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Social Contagion Effects in Intertemporal Decision Making

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Abstract of the Dissertation

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Intertemporal preferences refer to preferences for payoffs that occur at different times in the future. Though prior research has provided substantial information about the intertemporal preferences of individuals, little is known about group or collaborative intertemporal preferences. In the introduction of the current dissertation, we summarize two preliminary studies we carried out that began to investigate intertemporal decision making in a collaborative context. The three experiments included in the current dissertation follow this line of research and seek to gain a better understanding of the psychological and social processes involved in collaborative intertemporal decision making. In Experiment 1, we demonstrated that group members believed to have less "expertise" were more influenced by the collaborative experience than members believed to have more "expertise". In Experiment 2, a dyadic experiment was carried out where participants either completed a matching judgment task or a binary choice task. Similar patterns of results were found in the two different task environments, which suggest a generality to the observed collaborative effects. Finally, in Experiment 3, greater control was exerted over the intertemporal preferences participants were exposed to. This was accomplished by merely exposing participants to the decisions believed to be made by another individual. By manipulating the decisions participants were exposed to, Experiment 3 tested the ability to intervene and causally shift intertemporal preferences in a predicted direction (i.e., towards more patience or more impatience).

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Introduction

Choices often have to be made between alternatives which have outcomes at different times in the future. For example, an individual may choose going to college instead of getting a job after high school, believing that achieving a college degree, though costly in the short term, will have greater benefits over the long term. Such tradeoffs between time and reward are referred to as intertemporal choices. Within the literature on intertemporal choice, particular attention has been paid to the finding that decision makers discount the value of delayed rewards (e.g., Myerson, Green, Hanson, Holt, & Estle, 2003; Rachlin, Raineri, & Cross, 1991). That is, the subjective value of a reward decreases as its delivery is increasingly delayed (for reviews, see Frederick, Loewenstein, & O'Donoghue, 2002; Luhmann, 2009).

Research on intertemporal choice in both psychology and economics has primarily focused on decisions made by individuals. This line of research has provided substantial information about individuals' intertemporal preferences and how they relate to other real-world behaviors. For example, prior research has demonstrated that individual differences in laboratory intertemporal choice tasks are associated with many consequential behaviors, including alcoholism (Petry, 2001; Vuchinich & Simpson, 1998), drug use and abuse (Kirby, Petry, & Bickel, 1999), pathological gambling (Alessi & Petry, 2003; MacKillop, Anderson, Castelda, Mattson, & Donovick, 2006), credit card borrowing (Meier & Sprenger, 2010), income (Green, Myerson, Lichtman, Rosen, & Fry, 1996), academic performance (Kirby, Winston, & Santiesteban, 2005), and dietary and exercise habits (Bradford, 2010).

The emphasis on intertemporal decisions made by individuals is potentially problematic, however, because many real-world decisions are made by groups of two or more decision makers. For instance, a couple might jointly determine what portion of their discretionary income to designate for consumption and what portion they want to save. Similarly, individuals often discuss the costs and benefits associated with various short- and long-term investment options in consultation with a financial advisor. Because past research has focused on the intertemporal preferences of individuals, little is known about how intertemporal decisions might be made in such collaborative contexts. The current proposal is designed to provide insight into this important question.

Collaborative Decision Making

Though collaborative decision making has not been studied much in the context of intertemporal decisions, there is a large literature on group decision making in other domains. As an example, older work on group conformity has shown that social contexts can exert strong influences on individual behavior (Cialdini & Goldstein, 2004). In the classic experiments exploring the influence of social norms on perceptual judgments, Sherif (1936) found that observing the judgments of others led group members' judgments to converge. That is, group members' perceptual judgments were more related to each other post-collaboratively than they were pre-collaboratively. Asch (1956) also famously found that individuals' stimulus discrimination judgments conformed to other group members' judgments.

Another relevant line of research involves group polarization, which refers to the tendency of group members' attitudes (e.g., attitudes regarding capital punishment) to shift toward one extreme following group interaction and discussion (e.g., Moscovici & Zavalloni,

1969; Myers & Lamm, 1976). Early research on group polarization mainly focused on what has been referred to as the risky choice shift, which is the finding that a group will make riskier choices than the group members would make as individuals (Gardner & Steinberg, 2005; Johnson, Stemler, & Hunter, 1977; Wallach, Kogan, & Bem, 1964; but see Zajonc, Wolosin, Wolosin, & Sherman, 1968). Two broad classes of theories have been proposed to explain group polarization. The first is a social comparison process, which suggests that choice shifts and attitude polarization occur because individuals adjust their behavior in order to be perceived more positively by other group members (Blascovich, Ginsburg, & Veach, 1975; Goethals & Zanna, 1979). The second class of theory involves persuasive argumentation, which states that choice shifts and attitude polarization occur based on the amount and quality of the arguments provided by the members of the group (Burnstein, Vinokur, & Trope, 1973; Vinokur & Burnstein, 1974). Isenberg's (1986) survey of the literature and meta-analysis suggested that social comparison processes and persuasive argumentation are independent of one another, but in certain contexts can act to jointly produce group polarization.

Collaborative Economic Preferences

There are reasons why it may be difficult to apply the results summarized in the previous section to higher-order, economic decision making. That is, there are reasons to believe that economic preferences, and intertemporal preferences in particular, may not be susceptible to the collaborative influences reported in these older literatures. First, past work on conformity has frequently focused on decisions that entailed a large degree of response uncertainty (e.g., the perceptual judgments in Sherif's autokinetic tasks). Intertemporal preferences, in contrast, are conceptualized as an extremely stable property of an individual, with an individual's

intertemporal decisions being similar across different contexts and goods (e.g., money, food; Odum, 2011) and over time spans as long as a year (Kirby, 2009). Second, other work in the collaborative decision making literature, such as group polarization, has focused on behavior that is known to be labile and/or susceptible to social pressure (e.g., attitudes, opinions). Conversely, past work has demonstrated that intertemporal preferences are extremely resistant to even deliberate influence, requiring elaborate instructions about normative behavior (Senecal, Wang, Thompson, & Kable, 2012) or extremely long training periods (e.g., a 36-week intervention reported by Black & Rosen, 2011).

In an effort to explore how social and collaborative contexts can influence economic preferences, a small number of recent studies have begun to examine how collaboration influences individual group members' economic decision making. Typically, such influence is detected by having a pre-collaboration and post-collaboration phase during which participants make decisions individually, as well as a collaboration phase in which decisions are made by groups of two or more individuals. The individual decision making phases allow researchers to observe whether and how the experience of collaboration shifts individuals' decisions between the pre-collaboration and post-collaboration phases. These studies have explored decision making across a variety domains, including allotments in the dictator game (Cason & Mui, 1997; Luhan, Kocher, & Sutter, 2009), cooperation in a prisoner's dilemma (Hopthrow & Abrams, 2010), and risk preferences (Deck, Lee, Reyes, & Rosen, 2012). Despite these studies involving different types of decisions and contexts, individuals' decisions have generally been observed to be influenced by the collaborative decision making experience. For example, Hopthrow and Abrams (2010) found that individuals making decisions in a prisoner's dilemma became more cooperative following collaboration. However, because of the different nature of the above

decisions, it is difficult to predict how these results might inform collaborative intertemporal decisions. At the very least, though, such work does suggest that collaborative contexts may have the ability to influence the intertemporal preferences of individual group members.

Collaborative Intertemporal Preferences

Though collaborative intertemporal decision making is a relatively unexplored research topic, there has been recent research demonstrating that intertemporal preferences are sensitive to social context. Specifically, individuals making choices for themselves behave differently than when they are asked to make such choices on behalf of others. For example, it has been found that individuals are more patient when making choices on behalf of someone else compared to when they are making choices for themselves (Albrecht, Volz, Sutter, Laibson, & von Cramon, 2011). Ziegler and Tunney (2012) went on to find that this self/other asymmetry increases as the social distance between the decision maker and the "other" increases. That is, intertemporal choices were less patient when the referent "other" was socially close (e.g., parent, sibling) and more patient when the "other" was socially distant (e.g., unrelated stranger). These results demonstrate that intertemporal preferences may depend, in part, on social factors such as who is receiving the delayed rewards. However, self/other intertemporal decisions and collaborative intertemporal decisions differ in that the former still reflect the preferences of an individual decision maker.

Recognizing the gap in research on collaborative intertemporal decision making, we began carrying out studies that explored two general questions: (1) how do groups make collaborative intertemporal decisions and (2) what is the influence of this collaborative experience on subsequent decisions made by individual group members? Because these studies

inform the experiments included in the current dissertation, we first describe the results of each of the two studies in detail.

Preliminary Study 1

In Study 1, we had participants make a series of intertemporal decisions about monetary rewards. The task involved matching decisions, in which participants must supply a missing attribute value (e.g., reward amount) that would render them indifferent between two rewards (e.g., Chapman, 1996; Malkoc & Zauberman, 2006; Thaler, 1981). As an example, if one of the rewards was $40 to be received immediately, participants might be asked to supply how much money they would have to receive in three months such that they were indifferent between the two rewards. In the Pre- and Post-Collaboration phases, participants made their decisions individually. During the Collaboration phase, participants made their decisions in groups of three.

A few findings are important to note. For one, the preferences exhibited by groups during the Collaboration phase were strongly predicted by the mean of group members' individual preferences measured during the Pre-Collaboration phase. This finding suggests that groups combined their preferences together during the Collaboration phase and appeared to give roughly equal weight to each member's preferences. Second, it was found that group members' individual preferences converged Post-Collaboratively. That is, group members' preferences were more related to one another Post-Collaboratively than they were Pre-Collaboratively. Figure 1 includes two illustrative groups from Study 1 exhibiting this convergence effect.

