials). For the Waiting Condition choices, they were informed they have to "wait for the jump" which meant not being put back into the game until the wait was over. For the Postponing Condition choices, they were informed they could "ski up to the jump" which meant they were allowed to continue playing the game during the wait for the points.

The ITI. Waiting Condition (see Figure 1A for a diagram): the ITI was comprised of two parts, one part was fixed and lasted 15 seconds, and the other part varied based on the delay of the previous choice. So for example, the participant began the task by playing the game for 15 seconds before a choice appeared on the screen. If the choice involved a delay of 7 seconds, then depending on what the participant chose (if the smaller, immediate option was chosen) they either received their points, and then skied for 22 seconds (15 plus 7 seconds), or (if the larger, delayed option was chosen) they waited for 7 seconds, then received their points, and then skied for 15 seconds before the next choice appeared.

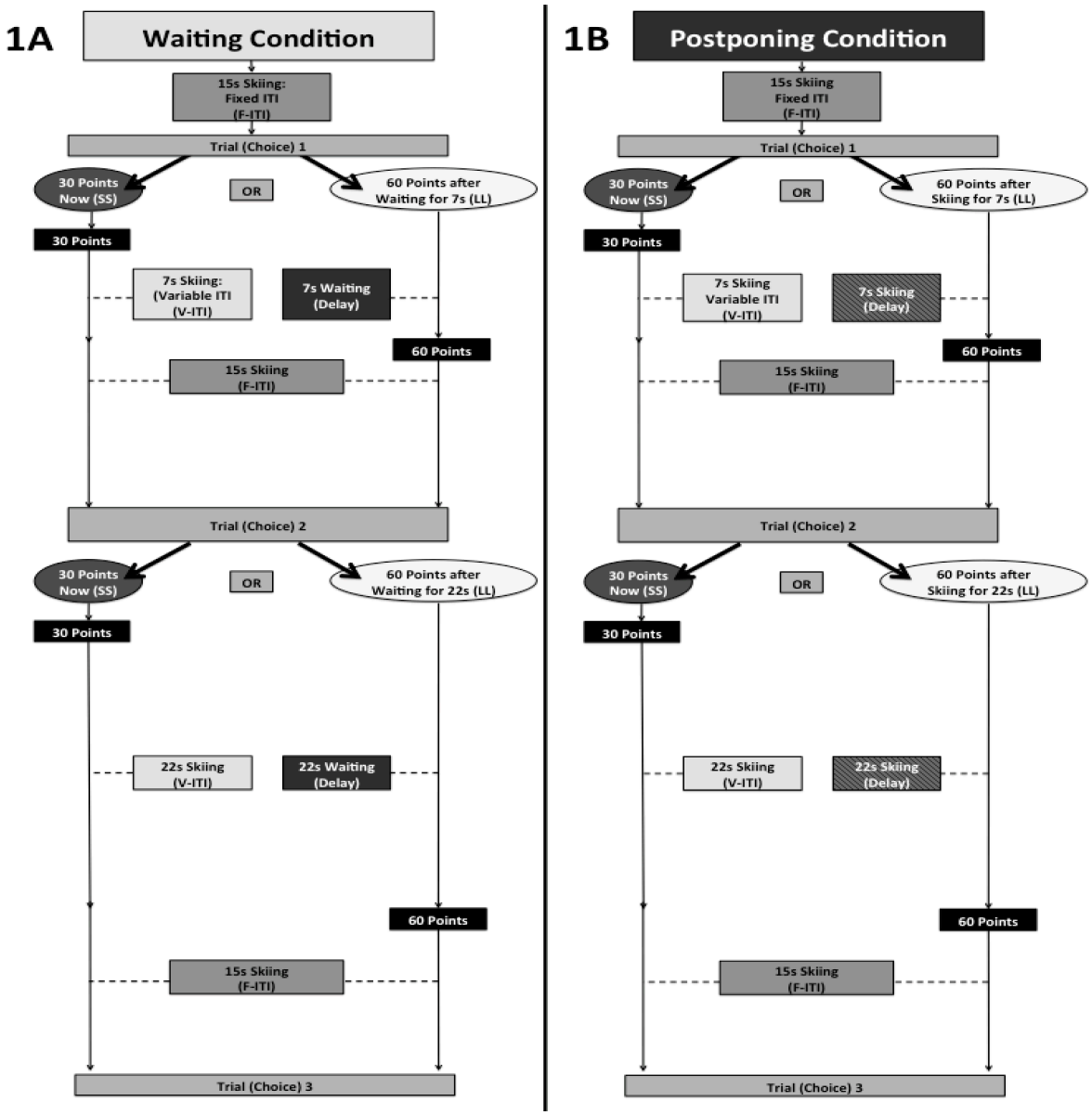


Figure 1A. Experiential Waiting Condition Diagram. The left diagram depicts an example of how the ITI functions in the experiential discounting task Waiting Condition.

Figure 1B. Experiential Postponing Condition Diagram. The right diagram depicts an example of how the ITI functions in the experiential discounting task Postponing Condition.

Postponing Condition (see Figure 1B for a diagram): the ITI functioned similarly to the Waiting Condition, except the time participants spent waiting they now spent skiing, e.g. they skied for 7 seconds, then the points were received, and then they skied again for 15 seconds before the next choice appeared. The key difference in the Postponing Condition was that participants were able to ski during the delay and earned points while doing so.

Hypothetical money discounting task – Waiting Condition. Participants first read these instructions on the screen:

> *"For each question, imagine the following hypothetical (pretend) scenario: You are presented with a choice between money now or later. For the money now option, the money is automatically deposited into your bank account now and you are immediately free to pursue other activities. For the money later option, you must wait at your computer for the entire time specified in the question. You cannot leave the survey and therefore cannot use the computer for other activities. All other sources of entertainment (e.g., cellphone, books, music) are unavailable. You cannot sleep. You are free to leave briefly only to eat, drink, or use the restroom. After the specified time, the money is deposited automatically into your bank account. Although the scenarios are pretend, we ask that you consider each scenario as if it was real and as if it was the only scenario you would face today. Finally, when considering each scenario, you should take into account your financial circumstances (e.g., current account balance, rent or bills due). Each time you choose, the next two options will be a bit different so read them carefully."*

After the participants read the instructions screen, they began the task by clicking to continue. This task involved the participant making hypothetical choices between smaller, immediate options of money and larger, but delayed options. In this task the same titrating amount procedure detailed earlier was used to adjust the smaller, immediate options (which started at $50) against the larger, delayed option (which was always $100). The task involved five trials for each of the five delays (10 minutes, 30 minutes, 2 hours, 6 hours, and 12 hours), totaling 25 trials – with each delay presented in a randomised order five times.

Hypothetical money discounting task – Postponing Condition. The procedure and materials for this task were identical to the hypothetical money discounting task – Waiting Condition, except the instruction screen stated:

> *"For each question, imagine the following hypothetical (pretend) scenario: You are presented with a choice between money now or later. For the money now option, the money is automatically deposited into your bank account now and you are immediately free to pursue other activities. For the money later option,*

you don't have to wait at the computer or return to the computer to have the money deposited into your bank account. Instead, you are immediately free to pursue other activities. After the specified time, the money is deposited automatically into your bank account, regardless of where you are at that time. Although the scenarios are pretend, we ask that you consider each scenario as if it was real and as if it was the only scenario you would face today. Finally, when considering each scenario, you should take into account your financial circumstances (e.g., current account balance, rent or bills due). Each time you choose, the next two options will be a bit different so read them carefully."

Hypothetical money discounting task – condition / trial setup. Both of the conditions for the Hypothetical Discounting Task were presented in a randomised order throughout the task (consistent with how both conditions for the Experiential Discounting Task were experienced), with the participants being told through the text accompanying each choice whether or not the current choice involved them having to imagine waiting (Waiting Condition) or not (Postponing Condition). See Figure 2A for an example of how the screen appeared for a Postponing Condition trial and see Figure 2B for an example how the screen appeared for a Waiting Condition trial.

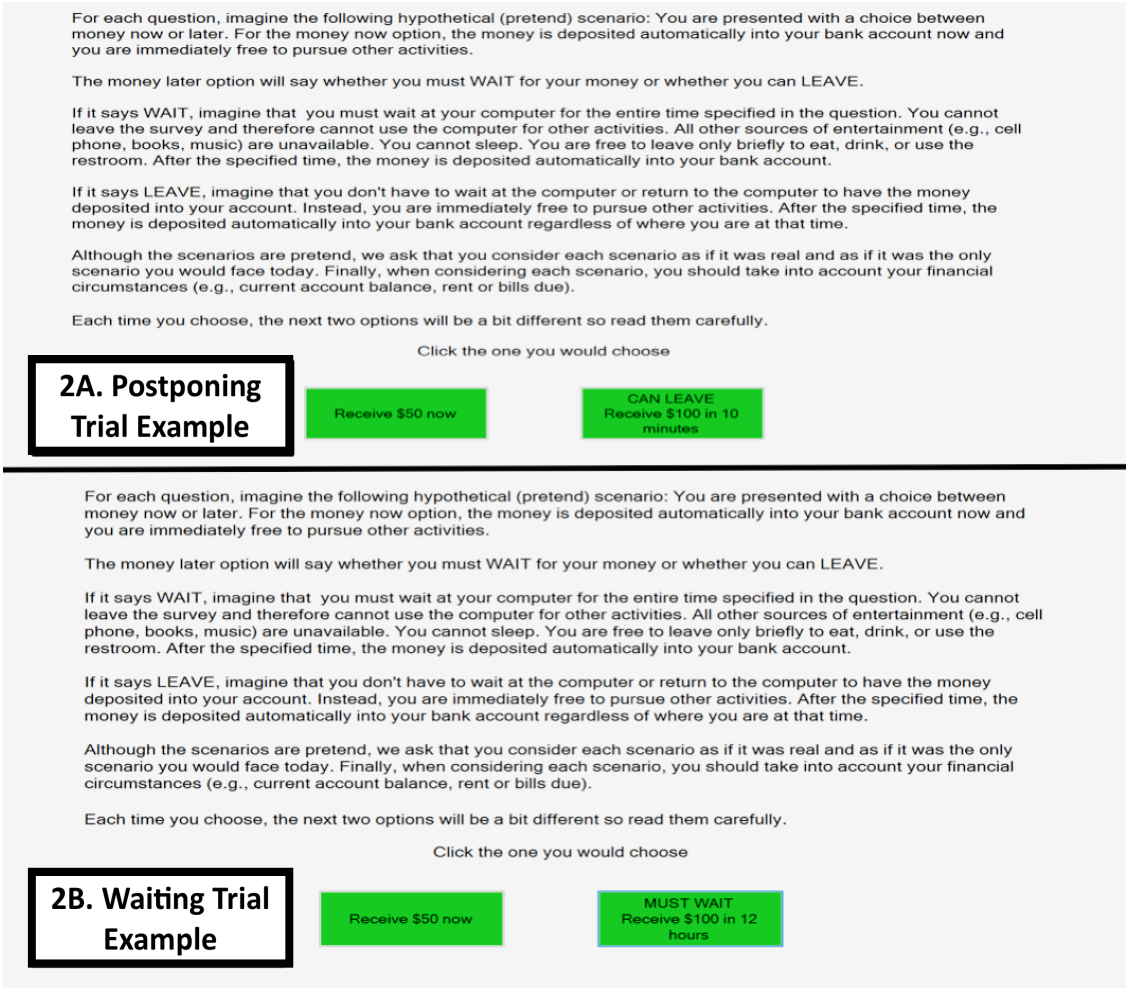


Figure 2A. Experiment 1 Hypothetical Discounting Task Instructions. This is an example of the screen presented to participants on a Postponing Condition trial.

Figure 2B. This is an example of the screen presented to participants on a Waiting Condition trial.

Procedure

Data were collected from four participants during each session. At the start of each session participants were greeted and provided a basic overview of what their participation would involve – completing two computerised tasks and a questionnaire, before they would be given a verbal debrief and discussion, and then be allowed to leave. They were told that the experiment would take roughly an hour to complete, and that after the session they would be awarded their earned credits. Participants then proceeded to their computers where they read through a consent form on the screen (See Appendix A for the consent form) indicated whether or not they were going to proceed with the experiment. Participants then completed the two computerised discounting tasks (both the experiential and hypothetical discounting tasks - each containing the Waiting and Postponing conditions) in a counterbalanced order, and

lastly completed the CFC scale. For the CFC scale they received the following on-screen instructions:

> *"For each of the statements shown, please indicate whether or not the statement is characteristic of you. Please select one of the number options to indicate how characteristic the statement is of you – where 1 indicates the statement is extremely unlike you, and 7 indicates the statement is extremely like you. Select the number options in the middle if you fall between the extremes. "*

After they completed the CFC scale, the participants were shown a 'thank you for participating' screen. They were instructed on this screen to wait patiently and quietly at their desk until all other participants had finished. At this point they were also handed a written debriefing statement to read and take home (See Appendix B for the debriefing statement).

Data Analyses

Each participant's indifference point was calculated for each delay by averaging the smaller, immediate amount option presented during the final trial (trial 5) at each delay and the smaller, immediate option that would have been presented on the next trial (a proposed sixth trial that doesn't actually occur). After consideration we decided to use AUC to evaluate our hypotheses. The basis for this was that studies that have chosen to fit the hyperbolic model typically use the two exclusion criteria provided by Johnson and Bickel (2008) to eliminate participants who show nonsystematic discounting. The *k* value obtained for non-systematic discounters does not describe their data well. In most studies using these criteria few participants are excluded. However in the current study the number of data sets that would be regarded as unsystematic according to Johnson and Bickel's second criterion might be expected to be influenced by the experimental manipulations. This criterion states that an indifference point for the last delay cannot be less than 10% of the larger, delayed option smaller than the first indifference point (for example: $10 for a $100 option). We anticipated that many of our participants in the Postponing Condition in the experiential and the hypothetical tasks would show little or no discounting. Rather than being error, this would constitute a finding even though such data would not be well described by a hyperbolic function.

Normality. Normality tests (Shapiro-Wilk) showed that the discounting data (AUCs) were non-normal (*ps* < 0.05), and log transformations failed to normalise them. As a result we used non-parametric tests throughout. The Wilcoxon Signed Ranks Test was used to determine whether AUCs for experiential waiting and experiential postponing were significantly different, and whether AUCs for hypothetical waiting and hypothetical postponing were significantly different. Due to the difference in delays between the hypothetical and experiential conditions we could not directly compare discounting rates between the two tasks, only within the two conditions of each task. Spearman's Rank Order correlation analysis was used to calculate correlations among the experiential and hypothetical tasks and the CFC scores. Bonferroni corrections were applied when appropriate.

Results

Waiting Versus Postponing

Participants discounted more steeply in the hypothetical Waiting Condition compared to the hypothetical Postponing Condition. A Wilcoxon Signed Ranks Test indicated that this difference was significant, with significantly steeper discounting in the hypothetical Waiting Condition (*Mdn* = 0.31) compared to the hypothetical Postponing Condition (*Mdn* = 0.83), Z = -5.67, *p* < .001.

