Contagion Effects in Intertemporal Decision Making

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Abstract

Prior research has provided substantial insight into individuals' intertemporal preferences (i.e., preferences about delayed rewards). The present study instead investigated the preferences of small groups of individuals asked to express collective intertemporal decisions. The paradigm consisted of three phases. During the Pre-Collaboration and Post-Collaboration phases participants completed an intertemporal matching task individually. During the Collaboration phase participants completed a similar task in small groups, reaching mutually agreed-upon decisions. Results suggest that group preferences were systematically related to group members' Pre-Collaboration preferences. In addition, collaborative decision making altered group members' intertemporal preferences. Furthermore, it was found that individuals' Post-Collaboration preferences were independently related to both their Pre-Collaboration preferences and the preferences of other group members, suggesting that individuals' Post-Collaboration preferences represented a revision of their Pre-Collaboration preferences based on the preferences observed in other group members.

Keywords: collaboration; intertemporal preferences

People must often make choices 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 a college degree 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 tend to 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. Prior research has found that individual differences in intertemporal preferences are associated with consequential real-world behaviors, including scholastic achievement, credit-card debt, substance abuse, and income (for reviews, see Frederick, Loewenstein, & O'Donoghue, 2002; Luhmann, 2009).

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

Collaborative Decision Making

Though collaborative decision making has not been studied in the context of intertemporal decisions, there is a large literature on group decision making in other domains. Much of this research stems from the study of group polarization, which refers to the tendency of group members' attitudes (e.g., attitudes towards capital punishment) to shift toward one extreme following group interaction and discussion (see Isenberg, 1986).

The research done on group polarization has primarily focused on how decisions made by groups are systematically different from the decisions of the group's individual members. Less attention has been devoted to exploring whether collaborative experiences carry over to influence the post-collaborative behavior of individuals. As others have noted (Schultze, Mojzisch, & Schulz-Hardt, 2012), this is problematic because the duration of many real-world collaboration experiences is often relatively brief when compared to the potential lifetime of decisions individuals will make after a collaborative experience ends. For instance, an individual may meet with a financial advisor to discuss various investment options, but the duration of this meeting will be much shorter compared to the many investment decisions the individual will go on to make following the meeting.

The concerns of Schultze et al. (2012) are particularly compelling because older work on group conformity has shown that social contexts can exert strong influences on individual behavior (Cialdini & Goldstein, 2004). For example, in the classic experiments exploring the influence of social norms on perceptual judgments, Sherif (1936) found that observing the judgments of others led to group members' judgments to converge. That is, group members' perceptual judgments were more related to each other post-collaboratively than they were initially (i.e., pre-collaboratively).

However, there are reasons to believe that economic preferences, and intertemporal preferences in particular, may not be susceptible to the collaborative influences previously reported in the literature. 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).

Recognition of these empirical gaps has led to a small number of recent studies examining 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. These 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 different domains, including allotment decisions in the dictator game (Luhan, Kocher, & Sutter, 2009), cooperative decisions in a prisoner's dilemma (Hopthrow & Abrams, 2010), and anchoring effects (Rutledge, 1993). Despite these studies involving different types of decisions and contexts, individuals' post-collaborative decisions have generally been observed to be altered as a result of the collaborative decision making experience. For example, Hopthrow and Abrams (2010) found that individuals became more cooperative in a prisoner's dilemma following collaboration. Furthermore, these changes appear to be durable, including measurable effects observed five weeks later on reasoning tasks such as the Wason selection task (Maciejovsky, Sutter, Budescu, & Bernau, 2013).

Social Influences on Intertemporal Choice

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 make different intertemporal choices when making choices for themselves compared to 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 for 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 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 an individual in a group is often still a recipient of the chosen reward.

The goal of the current study was to explore collaborative intertemporal decision making. Specifically, we were interested in exploring how the intertemporal preferences of the collaborative group relate to the intertemporal preferences of the individual group members. We also sought to determine whether the experience of collaborative decision making influences individuals' post-collaborative intertemporal preferences. In order to accomplish these goals, participants completed three phases during the study: a Pre-Collaboration individual phase, a Collaboration group phase, and a Post-Collaboration individual phase. This method allowed us to measure how the experience of collaborative decision making influenced individuals' intertemporal preferences.