Individuals' Post-Collaboration preferences were independently related to both their Pre-Collaboration preferences and the Pre-Collaborative preferences of their respective group

members (see Table 1). These results suggest that individuals' final preferences represented a revision of their initial preferences based on the preferences observed in other group members. We would suggest that our results reflect a social comparison process (e.g., Buunk & Gibbons, 2007; Mussweiler, 2003). For example, participants may have believed that their fellow group members' behavior provided normative information about appropriate behavioral patterns (Meeussen, Delvaux, & Phalet, in press), a mechanism that has been referred to as informational social influence (Deutsch & Gerard, 1955). If participants became aware that their personal preferences were consistently more or less patient than other group members, they may have adjusted their preferences accordingly (cf. Odum, 2011).

Preliminary Study 2

In Preliminary Study 1, we did not exert any control over the collaborative process. Participants were simply instructed to reach consensus for each decision. However, based on various psychological and social factors, it is likely that members in some groups assumed more of an influential role during the Collaboration phase. That is, a "leader" may have emerged during the discussions that would be expected to exert a disproportionate influence on group decisions. Because collaborative intertemporal decision making is a relatively unexplored phenomenon, we wanted to avoid exerting too much control over how groups made their decisions. However, it is the case that collaborative situations in the real-world often contain a leader who has greater influence on group decisions. For example, it may be expected that the head of a budgetary committee would exert a disproportionate influence on decisions made by the committee compared to other members.

As a result, in Study 2, we randomly assigned one individual in each group to be the "leader". The leader was the first one in the group on each trial to provide a response. Once the leader provided her initial response, the other two group members could provide their responses and the group could begin to reach consensus. There are two reasons why leaders would be expected to have a disproportionate influence on group decisions. If other group members are not motivated enough to attempt to exert a strong influence on the group, group preferences will reflect the preferences of the leader to a greater degree. However, even if other group members are motivated to participate in the collaborative process, responses made by the leader could still act as initial anchors that would bias the final decisions made by the group.

The effects found in Preliminary Study 1 summarized above were replicated in Study 2. Specifically, group members' preferences were more related to one another Post-Collaboratively than they were Pre-Collaboratively. Moreover, group preferences during the Collaboration phase were once again strongly predicted by the mean of group members' Pre-Collaborative preferences. If leaders had a disproportionate influence on group preferences exhibited during the collaborative phase, we would expect that group preferences would be more related to the preferences of the leader compared to non-leaders. However, as Figure 2 shows, the preferences exhibited by the group during the Collaboration phase were no closer (on average) to Pre-Collaborative preferences of leaders compared to non-leaders. This result suggests that group members did not attach additional weight to the preferences of members assigned to be leaders.

We also explored whether leaders were less likely to be influenced by the collaborative experience than non-leaders. That is, being in a leadership role may lead leaders to exhibit a reduced tendency to adjust their individual preferences during the Post-Collaboration phase. But as Figure 3 shows, the collaborative experience did not lead to a significant difference in shifts in

preferences from Pre- to Post-Collaboration between leaders and non-leaders. This result suggests that leaders were just as likely as non-leaders to be influenced by the collaborative experience and adjusted their individual preferences during the Post-Collaboration phase to a similar degree.

Conclusions

The results of the two above preliminary studies demonstrate a convergent effect in collaborative intertemporal decision making. Specifically, group members' preferences become more related to one another following a collaborative experience than they initially were prior to the collaborative experience. Moreover, the results suggest that group members combine their preferences when making collaborative decisions, with the preferences of all group members being given relatively equal weight. However, little is still known about the specific processes that gave rise to the observed social contagion effects. As a result, the current experiments that follow were designed to gain further insight into the psychological and social processes operating during collaborative intertemporal decision making.

Current Experiments

The experiments included in the current dissertation followed the line of research started by the two preliminary studies described above. In Experiment 1, we carried out a variation of Preliminary Study 2 in which participants were instructed that leaders were chosen based on that individual's Pre-Collaborative decisions being most aligned with a normative criterion. This contrasts with Preliminary Study 2 in which participants believed leaders were chosen through a random process. In Experiment 2, we carried out a dyadic experiment where participants either

completed an intertemporal matching task or a binary intertemporal choice task. Binary choices do not allow multiple individuals to average their preferences together when making a collaborative decision (in contrast to the matching decisions used in the other experiments). Because it would be expected that different social processes would be in operation when individuals with divergent preferences need to make forced choices, Experiment 2 allowed us to contrast collaborative intertemporal preferences across different task environments. Finally, in Experiment 3, we exerted greater control over the intertemporal preferences participants were exposed to. This was accomplished by replacing the Collaboration phase with an Exposure phase, where participants were merely exposed on the computer to the decisions made by another individual. By manipulating the decisions participants were exposed to, Experiment 3 tested the ability to intervene and causally shift intertemporal preferences in a predicted direction (i.e., towards more patience or more impatience). Furthermore, the results of Experiment 3 helps shed light on the processes involved in the social contagion effects observed in the preliminary studies described above.

Experiment 1

In Preliminary Study 2 described above, the leader in each collaborative group was chosen randomly and group members were aware of this fact. As a result, groups may have believed that there was no particular reason to disproportionally weight the preferences of the leader during the Collaboration phase. In Experiment 1, participants were instructed before the Collaboration phase that the leadership role was being assigned to the participant who made

decisions during the Pre-Collaboration phase that were most aligned with a normative criterion. This scenario may better reflect real-world situations because leaders in collaborative situations are often not chosen randomly, but instead are chosen based on some presumed expertise or position of authority. For example, when a business is planning on introducing a new product, management will usually choose the leader of the new team based on prior productivity or knowledge.

If participants are given a reason to believe that the leader represents a more normative model of intertemporal preferences, we would expect that groups during the Collaboration phase exhibit a tendency to weight the preferences of the leader more than the preferences of the non-leaders. Having participants believe leadership roles are not assigned randomly may also lead to reduced Pre- to Post-Collaboration shifts in preferences for leaders compared to non-leaders (in contrast to the previous results in Figure 3 above). That is, if leaders believe that they have greater "expertise" than other group members, they may be less likely to adjust their individual preferences during the Post-Collaboration phase. Conversely, non-leaders may feel the need to adjust their individual preferences during the Post-Collaboration phase to more closely align them with the preferences exhibited by their respective leader. Prior research has demonstrated that decision makers are more likely to follow the advice given by an advisor when the advisor is perceived to be an expert (e.g., Birnbaum & Mellers, 1983; Sniezek & Van Swol, 2001).

Methods

Participants

Sixty undergraduate students participated in Experiment 1 in exchange for partial course credit. The 60 participants consisted of 20 triads. Participants' average age was 19.47 years (*SD* = 1.70) and 62% of the sample was female.

Materials

Task. The intertemporal decision task used in Experiment 1 was similar to those that were used to elicit intertemporal preferences in the two preliminary studies mentioned in the introduction. On each trial of the task, two reward items were displayed on the computer screen (see Figure 4 for an example). The reward items included a magnitude (in dollars) and a delay until the reward would be received (in months). Importantly, each trial omitted one of the two reward magnitudes. Participants' task was to supply this missing reward magnitude with a value that would render them indifferent between the two reward items. That is, if given a choice between the two, completed reward items, participants would not have a preference for one or the other item.

The decision task included four trial types: Defer Immediate, Defer Non-Immediate, Expedite Immediate, and Expedite Non-Immediate. Different trial types were included in the task to ensure that participants made decisions across a number of different contexts. On Defer Immediate trials, there was an immediate reward and a delayed reward, and participants had to supply the delayed reward magnitude that would lead them to be indifferent between the delayed and immediate rewards. Defer Non-Immediate trials were similar to Defer Immediate trials, except that both reward items were delayed. These trials are labeled as "Defer" because they can be thought of as asking participants how much they would need to be compensated for the receipt of a reward being deferred a specified amount of delay.

On Expedite Immediate trials, participants had to supply the immediate reward that would lead them to be indifferent between the immediate and delayed rewards. Expedite Non-Immediate trials were similar to Expedite Immediate trials, with the only difference being that both reward items were delayed. These trials are labeled as "Expedite" because they can be thought of as asking participants how much they would be willing to forgo in order to expedite the receipt of a reward.

Trials in the Pre-Collaboration and Post-Collaboration phases were constructed using four reward magnitudes ($30, $75, $150, $275) and three delays (3 months, 6 months, 12 months). With the four trial types described above, this yielded 48 trials that were presented during the Pre-Collaboration and Post-Collaboration phases. Trials in the Collaboration phase were constructed using three reward magnitudes ($40, $125, $250) and three delays (3 months, 6 months, 12 months). With the four trial types described above, this yielded 36 trials that were presented during the Collaboration phase. Within each phase of the experiment, trials were presented in a randomized order.

Statistical analyses. Participants' responses on each trial were converted to annual discount rates using Equation 1 (Zauberman, Kim, Malkoc, & Bettman, 2009):

$$r = \left[\ln\left(\frac{X_{t+k}}{X_t}\right)\right]\left[\frac{k}{12}\right]^{-1} \quad (1)$$

where X_t is the magnitude of the sooner reward item, X_{t+k} is the magnitude of the later reward item, t is the delay associated with the sooner reward item, and k is the additional delay associated with the later reward item. In the current task, participants provided X_{t+k} on trials that involved deferring a reward, whereas participants provided X_t on trials that involved expediting a reward. Overall discount rates were calculated for each individual participant and group by

computing the discount rates implied by each response and then averaging the resulting set of discount rates.