Figure 3A (left graph) depicts the group discounting curves for hypothetical Waiting and hypothetical Postponing using the median indifference points for both groups. The group discounting curve for Waiting is steeper compared to Postponing. Figure 3B (left graph) is a Modified Brinley Plot - which plots each individual's postponing AUC as a function of their waiting AUC (thus each white diamond represents an individual participant's AUC for both conditions), with a reference line to aid visualisation. The majority of participants lie above the reference line, indicating their AUCs were higher for the Postponing Condition compared to the Waiting Condition. This indicates that the effects present in the median data were representative of most individuals - the participants showed steeper discounting for Waiting compared to Postponing.

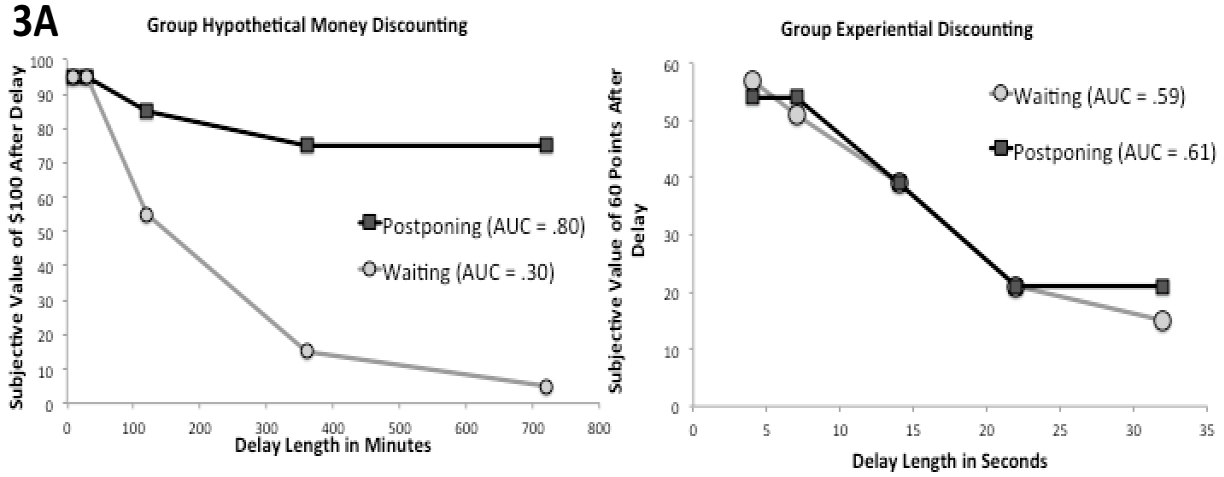
Figure 3C (left graphs) depicts the range in discounting by providing three individual discounting curves for hypothetical discounting. The top left participant displayed the minimum difference in their discounting behaviour between the two

conditions. This was the participant that was least affected by the experimental manipulation and showed the opposite effect - discounting more steeply in the Postponing Condition compared to the Waiting Condition. The middle left participant displayed the median difference in their discounting behaviour. This participant discounted more steeply in the Waiting Condition compared to the Postponing Condition, a pattern shared by the majority of participants. The bottom left participant displayed the maximum difference in their discounting behaviour between the two conditions. This was the participant that was most affected by the experimental manipulation – discounting extremely steeply in the Waiting Condition and not discounting at all in the Postponing Condition.

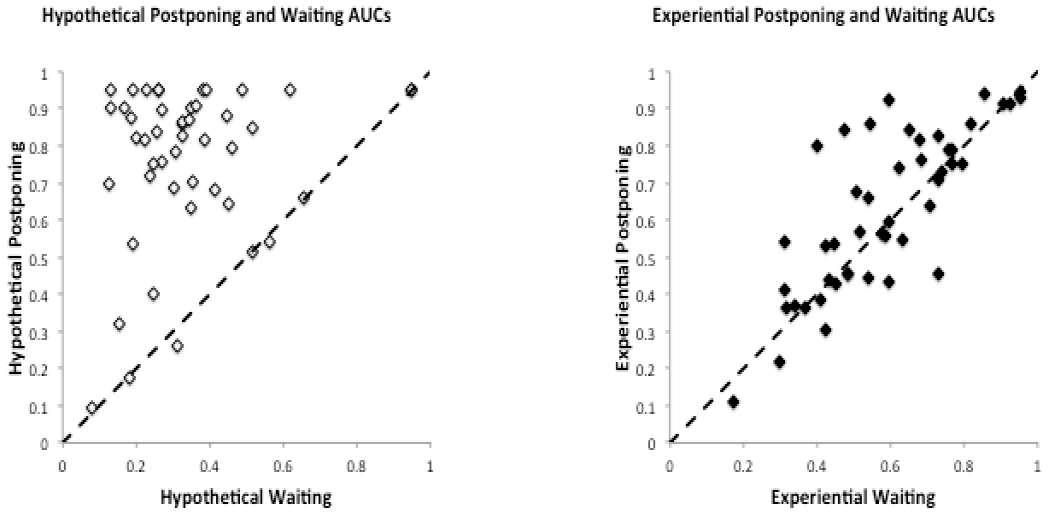
However participants did not discount more steeply in the experiential Waiting Condition compared to the experiential Postponing Condition. A Wilcoxon Signed Ranks Test indicated that there was not significantly steeper discounting in the experiential Waiting Condition (*Mdn* = 0.59) compared to the experiential Postponing Condition (*Mdn* = 0.64), Z = -1.70, *p* = .088. Figure 3A (right graph) depicts the group discounting curves for experiential Waiting and experiential Postponing using the median indifference points for both groups. The group discounting curves for and Postponing are similarly steep, indicating participants discounted similarly in both conditions.

Figure 3B (right graph) is a Modified Brinley Plot (each black diamond represents an individual participant's AUC for both conditions), with a reference line to aid visualisation. The participants are scattered similarly above and below the reference line, indicating their AUCs were not consistently higher in one condition compared to the other. Figure 3C (right graphs) depicts three representative individuals selected in the same manner as the left-hand graphs. Once again, these graphs indicate no consistent difference between discounting rates in the waiting and postponing conditions.

3A


Group Hypothetical Money Discounting
Subjective Value of $100 After Delay
Delay Length in Minutes
Postponing (AUC = .80)
Waiting (AUC = .30)
Group Experiential Discounting
Subjective Value of 60 Points After Delay
Delay Length in Seconds
Waiting (AUC = .59)
Postponing (AUC = .61)

3B


Hypothetical Postponing and Waiting AUCs
Hypothetical Postponing
Hypothetical Waiting
Experiential Postponing and Waiting AUCs
Experiential Postponing
Experiential Waiting

3C

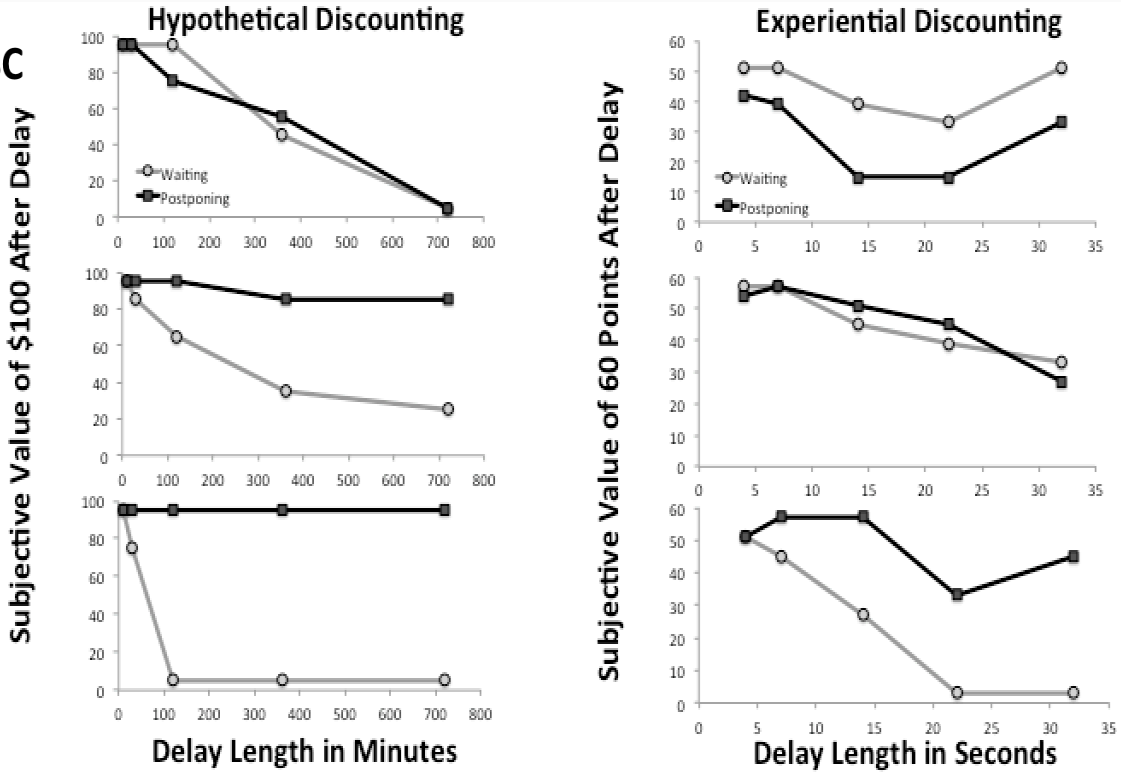

Hypothetical Discounting
Experiential Discounting
Subjective Value of $100 After Delay
Subjective Value of 60 Points After Delay
Waiting
Postponing
Delay Length in Minutes
Delay Length in Seconds

Figure 3A. Experiment 1 discounting graphs. The left (right) graph depicts participants' (n = 47) group discounting function on the hypothetical (experiential) discounting task with delay length in minutes (seconds) on the x-axis and Subjective Value of $100 (60 points) After Delay on the y-axis. The grey circles (black squares) represent the group median indifference points for waiting (postponing). AUCs are reported in the legend.

Figure 3B. The left (right) graph depicts the Hypothetical Waiting (Experiential Waiting) and Hypothetical Postponing (Experiential Postponing) discounting modified Brinley plot(s). Each white (black) diamond represents an individual (n = 47). Participants' AUCs are plotted with Postponing on the y-axis and Waiting on the x-axis for both graphs. A diagonal reference line was included on both graphs to aid visualisation.

Figure 3C. The top left (right) graph depicts the participant with the minimum difference between their Hypothetical Waiting (Experiential Waiting) and Hypothetical Postponing (Experiential Postponing) indifference points. The middle graphs show the participant with the median difference and the bottom graphs show the participant with the maximum difference. All graphs use the same legends and axes as Figure 3A.

Hypothetical and Experiential Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the four discounting conditions are presented in Table 1. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .008. A significant correlation between the Experiential Waiting AUCs and Experiential Postponing AUCs was found.

Table 1.

Spearman's Rank Order correlations among Hypothetical Waiting AUCs, Hypothetical Postponing AUCs, Experiential Waiting AUCs, and Experiential Postponing AUCs (n = 47 for all).

	Hypothetical Waiting	**Hypothetical Postponing**	**Experiential Waiting**
Hypothetical Postponing	.145		
Experiential Waiting	.021	.223	
Experiential Postponing	-.060	.270	.774*

*$p < 0.008$

CFC and Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the CFC-Total, CFC-Future and CFC-Immediate scores and the AUCs for the four discounting conditions are presented in Table 2. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .003. The only significant correlations found were among the CFC-T scale and the CFC-F and CFC-I subscales scores. Participants' CFC scores were not related to their discounting scores on either the hypothetical discounting or experiential discounting tasks in either of the Waiting or Postponing conditions.

Table 2.

Spearman's Rank Order correlations among CFC-Total (CFC-T), CFC-Future (CFC-F) and CFC-Immediate (CFC-I) scores, Hypothetical Waiting AUCs (H-W), Hypothetical Postponing AUCs (H-P), Experiential Waiting AUCs (E-W), and Experiential Postponing AUCs (E-P), (n = 47 for all).

	CFC-F	**CFC-I**	**H-W**	**H-P**	**E-W**	**E-P**
CFC-T	.899*	-.918*	-.044	-.196	-.304	-.280
CFC-F		-.680*	-.137	-.217	-.342	-.266
CFC-I			-.019	.114	.157	.180

*$p < 0.003$.

Discussion

Discounting

Consistent with our predictions, participants showed significantly steeper discounting rates in the Hypothetical Waiting Condition compared to the Hypothetical Postponing Condition. This further provides evidence for the effect suggested by Paglieri (2013) and found by Johnson et al. (2015). Our results support this idea that increasing the amount of restriction involved in the hypothetical scenario will result in participants behaving more impulsively in their decision-making. This result supports the conclusion that the seemingly high number of self-controlled choices found in typical discounting scenarios may not be a reflection of the participants' waiting preferences and instead shows their postponing preferences. When the task specifically details the degree to which the participant must "wait" for their delayed reward, discounting steeply increases even if the waiting is imagined.

As the majority of discounting tasks require participants to make decisions about postponing, results may not be a reflection of their likely choice if there were constraints during the delay. For example, an individual might be self-controlled when making a decision to save money to purchase something important in the future. But that same individual might be impulsive when making a decision to eat fast food for dinner instead of waiting the time it would take to cook a healthier meal at home. The long-term rewards of saving up for something important and maintaining a healthy body are both desirable. But if one involves immediate and aversive consequences (having to buy, prepare, and wait for a meal), it loses appeal compared to an impulsive alternative much quicker than if it involved less aversive consequences (having slightly less money to spend). Whether or not a delayed reward involves immediate, aversive consequences affects an individual's decision-making. Future discounting tasks need to take this into account, perhaps by specifying the hypothetical scenario to the level of restriction they are aiming to investigate.

Inconsistent with our predictions, participants did not show steeper discounting rates in the experiential Waiting Condition compared to the experiential Postponing Condition. This was an unexpected result; it appeared that participants did not distinguish between the conditions in the experiential task as they did in the hypothetical task. This result might have been due to the procedure we used.

Participants may have gotten fatigued during the task and stopped discriminating between the conditions, or the conditions may have been indistinguishable for some other reason that resulted in participants treating them both as the same condition. In order to uncover whether this result was a true discounting phenomenon or a procedural one, we investigated this further in Experiment 2.

CFC and Discounting

We did not find any significant relationships among the CFC and any of the discounting conditions. The CFC-T, CFC-F and CFC-I were all strongly correlated (Cosenza & Nigro, 2015; Joireman, 2012) as expected from previous studies that have investigated the subscales. This showed that the participants were not simply responding arbitrarily to all of the questions. Their patterns of concern for future versus immediate consequences were consistent between both subscales, so if a participant indicated they had a higher concern for future consequences on the CFC-F, they also showed a lower concern for immediate consequences on the CFC-I, as anticipated.

To our knowledge no previous study has investigated whether hypothetical waiting is related to CFC. The way we measured hypothetical postponing was also different to how discounting has typically been measured in existing research that has found a relationship between hypothetical discounting and CFC because we used shorter delays than those typically used. We originally suspected that steeper discounting in the Waiting and Postponing conditions would be related to higher CFC-I scores, due to the potential link where participants that display impulsive decision-making might be more concerned for immediate outcomes (Cosenza & Nigro, 2015; Charlton et al., 2011; Joireman et al., 2008). The CFC-F results are not surprising given that we used short delays for both tasks (minutes and hours), while the CFC-F may assess the extent to which participants consider consequences in the more distant future.