Method

Participants

Participants were 61 Stony Brook University undergraduates who participated in exchange for partial course credit. Participants completed the study in 19 three-person groups and one four-person group.

Materials

The study consisted of three phases: Pre-Collaboration, Collaboration, and Post-Collaboration. In all three phases, participants completed an intertemporal decision task. In the Pre- and Post-Collaboration phases, this task was performed individually. In the Collaboration phase, the task was performed as a group.

On each trial of the intertemporal decision task, two reward items were displayed on the computer screen. 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.

The decision task included four trial types: Defer Immediate, Defer Non-Immediate, Expedite Immediate, and Expedite Non-Immediate. 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. 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.

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 study, trials were presented in a randomized order. Different reward magnitudes were used during the Collaboration phase to prevent individuals from simply reiterating the exact responses their group made during the Collaboration phase.

Statistical Analyses

Participants' responses on each trial were converted to annual discount rates using Equation 1:

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

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

After 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 study. 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 instructed to provide one answer on each trial as a group. If there was a disagreement about the amount on a given trial, participants were instructed to reach consensus and provide an amount that the group was satisfied with. Participants were also instructed to imagine that the rewards during the Collaboration phase would still be received individually.

After receiving these instructions, the group of participants was escorted to a single computer workstation where the Collaboration phase of the study was performed. Upon completion, participants were 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 study. The entire study took less than one hour to complete.

Results

We first investigated whether we could predict the discount rates of groups themselves. We did so by averaging group members' discount rates during the Pre-Collaboration phase. These averages were strongly correlated with the group discount rates derived from the Collaboration phase ($r = .77$, $p < .001$). This means that individuals exhibiting high [low] discount rates during the Pre-Collaboration phase tended to produce groups that exhibited a high [low] discount rate during the Collaboration phase.

Group Convergence

The main goal of the current study was to determine whether collaborative decision making would alter individuals' intertemporal preferences. In particular, we wanted to explore whether individuals' decisions would come to resemble decisions made by their group during the Collaboration phase. Figure 1 includes an illustrative group exhibiting this pattern.

To evaluate this convergence effect statistically, we computed the absolute differences between the group discount rate during the Collaboration phase and group members' discount rates during the Pre-Collaboration/Post-Collaboration phases. That is, for each participant we calculated the absolute difference between her discount rate during the Pre-Collaboration phase and her respective group's discount rate during the Collaboration phase. Within each group, participants' difference scores were then

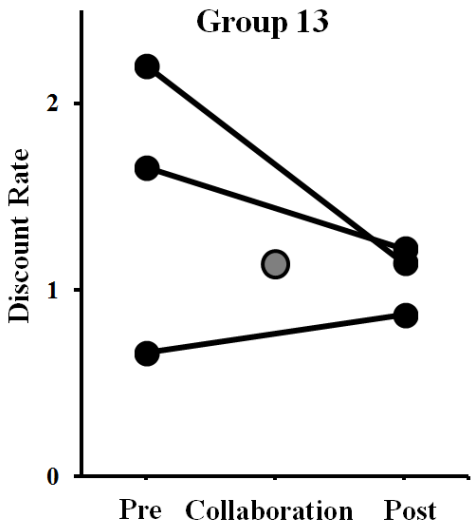

Figure 1 - An illustrative group's discount rates during the Pre-Collaboration phase, the Collaboration phase, and the Post-Collaboration phase.

averaged together. We next calculated the absolute differences between group members' discount rate during the Post-Collaboration phase and the group discount rate during the Collaboration phase. If collaborative decision making leads to convergence in group members' subsequent intertemporal preferences, then the average of these difference scores should be smaller for the Post-Collaboration phase compared to the Pre-Collaboration phase.