Procedure

Once all group members arrived to the lab, participants received instructions regarding the intertemporal decision task in both verbal and written formats. Participants were not alerted to the fact that they would be collaborating with other participants. After receiving the instructions, participants were then escorted to individual computer workstations where they completed the Pre-Collaboration phase of the experiment. On each trial, the two reward items were displayed on the left and right sides of the computer screen for five seconds. A small dialog box then appeared at the bottom of the computer screen into which participants entered their responses. The two reward items remained on the screen after the dialog box appeared and participants had unlimited time to enter in their responses. Once participants entered a response and selected the "OK" button, the computer screen cleared and remained blank for a two second inter-trial-interval (ITI). Upon completion of the Pre-Collaboration phase, all participants were gathered together and informed that they would be completing a similar task but as a group. Participants were also provided with the following instructions:

> As a group, you will only provide one response on each trial. So you will have to come to a consensus for the reward amount that would lead to equal liking of the two items on the screen. Now, you may disagree about the amount that makes the two items on the screen liked equally, but in these situations we would like you to discuss it as a group so that your response is an amount that the group is satisfied with.

> Also, even though you are making judgments as a group, imagine that the rewards would be received individually. That is, if one of the reward items is $60 to be received in 4 months, that $60 would not be divided amongst the group, but would be received individually.
>
> Finally, one of you three will be assigned to be the proposer. The role of the proposer on each trial is to be the first one of the group who voices a response. So on each trial, after the rewards have been presented on the screen, the proposer voices his/her response first. Once the proposer has voiced his/her response, the other two group members can voice their responses and then the group can begin to reach consensus. The assigning of the role of the proposer will be based on the individual who made decisions in the previous phase of the study that most closely aligned with the normative strategy prescribed by financial experts. That is, the proposer will be the participant who made decisions that were closest to how financial experts advise time and money should be traded off.

After receiving these instructions, one participant was assigned to be the leader/proposer. Though participants were led to believe the leader was being assigned because of decisions during the Pre-Collaboration phase, the leader was actually chosen randomly. The group of participants was then escorted to a single computer workstation where the Collaboration phase of the experiment was performed. Upon completion, participants were then instructed that they would be completing a similar decision task but once again individually. Participants were then escorted back to the same individual computer workstations and completed the Post-Collaboration phase of the experiment. The entire experiment took less than one hour to complete.

Results

In order to see whether leaders exerted a disproportionate influence on group preferences during the Collaboration phase, we contrasted how group discount rates during the Collaboration phase deviated absolutely with the Pre-Collaboration discount rates of leaders compared to non-leaders. A smaller deviation in discount rates with leaders would be evidence that group preferences more resembled the preferences of the individuals assigned to the leadership position compared to the non-leadership positions. As shown in Figure 5, group discount rates during the Collaboration phase deviated significantly less from the Pre-Collaboration discount rates of leaders (M = .30, SD = .30) compared to non-leaders (M = .83, SD = .79) ($t(38) = 2.77$, $p < .01$). That is, the discount rates exhibited by groups aligned more with leader's baseline discount rates during the Pre-Collaboration phase compared to the baseline discount rates of non-leaders.

Another goal of Experiment 1 was to explore whether leaders who believed they were assigned their position based on a normative standard would be less influenced by the collaborative experience than non-leaders. As Figure 6 shows, leaders' discount rates (M = .28, SD = .31) changed from the Pre-Collaboration to Post-Collaboration phases significantly less than non-leaders' discount rates (M = .72, SD = .73) ($t(38) = 2.45$, $p < .05$). This result suggests that leaders were less likely to adjust their preferences post-collaboratively compared to non-leaders.

Discussion

In Experiment 1, it was demonstrated that leaders who were in charge of guiding group discussions during Collaboration exerted a larger influence on the intertemporal preferences

exhibited by the group than non-leaders. This contrasts with the results of Preliminary Study 2 where leaders and non-leaders appeared to exert equal weight on group preferences. Taken together, these results suggest that groups only place additional weight on the intertemporal preferences of individuals in leadership positions if group members believe that the leadership assignment was based on a normative criterion. When group members believe that the leadership position was assigned randomly, proportionate weight is placed on the preferences of leaders and non-leaders.

Another finding of Experiment 1 was that leaders changed their preferences from Pre-Collaboration to Post-Collaboration at a reduced rate compared to non-leaders. Once again, this contrasts with the results of Preliminary Study 2 where the difference in leaders' and non-leaders' change in discount rates did not reach significance. The current results suggest that leaders who believe their preferences are more aligned with a normative standard are less likely to be influenced by the preferences they observe in other individuals they interact with.

Experiment 2

Experiment 2 differed from the previous experiments in that it dealt with dyads. The general design of Experiment 2 was still similar to previous experiments in that there was once again a Pre-Collaboration phase, a Collaboration phase, and a Post-Collaboration phase. However, whereas half of the dyads in Experiment 2 completed an intertemporal matching task similar to the task used in Experiment 1, the other half completed a binary intertemporal choice task. Important distinctions between choice and matching tasks can lead to different effects being

observed in collaborative intertemporal contexts. For instance, the matching tasks used in the above experiments allow for continuous responses. This allows participants to compromise during the Collaboration phase by providing a response that is between each member's desired response. On a choice task, in contrast, it is no longer feasible to average together divergent preferences when forced choices need to be made.

The addition of a binary choice task in a collaborative intertemporal experiment is necessary for the following two reasons. For one, as alluded to in the previous paragraph, different processes are involved during choice and judgment tasks (Einhorn & Hogarth, 1981; Hardisty, Thompson, Krantz, & Weber, 2013; Huber, Ariely, & Fischer, 2002), which becomes especially apparent in a collaborative context. Because groups can no longer simply combine the preferences of their members, some group members need to persuade other members to switch their preferences if a disagreement exists over which reward is to be chosen. What social/psychological processes influence collaborative intertemporal choices are unknown at this time. Secondly, choice tasks are a common alternative to matching tasks when eliciting intertemporal preferences in psychology and economics. As a result, any direct comparisons between the results of the current proposal and prior research on intertemporal preferences of individuals will be aided by incorporating a choice task. The differences in processes between choice and matching tasks are not just relevant for research conducted in the lab, however. Various real-world situations involve intertemporal decisions that are more continuous in nature (e.g., deciding the specific amount of income to allot towards savings), whereas in other situations choices need to be made between pre-established items (e.g., defined retirement contribution plans). As a result, a complete picture of collaborative intertemporal preferences will require research conducted across both domains.

Methods

Participants

Experiment 2 consisted of 120 undergraduate students participating in exchange for partial course credit. The sample consisted of 30 dyads completing the matching task and 30 dyads completing the binary choice task. Participants' average age was 19.74 years (*SD* = 1.95) and 59% of the sample was female.

Materials

***Matching Task*.** The matching task was similar to the task used in Experiment 1, with the following exceptions. Trials in all three phases were constructed using four reward magnitudes ($20, $35, $50, $75) and three delays (14 days, 30 days, 60 days). With the four trial types (Defer Immediate, Defer Non-Immediate, Expedite Immediate, Expedite Non-Immediate), this yielded 48 trials that were presented during each phase. For the Non-Immediate trials, 30 days were added to the above delays. The reward magnitudes and delays were altered from the values used in Experiment 1 in order to more closely align with the values used in the choice task described below.

Choice Task. On each trial, a smaller-sooner (SS) reward and a larger-later (LL) reward was presented on the computer screen. An example trial is presented in Figure 7. See the Appendix for a complete listing of the reward values that were included in the task. The task consisted of 48 trials. Half of the trials contained a choice between an immediate reward and a delayed reward, whereas the other half of trials contained a choice between two delayed rewards. Prior research has demonstrated that intertemporal preferences differ when an immediate reward

is present (e.g., Green, Myerson, & Macaux, 2005), so the inclusion of both types of trials was important to capture any influence that may stem from this factor.

Whether the SS reward or the LL reward was presented on the left side of the screen was randomized on each trial. The two reward items remained on the screen until participants made their choices, by pressing the left or right arrow on the computer keyboard. Once participants made a choice, the computer screen was cleared and remained blank for a two second inter-trial-interval (ITI). Within each phase of the experiment, trials were presented in a randomized order.

Post-task questionnaire. Upon finishing the Post-Collaboration phase of the study, participants completed a quick questionnaire. The items included in the questionnaire were designed to capture individual differences that would be expected to influence whether an individual would be more or less likely affected by a collaborative experience. For example, the shifts in intertemporal preferences found in the preliminary studies described in the introduction might stem from individuals having a degree of uncertainty about their preferences (Ariely, Loewenstein, & Prelec, 2003). Prior research has demonstrated that uncertainty magnifies social influences on decisions (e.g., increased conformity; Wiener, 1958). This effect of uncertainty has been found in a variety of decisions, from stimulus discrimination tasks (Tesser, Campbell, & Mickler, 1983) to recognition memory tasks (Walther, Bless, Strack, Rackstraw, Wagner, & Werth, 2002). The results of the two preliminary studies described in the introduction demonstrated that this type of effect can possibly be observed even in higher-order behaviors, such as intertemporal decisions. The post-task questionnaire in Experiment 2 began to gauge whether individual differences in uncertainty about one's behavior, among other things, predicted collaborative experiences having a greater influence on shifting intertemporal

preferences. The following eight items were included in the questionnaire (words in brackets reflect instructions for the choice task):

1. In the first phase of the study, when you were responding [making choices] individually for the first time, how confident were you when you were making your responses [choices]? (1 = “Not confident”, 7 = “Confident”)
2. In the first phase of the study, when you were responding [making choices] individually for the first time, how much did you believe there was a 'correct' response [choice] on each trial? (1 = “Didn’t believe”, 7 = “Believed”)
3. When you and your partner were responding [making choices] together, to what degree did you notice the responses [choices] you and your partner wanted to make differed from each other? (1 = “Differed”, 7 = “Were the same”)
4. When you and your partner were responding [making choices] together, how influenced were you by your partner? (1 = “Not influenced”, 7 = “Influenced”)
5. When you and your partner were making choices together, were you ever nervous that your partner would judge you based on the responses [choices] you wanted to make? (1 = “No”, 7 = “Yes”)
6. When you and your partner were responding [making choices] together and you disagreed on a trial, who usually had the most influence on the response [choice] that was ultimately made? (1 = “You”, 2 = “Equally influential”, 3 = “Your partner”)
7. In the final phase of the study, when you were responding [making choices] individually for the second time, did you feel you were responding [making your choices] similarly or differently from the first phase? (1 = “Similarly”, 7 = “Differently”)