As the hypothetical Postponing Condition resulted in a large number of ceiling responses where participants always chose the larger, delayed reward, this could have interfered with the ability to find a relationship between hypothetical postponing and the CFC scales. Also, as there was little to no costs associated with always making the self-controlled “future” choice in the hypothetical Postponing Condition, it might be that this type of choice is unrelated to the future outcomes considered in the CFC. CFC and

discounting may be uncorrelated as they involve decisions and outcomes on different timescales.

The experiential task involved delays of seconds and perhaps those were too short to be related to scores even for the concerns of immediate consequences. Participants also seemed to treat both experiential conditions the same, which resulted in similar relationships with the CFC scores for both conditions. It might be that if participants distinguished between the Waiting and Postponing conditions in the experiential task, differing relationships with the CFC would occur. We decided to include the CFC measure again in Experiment 2 to see whether changing the method (to hopefully help participants better distinguish between the Waiting and Postponing experiential conditions) revealed any correlations among the discounting rates and CFC scores that were previously obscured due to methodological issues.

Experiment 2 – Waiting Versus Postponing Continued

We investigated the unanticipated result from Experiment 1 for the experiential task where the participants responded similarly for both the Waiting and Postponing conditions. We suspected there might have been methodological issues prompting the similarity in participants' responding.

Fatigue

The first potential issue was that our participants became fatigued during the experiential task. This task took significantly longer to complete than the hypothetical task, as they had to complete 5 blocks of trials (each of the five delays involved a block of 5 trials for that delay – 25 trials in total) for both conditions (50 trials / 10 blocks in total, and the trials were randomised), and each trial involved actively playing the ski game during the ITIs. We suspected that participants might have started off showing the anticipated difference for the early trials but due to fatigue over time lost their energy / desire to carefully evaluate the options. To investigate this potential fatigue effect we calculated the percentage of SS and LL choices for each of the 5 trial blocks for all of the five delays that comprised the experiential discounting task (see Figure 4).

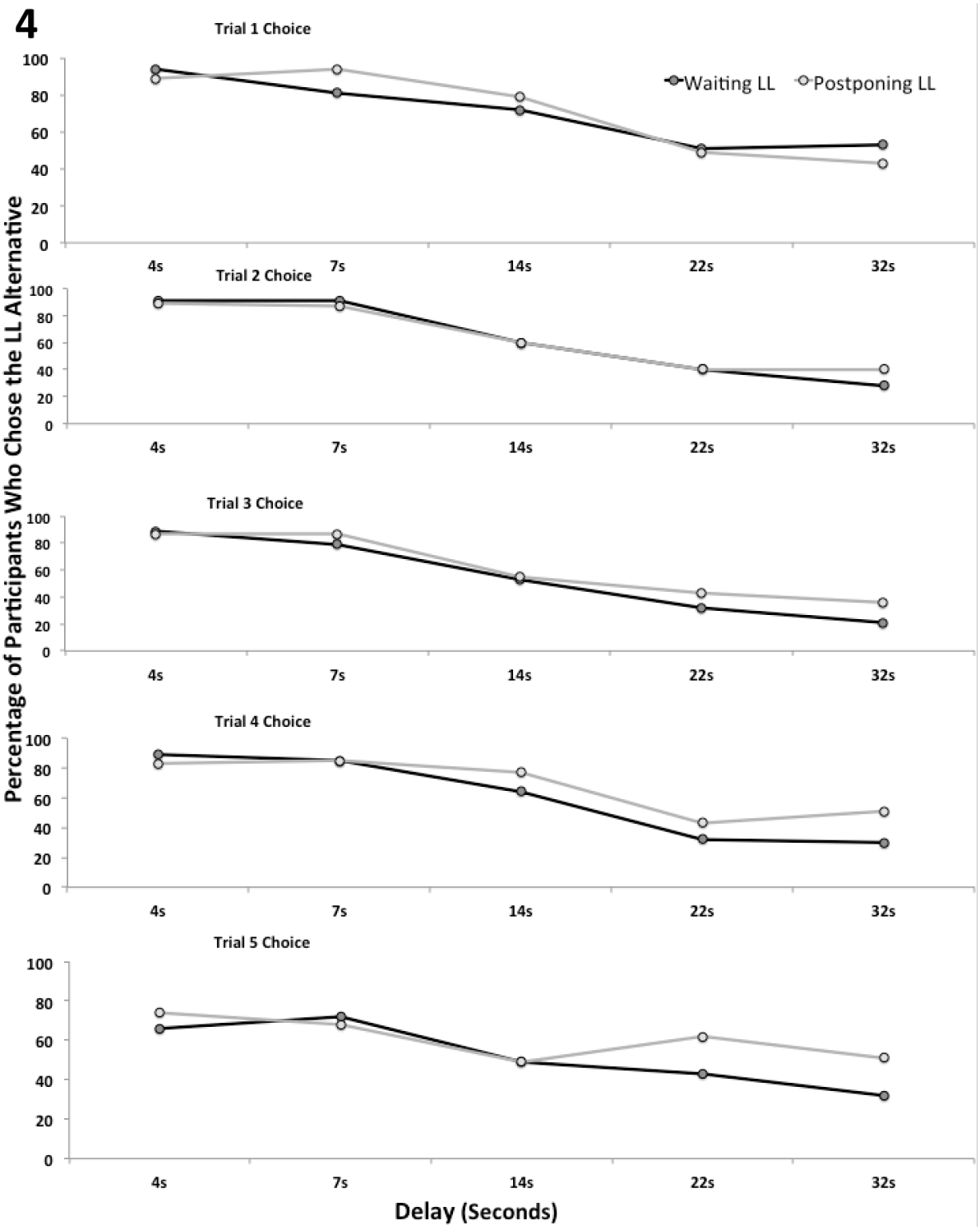


Figure 4. LL vs. SS choices at each delay. All graphs have the percentage of participants (n = 47) who chose the LL on the y-axis, the 5 delays at which each choice was made is on the x-axis, the black line represents Waiting and the grey line represents Postponing. The graphs depict the percentage of LL choices for the first trial, second trial, third trial, fourth trial, and final trial in the experiential task for each of the 5 delays.

If the lack of a difference was simply due to the participants becoming fatigued and ceasing to give the alternatives full consideration, then the first trial graph would show a clearly steeper decline for waiting compared to postponing and the difference would gradually reduce throughout the rest of the trials. However, the participants showed little to no difference in their choices from the first block of trials, and this lack of discrimination between the conditions is maintained throughout all of the trials. We conducted McNemar's tests for each choice comparison to detect any significant differences and applied the Bonferroni correction, which reduced the alpha level to 0.002. Confirming the pattern of responding seen in Figure 4, we found no significant difference between conditions at any of the trials. This suggests that fatigue is not the issue driving our lack of a difference between the waiting and postponing conditions in the experiential task.

Inability to Discriminate

The next potential methodological issue we investigated was whether our task structure enabled participants to discriminate between the two experiential conditions. We suspected that the wording for the instructions/choice dialogue boxes might have been confusing in the postponing condition. The waiting condition instructed participants they would have to "wait for jump" if they selected the delayed option, but the postponing condition instructed participants they would get to "ski up to jump". This particular phrasing could have been ambiguous and participants may not have been spending enough time in their decision making to discriminate between the two conditions. That is, participants may have only focused on the delays, instead of whether or not they had to wait. We also suspected that participants might have been spending less time in general on the experiential task choices compared to the hypothetical task choices, this reduced time may have reduced their ability to discriminate between the conditions.

To investigate this we calculated the median choice latency over all 5 trials (see Figure 5), to determine whether there was a difference in how participants responded between tasks and between conditions. If participants did not read or understand the instructions for the experiential task then we would see lower median choice latencies for the experiential conditions compared to the hypothetical conditions, and little to no difference between the experiential Waiting and Postponing conditions.

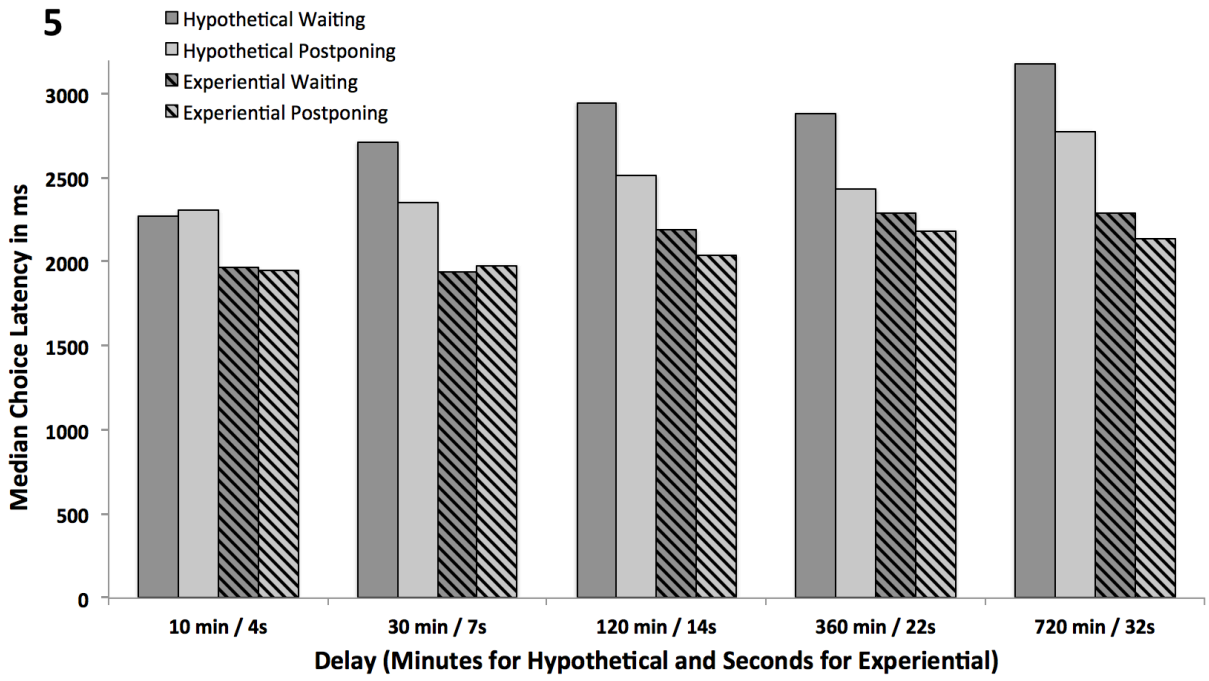


Figure 5. Group Choice Latency. The bar graph depicts the group (n = 47) median choice latency for hypothetical (plain bars) and experiential (striped bars) waiting (dark grey) and postponing (light grey) conditions. Median Choice Latency in ms is on the y-axis, and the five trial delays are on the x-axis (with the first delay presented in minutes for the hypothetical discounting task and the second delay presented in seconds for the experiential discounting task, and shortest to longest delays for both tasks being displayed left to right).

Participants spent roughly 2s to 3s making their choices, and there is a pattern for the hypothetical conditions where after the first delay participants spent longer making their decisions for Waiting compared to Postponing. However, participants spent less time when making decisions for the experiential conditions compared to the

hypothetical conditions, and there was no clear difference between the experiential Waiting and Postponing conditions, suggesting that participants may not have been reading or understanding the different condition instructions as anticipated. We conducted the Friedman Test to assess whether there was a difference in median choice latency among the conditions. The result indicated there was a statistically significant difference in median choice latency, $\chi2(3) = 26.21$, $p < .001$. We then conducted Post hoc analysis using Wilcoxon Signed Ranks Tests and applied a Bonferroni correction that reduced the alpha level to .008. The results are presented in Table 3. There was a significant difference in median choice latency between hypothetical waiting and postponing, with higher choice latency for waiting compared to postponing. However, there was not a significant difference in median choice latency between experiential waiting and postponing. These analyses support the pattern of responding seen in Figure 5 and support the idea that participants did not discriminate between the conditions in the experiential task as they did in the hypothetical task.

Table 3.

Wilcoxon Signed Ranks Test Z values for the median choice latency comparisons for Hypothetical Waiting and Postponing, and for Experiential Waiting and Postponing (n = 47 for all).

	Hypothetical Waiting	**Hypothetical Postponing**	**Experiential Waiting**
Hypothetical Postponing	-2.67*		
Experiential Waiting	-4.18*	-2.31	
Experiential Postponing	-4.21*	-2.48	-1.84

*$p < 0.008$

Experiment 2 was therefore designed to address the methodological issue of the instruction clarity by replicating Experiment 1 and implementing two changes. The first being a change in how the conditions were presented. In Experiment 1 the waiting and postponing trials within each task were randomised and there were two presentation orders – either hypothetical task first or experiential task first. For Experiment 2 we blocked the conditions - so participants either experienced all of the waiting trials first or all of the postponing trials first. The second change involved modifying the instructions and choice dialogue boxes to make them clearer.

We suspected that changing from randomised to blocked conditions, and clarifying the instructions for each condition would allow participants to discriminate between the two conditions within the few seconds they would spend choosing. We also predicted that this would result in the originally anticipated difference in discounting behaviour - with steeper discounting for Waiting than Postponing for both tasks. The hypothetical task was unchanged except for the conditions also being blocked instead of randomised.

Method

Participants

Participants were 41 first-year psychology students from Victoria University of Wellington who were recruited via a research participation programme as a course requirement. All participants provided informed consent before any data were collected, and all received written and verbal debriefing after the experiment. The procedure was reviewed and approved by School of Psychology Human Ethics Committee before any data were collected.

Materials

All materials used in the experimental tasks were identical to Experiment 1.

Procedure

The experiment and task procedure were similar to Experiment 1 except for a few changes. First, the design for the Waiting and Postponing trials for both tasks were changed from interspersed to blocked. Participants either experienced all Postponing trials first or all Waiting trials first in both the hypothetical and experiential tasks. This resulted in four task orders, participants either had the experiential task first or the hypothetical task first, and they also either had Waiting first for both tasks or Postponing first for both tasks. 10 of the 41 participants were in each of the four orders, except for the experiential task first Postponing first order that consisted of 11 of the 41 participants.

The other changes were minor edits to the instructions/choice screens to further clarify the transition between the waiting and postponing conditions in the experiential task. The phrase “ski up to jump” was replaced by the phrase “ski during delay”, and the instruction screen when participants were transitioning between conditions indicated that participants would experience a change in the gameplay mechanics where now

they would either be able to ski during the delays (if they are transitioning from the waiting condition to the postponing condition) or they would now have to wait during the delays (if they were transitioning from the postponing condition to the waiting condition).

Data Analyses

Data analysis for Experiment 2 was identical to Experiment 1.

Normality. Normality tests (Shapiro-Wilk) showed that the discounting data (AUCs) were non-normal (*ps* < 0.05), and log transformations failed to normalise them. As a result we used non-parametric tests throughout. Bonferroni corrections were applied when appropriate.