The average absolute difference between Post-Collaboration discount rates and Collaboration discount rates (M = .46, SD = .27) was smaller than the average absolute difference between Pre-Collaboration discount rates and Collaboration discount rates (M = .74, SD = .27) ($t(19) = 5.56$, $p < .001$). This means that group members' discount rates shifted between the Pre- and Post-Collaboration phases. Specifically, group members' discount rates during the Post-Collaboration phase converged towards their respective group's discount rate during the Collaboration phase (Figure 2).

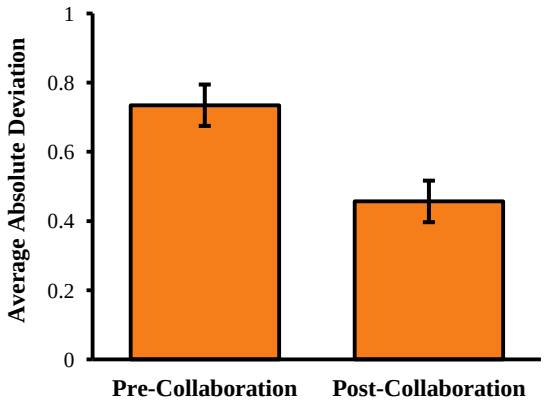

Figure 2 - The average absolute deviation between discount rates in the Pre-Collaboration/Post-Collaboration phase and groups' discount rates during the Collaboration phase. Error bars indicate the standard errors of the means.

To investigate how collaborative decision making produced these shifts in behavior, the relationship between group discount rates during the Collaboration phase and the change in discount rates among the group members from Pre- to Post-Collaboration (i.e., Post-Collaboration discount rates minus Pre-Collaboration discount rates) was explored. The correlation between Collaboration discount rates and Pre- to Post-Collaboration changes in discount rates was significant (r = .53, $p < .05$). As Figure 3 illustrates, members of groups exhibiting high discount rates during the Collaboration phase tended to increase their discount rates from Pre- to Post-Collaboration. In contrast, members of groups exhibiting low discount rates during the Collaboration phase tended to decrease their discount rates.

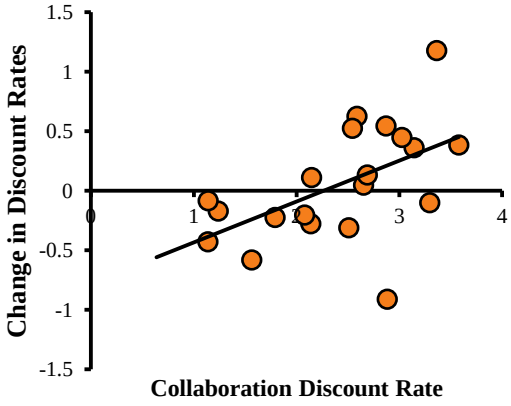

Figure 3 - The relation between groups' discount rates during the Collaboration phase and group members' average Pre- to Post-Collaboration change in discount rates. Members of groups exhibiting high [low] discount rates during the Collaboration phase tended to increase [decrease] their discount rates.

Predicting Post-Collaboration Discount Rates

By the time individual participants reached the Post-Collaboration phase of the study, they had made individual intertemporal decisions during the Pre-Collaboration phase and as part of a group during the Collaboration phase. To more thoroughly understand the origin of the effects reported above, we next explored how individuals' Post-Collaboration decisions were related to their Pre-Collaboration decisions and the decisions made by their respective group. If these two factors exerted independent influences, it would suggest that individuals' Post-Collaboration preferences represented a revision of their Pre-Collaboration preferences based on the preferences observed in the other group members.

A multiple regression analysis was performed to evaluate whether individual discount rates during the Pre-Collaboration phase and the discount rates of other group members during the Pre-Collaboration phase predicted individual discount rates during the Post-Collaboration phase. The multiple regression analysis included individuals' Pre-Collaboration discount rates and the average of other group members' Pre-Collaboration discount rates as predictor variables and Post-Collaboration discount rates as the criterion variable. The overall model accounted for a significant proportion of the variance in Post-Collaboration discount rates, $R^2 = .53$, $F(2, 58) = 39.92$, $p < .001$. Furthermore, both participant's Pre-Collaboration discount rates and the Pre-Collaboration discount rates of other group members accounted for a unique proportion of the variance in Post-Collaboration discount rates (see Table 1).