8. In the final phase of the study, when you were responding [making choices] individually for the second time, do you believe your responses [choices] were influenced by the interaction with your partner? (1 = "Not influenced", 7 = "Influenced")

Procedure

Once both dyad members arrived to the lab, participants received instructions regarding the intertemporal task in both verbal and written formats. Participants were not alerted to the fact that they would be collaborating with one another. After receiving the instructions, participants were then escorted to individual computer workstations where they completed the Pre-Collaboration phase of the experiment. Upon completion of the Pre-Collaboration phase, both participants were gathered together and informed that they would be completing a similar task but as a dyad. Participants were also provided with the following instructions (words in brackets reflect instructions for the choice task):

> As a pair, you will only make one response [choice] on each trial. So you will have to come to an agreement about the reward amount that would lead to equal liking of the two items on the screen [the reward that is most preferred]. Now, you may disagree on a trial about the amount that makes the two items on the screen liked equally [about which of the two rewards is most preferable], but in these situations we would like you to discuss it as a pair so that you can reach a response [choice] that both of you are satisfied with.
>
> Also, even though you are making judgments [choices] as a pair, imagine that the rewards would be received individually. That is, if one of the reward

items is $60 to be received in 30 days, that $60 would not be divided between you two, but would be received individually.

After receiving these instructions, the dyad was escorted to a single computer workstation where the Collaboration phase of the experiment was performed. Upon completion, participants were then instructed that they would be completing a similar task but once again individually. Participants were then escorted back to the same individual computer workstations and completed the Post-Collaboration phase of the experiment. After completing the final trial of the task, a two second ITI occurred. The eight self-report questions were then presented on the screen one at a time. Participants used the numbers at the top of the keyboard to enter their responses. The entire experiment took less than one hour to complete.

Statistical analyses. For the matching task, annual discount rates were calculated by equation 1 with the following modification. Because the units of delay in Experiment were days, the difference between the two delays was divided by 365 instead of 12.

For the choice task, a measure of delay discounting was constructed by calculating the proportion of choices for the smaller-sooner reward. As a result, scores ranged from 0 to 1 with higher scores evidence of greater delay discounting.

Results

The two results from Preliminary Study 1 we were interested in exploring in different task environments were the averaging effect and convergence effect. The averaging effect refers to the finding that group preferences during the Collaboration phase were strongly predicted by the mean of individual group members' preferences during the Pre-Collaboration phase. The convergence effect refers to the finding that group members' individual preferences were more

similar during the Post-Collaboration phase than they initially were during the Pre-Collaboration phase.

Averaging effect. As shown in Figure 8, the preferences exhibited by dyads during the Collaboration phase were significantly related to the mean of dyad members' individual preferences measured during the Pre-Collaboration phase. This averaging effect was demonstrated in both the matching task ($r = .94$, $p < .001$) and the choice task ($r = .78$, $p < .001$). These results suggest that dyadic intertemporal preferences are strongly related to the average preferences of the dyad members in both matching and choice environments.

Convergence effect. As shown in Figure 9 (Left), the average difference between dyad members' discount rates on the matching task was larger during the Pre-Collaboration phase ($M = 6.56$, $SD = 5.17$) compared to the Post-Collaboration phase ($M = 3.03$, $SD = 4.04$) ($t(29) = 4.27$, $p < .001$). Similarly, for the choice task (see Figure 9 Right), the average difference between dyad members' preference for the smaller-sooner reward was larger during the Pre-Collaboration phase ($M = .22$, $SD = .19$) compared to the Post-Collaboration phase ($M = .12$, $SD = .11$) ($t(29) = 3.37$, $p < .01$). These results demonstrate that the intertemporal preferences of dyad members are more similar following a collaborative experience than before the experience.

***Post-task questionnaire*.** Responses to the eight post-task questionnaire items are included in Table 2. First we explored whether responses differed between the two task conditions. For Item 1, when participants were to rank their confidence in the responses they made during the Pre-Collaboration phase, a significant difference was observed between participants in the two task conditions. Specifically, participants in the matching condition were less confident in their responses ($M = 4.95$, $SD = 1.56$) than participants in the choice condition ($M = 5.75$, $SD = 1.34$) ($t(118) = 3.02$, $p < .01$). For Item 3, when participants were to rank the

degree they noticed the responses they and their partner wanted to make during the Collaboration phase were similar to each other, participants in the choice condition thought they were more similar (M = 5.45, SD = 1.42) than participants in the matching condition (M = 4.48, SD = 1.96) ($t(118) = 3.09$, $p < .01$). Finally, a significant difference was found between task conditions on Item 7, when participants were to rank the degree they believed their responses during the Post-Collaboration phase and Pre-Collaboration phase differed from each other. Participants in the matching condition believed their decisions were more different (M = 3.57, SD = 1.85) than participants in the choice condition (M = 2.80, SD = 1.80) ($t(118) = 2.30$, $p < .05$).

We next explored whether responses on the post-task questionnaire items were related to the degree participants' preferences changed from the Pre-Collaboration phase to the Post-Collaboration phase. For the matching task, change scores were calculated by taking the absolute difference between Pre-Collaboration discount rates and Post-Collaboration discount rates. For the choice task, change scores were calculated by taking the absolute difference between Pre-Collaboration preference for the smaller-sooner reward and Post-Collaboration preference for the smaller-sooner reward.

Participants in the matching task condition exhibited a negative correlation between confidence during the Pre-Collaboration phase and the degree preferences changed between the Pre-Collaboration and Post-Collaboration phases. That is, individuals who were less confident in their responses during the Pre-Collaboration phase were more likely to subsequently adjust their preferences. Changes in preferences on the matching task were also positively correlated with responses on Items 7 and 8. These items measured, respectively, how aware individuals were about making decisions differently during the Pre-Collaboration and Post-Collaboration phases and how aware individuals were about their collaborative partner influencing their decisions

during the Post-Collaboration phase. For the choice task, the only item on the post-task questionnaire that was correlated with change in preferences was Item 4. This correlation suggests that individuals who reported being more influenced by their partner during the Collaboration phase were more likely to exhibit larger changes in preferences between the Pre-Collaboration and Post-Collaboration phases.

Discussion

In Preliminary Studies 1 and 2, as well as Experiment 1 in the current dissertation, a matching task was used to elicit intertemporal preferences. As a result, it was not clear if the results found in these previous studies would generalize to different task environments. By including both a matching and choice task condition in Experiment 2, we were able to observe the extent that patterns of results were similar across the two conditions. Specifically, the results demonstrated that dyadic intertemporal preferences were strongly predicted by the average intertemporal preferences of the individual dyad members in both matching and choice task environments. Furthermore, in both conditions, a convergence effect was observed in that the intertemporal preferences of individual dyad members were more similar post-collaboratively than they initially were pre-collaboratively. These similarities in results occurred even though noticeable differences exist between the two types of tasks, which are particularly apparent in collaborative contexts. For example, when making a binary choice, a group of individuals cannot compromise on an individual trial and produce a response between the preferences of the individual group members. Moreover, less is learned about the intertemporal preferences of a partner on an individual choice trial during the Collaboration phase. Whereas the continuous response space in the matching task allows dyad members to observe the degree that their

intertemporal preferences diverge from one another, the most that can be learned on an individual choice trial is that one dyad member prefers one of the two rewards and the other dyad member prefers the other reward. However, regardless of these task differences, similar results were found in Experiment 2 in both the matching and choice task conditions. These similarities in results suggest a generality to the observed collaborative effects in intertemporal decision making.

Even though the patterns of results were similar in the two task conditions, there were differences in participants' experiences between the two conditions. This was evidenced by differences in responses to items on the post-task questionnaire. For instance, participants in the matching condition were less confident in their responses during the Pre-Collaboration phase and were more aware of changing their responses between the Pre-Collaboration and Post-Collaboration phases. These differences most likely stemmed from the different types of responses required by the two tasks. For example, slight shifts in preference for smaller-sooner rewards in the choice task might be less apparent to participants than shifts in responses on the more continuous response scale used in the matching task. Furthermore, the act of having to produce a value on each trial in the matching task in contrast to having to only choose between two presented rewards in the choice task might instill less confidence in participants' responses.

Experiment 3

In Preliminary Study 1, no control was exerted over the collaborative process other than requiring group members to reach consensus. In Preliminary Study 2 and Experiment 1, we

began exerting more control by assigning a participant in each group to a leadership role. Yet, even in these situations, control was still not exerted over the preferences that participants were exposed to during the Collaboration phase. This aspect prevents the ability to make causal predictions about the direction individuals will shift their preferences in response to a collaborative experience. Experiment 3 overcame this issue by exerting greater control over the intertemporal preferences participants were exposed to. Specifically, the Collaboration phase was replaced with an Exposure phase, where participants were merely exposed on the computer to the decisions believed to be made by another individual. By manipulating the decisions participants were exposed to, Experiment 3 provided the opportunity to intervene and measure shifts in intertemporal preferences in predicted directions (i.e., towards more patience or more impatience).

Experiment 3 also allowed us to differentiate between possible explanations for the social contagion effects reported in the two preliminary studies described in the introduction. Because quantifiable data of the discussions during Collaboration were not collected, no definitive statement could be made on whether the social contagion effects were due to persuasive argumentation or solely a social comparison process. However, by merely exposing participants to the decisions of another participant, Experiment 3 precluded any argumentation or discussion-based processes from the Collaboration phase. If similar effects could be found when no collaborative discussion is present, a persuasive argumentation process would not be needed to observe the social contagion effects demonstrated in the preliminary studies. An application of Experiment 3 was to gain an understanding of how intertemporal preferences can be influenced by non face-to-face social interactions. Especially with the rapid growth of the internet and online social networks, as well as the increasing popularity of online financial services, any

knowledge to be gained about how preferences can be influenced by non face-to-face transmission of information would add to our understanding of how intertemporal preferences operate in the real-world.