Results

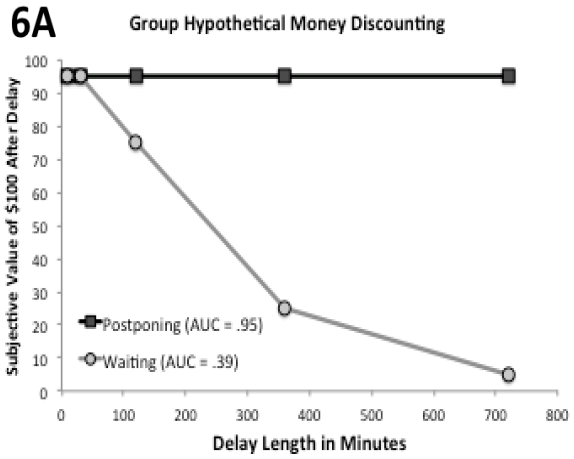
Hypothetical and Experiential Discounting Differences

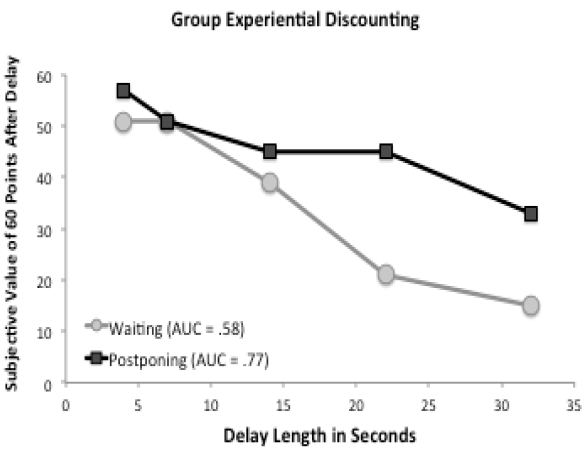
Participants discounted more steeply in the Hypothetical Waiting condition compared to the Hypothetical Postponing condition. A Wilcoxon Signed Ranks Test indicated that this difference was significant, with significantly steeper discounting in the Hypothetical Waiting condition (*Mdn* = 0.44) compared to the Hypothetical Postponing condition (*Mdn* = 0.93), Z = -5.11, *p* < .001. Figure 6A (left graph) depicts the group discounting curves for hypothetical Waiting and Postponing using the median indifference points for both groups. The group discounting curve for Waiting is clearly steeper compared to Postponing. Figure 6B (left graph) is a Modified Brinley Plot, it depicts that the majority of participants lie above the reference line, indicating their AUCs were higher for the Postponing Condition compared to the Waiting Condition. This indicates that the effects present in the median data were representative of most individuals - the participants showed steeper discounting for Waiting compared to Postponing. Figure 6C (left graphs) depicts the range in discounting by providing three individual discounting curves for hypothetical discounting selected in the same manner as Figure 3C. These graphs indicate the same pattern evident in the other Figures.

Participants also discounted more steeply in the Experiential Waiting condition compared to the Experiential Postponing condition. A Wilcoxon Signed Ranks Test indicated that there was significantly steeper discounting in the Experiential Waiting condition (*Mdn* = 0.56) compared to the Experiential Postponing condition (*Mdn* = 0.78), Z = -4.46, *p* < .001. Figure 6A (right graph) depicts the group discounting curves for

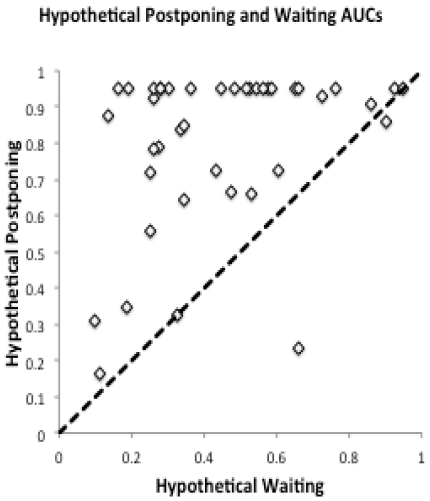
experiential Waiting and Postponing using the median indifference points for both groups. The group discounting curve for Waiting is clearly steeper compared to Postponing. Figure 6B (right graph) is a Modified Brinley Plot, it depicts that the majority of participants lie above the reference line, indicating their AUCs were higher for the Postponing Condition compared to the Waiting Condition. This indicates that the effects present in the median data were representative of most individuals - the participants showed steeper discounting for Waiting compared to Postponing in the experiential task as well. Figure 6C (right graphs) depicts the range in discounting by providing three individual discounting curves for experiential discounting selected in the same manner as for Figure 3C. These graphs indicate the same pattern evident in the other Figures.

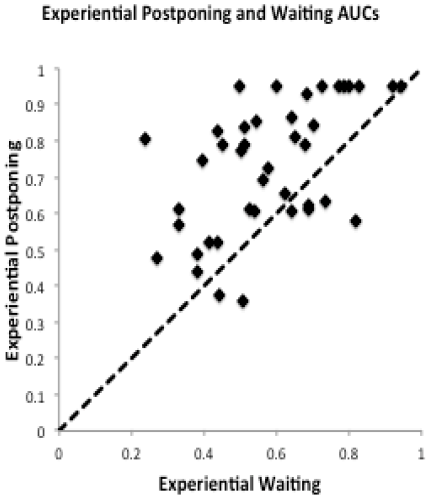
6A


Group Hypothetical Money Discounting
Subjective Value of $100 After Delay
Postponing (AUC = .95)
Waiting (AUC = .39)
Delay Length in Minutes

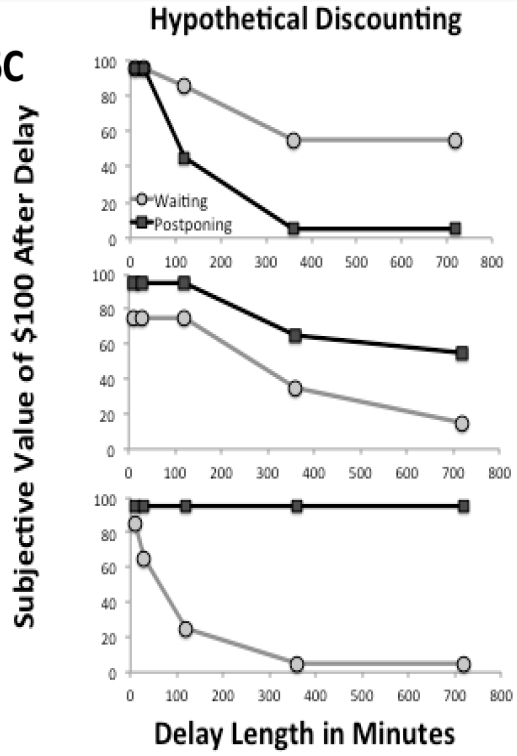

Group Experiential Discounting
Subjective Value of 60 Points After Delay
Waiting (AUC = .58)
Postponing (AUC = .77)
Delay Length in Seconds

6B


Hypothetical Postponing and Waiting AUCs
Hypothetical Postponing
Hypothetical Waiting


Experiential Postponing and Waiting AUCs
Experiential Postponing
Experiential Waiting

6C


Hypothetical Discounting
Subjective Value of $100 After Delay
Waiting
Postponing
Delay Length in Minutes

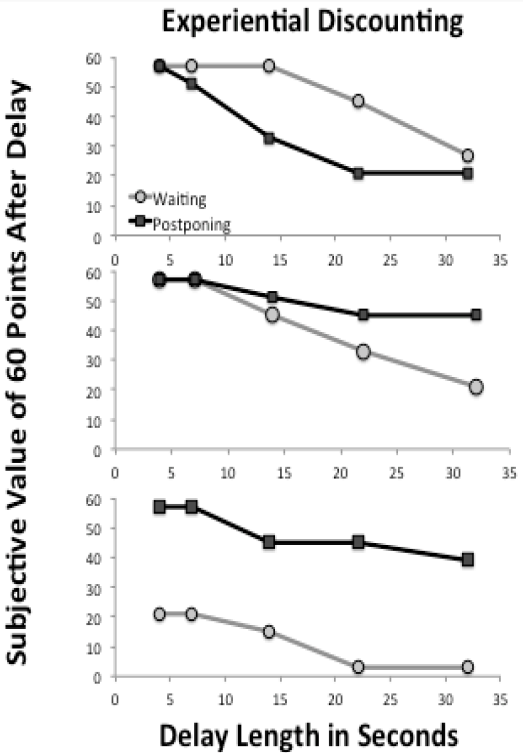

Experiential Discounting
Subjective Value of 60 Points After Delay
Waiting
Postponing
Delay Length in Seconds

Figure 6A. Experiment 2 discounting graphs. The left (right) graph depicts participants' (n = 41) group discounting function on the hypothetical (experiential) discounting task with delay length in minutes (seconds) on the x-axis and "Subjective Value of $100 (60 points) After Delay" on the y-axis. The grey circles (black squares) represent the group median indifference points for waiting (postponing). AUCs are reported in the legend.

Figure 6B. The left (right) graph depicts the Hypothetical Waiting (Experiential Waiting) and Hypothetical Postponing (Experiential Postponing) discounting modified Brinley plot. Each diamond represents an individual (n = 41). Participants' AUCs are plotted with Postponing on the y-axis and Waiting on the x-axis for both graphs. A diagonal reference line was included on both graphs to aid visualisation.

Figure 6C. The top left (right) graph depicts the participant with the minimum difference between their Hypothetical Waiting (Experiential Waiting) and Hypothetical Postponing (Experiential Postponing) indifference points. The middle graphs show the participant with the median difference and the bottom graphs show the participant with the maximum difference. All graphs use the same legends and axes as Figure 6A.

Hypothetical and Experiential Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the four discounting conditions are presented in Table 4. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .008. Only a significant correlation between the Experiential Waiting AUCs and Experiential Postponing AUCs was found.

Table 4.

Spearman's Rank Order correlations among Hypothetical Waiting AUCs, Hypothetical Postponing AUCs, Experiential Waiting AUCs, and Experiential Postponing AUCs (n = 41 for all).

	Hypothetical Waiting	**Hypothetical Postponing**	**Experiential Waiting**
Hypothetical Postponing	.335		
Experiential Waiting	-.031	-.045	
Experiential Postponing	.218	.064	.566*

*$p < 0.008$

CFC and Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the CFC-Total, CFC-Future and CFC-Immediate scores and the AUCs for the four discounting conditions are presented in Table 5. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .003. The only significant correlations found were among the CFC-T scale and the CFC-F and CFC-I subscales scores. Participants' CFC scores were not related to their discounting scores on either the hypothetical discounting or experiential discounting tasks in either of the waiting or postponing conditions.

Table 5.

Spearman's Rank Order correlations among CFC-Total (CFC-T), CFC-Future (CFC-F) and CFC-Immediate (CFC-I) scores, Hypothetical Waiting AUCs (H-W), Hypothetical Postponing AUCs (H-P), Experiential Waiting AUCs (E-W), and Experiential Postponing AUCs (E-P), (n = 41 for all).

	CFC-F	**CFC-I**	**H-W**	**H-P**	**E-W**	**E-P**
CFC-T	.889*	-.868*	.287	.262	.174	.313
CFC-F		-.587*	.260	.142	.132	.352
CFC-I			-.255	-.244	-.129	-.167

*$p < 0.003$.

Discussion

Discounting

Consistent with our first prediction, participants showed significantly steeper discounting rates in the hypothetical waiting condition compared to the hypothetical postponing condition. This replicates the result from Experiment 1 and provides further evidence for the effect suggested by Paglieri (2013) and found by Johnson et al. (2015).

Modifying the method to help participants distinguish between the waiting and postponing experiential task conditions resulted in the participants also showing significantly steeper discounting rates in the experiential waiting condition compared to the experiential postponing condition, as originally anticipated. This result provides even more support for the effect suggested by Paglieri (2013) and found by Johnson et al. (2015) in the hypothetical task by mirroring it in an experiential task as well. This result is consistent with our second prediction. When participants were able to distinguish between waiting and postponing in the experiential task they responded as they did in the hypothetical task.

These results indicate that individuals discount similarly across hypothetical and experiential tasks - displaying steeper discounting for waiting than postponing. Therefore, it is necessary to use the appropriate condition type to investigate waiting and postponing, in order to reach fair and accurate conclusions about our waiting and postponing preferences. The tasks used and the conclusions drawn from existing discounting research in the areas of impulsivity; self-control; decision-making; and species differences should also be examined carefully for this issue of waiting versus postponing.

CFC and Discounting

Our second investigation into CFC and discounting again did not result in any significant relationships between CFC and any of the discounting conditions. As expected, the CFC-T, CFC-F and CFC-I, again, were all strongly correlated. This replicates the result from Experiment 1 and the results from previous CFC research that examined correlations among CFC scores (Cosenza & Nigro, 2015; Joireman, 2012). This showed that the participants were again not simply responding arbitrarily to all of the questions.

Participants' concern for future or immediate consequences were not correlated with their discounting rates either hypothetically or experientially, or under conditions

of waiting or postponing. Modifying the experiential task did not result in a difference in CFC score correlations. The CFC and discounting results from E1 and E2 are inconsistent with the previous studies that found a relationship between CFC-I and discounting (Cosenza & Nigro, 2015; Charlton et al., 2011; Joireman et al., 2008). Our lack of correlation might largely be due to the procedures we used to investigate discounting, as discussed above in relation to Experiment 1.

The relationship between discounting and CFC-I appears stronger in tasks that involve hypothetical discounting, large delays (days, months or years) and choices about postponing(Cosenza & Nigro, 2015; Charlton et al., 2011; Joireman et al., 2008). This further supports the importance of the research by Paglieri (2013) and Johnson et al. (2015) and the idea that we need to take into consideration what procedures we use to investigate discounting, as different procedures reflect different aspects of decision-making that interact differently. CFC and discounting might be one such example where individuals' tendencies to favour immediate or future consequences relates to their preferences around postponing rewards over long delays and not their preferences for postponing rewards over shorter delays, or for waiting for rewards (as we found no correlations among our conditions). However, it would still be useful to replicate this lack of a relationship in experiential tasks involving longer delays, and larger samples that did not involve hypothetical discounting tasks that anticipated ceiling effects, to further solidify this result across the broad spectrum of discounting tasks.

Experiment 3 – Opportunity Costs

For Experiment 3 we investigated the effect of varying the level of reinforcement restriction in the experiential discounting task. Given that Johnson et al. (2015) found that hypothetical discounting rates increased as the level of hypothetical restriction increased, we decided to explore whether this pattern would be found in experiential discounting as well. Specifically, we were interested in whether participants would still display shallower discounting in the Postponing Condition compared to the Waiting Condition if they were no longer able to earn points during the delay when playing the game.

To test this, we included a second Postponing Condition in the experiential discounting task that allowed participants to continue playing the ski game during the delay if they chose the LL option, but they were unable to earn points for any jumps they

made during this delay. This would allow us to see how restricted access to reinforcement would affect experiential discounting rates.

As detailed in Johnson et al. (2015) there are two potential aversive aspects of delayed rewards that might be influencing the steeper discounting in waiting compared to postponing. The opportunity costs associated with a delayed reward (restriction of alternative reinforcers and temporary restriction of the delayed reinforcer) as well as the subjective experience of these opportunity costs (e.g. boredom or discomfort during the delay). Our aim in Experiment 3 was to determine whether the inability to access alternative reinforcement during the delay drives the difference between waiting and postponing.

If the driving force behind the waiting versus postponing difference is the opportunity costs then participants should discount similarly in the two Postponing conditions, and steeply in the Waiting Condition. As despite the Postponing-No-Points Condition no longer providing access to alternative reinforcement via points during the delay – it still allows the participant to avoid the subjective experience of waiting out each delay during the Waiting Condition similar to the Postponing Condition.

If instead the driving force behind the waiting versus postponing difference is the inability to earn reinforcement during the delay then participants should discount similarly steeply in both the Waiting and Postponing-No-Points conditions, and shallowly in the Postponing Condition. As both the Waiting and the Postponing-No-Points conditions involve opportunity costs while the Postponing Condition does not, despite the Postponing-No-Points Condition alleviating the subjective experience of those costs by allowing participants to keep playing the game during the delay. Thus, we could determine whether removed access to earn reinforcement via points or the subjective experience of those opportunity costs (boredom or discomfort during the delay) is more influential in experiential discounting.

Delay Discounting and Delayed Gratification

As a side interest, we also investigated the relationship between delay discounting and delayed gratification. Delay of gratification is similar to delay discounting as it involves an individual choosing between an SS and an LL, but during the delay the individual is allowed to switch their preference at any time to the SS. Thus, it involves not only the self-control of initially resisting an immediate gratification for a

more valuable reward after a delay, but also then maintaining that self-control during the delay (Liu, Wang, and Jiang, 2013).

Recently, Liu et al. (2013) investigated delayed gratification, and delay discounting. They found that their measure of delayed gratification (the Generalizability of Deferment of Gratification Questionnaire - GDGQ) was multidimensional, with one factor involving Controlling-Impulse (CI) and the other involving Planning-and-Waiting (PW), with both factors being involved in self-control/self-regulation. They found that these two different subscales had different correlational patterns with delay discounting on a typical hypothetical postponing task.

Only PW was significantly related with discounting rate, suggesting that discounting is more related to future planning than impulse control. Individuals that focused more on the future, discounted less steeply. However, as they only used a typical hypothetical postponing discounting task, it might be that CI and PW would relate differently to experiential discounting tasks, or a hypothetical discounting task that involves waiting. PW might be more related to hypothetical postponing of rewards well into the future, whereas CI might be more related to discounting tasks that involve controlling the impulse to avoid waiting.

Tentatively, we hypothesised that GDGQ scores and delay-discounting rates would be negatively related. We anticipated that higher PW scores (higher tendency to plan and wait) would be more related to shallower discounting rates (more self-controlled decision-making) in the Postponing conditions due to the decisions not involving having to control the impulse to avoid waiting. As our Waiting conditions involve resisting the appeal of immediate gratification and coping with an aversive delay, impulse control might play a key role in that ability for discounting. This role might only be discovered via a discounting task that involves waiting and not just postponing. Therefore, we anticipated higher CI scores (higher tendency to resist impulses) would be more related to shallower discounting rates in the Waiting conditions due to the decisions involving actively having to control the impulse to avoid waiting.

Method

Participants

Participants were 49 first-year psychology students from Victoria University of Wellington who were recruited via a research participation programme as a course requirement. All participants provided informed consent before any data were collected, and all received written and verbal debriefing after the experiment. The procedure was reviewed and approved by School of Psychology Human Ethics Committee before any data were collected.

Materials / Tasks

All materials used in the discounting tasks were identical to Experiments 1 and 2. Instead of the CFC scale however, for Experiment 3 we used Ray and Najman's (1986) Generalisability of Deferment of Gratification Questionnaire (GDGQ).
The GDGQ contains six positively worded items and six negatively worded items. Participants responded via a 7-point Likert scale ranging from 1 (extremely uncharacteristic) to 7 (extremely characteristic). The scale has been shown (Liu et al., 2013) to contain two factors: one pertaining to planning and waiting (GDGQ-PW) via 4 items, and one pertaining to controlling impulse (GDGQ-CI) via 7 items. Scores for items in both of these factors were reversed (if negative) and averaged to provide each participant's score for GDGQ-PW and GDGQ-CI. In order to get each participant's overall GDGQ score, the six negative items were reverse scored and scores on the total 12 items were averaged. An example GDGQ-PW item is: "I fairly often find that it is worthwhile to wait and think things over before deciding.". An example GDGQ-CI item is: "I describe myself as often being too impulsive for my own good." (See Appendix D for the full GDGQ).

Experiential discounting task – Postponing-No-Points Condition. This condition was nearly identical to the original Postponing Condition except now when the participant was skiing during the delay they were unable to earn points during these delays. This was designed to attempt to remove the subjective (aversive) experience of the opportunity costs associated with the LL, while still retaining those opportunity costs. Participants were instructed again at the start of each condition whether they would have to "wait" (Waiting Condition) to make the jump, or whether they could "keep skiing" during the delay and either "earn points during that time" (Postponing

Condition) or "not be able to earn points during that time" (Postponing-No-Points Condition).

Procedure

The experiment and task procedure was identical to Experiments 1 and 2 except for a few changes. The first change was the GDGQ replaced the CFC scale, but was still completed last after the experimental tasks were finished. For the GDGQ they received the following on-screen instructions:

> *"For each of the statements shown, please indicate whether or not the statement is characteristic of you. If the statement is extremely uncharacteristic of you (not at all like you) please select the circle on the left; if the statement is extremely characteristic of you (very much like you) select the circle on the right. And, of course, use the circles in the middle if you fall between the extremes."*

Second, we changed the hypothetical Postponing task to have different delays compared to the hypothetical Waiting task (which used the original delays). The new delays were 1, 3, 6, 9, and 12 Months. This change was to reduce the ceiling affect that accompanied the original delays of 10 m, 30 m, 2 hrs, 6 hrs, and 12 hrs, and would hopefully result in a wider range of discounting rates that could be correlated with the GDGQ measure. The hypothetical tasks were included again in this experiment mainly to assess the potential GDGQ correlations.

The third change was to the experiential tasks. The fixed part of the ITI was reduced from 15 seconds to 10 seconds in order to reduce the overall task time so we could include a third condition in the task. The Waiting and Postponing conditions were identical to Experiments 1 and 2. Participants either had the experiential task first or the hypothetical task first; they also either had Waiting or Postponing first within the hypothetical task; and they had all three orders of Waiting, Postponing, and Postponing-No-Points within the experiential task. 4 of the 49 participants were in each of the 12 presentation orders, except for the order where the experiential task was first (conditions: Waiting first, Postponing-No-Points second, and Postponing last), and the hypothetical task was second (Postponing first and Waiting second), which consisted of 5 of the 49 participants.

Data Analyses

Data analysis for Experiment 3 was identical to Experiments 1 and 2.

Normality. Normality tests (Shapiro-Wilk) showed that the discounting data (AUCs) were non-normal (*ps* < 0.05), and log transformations failed to normalise them. As a result we used non-parametric tests throughout. We used the Friedman Test to determine whether there was a significant difference among the three experiential conditions. We then used The Wilcoxon Signed Ranks Test for the post hoc analysis to determine whether AUCs for experiential Waiting, experiential Postponing, and Experiential Postponing-No-Points were significantly different. Spearman's Rank Order correlation analysis was used to calculate correlations among the experiential and hypothetical tasks and the GDGQ scores. Bonferroni corrections were applied when appropriate.

Results

Hypothetical and Experiential Discounting

Figure 7A depicts the discounting curve using the group median indifference points for Hypothetical Waiting. This curve shows that as delay to the reward increases, the subjective value sharply decreases. Figure 7B depicts the discounting curve using the group median indifference points for Hypothetical Postponing. This curve again shows that as delay to the reward increases, the subjective value sharply decreases.

The Friedman Test indicated there was a statistically significant difference in discounting rates among the three experiential conditions, $\chi2(2) = 41.56$, $p < .001$. We then conducted Post hoc analysis using Wilcoxon Signed Ranks Tests and applied a Bonferroni correction that reduced the alpha level to 0.017. The first Wilcoxon Signed Ranks Test indicated that there was significantly steeper discounting in the experiential Waiting Condition (*Mdn* = 0.53) compared to the experiential Postponing Condition (*Mdn* = 0.82), Z = -5.71, $p < .001$. The second Wilcoxon Signed Ranks Test indicated that there was significantly steeper discounting in the experiential Postponing-No-Points Condition (*Mdn* = 0.58) compared to the experiential Postponing Condition, Z = -5.21, $p < .001$. The third Wilcoxon Signed Ranks Test indicated that there was not a significant difference in discounting between the experiential Waiting Condition and the experiential Postponing-No-Points Condition, Z = -1.29, $p = .199$. Figure 7C depicts the discounting curves using the group median indifference points for Experiential Waiting, Experiential Postponing, and Experiential Postponing-No-Points. The group discounting

curves for Waiting and Postponing-No-Points are similarly steeper compared to Postponing.

Figure 7D depicts the Modified Brinley Plots for experiential discounting, with reference lines to aid visualisation.

For the experiential Waiting and experiential Postponing Modified Brinley Plot (top graph), the majority of participants lie above the reference line, indicating their AUCs were higher for the Postponing Condition compared to the Waiting Condition. This indicates that the effects present in the median data were representative of most individuals - the participants showed steeper discounting for Waiting compared to Postponing.

For the experiential Postponing and the experiential Postponing-No-Points Modified Brinley Plot (bottom right graph), the majority of participants lie below the reference line, indicating their AUCs were higher for the Postponing Condition compared the Postponing-No-Points Condition. This indicates that the effects present in the median data were representative of most individuals - the participants showed steeper discounting for Postponing-No-Points compared to Postponing.

For the experiential Waiting and experiential Postponing-No-Points Modified Brinley Plot (bottom left graph), the participants are scattered similarly above and below the reference line, indicating their AUCs were not consistently higher in one condition compared to the other.

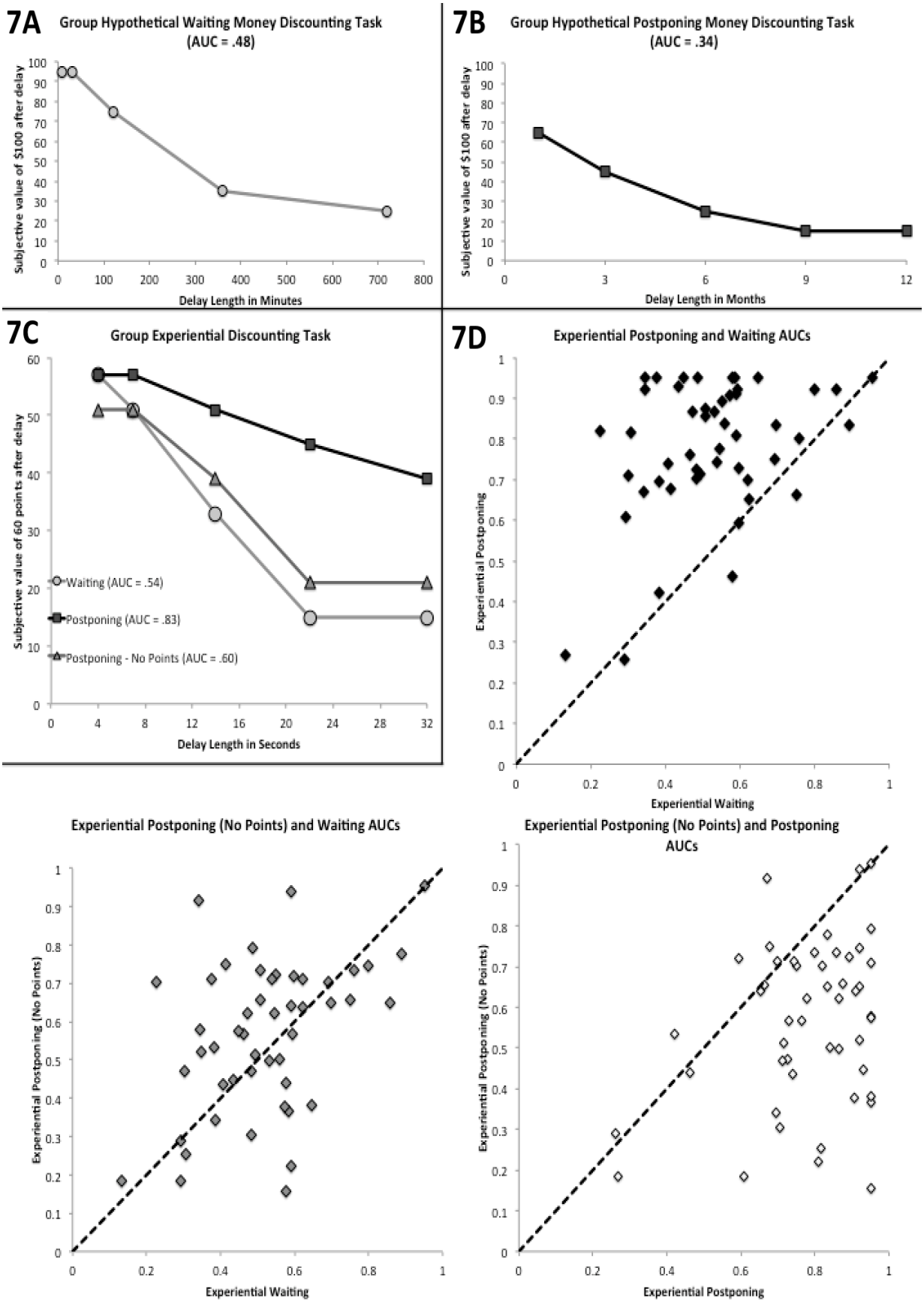

7A
Group Hypothetical Waiting Money Discounting Task
(AUC = .48)
Subjective value of $100 after delay
Delay Length in Minutes
7B
Group Hypothetical Postponing Money Discounting Task
(AUC = .34)
Subjective value of $100 after delay
Delay Length in Months
7C
Group Experiential Discounting Task
Subjective value of 60 points after delay
Waiting (AUC = .54)
Postponing (AUC = .83)
Postponing - No Points (AUC = .60)
Delay Length in Seconds
7D
Experiential Postponing and Waiting AUCs
Experiential Postponing
Experiential Waiting
Experiential Postponing (No Points) and Waiting AUCs
Experiential Postponing (No Points)
Experiential Waiting
Experiential Postponing (No Points) and Postponing AUCs
Experiential Postponing (No Points)
Experiential Postponing

Figure 7A. Experiment 3 Hypothetical Waiting Discounting Graph. The graph depicts participants' (n = 49) group discounting function on the hypothetical waiting discounting task with delay length in minutes on the x-axis and "Subjective Value of $100 After Delay" on the y-axis. The grey circles represent the group median indifference points. AUC is reported in the title.

Figure 7B. Experiment 3 Hypothetical Postponing Discounting Graph. The graph depicts participants' (n = 49) group discounting function on the hypothetical postponing discounting task with delay length in months on the x-axis and "Subjective Value of $100 After Delay" on the y-axis. The black squares represent the group median indifference points. AUC is reported in the title.

Figure 7C. Experiment 3 Experiential Discounting Graph. The graph depicts participants' (n = 49) group discounting function on the experiential discounting task with delay length in seconds on the x-axis and "Subjective Value of 60 Points After Delay" on the y-axis. The grey circles represent the group median indifference points for waiting, the black squares for postponing, and the dark grey triangles for postponing-no-points. AUCs are reported in the legend.

Figure 7D. Experiential Discounting Modified Brinley Plots. The top graph depicts the experiential waiting (x-axis) and experiential postponing (y-axis) AUCs modified Brinley plot. The bottom left graph depicts experiential waiting (x-axis) and experiential postponing-no-points (y-axis) AUCs modified Brinley plot. The bottom right graph depicts the experiential Postponing (x-axis) and experiential postponing-no-points (y-axis) AUCs modified Brinley plot. A diagonal reference line was included in each graph to aid visualisation. Each diamond represents an individual (n = 49) for all three graphs.