A brief summary of the design of Experiment 3 is as follows. Participants first completed an intertemporal matching task similar to the task used in Experiment 1. This was the Pre-Exposure phase. During the Exposure phase, participants once again completed an intertemporal matching task individually. However, this time after each decision participants made they were exposed to the decision believed to be made by another participant. Participants were placed in one of two conditions. Participants in one condition were exposed to decisions that were more Patient than participants' own preferences, whereas participants in the second condition were exposed to decisions that were more Impatient than participants' on preferences. Once the Exposure phase was completed, participants completed the Post-Exposure phase in which they once again completed the intertemporal decision task individually without being exposed to any decisions made by another participant.

Methods

Participants

Eighty undergraduate students participated in Experiment 3 in exchange for partial course credit. Participants' average age was 19.51 years (*SD* = 1.33) and 59% of the sample was female.

Materials

Task. The intertemporal decision task used in Experiment 3 was similar to the matching task used in Experiment 1, with the following exceptions. Trials in all three phases were constructed using three reward magnitudes ($40, $125, $275) and three delays (3 months, 6

months, 12 months). With the four trial types (Defer Immediate, Expedite Immediate, Defer Non-Immediate, Expedite Non-Immediate), this yielded 36 trials that were presented during each phase. Within each phase of the experiment, trials were presented in a randomized order.

Procedure

Upon entering the lab, participants received instructions regarding the intertemporal decision task in both verbal and written formats. After receiving the instructions, participants were then escorted to individual computer workstations where they completed the Pre-Exposure phase of the experiment. On each trial, the two reward items were displayed on the left and right sides of the computer screen for five seconds. A small dialog box then appeared at the bottom of the computer screen into which participants entered their responses. The two reward items remained on the screen after the dialog box appeared and participants had unlimited time to enter in their responses. Once participants entered a response and selected the "OK" button, the computer screen was cleared and remained blank for a two second inter-trial-interval (ITI). Upon completion of the Pre-Exposure phase, participants were then provided with the following instructions:

> In the next phase of the study, you will be completing a task similar to the one you just previously completed. However, this time there is the chance that you will be shown on each trial the judgment that was made on that trial by another participant who completed the task at an earlier time. That is, after you make your judgment, you will be shown for a few seconds the judgment that was made by this prior participant. This other participant will be randomly chosen from the pool of participants who have previously completed the task.

After receiving these instructions, participants completed the Exposure phase of the experiment. The task during the Exposure phase was the same as the task used during the Pre-Exposure phase, with the following exception. After participants entered their decisions on a trial, a two second interval occurred and then the screen presented the decision that was believed to be made by another participant. Half of the participants in Experiment 3 were exposed to the decisions of a more Patient decision maker while the other half of participants was exposed to the decisions of a more Impatient decision maker.

The decisions that participants observed during the Exposure phase were determined as follows. In order to ensure that participants were exposed to decisions that were either more Patient or Impatient than their own preferences, participants' own decisions on trials during the Exposure phase were adjusted in either the Patient or Impatient direction based on condition. This proportional adjustment was determined by a Gaussian distribution with a mean of 20% and a standard deviation of 10%. As an example, if a participant was in the Impatient condition and provided a response of $100 on a Defer trial, the decision she would then be exposed to would be $120 on average. Because our past research using these matching tasks has shown that participants most often provide responses that are multiples of five (e.g., $80 or $85, not $81 through $84), we also rounded off the decisions participants observed to the nearest multiple of five.

An example of what the screen looked like when participants were exposed to decisions during the Exposure phase is shown in Figure 10. This information remained on the screen for five seconds and then the screen was cleared and a two second ITI occurred.

Upon completion of the Exposure phase, participants were then instructed that they would be completing a similar decision task but once again individually. Participants then

completed the Post-Exposure phase of the experiment. The entire experiment took less than one hour to complete.

Results

Table 3 includes participants' discount rates in the Pre-Exposure, Exposure, and Post-Exposure phases broken down by condition. In order to better demonstrate how the decisions participants observed during the Exposure phase influenced participants' own decisions, Figure 11 includes changes in discount rates between the Pre-Exposure and Post-Exposure phases for participants in the Patient and Impatient conditions. As shown, the change in discount rates for participants in the Patient condition (M = -.22, SD = .59) was significantly different than the change in discount rates for participants in the Impatient condition (M = .42, SD = .58) ($t(78) = 4.89$, $p < .001$).

In order to explore how general the effect was of the exposure manipulation on changes in preferences, results were broken down by trial type. For both defer and expedite trials, change in discount rates differed for participants in the Patient condition (Defer: M = -.32, SD = .69; Expedite: M = -.13, SD = .64) and the Impatient condition (Defer: M = .47, SD = .75; Expedite: M = .36, SD = .78) (ts(78) > 3.05, ps < .01). Similarly, for both immediate and non-immediate trials, change in discount rates differed for participants in the Patient condition (Immediate: M = -.20, SD = .87; Non-Immediate: M = -.25, SD = .46) and the Impatient condition (Immediate: M = .49, SD = .77; Non-Immediate: M = .34, SD = .59) (ts(78) > 3.70, ps < .001). Moreover, changes in discount rates for defer and expedite trials were correlated together (r = .42, $p < .001$), as were changes in discount rates for immediate and non-immediate trials (r = .56, $p < .001$) (see

Figure 12). These results suggest that the shifts in intertemporal preferences observed in the current experiment are general in nature, and not confined to any particular trial type.

Discussion

By exerting more control over the intertemporal preferences participants were exposed to in Experiment 3, more causality could be attributed to the changes in discount rates that were observed. Specifically, it was found that participants that were exposed to intertemporal preferences that were, on average, more patient than their own preferences, subsequently exhibited greater patience (i.e., lower discount rates) during the Post-Exposure phase compared to the Pre-Exposure phase. The results were vice versa for participants that were exposed to intertemporal preferences that were, on average, more impatient than their own preferences.

The results of Experiment 3 help clarify what social processes are likely to be in operation during collaborative intertemporal decision making. In particular, the current results suggest that extensive interaction or argumentation is not required for social influence to occur in intertemporal decision making. That is, merely being exposed to another individual's preferences that systematically diverge from one's own appears sufficient in leading participants to adjust their own preferences. As a result, a social comparison process is a likely candidate to account for the convergence effects demonstrated in the above experiments.

General Discussion

All three experiments in the current dissertation focused on gaining a better understanding of the psychological and social processes involved in collaborative intertemporal decision making. These experiments built on the line of research begun by the two preliminary studies described in the introduction. Though particular contagion effects were found in both of these preliminary studies, little was known about the specific mechanisms that led individuals' preferences to be influenced by the preferences they observed in other group members. In Experiment 1, we explored whether group members believed to have less "expertise" were more influenced by the collaborative experience than members believed to have more "expertise". We found that members believed to have less "expertise" exerted less of an influence on the intertemporal preferences exhibited by the group during the Collaboration phase, and were more likely to change their preferences between the Pre-Collaboration and Post-Collaboration phases. Experiment 2 was a dyadic experiment where pairs of individuals either made intertemporal judgments or choices. Because both types of responses are prevalent in the real-world, the results of Experiment 2 provide a fuller picture of collaborative intertemporal preferences. Finally, in Experiment 3, greater control was exerted over the intertemporal preferences participants were exposed to. By manipulating the decisions participants were exposed to, Experiment 3 tested the ability to intervene and causally shift intertemporal preferences in a predicted direction (i.e., towards more patience or more impatience).

There were two particular effects found in Preliminary Study 1 that motivated the three experiments in the current dissertation—namely, the averaging effect and the convergence effect. The averaging effect refers to the finding that group intertemporal preferences during the Collaboration phase were strongly related to the average of the group members' individual preferences during the Pre-Collaboration phase. That is, groups tended to produce responses

during the Collaboration phase that approximated the average of the three group members' individual preferences. The convergence effect refers to the finding that group members' individual intertemporal preferences were more similar during the Post-Collaboration phase than they initially were during the Pre-Collaboration phase. This effect suggests that individuals adjusted their preferences to be more aligned with the preferences they observed in the other members of their respective group.

The results of the experiments in the current dissertation suggest that social information may be particularly powerful in influencing individuals' intertemporal preferences. Though previous work has demonstrated that intertemporal decisions can be influenced through targeted intervention (e.g., Bickel, Yi, Landes, Hill, & Baxter, 2011; Black & Rosen, 2011; Landes, Christensen, & Bickel, 2012), shifts in decisions usually followed extended periods of involved intervention. The collaborative experience in the current experiments was relatively short in comparison, usually lasting between 15 and 30 minutes. Moreover, as the results of Experiment 3 demonstrated, merely being exposed to the decisions believed to be made by another individual was sufficient to lead participants to exhibit significant shifts in preferences. These latter results suggest that substantive interaction or argumentation is not necessary to influence intertemporal preferences, which contrasts with persuasive argumentation theories of group influence (e.g., Burnstein, Vinokur, & Trope, 1973; Vinokur & Burnstein, 1974). Instead, a social comparison theory of group influence (e.g., Blascovich, Ginsburg, & Veach, 1975; Buunk & Gibbons, 2007; Mussweiler, 2003) is a likely candidate to account for the current results. For instance, merely recognizing a discrepancy between one's own decisions and the decisions made by another individual was able to lead participants in Experiment 3 to adjust their preferences to be more aligned with the preferences exhibited by the other individual.