Hypothetical and Experiential Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the five discounting conditions are presented in Table 6. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .005. No significant correlations were found.

Table 6.

Spearman's Rank Order correlations among Hypothetical Waiting (HW) AUCs, Hypothetical Postponing (HP) AUCs, Experiential Waiting (EW) AUCs, Experiential Postponing (EP) AUCs and Experiential Postponing-No-Points AUCs (n = 49 for all).

	Hypothetical Waiting	**Hypothetical Postponing**	**Experiential Waiting**	**Experiential Postponing**
Hypothetical Postponing	.054			
Experiential Waiting	.209	-.085		
Experiential Postponing	-.107	.241	.230	
Experiential Postponing-No-Points	.140	.397	.390	.179

GDGQ and Discounting Correlations

Results of the Spearman's Rank Order correlation analysis performed on the GDGQ-Total, GDGQ-PW and GDGQ-CI scores and the AUCs for the five discounting conditions are presented in Table 7. To control for the number of correlations being tested, Bonferroni corrections were applied which reduced the alpha level to .003. The only significant correlations were among the GDGQ-T scores, the GDGQ-PW and GDGQ-CI subscales scores. Participants' GDGQ scores were not related to their discounting scores on either the hypothetical discounting or experiential discounting tasks among any of the Waiting or Postponing conditions.

Table 7.

Spearman's Rank Order correlations among GDGQ-Total (GDGQ-T), GDGQ-PW and GDGQ-CI scores, Hypothetical Waiting AUCs (HW), Hypothetical Postponing AUCs (HP), Experiential Waiting AUCs (E-W), Experiential Postponing AUCs (EP), and Experiential Postponing-No-Points AUCs (EPNP) (n = 49 for all).

	GDGQ-PW	**GDGQ-CI**	**HW**	**HP**	**EW**	**EP**	**EPNP**
GDGQ-T	.756*	.936*	.053	.146	-.122	.201	.050
GDGQ-PW		.533*	.000	.146	-.037	.210	.147
GDGQ-CI			-.016	.074	-.136	.205	-.012

*$p < 0.003$.

Discussion

Discounting

Participants showed steeper discounting rates in the experiential Waiting and the Postponing-No-Points conditions compared to the Postponing Condition. Discounting rates in the experiential Waiting Condition were not significantly steeper than in the experiential Postponing-No-Points Condition. This result suggests that removing the ability to access alternative reinforcement during the delay rendered the Postponing Condition as aversive as the Waiting Condition for participants. This indicates that the opportunity costs (removed access to earn reinforcement via points) affects discounting behaviour more than the subjective experience of those opportunity costs (boredom or discomfort during the delay). These results support our hypothesis that the inability to seek out alternative reinforcement drives the steep discounting and preference for impulsive and immediate rewards.

GDGQ and Discounting

Our investigation into GDGQ and discounting did not result in any significant relationships between GDGQ and any of the discounting conditions. As anticipated, the GDGQ-T, GDGQ-PW and GDGQ-CI were strongly correlated (Liu et al., 2013). This showed that the participants were again not simply responding arbitrarily to all of the

questions. Participants who showed higher tendencies to plan and wait also showed higher tendencies to control their impulses. However, participants' tendency to defer gratification by planning and waiting and controlling impulses were not related in any way to their discounting rates either hypothetically or experientially, or under conditions of Waiting or Postponing.

Liu et al. (2013) found a significant correlation between hypothetical postponing discounting rates and PW, we did not replicate this finding. The main differences between our study and theirs are the discounting tasks used, and the sample population. These differences might have contributed to this failure to replicate. Their discounting task was a typical hypothetical postponing one, which is different on multiple levels to the discounting tasks we used. Our hypothetical tasks involved shorter delays (30m - 12h), the Waiting Condition involved waiting and not postponing, and we used an experiential task involving points as rewards, and very short delays (seconds). Another potential issue cautioned by Liu et al. (2013), is that their study was conducted in a Chinese sample where there is a focus on the long-term over the short-term among individuals. There might be different relationships between GDGQ and delay discounting via hypothetical postponing in cultures that are less future oriented.

General Discussion

We investigated in this study the effects of waiting and postponing in hypothetical and experiential discounting tasks. Paglieri's (2013) hypothesis is that waiting and postponing result in different discounting behaviours. Individuals tend to display more impulsive decision-making in tasks when they wait compared to when they postpone. Johnson et al. (2015) found evidence for this hypothesis by finding that participants discounted more steeply on a hypothetical waiting task compared to a hypothetical postponing task.

Experiment 1 replicated the Johnson et al. (2015) finding for the hypothetical Waiting and Postponing conditions. Experiment 2 found this effect in both the hypothetical and the experiential Waiting and Postponing conditions. Experiment 3 provided additional insight into the potential crucial element behind this difference in discounting behaviours when it comes to waiting versus postponing. The results from Experiment 1 provided two key insights for the consideration of waiting versus postponing in delay discounting research. The first key insight was that the effect found by Johnson et al. (2015) was a replicable finding. Paglieri's (2013) concern was vindicated and our replication provided further support for that.

The second key insight came from the failure to extend this finding to the experiential discounting task. Further investigation of the data from this experiment indicated that this unanticipated outcome was an artefact of the procedure. In our attempt to make the experiment as rigorous as possible via trial randomisation we affected our ability to accurately conclude about waiting versus postponing. The investigation into Experiment 1's failure allowed us to fix this issue in Experiment 2 and provided a warning for future discounting studies that may attempt to intersperse condition trials within an experiential discounting task such as we did.

The results from Experiment 2 indicated that whether or not the delay is hypothetical or experiential is not as crucial as whether or not the delay involves waiting or postponing. If individuals wait or imagine waiting, they will display more impulsive discounting behaviour compared to if they postpone or imagine postponing. This further supports the conclusion that different discounting tasks measure different decision-making behaviours, and that this aspect of the delay plays a vital role in the difference.

Experiment 2 thus vindicated the consideration of waiting and postponing as separate decision-making and discounting constructs.

The aim of Experiment 3 was to further investigate why participants discount more steeply when they wait compared to when they postpone by determining what makes waiting cause steeper discounting. The experience of waiting involves opportunity costs that are subjectively aversive to an individual as they restrict access to reinforcement (Johnson et al., 2015; Paglieri, 2013). The first restriction of these opportunity costs is the inability to access alternative reinforcement during the delay. The second restriction is the temporary inability to access the delayed reward. For a real world example of the experience of these opportunity costs, imagine you have chosen to make a healthy dinner (LL) instead of buying takeout (SS). Before you are able to enjoy your reward, you have to wait for the preparation and cooking process to finish, and during this time you are unable to pursue other enjoyable activities.

Waiting in a discounting task involves these opportunity costs. Participants must wait before they able to receive their reward, and during the delay they are unable to earn alternative reinforcement. Whereas postponing only involves one aspect of the opportunity costs – the inability to access the delayed reward immediately. If we go back to our dinner example, postponing would be as if someone else cooked the healthy dinner for you. You still have to wait for how long the cooking process takes, but during the delay you are free to do whatever you like - reading a book or watching television for example. This provides a source of reinforcement that would not be experienced if you had to prepare the meal yourself.

It is not surprising that postponing and waiting results in different discounting behaviour. It is easier to make the self-controlled choice when there is less cost involved in making it. Just as it would be easier to choose the healthy dinner alternative over takeout if you had someone else make it for you. This key difference in opportunity costs results in steeper discounting for waiting compared to postponing.

The aim of Experiment 3 was to determine whether removing the ability to access reinforcement during the delay while alleviating the subjective experience of the delay (e.g. boredom) would still result in shallow discounting in the Postponing Condition. To achieve this we created the Postponing-No-Points Condition, which allowed us to determine whether individuals discounted less steeply compared to

Waiting if they were no longer forced to solely experience the wait, but still were unable to access alternative reinforcement during the delay. The participant was now able to keep playing the game during the delay instead of watching the wait screen, despite not being able to earn points.

The results from Experiment 3 provided another key insight for the consideration of waiting versus postponing in delay discounting research. We found that participants discounted similarly steeply across the Waiting and the Postponing-No-Points conditions, and they discounted shallowly in the Postponing Condition. This indicated that simply alleviating the subjective experience of the delay (e.g. boredom while waiting) was not enough to lower discounting. It appears that the inability to access alternative reinforcement plays the largest role in affecting discounting behaviours. When individuals have access to alternative reinforcement during a delay, they display more self-controlled decision-making.

Delay Discounting – Waiting Versus Postponing

Another interesting finding from Experiment 1 was that participants spent longer making their decisions for the hypothetical Waiting Condition compared to the hypothetical Postponing Condition after the initial delay. One potential reason for this might be due to the difference in cost associated with the choice. The Postponing Condition did not present a high level of cost associated with choosing the LL – the participants imagined they were free to pursue alternative reinforcement during the delay. Whereas in the Waiting Condition, the participants imagined the strict costs associated with the LL (having to stay in the room with no access to alternative reinforcement during the delay). This difference in associated cost may have resulted in the decision-making process for the Postponing Condition being easier and quicker than the Waiting Condition, as the latter involved a more difficult evaluation of cost against reward. One way to investigate this further would be to run the experiment again and include a self-report measure of how difficult they perceived the decision-making to be within each condition. This would allow the comparison of the subjective difficulty of the decision-making process alongside the choice latency to see if they are related.

The next step in the waiting versus postponing distinction in delay discounting research is applying the hypothetical waiting discounting task to research areas that have previously only used the hypothetical postponing discounting task. The change

alone in the tasks is simple – just briefly instructing participants whether they have to imagine waiting or postponing would allow researchers to determine what type of discounting behaviour is being affected. The use of the hypothetical waiting discounting task would also be beneficial over simply administering an experiential discounting task, as experiential tasks are more time-consuming and resource intensive. The hypothetical waiting task, similar to the typical hypothetical postponing task, would be just as easy to administer in research that is interested in decisions about waiting.

Research areas involving impulsivity or maladaptive decision-making that use delay discounting may find it valuable to distinguish between waiting and postponing type decision-making behaviours for arriving at appropriate conclusions and then applying those conclusions to real-world settings. Every-day decision-making does not always involve the pitting of an SS against a postponed LL. If we return to the previous takeout versus healthy dinner example, an individual may prefer impulsive and unhealthy food choices to avoid having to wait for how long the cooking process takes. If a researcher in the area of self-control and healthy eating decides to investigate that individual's discounting on a hypothetical postponing task alongside their self-reported eating habits they may find no relationship between the two. The individual may be self-controlled at the postponing task, but impulsive in their eating decisions. However, there might be a relationship with a hypothetical waiting task – as both would capture the individual's particular aversion to waiting.

When Appelhans et al. (2012) investigated delay discounting and intake of home-prepared versus takeout meals they found no relationship between discounting rates and frequency of takeout choices, despite anticipating one. They suggested a potential explanation for this unexpected result might be due to the effort or time it takes to obtain takeout meals, which may have reduced the extent to which impulsivity drives consumption. However, they used only a postponing task.

If the participants' meal choices were based on a preference to avoid waiting, then the use of a waiting task could have potentially revealed the anticipated relationship between impulsive discounting choices and meal choices. This would have provided more insight into the preference for unhealthy meal choices over healthy meal choices in terms of the opportunity costs associated with decision-making that are only experienced in situations that involve waiting and not postponing. Impulsivity in terms

of postponing may have little to do with the frequency of takeout consumption. Thus when investigating delay discounting alongside other decision-making behaviours that involve waiting, it is crucial to use a discounting task that captures waiting as well.

Our Experiment 3 results might also provide insight into the decision-making behaviour behind preferences for impulsive and unhealthy meal choices. The choice to prepare a healthy meal at home requires restricted access to alternative reinforcement during the time it takes to prepare, thus making this option less preferable when compared to takeout. If the individual chooses the takeout option then they are not only able to access the reward immediately but they are also able to access alternative sources of reinforcement as well. They can eat their meal while watching television for example during the time it would take to prepare the healthy meal alternative.

To further investigate the results from Experiment 3 in this area of decision-making, we could assess discounting across meal choices that involve waiting and postponing. The Waiting Condition would involve the participant choosing between takeout (SS) and preparing a healthy meal at home (LL) that would take a certain number of minutes. The Postponing Condition would involve the participant choosing between takeout and having someone prepare the meal for them. The Postponing-No-Points Condition would involve the participant choosing between takeout and again having someone prepare the meal for them, but this time instead of being free to pursue alternative reinforcement during the delay, they have to stay in the kitchen with the person and observe the process. Discounting across these conditions might reflect the pattern we observed in our ski task. Participants might display similarly steep discounting when they have to prepare the meal themselves and when they have to observe the process, as both of these choices involve the inability to access alternative reinforcement during the delay. This would indicate that in order to increase individuals' preference for healthy meals at home compared to takeout, we first need to increase the ability to access some alternative source of reinforcement during the process.

Many studies use discounting tasks to compare the decision-making of individuals with a disease or disorder against healthy controls. Recently one such study by Horan, Johnson, and Green (2017) provided another example of why the treatment of waiting and postponing as different discounting procedures is important. They investigated delay discounting in individuals with schizophrenia and found that

schizophrenics showed higher discounting rates than controls on an experiential money discounting task but not on a hypothetical postponing money discounting task. They suggested based on this result that schizophrenia might be associated with increased valuation of small (and not large) monetary rewards or hypersensitivity to costs associated with inactive waiting for rewards.

Our results would support the conclusion that the hypersensitivity to opportunity costs associated with waiting was driving the difference in discounting behaviour. Schizophrenia might affect the preference to wait and not the preference to postpone because only waiting involves the opportunity costs. Individuals with schizophrenia may be particularly sensitive to being unable to earn reinforcement during delays, which makes waiting more aversive to them than controls. This insight could aid understanding of the relationship between delay discounting and schizophrenia, and how schizophrenics' decision-making may be impaired (and therefore treatments aimed at improving this can be better targeted).

Similarly, a study by Yu and Sonuga-Barke (2016) recently investigated the difference in discounting on tasks that involve real time delays against hypothetical delays among children with ADHD and healthy controls. Individuals with ADHD tend to show steep discounting, however they only find steeper discounting in the children compared to controls for the real time delay task where the delay was actually experienced, and not the typical hypothetical postponing task. They concluded that the aversive experience of waiting plays a crucial part in the steeper discounting displayed by individuals with ADHD. They suggested based on the result for the experiential waiting task that perhaps delay aversion is exacerbated in individuals with ADHD due to the negative emotional experience associated with passively waiting out a delay.

It would be useful to assess discounting in individuals with ADHD against controls on a hypothetical waiting task alongside an experiential task – as the delay itself and aversion to waiting seem to be a key aspect of the steeper discounting. Hypothetical waiting appears more suitable to assess discounting than hypothetical postponing in this investigation. If the delay itself is more aversive to individuals with ADHD than controls, then we'd see steeper discounting in both the hypothetical waiting task as well as the experiential waiting task. Yu and Sonuga-Barke (2016) also suggested that perhaps the experience of the delay could be made less aversive and this would reduce discounting.

They detailed a study by Antrop et al. (2006) that found providing additional stimulation (watching pictures) during the delay between trials resulted in children with ADHD performing similar to controls. Thus making the waiting experience more tolerable by allowing time to be perceived as passing more quickly.