Though social contagion was observed in intertemporal decision making, certain personal and situational factors were found in the current dissertation to influence the degree individuals' preferences were influenced by collaboration. For example, in Experiment 1, participants that believed they were further away from a normative criterion were more influenced by the collaborative experience compared to participants that believed they were closer to the normative criterion. This was evidenced by the finding that "non-normative" participants exhibited larger changes in discount rates between the Pre-Collaboration and Post-Collaboration phases. Moreover, in Experiment 2, a positive correlation was observed between self-reported uncertainty and changes in discount rates. These results begin to clarify the factors that moderate social influence on intertemporal preferences. Specifically, they suggest that uncertainty about one's decisions can magnify the impact of social influence (e.g., Tesser et al., 1983; Walther et al., 2002). Future research should continue to investigate the factors, both individual and situational, that moderate the extent that social and collaborative experiences subsequently influence the intertemporal preferences of individuals.

Another avenue of future research is to explore the durability of the observed social contagion effects. This can be accomplished by running an experiment where participants are brought back to the lab after some specified delay (e.g., 1 week, 1 month). By observing the degree that group members' preferences still exhibit convergence after an extended delay has elapsed, a clearer picture of the durability of the current results will emerge. Previous research in the group decision making literature suggests that social influence on decisions and judgments are still noticeable after an extended delay (e.g., Maciejovsky, Sutter, Budescu, & Bernau, 2013, Rajaram & Pereira-Pasarin, 2007; Senecal et al., 2012). For instance, Maciejovsky et al. (2013) found that decisions on reasoning tasks such as the Wason selection task were still influenced by

a previous group experience five weeks later. However, whether similar durability can be observed in the intertemporal decision domain requires empirical support. This and related research will help shed light on the strength and limits of social contagion in intertemporal decision making.

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Table 1. Post-Collaboration discount rates predicted by each individual participant's Pre-Collaboration discount rate (Self) and the average of the other group members' Pre-Collaboration discount rates (Other).

Variable	**b**	**SE**	**β**	**t**	**p**
Intercept	.04	.39		.11	.915
Self	.67	.09	.71	7.85	< .001
Other	.33	.13	.24	2.64	.011

Table 2. (A) Responses on the eight post-task questionnaire items for both task conditions. (B) Pearson correlations between each item and the degree participants' preferences changed from the Pre-Collaboration phase to the Post-Collaboration phase for both task conditions. § $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

	Descriptive Statistics		**Correlations**	
Questionnaire	Matching Task	Choice Task	Matching Task	Choice Task
Item 1	4.95	5.75	-.28*	-.11
Item 2	3.60	3.82	.07	-.07
Item 3	4.48	5.45	.12	.17
Item 4	4.32	3.88	.21	.25*
Item 5	2.97	2.55	.23§	-.08
Item 6	1.97	1.98	.02	.05
Item 7	3.57	2.80	.48***	.21
Item 8	4.25	3.73	.37**	.17

Table 3. Discount rates for participants in both the Patient and Impatient conditions for the three phases of the experiment. Standard deviations are included in parentheses.

Condition	Pre-Exposure Phase	Exposure Phase	Post-Exposure Phase
Patient	2.69 (.79)	2.54 (1.09)	2.47 (1.11)
Impatient	2.56 (1.17)	2.80 (1.30)	2.98 (1.46)

Figure 1. Two illustrative groups' discount rates during the Pre-Collaboration phase, the Collaboration phase, and the Post-Collaboration phase. Higher values mean greater impatience.

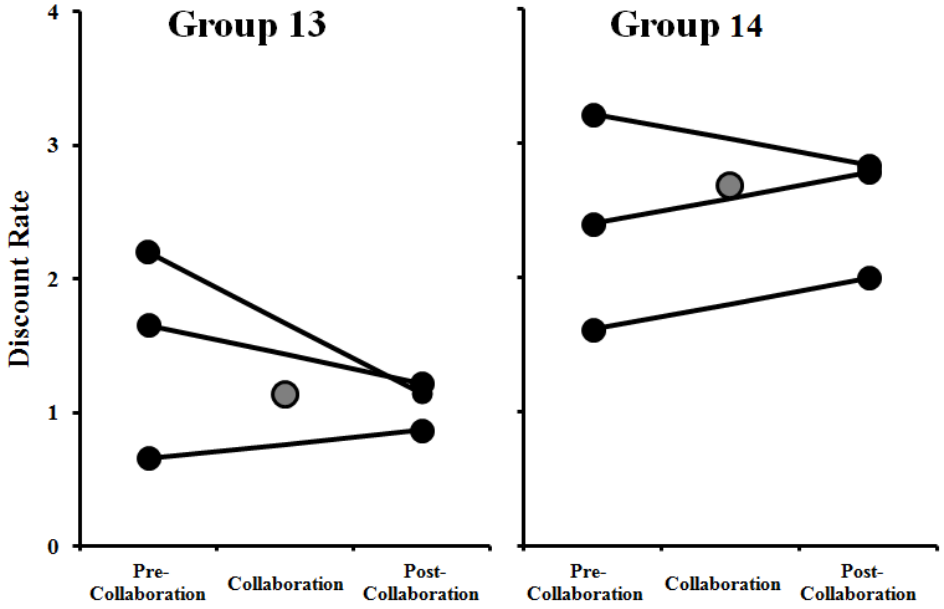


Figure 2. The average absolute deviation between individual Pre-Collaboration discount rates and respective group's discount rates during the Collaboration phase. Lower values mean that group discount rates are closer to individuals' Pre-Collaborative discount rates. Error bars represent standard errors of the mean.

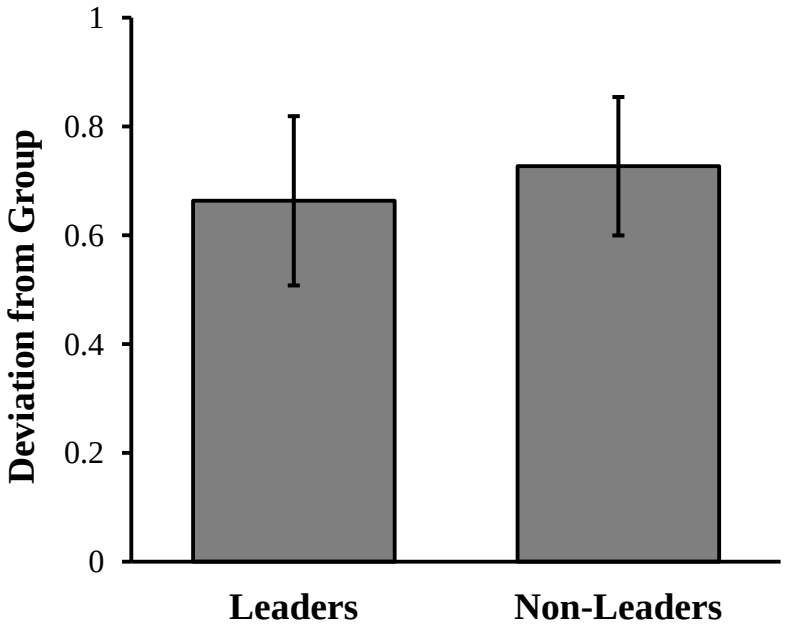


Figure 3. The absolute change in individuals' discount rates from Pre-Collaboration to Post-Collaboration. The preferences of leaders and non-leaders did not shift at significantly different rates. Error bars represent standard errors of the mean.

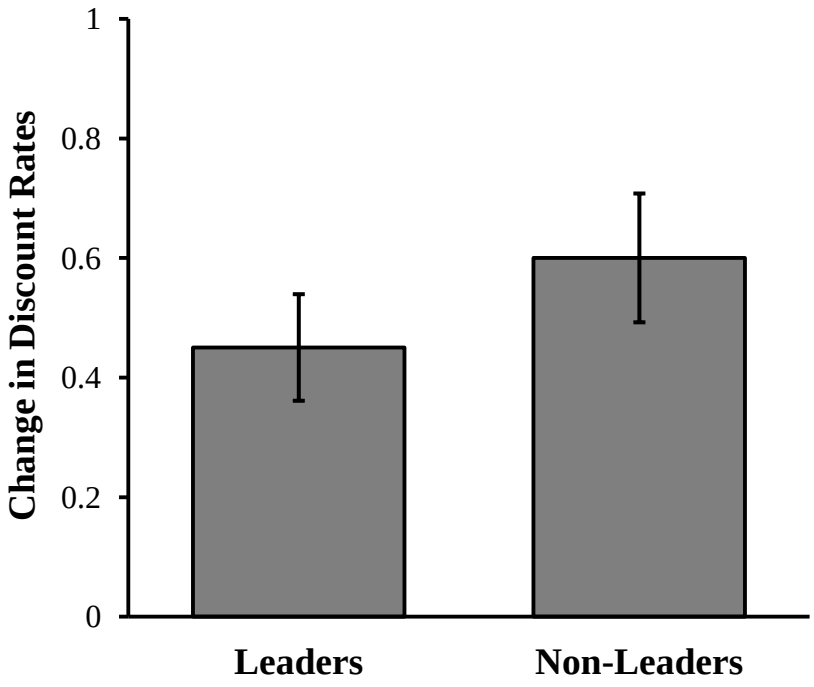


Figure 4. An example trial from the intertemporal matching task that was used in Experiment 1.

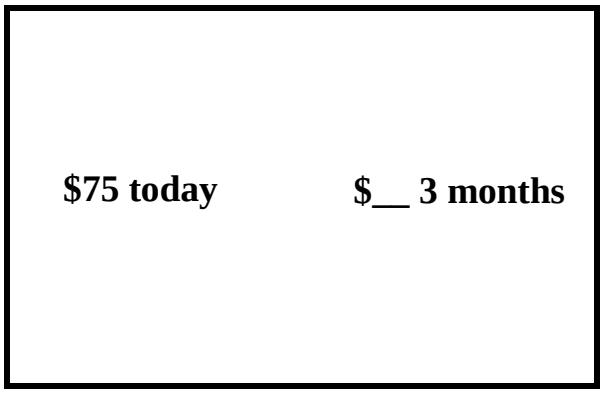


Figure 5. The average absolute deviation between individual Pre-Collaboration discount rates and respective group's discount rates during the Collaboration phase. Lower values mean that group discount rates are closer to individuals' Pre-Collaborative discount rates. Error bars represent standard errors of the mean.

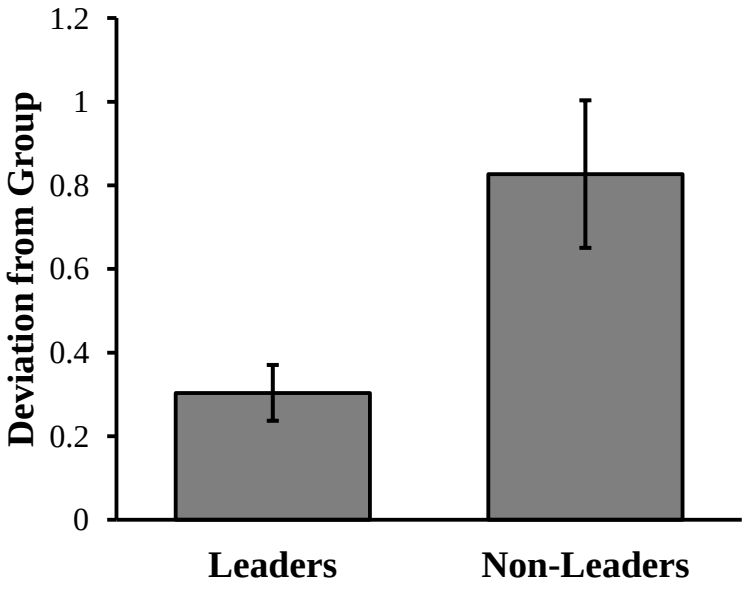


Figure 6. The absolute change in individuals' discount rates from Pre-Collaboration to Post-Collaboration. The preferences of leaders and non-leaders did not shift at significantly different rates. Error bars represent standard errors of the mean.

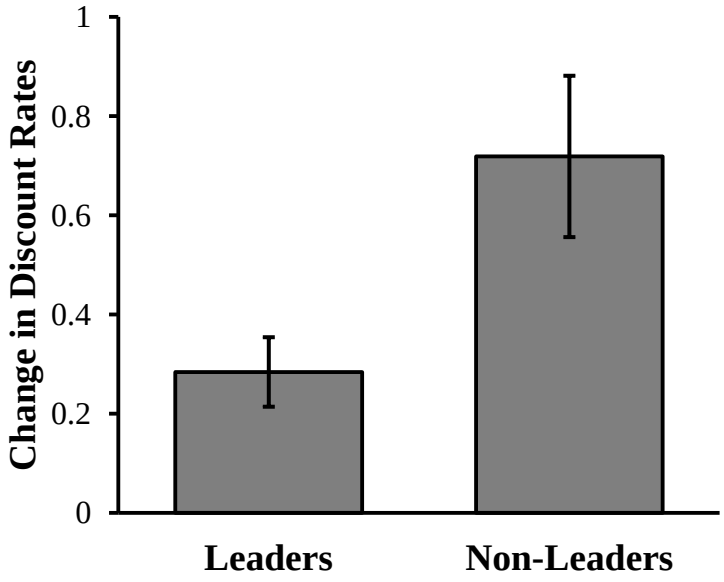


Figure 7. An example trial from the intertemporal choice task that was used in Experiment 2.

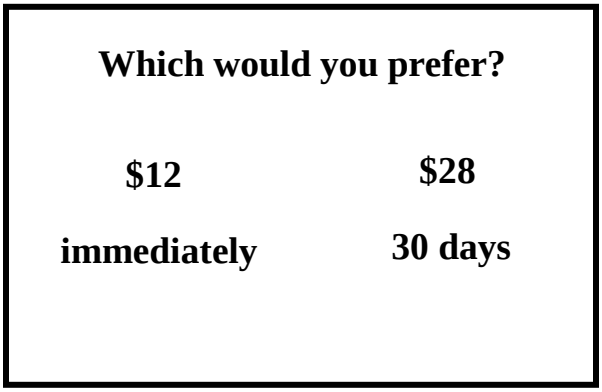


Figure 8. The relationship between the mean of dyad members' individual preferences during the Pre-Collaboration phase and dyadic preferences during the Collaboration phase. Results from the matching task are on the left and results from the choice task are on the right.

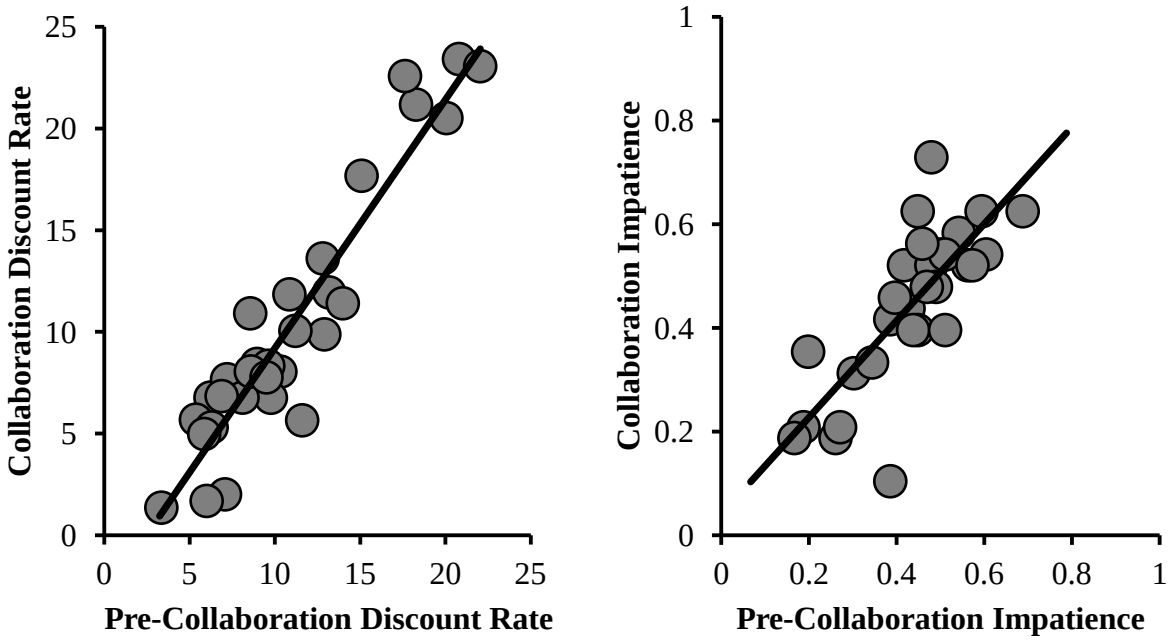


Figure 9. The average difference between dyad members' preferences during the Pre-Collaboration and Post-Collaboration phases. Results from the matching task are on the left and results from the choice task are on the right. Error bars represent standard errors of the mean.

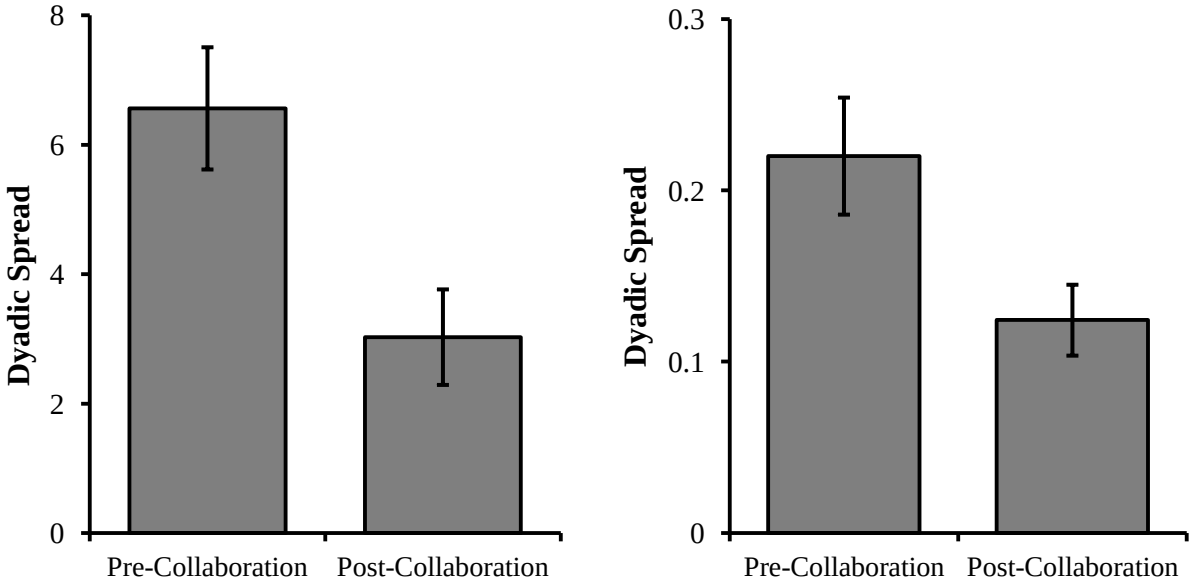


Figure 10. An example of what participants in Experiment 3 saw when being exposed to the decisions believed to be made of another participant.