However, it might also be that the inability to earn reinforcement during the delay is driving how aversive individuals with ADHD find waiting. Our results from Experiment 3 would suggest that there is potential to decrease discounting even further if there is access to alternative reinforcement during the delay. Thus, it would also be useful to administer the ski game task to individuals with ADHD and controls using our Waiting, Postponing, and Postponing-No-Points conditions to determine the effect on discounting.

It might be that individuals with ADHD are uniquely susceptible to the subjective emotional experience of passively waiting out a delay and would discount similarly in the Postponing and Postponing-No-Points conditions. This could be based on just having the ability to ground their focus on playing the game, which would make waiting out the delay less aversive to them. This would be unlike controls that might require the additional earning of reinforcement via points to similarly reduce their discounting. If individuals with ADHD display shallow discounting in both the Postponing-No-Points and the Postponing conditions while controls display steep discounting in both the Waiting and Postponing-No-Points conditions this would suggest there is something uniquely present in the decision-making process of individuals with ADHD. This difference would result in delay aversion based on the avoidance of passively waiting due to the subjective aversive experience of it, and not just the inability to access alternative reinforcement. However, if both controls and individuals with ADHD perform similarly (steep discounting in the Waiting and Postponing-No-Points conditions and shallow discounting in the Postponing Condition), this would indicate that the inability to earn reinforcement is still the key factor for the observed delay aversion in decision-making in both individuals with ADHD and controls. This experiment would provide further insight into the nature of decision-making, delay discounting, and delay aversion in individuals with ADHD and how it differs from controls.

Our results from Experiment 3 also provide additional insight for the potential consideration of delay discounting as a trans-disease process. Bickel and Mueller (2009)

suggested that determining the key factors behind impulsive delay discounting is beneficial for the improvement of diseases and disorders that share impaired and maladaptive decision-making. The ability to access alternative reinforcement during delays might be especially crucial for individuals that have impaired decision-making, and being able to tailor future experiments and treatments to improve this aspect might help improve their impaired ability to resist the temptation of short-term rewards in favour of more beneficial long-term rewards.

A next step in investigating experiential discounting in terms of waiting versus postponing would be to further explore the result of Experiment 3. In particular, we would suggest further assessing how the inability to access alternative reinforcement during a delay affects choice preference. One way to achieve this would be to include in the tasks a self-report measure of how aversive the participant rates each delay across various conditions that involve full, limited, or no access to alternative reinforcement. We could also ask participants after their choices to detail the reasoning behind them, for example to avoid the delay versus to gain the points. Participants' estimation of how aversive they find a delay under differing conditions could then be compared to their own SS versus LL preferences for those delays. This would allow us to determine how aversive restricted access to alternative reinforcement during a delay is, whether participants consciously make their choices due to how aversive they perceive a delay, and also whether delay-avoidance plays a large role in the decision-making process when it comes to waiting.

There is one condition in particular that would be useful to include in a future study. This would essentially be a Postponing Condition that allows the participants to continue to access alternative reinforcement during the delays in the form of points, but the number of points would be significantly reduced compared to the standard Postponing Condition. If participants discount similarly across the Waiting Condition, the Postponing-No-Points Condition, and this new Postponing-Fewer-Points Condition, then it would indicate that individuals require a significant source of reinforcement available during a delay in order to tolerate it. However, if participants discount similarly shallowly in the Postponing-Fewer-Points and the Postponing conditions compared to the Waiting and Postponing-No-Points conditions, this would suggest that access to any amount of alternative reinforcement during a delay is enough to make it tolerable. This experiment

would provide additional insight into the reasoning behind why waiting is less preferable than postponing, and the contexts in which this difference is the most visible.

Another potentially useful condition to examine would be a Waiting Condition mirror of the Postponing-No-Points Condition. This would be similar to how the Postponing-No-Points Condition demonstrated that removing the ability to earn reinforcement via points during the delay resulted in participants treating it similarly to a Waiting Condition. The opposite could occur in this new Waiting-With-Points Condition, the ability to earn points during the wait might result in participants now discounting similarly to the Postponing Condition. Participants would still have to wait out the delay while watching the wait screen, but during this delay they would be instructed and visually shown that they are still earning points during the delay despite not playing the game.

This would allow us to determine whether the effect we found with the Postponing-No-Points Condition would be mirrored in the Waiting-With-Points Condition and would further strengthen the conclusion that the ability to earn reinforcement during a delay drives choice preference. If participants discount similarly steeply in the Waiting and the Waiting-With-Points conditions compared to the Postponing Condition, then it would indicate that individuals require more than an alternative source of reinforcement available during a delay in order to tolerate it. However, if participants discount similarly shallowly in the Waiting-With-Points and the Postponing conditions compared to the Waiting Condition, this would suggest that access to alternative reinforcement during a delay is enough to make it preferable even when the individual is just passively waiting out the delay. This experiment would again provide insight into the reasoning behind why waiting is less preferable than postponing, and the contexts in which this difference is the most visible.

Delay Discounting Correlations

A current limitation of our study is that the delay range we used in the hypothetical tasks in Experiments 1 and 2 was relatively short (30m to 12h). This resulted in a large number of ceiling responses where the participants always chose the LL in the Postponing Condition. This potentially attenuated our correlations among the discounting conditions, as well as the CFC and GDGQ scores due to the restricted range. We used this delay range to maintain the feasibility of the hypothetical scenario of

waiting in the lab room for the participants. But it would be useful to assess hypothetical waiting versus postponing across longer delays to further distinguish the contexts under which individuals discount shallowly and steeply. A future experiment could increase the delays to 24-48h and provide the participants with a hypothetical scenario that perhaps instructs them they are only allowed to take care of necessary functions (eating, sleeping, etc.), otherwise they must be sitting down at a computer screen and waiting. This would allow the delay range at which the majority of participants discount under both Waiting and Postponing conditions to be determined. It would also be useful to extend the delay range in the experiential discounting task up to one minute as there were ceiling responses for the experiential Postponing Condition as well, although not to the same degree as the hypothetical Postponing Condition. Running the ski game task again with a delay of one minute should allow discounting functions to be observed for the majority of participants.

Discounting scores in the experiential Waiting Condition were not related to scores in the hypothetical Postponing Condition in any of our 3 Experiments. This supports earlier research that found no correlation between discounting on a typical hypothetical postponing task and an experiential discounting task (Jimura et al., 2011; Johnson, 2012; Smits et al., 2013). However, we did not find relationships among experiential waiting and hypothetical waiting or experiential postponing and hypothetical postponing, and for Experiment 2, there was a correlation between experiential postponing and waiting despite participants distinguishing between the two.

Further research is necessary to better understand the relationships among hypothetical and experiential discounting of waiting and postponing in various tasks. It may be that discounting across delays of less than a minute is unrelated to discounting of delays of 30m up to 12h. To investigate the potential difference in short delay discounting, further correlations of discounting scores across a delay range of 5s to 12hrs would provide insight into whether or not our lack of a correlation is replicable.

As our experiment was (to our knowledge) the first to compare an experiential Postponing Condition, it could also be that experiential discounting of both Waiting and Postponing conditions across very short delays is related. To investigate this possibility, we could assess discounting on experiential discounting tasks that involve very short

delays (one minute and under) for both waiting and postponing conditions. These waiting and postponing correlations could then be compared to correlations of discounting on an experiential task with a longer delay-range (5 - 15m perhaps). This would allow us to determine whether discounting is only related between the experiential Waiting and Postponing conditions on a very short delay range or if this extends to longer delay ranges as well.

It would also be useful to assess whether discounting is similar between a hypothetical and experiential discounting task that uses the same delay range and reward type. Using a hypothetical waiting task instead of a hypothetical postponing task would allow for the direct comparison of discounting on two tasks where the only difference is whether the delay is imagined or experienced. If discounting were similar between the two, then this would further suggest that the lack of a relationship between hypothetical and experiential discounting (Jimura et al., 2011; Johnson, 2012; Smits et al., 2013) was due to the postponing task being unsuitable for the comparison. Comparing discounting on a postponing version of the same tasks could also mirror this effect and further support the distinction between waiting and postponing in discounting research.

A potential way to investigate hypothetical and experiential discounting of waiting across the same delay range would be to use the experiential video discounting task. This task involves participants choosing between SS clips of a preferred video reward, and LL clips after a short delay (under a minute). Participants' discounting on this experiential task could be compared to their discounting on a hypothetical version of the same task. For example, this hypothetical version would have participants imagine choosing between watching 10 seconds of a video immediately, or waiting 20 seconds and then getting to watch 45 seconds of the video. Participants' choices of what they thought they would prefer could then be directly compared to what they actually preferred in the experiential task.

This would allow us to determine whether there is a difference between hypothetical and experiential discounting of a waiting task using the same rewards and delay range. If participants discount more steeply on the experiential version of this task compared to the hypothetical, then it would indicate that there is still something unique to the experience of waiting that is not similarly captured by hypothetical waiting. It

would also indicate that participants overestimate their own tendency/ability to wait. If the opposite occurs and participants discount similarly across both versions of the task it would indicate that hypothetical waiting is a valid substitute for experiential waiting, and that participants are able to accurately estimate their preferences for decisions about waiting even for very short delays.

Delay Discounting and CFC

Our results from Experiment 1 and 2 indicated there were no significant relationships among our discounting conditions and CFC-T, CFC-F, or CFC-I. As mentioned in the discussion for Experiment 2, this might be due to the procedural differences between our discounting tasks and the hypothetical postponing task that has typically been used alongside CFC in the existing research. Our experiment involved experiential discounting, waiting, and generally short delays (30s to 12h). This is different to the typical hypothetical postponing discounting procedure that has been used in past research that has found a relationship between delay discounting and CFC (Cosenza & Nigro, 2015; Charlton et al., 2011; Joireman et al., 2008). Just as discounting tasks themselves can measure different decision-making constructs (waiting versus postponing), these different constructs might also relate differently to other measures of decision-making or outcome consideration such as CFC. The conditions under which discounting and CFC are related might be more complex and context specific than originally thought.

CFC might only be related to postponing over long delays as the decision-making only involves long-delays. The questions involved in the CFC-F subscale are about outcomes that are significantly further into the future (e.g. years) and the CFC-I subscale involves “immediate” outcomes of at least days to weeks. What is considered an immediate outcome in CFC is not the same as an immediate outcome in delay discounting. The items in both scales don’t appear to relate to decision-making of postponed outcomes across short delays (seconds, minutes, or hours). Thus, CFC and hypothetical and experiential discounting of short delays may not be related.

Delay Discounting and GDGQ

Our results from Experiment 3 indicated there were no significant relationships among our discounting conditions and GDGQ-T, GDGQ-PW, or GDGQ-CI. Similar to CFC, this might also be due to procedural differences. Our discounting tasks were different to

the typical hypothetical postponing discounting task that was used by Liu et al. (2013). This alongside the other potential limitation mentioned in Experiment 3's discussion section (the sample population that was used) might have been enough to affect the ability to detect relationships among our discounting measures and the GDGQ subscales.

Additionally, a limitation raised by Liu et al. (2013) about the poor internal reliability of the PW subscale might have played a role in the lack of replication of the hypothetical postponing and PW correlation. They suggested that the poor reliability might be due to the subscale's small number of items, and that future research could bolster it with additional items. As PW is the subscale that would potentially correlate with hypothetical postponing, perhaps after the reliability is increased a relationship could be detected despite the three main issues mentioned above.

The relationship between hypothetical postponing and PW found so far might be more due to the method and task used to measure discounting, and thus when measured in a different way it may no longer be significant. Similar to CFC, the vast majority of items in GDGQ do not target outcomes over short delays (seconds, minutes, hours). The tendencies to plan and wait or control impulses of short delays may be different to long delays. Thus the preferences indicated via GDGQ may be similar only to decisions made on postponing tasks.

Whether or not an individual discounts steeply or shallowly largely appears dependent on the context they are discounting under. Their decision-making is more impulsive when they wait, and more self-controlled when they postpone. It is therefore not surprising that the relationships with other similar measures are also context dependent. An individual's tendency to plan and wait and their tendency to control their impulses might only be related to their discounting behaviours within specific contexts that are not equally captured by every discounting task.

Thus, a next step would be to again investigate discounting rates with GDGQ scores within a wider range of discounting tasks and conditions (waiting and postponing), across longer delay ranges, to ascertain under what contexts certain relationships occur. It would also be beneficial for those future studies to address the other concerns of the sample populations used, and the relatively poor reliability of the PW subscale itself.

Conclusion

Our study has provided two key insights into delay discounting research and specifically the issue of waiting versus postponing. The first is that waiting and postponing tasks do measure different decision-making and discounting behaviours. Individuals discount more steeply when they wait compared to when they postpone. It doesn't matter whether this wait is hypothetical or experienced, as individuals will display this pattern of discounting in both experiential and hypothetical discounting tasks. The second is that waiting appears less subjectively preferable compared to postponing due to the inability to access alternative reinforcement during the delay. This is the crucial difference between the two constructs that results in different discounting behaviour.

The results from this thesis add to the potential of delay discounting as an effective research tool across a wide variety of investigations of decision-making processes. By understanding that delay discounting involves more than one construct and that different tasks capture these different constructs allows us to better refine the tasks we use to investigate the constructs we are interested in.
Acknowledging the difference of the waiting versus postponing in differing contexts allows for more appropriate conclusions to be drawn from research and then applied to societally important decision-making areas. This could prevent studies from designing treatments to reduce postponing, when the decision-making behaviour they are trying to reduce via their interventions is actually waiting. Treating the two different discounting constructs as the same when they are not reduces the potential efficacy of delay discounting research, and the current study has helped demonstrate that.

References

Acuff, S. F., Soltis, K. E., Dennhardt, A. A., Borsari, B., Martens, M. P., & Murphy, J. G. (2017). Future so bright? delay discounting and consideration of future consequences predict academic performance among college drinkers. *Experimental and Clinical Psychopharmacology, 25*(5), 412-421.

Antrop, I., Stock, P., Verté, S., Wiersema, J. R., Baeyens, D., & Roeyers, H. (2006). ADHD and delay aversion: the influence of non-temporal stimulation on choice for delayed rewards. *The Journal of Child Psychology and Psychiatry, and Allied Disciplines, 47*, 1152-1158.

Appelhans, B. M., Waring, M. E., Schneider, K. L., Pagoto, S. L., DeBiasse, M. A., Whited, M. C., & Lynch, E. B. (2012). Delay discounting and intake of ready-to-eat and away-from-home foods in overweight and obese women. *Appetite, 59*(2), 576-584.

Bickel, W. K., MacKillop, J., Madden, G. J., Odum, A. L., & Yi, R. (2015). Experimental manipulations of delay discounting & related processes: An introduction to the special issue. *Journal of the Experimental Analysis of Behavior, 103*(1), 1-9.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: delay discounting processes. *Addiction*, *96(1),* 73-86.

Bickel, W. K., & Mueller, E. T. (2009). Toward the study of trans-disease processes: a novel approach with special reference to the study of co-morbidity. *Journal of Dual Diagnosis*, *5*(2), 131–138.

Charlton, S. R., Gossett, B. D., & Charlton, V. A. (2011). Beyond the shadow of a trait: Understanding discounting through item-level analysis of personality scales. *The Psychological Record, 61*(4), 583-598.

Cosenza, M., & Nigro, G. (2015). Wagering the future: cognitive distortions, impulsivity, delay discounting, and time perspective in adolescent gambling. *Journal of Adolescence, 45*, 56-66.