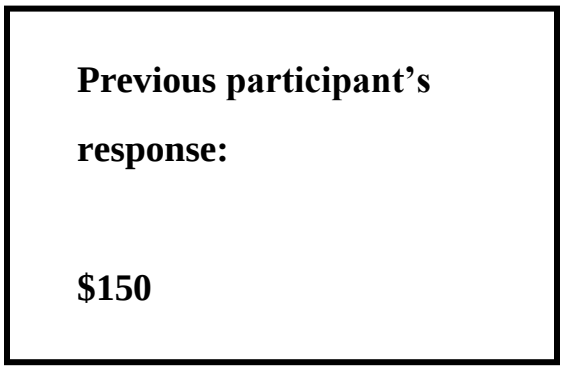


Figure 11. The average change in discount rates from the Pre-Exposure phase to the Post-Exposure phase for participants in the Patient and Impatient conditions. Negative values imply that participants were more patient in the Post-Exposure phase compared to the Pre-Exposure phase, with the opposite being the case for positive values. Error bars represent standard errors of the mean.

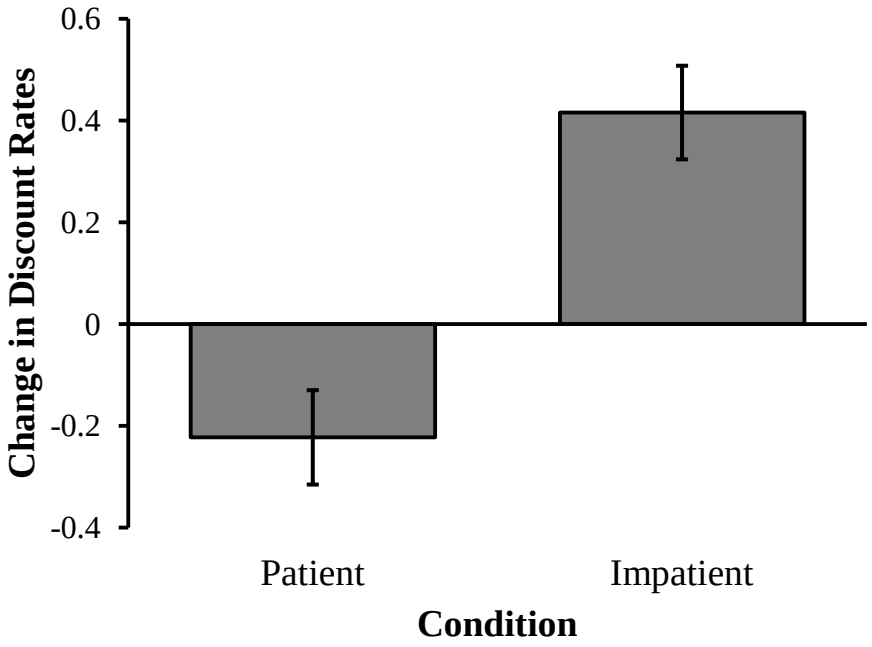
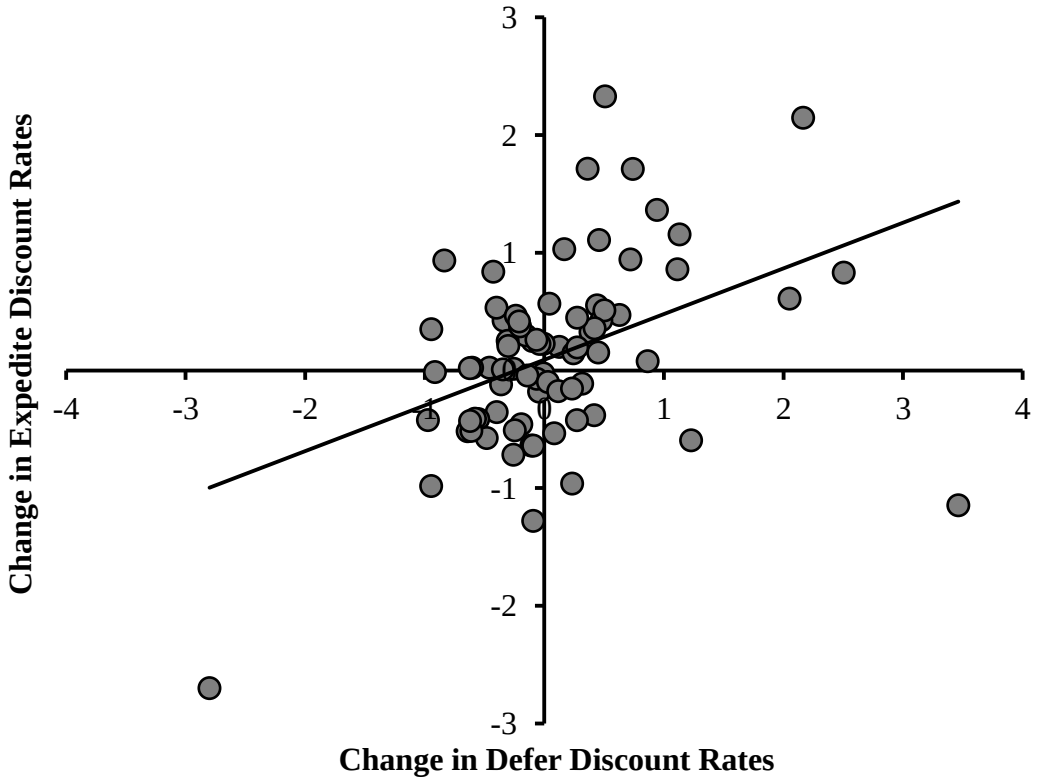
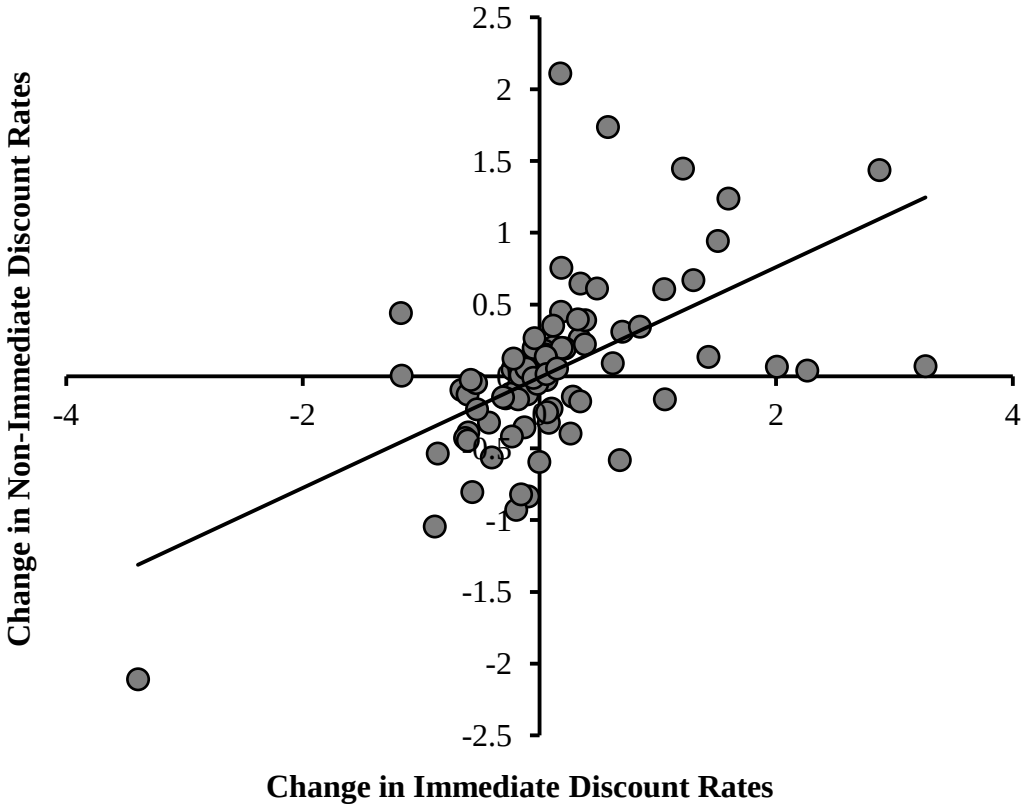


Figure 12. The relationship between changes in discount rates broken down by defer and expedite trials (A) and immediate and non-immediate trials (B). Negative values imply that participants were more patient in the Post-Exposure phase compared to the Pre-Exposure phase, with the opposite being the case for positive values.

A.



B.


Change in Non-Immediate Discount Rates
2.5
2
1.5
1
0.5
-4
-2
2
4
-1
-1.5
-2
-2.5
Change in Immediate Discount Rates

Appendix

The various rewards that were used in the choice task in Experiment 2. The non-immediate trials were the same as the trials listed in the Appendix, but with 30 days added to both the SS Delay and LL Delay. The *k* column includes the value of the discount rate that would lead to indifference between the two reward items. The *k* value is derived from the standard exponential discounting model (Samuelson, 1937): SV = Aexp(-kD), where SV is the subjective value of a delayed reward, A is the objective reward amount of the delayed reward, D is the delay interval associated with the delayed reward, and *k* is a free parameter that measures the degree future rewards are discounted. Higher values of *k* imply greater impatience. SS = smaller-sooner. LL = larger-later.

SS Reward	LL Reward	SS Delay	LL Delay	*k*
34	35	0	43	0.00067
83	86	0	35	0.00101
27	29	0	35	0.00204
47	58	0	50	0.00421
25	30	0	35	0.00521
40	48	0	28	0.00651
67	88	0	35	0.00779
32	47	0	45	0.00854
50	98	0	70	0.00961
35	55	0	40	0.01130
30	75	0	62	0.01478
20	26	0	15	0.01749
40	67	0	25	0.02063
20	65	0	48	0.02456
12	28	0	30	0.02824
25	58	0	25	0.03366
20	62	0	25	0.04526
32	93	0	20	0.05334
15	43	0	14	0.07522
24	68	0	10	0.10415
15	64	0	10	0.14508
22	120	0	8	0.21206
10	89	0	7	0.31229
10	95	0	5	0.45026