Daugherty, J. R., & Brase, G. L. (2010). Taking time to be healthy: predicting health behaviors with delay discounting and time perspective. *Personality and Individual Differences*, *48*(2), 202-207.

Decker, J. H., Figner, B., & Steinglass, J. E. (2015). On weight and waiting: delay discounting in anorexia nervosa pretreatment and posttreatment. *Biological Psychiatry*, *78(9)*, 606–614.

Dixon, M. R., Marley, J., & Jacobs, E. A. (2003). Delay discounting by pathological gamblers. *Journal of Applied Behavior Analysis, 46*(2), 512–517.

Dixon, M. R., Mui Ker Lik, N., Green, L., & Myerson, J. (2013). Delay discounting of hypothetical and real money: the effect of holding reinforcement rate constant. *Journal of Applied Behavior Analysis, 36*(4), 449–458.

Du, W., Green, L., & Myerson, J. (2002). Cross-cultural comparisons of discounting delayed and probabilistic rewards. *Psychological Record*, *52(4)*, 479-492

Grecucci, A., Giorgetta, C., Rattin, A., Guerreschi, C., Sanfey, A. G., & Bonini, N. (2014). Time devours things: How impulsivity and time affect temporal decisions in pathological gamblers. *PLoS One, 9*(10).

Greenhow, A. K., Hunt, M. J., Macaskill, A. C., & Harper, D. N. (2015). The effect of reinforcer magnitude on probability and delay discounting of experienced outcomes in a computer game task in humans. *Journal of the Experimental Analysis of Behavior, 104*(2), 186-197.

Hayashi, Y., Miller, K., Anne M. Foreman, A. M., & Wirth, O. (2016). A behavioural economic analysis of texting while driving: Delay discounting processes. *Accident Analysis & Prevention, 97.* 132-140.

Hinvest, N. S., & Anderson, I. M. (2010). The effects of real versus hypothetical reward on delay and probability discounting. *The Quarterly Journal of Experimental Psychology*, *63(6)*, 1072-1084.

Horan, W. P., Johnson, M. W., & Green, M. F. (2017). Altered experiential, but not hypothetical, delay discounting in schizophrenia. *Journal of Abnormal Psychology, 126*(3), 301-311.

Jimura, K., Myerson, J.,Hilgard, J., Braver, T., & Green, L. (2009). Are people really more patient than other animals? Evidence from human discounting of real liquid rewards. *Psychonomic Bulletin & Review*, *16*, 1071–1075.

Jimura, K., Myerson, J.,Hilgard, J., Keighley, J., Braver, T., & Green, L. (2011). Domain independence and stability in young and older adults' discounting of delayed rewards. *Behavioural Processes, 87*(3), 253-259.

Johnson, M. W. (2012). An efficient operant choice procedure for assessing delay discounting in humans: Initial validation in cocaine-dependent and control individuals. *Experimental and Clinical Psychopharmacology, 20*(3), 191-204.

Johnson, M. W. and Bickel, W. K. (2002). Within-subject comparison of real and hypothetical money rewards in delay discounting. *Journal of the Experimental Analysis of Behavior, 77*(2), 129–146.

Johnson, P. S., Herrmann, E. S., & Johnson, M. W. (2015). Opportunity costs of reward delays and the discounting of hypothetical money and cigarettes. *Journal of the Experimental Analysis of Behavior, 103*(1), 87-107.

Joireman, J., Balliet, D., Sprott, D., Spangenberg, E., & Schultz, J. (2008). Consideration of future consequences, ego-depletion, and self-control: support for distinguishing between CFC-Immediate and CFC-Future sub-scales. *Personality and Individual Differences*, *45*, 15-21.

Joireman, J., & King, S. (2016). Individual differences in the consideration of future and (more) immediate consequences: A review and directions for future research. *Social and Personality Psychology Compass, 10*(5), 313-326.

Joireman, J., Shaffer, M . J., Balliet, D., Strathman, A. (2012). Promotion orientation explains why future-oriented people exercise and eat healthy: evidence from the two-factor Consideration of Future Consequences-14 Scale. *Personality and Social Psychology Bulletin, 38*, 1272-1287.

Kaplan, B. A., Reed, D. D., & Jarmolowicz, D. P. (2015). Effects of episodic future thinking on discounting: personalized age-progressed pictures improve risky long-term health decisions. *Journal of Applied Behavior Analysis, 49*(1), 148-169.

Kirby, K. N. (1997). Bidding on the future: evidence against normative discounting of delayed rewards. *Journal of Experimental Psychology General*, *126*, 54–70.

Lerner, J. S., Li, Y., & Weber, E. U. (2013). The financial costs of sadness. *Psychological Science, 24*(1), 72 – 79.

Liu, X., Wang, L., & Jiang, J. (2013). Generalizability of delay of gratification: dimensionality and function. *Psychological Reports, 113*(2), 464-485.

Madden, G. J., Raiff, B. R., Lagorio, C. H., Begotka, A. M., Mueller, A. M., Hehli, D. J., & Wegener, A. A. (2004). Delay discounting of potentially real and hypothetical

rewards: II. between- and within-subject comparisons. *Experimental and Clinical Psychopharmacology, 12*(4), 251-261.

Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In M. L. Commons, J. E. Mazur, J. A. Nevin, & H. Rachlin (Eds.), *The Effect of Delay and of Intervening Events on Reinforcement Value: Quantitative Analyses of Behavior* (Vol. 5, pp. 55–73). Psychology Press.

McKay, M. T., Perry, J . L., Percy, A., & Cole, J. C. (2016). Evidence for the reliability and validity, and some support for the practical utility of the two-factor Consideration of Future Consequences Scale-14. *Personality and Individual Differences*, *98*, 133-136.

Myerson, J., Green, L., & Warusawitharana, M. (2001). Area under the curve as a measure of discounting. *Journal of the Experimental Analysis of Behavior*, *76(2)*, 235-243.

Odum, A. L. (2011a). Delay discounting: I'm a k, you're a k. *Journal of the Experimental Analysis of Behavior, 96*(3), 427–439.

Odum, A. L. (2011b). Delay discounting: trait variable? *Behavioural Processes*, *87(1)*, 1-9.

Odum, A. L., & Rainaud, C. P. (2003). Discounting of delayed hypothetical money, alcohol, and food. *Behavioural Processes, 64*, 305-313.

Olsen, R. (2016). *Delay discounting and student success* (Unpublished master's thesis). University of Victoria, Wellington, New Zealand.

Paglieri, F. (2013). The costs of delay: Waiting versus postponing in intertemporal choice. *Journal of the Experimental Analysis of Behavior, 99*(3), 362-377.

Reynolds, B. (2006). The Experiential Discounting Task is sensitive to cigarette-smoking status and correlates with a measure of delay discounting. *Behavioural pharmacology*, *17*(2), 133-142.

Rodzon, K., Berry, M. S., & Odum, A. L. (2011). Within-subject comparison of degree of delay discounting using titrating and fixed sequence procedures. *Behavioural Processes, 86*(1), 164-167.

Smits, R. R., Stein, J. S., Johnson, P. S., Odum, A. L., & Madden, G. J. (2013). Test–retest reliability and construct validity of the experiential discounting task. *Experimental and Clinical Psychopharmacology, 21*(2), 155-163.

Steward, T., Mestre-Bach, G., Vintro-Alcaraz, C., Aguera, Z., Jimenez-Murica, S., Granero, R., & Fernandez-Aranda, F. (2017). Delay discounting of reward and impulsivity in eating disorders: from anorexia nervosa to binge eating disorder. *European Eating Disorders Review, 25*(6), 601-606.

Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: weighing immediate and distant outcomes of behavior. *Journal of Personality and Social Psychology, 66*(4), 742-752.

Vanderveldt, A., Green, L. & Rachlin, H. (2015). Discounting by probabilistic waiting. *Journal of Behavioural Decision Making*. doi: 10.1002/bdm.1917.

Yu, X., & Sonuga-Barke, E. (2016). Childhood ADHD and delayed reinforcement: a direct comparison of performance on hypothetical and real-time delay tasks. *Journal of Attention Disorders*. doi: 10.1177/1087054716661231.

Appendix A

Consent Form

SOPHEC approval number: 0000024179. This research has been approved by the School of Psychology Human Ethics Committee under delegated authority of Victoria University of Wellington's Human Ethics Committee.

Dr. Maree Hunt
Senior Lecturer
Maree.Hunt@vuw.ac.nz
Principal Investigator

Dr. Anne Macaskill
Research Fellow
Anne.Macaskill@vuw.ac.nz

Rebecca Olsen
PhD student
Rebecca.Olsen@vuw.ac.nz

Rana Asgarova
PhD student
Rana.Asgarova@vuw.ac.nz

Kendra Thompson-Davies
Master's student
kendra.thompson-davies@vuw.ac.nz

What is the purpose of this research?

- The purpose of this research is to examine people's choices on a computer-based task. The choices that you will make on these tasks are similar in structure to choices that people make in important real-life contexts. The choices you make in this task will help us to understand those real-life choices better.

Who is conducting the research?

- Maree Hunt and Anne Macaskill are researchers at Victoria and conduct research about how people make choices. Rebecca Olsen is a PhD student at Victoria writing her thesis on this project. Rana Asgarova and Kendra Thompson-Davies are PhD and master's students at Victoria writing their theses on related projects.

What is involved if you agree to participate?

- If you agree to participate in this study you will complete a task in which you make a series of choices about hypothetical amounts of money that you could receive after different delays.
    - You will also play a simple computer game in which you can win points.
    - You will complete a questionnaire assessing the way you think about the future consequences of your choices.
- We anticipate that your total involvement will take no more than an hour.
- You are able to cease participation at any time without penalty until the end of the session. You can also request that your data be excluded from the study at any time until you leave today.
- If you complete each task you will receive 1 hour of IPRP credit for your participation.

Privacy and Confidentiality

- The computer programme we are using will record your responses in a data file that does not include any information that would connect you with your data. Your data file will be combined with others and we will keep these de-identified data files indefinitely.
- In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other researchers.
- Your data may be used in other, related studies.

What happens to the information that you provide?

- The overall findings may be submitted for publication in a scientific journal, presented at scientific conferences, or used in student theses that will be available in the university library.

If you have any questions, please ask the researcher running this session now. If you have questions later on, please contact any of the listed researchers at the top of this sheet.

If you would like to read a summary of the findings of this research, this will be posted on our laboratory website: https://humanlearninglab.com/

Statement of consent

Please click the following if you agree:

☐ I have read the information about this research and any questions I wanted to ask have been answered to my satisfaction. I agree to participate in this research. I understand that I am able to cease participating and request that my data be excluded at any point up to the end of this session.

If you do not wish to participate, you are free to leave. Please click the following to close the computer program:

☐ I do not agree to participate in this research.

Appendix B

Debriefing Statement

SOPHEC approval number: 0000024179. This research has been approved by the School of Psychology Human Ethics Committee under delegated authority of Victoria University of Wellington's Human Ethics Committee.

Dr. Maree Hunt
Senior Lecturer
Maree.Hunt@vuw.ac.nz
Principal Investigator

Dr. Anne Macaskill
Research Fellow
Anne.Macaskill@vuw.ac.nz

Rebecca Olsen
PhD student
Rebecca.Olsen@vuw.ac.nz

Rana Asgarova
PhD student
Rana.Asgarova@vuw.ac.nz

Kendra Thompson-Davies
Master's student
kendra.thompson-davies@vuw.ac.nz

Thank you for participating in this study. We hope you found your involvement to be a useful and interesting experience.

A bit of background to this research project: In general people value larger rewards more than smaller rewards - e.g. if you had the choice between $100 and $200 you would almost certainly choose $200. We also value rewards we can get sooner more than those we can get later. For example, if you had the choice between $100 now and $100 in a year you would likely opt to receive $100 now. Things get a bit trickier if you were given the choice between $100 and $200 in one year. People find this type of choice difficult because they have to trade off delay and amount. Similar things might happen when you need to choose between definitely getting a small reward and maybe getting a larger reward.

Many of the situations in which you find yourself frustrated with your own choices may be because you have chosen to prioritise getting something now over waiting for something larger (many people experience this!). For example, you likely value good marks more than watching TV but may sometimes find yourself watching TV now rather

than studying for a good test mark later. Similar delay-amount trade-offs occur in choices about smoking, exercising, saving for retirement, and pollution.

This is why we asked participants to make choices between smaller, sooner amounts of money and larger, delayed amounts of money. Some participants also made choices between studying versus a more immediately appealing activity; this projects attempts to better understand these types of choices in a studying context too. These are *experimental analogues* of the kinds of real-world situations described above.

Should you have any further questions about the study, or if you found any of the material in this study bothersome, please feel free to contact us.

Thank you again for participating. If we can understand these choices better we may be able to figure out how to increase the likelihood that we will all make choices that help us get the things we value most in the long term.

Appendix C

CFCS-14 Scale

1. I consider how things might be in the future, and try to influence those things with my day-to-day behavior. (CFC-F)
2. Often I engage in a particular behavior in order to achieve outcomes that may not result for many years. (CFC-F)
3. I only act to satisfy immediate concerns, figuring the future will take care of itself. (CFC-I)*
4. My behavior is only influenced by the immediate (i.e., a matter of days or weeks) outcomes of my actions. (CFC-I)*
5. My convenience is a big factor in the decisions I make or the actions I take. (CFC-I)*
6. I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes. (CFC-F)
7. I think it is important to take warnings about negative outcomes seriously even if the negative outcome will not occur for many years. (CFC-F)
8. I think it is more important to perform a behavior with important distant consequences than a behavior with less important immediate consequences. (CFC-F)
9. I generally ignore warnings about possible future problems because I think the problems will be resolved before they reach crisis level. (CFC-I)*
10. I think that sacrificing now is usually unnecessary since future outcomes can be dealt with at a later time. (CFC-I)*
11. I only act to satisfy immediate concerns, figuring that I will take care of future problems that may occur at a later date. (CFC-I)*
12. Since my day-to-day work has specific outcomes, it is more important to me than behavior that has distant outcomes. (CFC-I)*
13. When I make a decision, I think about how it might affect me in the future. (CFC-F)
14. My behavior is generally influenced by future consequences. (CFC-F)

* Indicates reverse-scored items for the CFC-Total score.

Appendix D

GDGQ Scale

1 – I am good at saving my money rather than spending it straight away. (GDGQ-CI)

2 – I enjoy a thing all the more because I have had to wait for it and plan for it. (GDGQ-PW)

3 – I tended to save my pocket money as a child. (GDGQ-CI)

4 – When I am in a supermarket, I always tend to buy a lot of things I hadn't planned to buy. (GDGQ-CI)*

5 – I am constantly "broke”. (GDGQ-CI)*

6 – I agree with the philosophy: "Eat, drink and be merry, for tomorrow we may be all dead”. (GDGQ-CI)*

7 – I describe myself as often being too impulsive for my own good. (GDGQ-CI)*

8 – I fairly often find that it is worthwhile to wait and think things over before deciding. (GDGQ-PW)

9 – I like to spend my money as soon as I get it. (GDGQ-CI)*

10 – I can tolerate being kept waiting for things fairly easily most of the time. (GDGQ-PW)

11 – I am good at planning things way in advance. (GDGQ-PW)

12 – It is hard for me to keep from blowing my top when someone gets me very angry. (Neither subscale)*

* Indicates reverse-scored items for the GDGQ-Total score.