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	β	t	p
Intercept		.11	.915
Self	.71	7.85	< .001
Other	.24	2.64	.011

We note that one concern regarding the convergence effects reported above is that individuals' behavior may simply be regressing to the mean. That is, individuals' discount rates may become less extreme over time (regardless of any collaborative experience). However, there are aspects of the current data that argue against this regression-to-the mean explanation. For example, the mean discount rate during the Pre-Collaboration phase (M = 2.423) was roughly equal to the mean discount rate during the Post-Collaboration phase (M = 2.475). Furthermore, the standard deviation was actually *lower* during the Pre-Collaboration phase (SD = .55) compared to the Post-Collaboration phase (SD = .73). So individuals' behavior during the Post-Collaboration phase was not simply regressing toward a mean, but was instead converging towards the *respective* group's mean discount rate following collaboration.

Discussion

How individuals resolve intertemporal tradeoffs has been the focus of a long history of work, in large part, due to the fact that such preferences inform a variety of critical, real-world behaviors. However, the focus on individual decision makers ignores the fact that many real-world intertemporal decisions involve a group of two or more individuals making mutually-agreed upon decisions through a collaborative process. The current study sought to shed light on how the intertemporal preferences of the individual group members shape the choices of the group, as well as how the act of collaborative decision making influences individuals' subsequent intertemporal preferences. The results demonstrate that group members' pre-collaborative intertemporal preferences were strongly related to the preferences exhibited by the group during the Collaboration phase; individuals exhibiting a high discount rate during the Pre-Collaboration phase tended to produce groups that exhibited a high discount rate during the Collaboration phase. Furthermore, individuals' intertemporal preferences were altered as a result of the collaborative decision making experience. Specifically, individuals' preferences converged towards the preferences exhibited by their fellow group members.

Individuals' Post-Collaboration preferences were independently related to both their Pre-Collaboration preferences and the preferences of their respective group members. These results suggest that individuals' ultimate preferences represented a revision of their initial preferences based on the preferences observed in other group members. This pattern of results appears to provide evidence against the idea that intertemporal preferences are a stable property of individuals, which stands in contrast to the common conception of decision-related preferences and intertemporal preferences specifically. For example, it has been argued (Odum, 2011) that intertemporal preferences meet the criteria for traithood. Moreover, the test-retest reliability of discount rates has been found to be high (Black & Rosen, 2011), even over intervals of one year (Kirby, 2009). However, the current results suggest that individuals' intertemporal preferences can be systematically influenced. There has been previous research suggesting that discount rates can be manipulated within an individual, however, these prior reports employed rather forceful manipulations. For example, one study (Black & Rosen, 2011) utilized a 36-week money-management intervention and another (Senecal et al., 2012) utilized explicit instructions about how a normative decision maker ought to make intertemporal choices. In contrast, the shifts in intertemporal preferences observed in the current study were derived from the simple act of collaborative decision making and the observation of others' intertemporal preferences.

Why did collaborative decision making lead to subsequent shifts in individuals' intertemporal preferences? We would suggest that our results may 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 information about normatively appropriate behavioral patterns (Deutsch & Gerard, 1955). If individuals 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). This suggestion is consistent with the

observation that the member in each group who exhibited the highest [lowest] discount rate during the Pre-Collaboration phase tended to decrease [increase] her discount rate during the Post-Collaboration phase (see Figure 1).

The present results can also be seen as evidence that individuals have a degree of uncertainty about their preferences (Ariely, Loewenstein, & Prelec, 2003). Prior research has demonstrated that uncertainty allows social influences to have an increased effect on decisions (e.g., Walther, Bless, Strack, Rackstraw, Wagner, & Werth, 2002). The current study demonstrates that this type of effect can be observed in even higher-order decisions, such as economic preferences. In order to explore the contribution of uncertainty about one's preferences to the current results, future research will be needed to see if uncertain individuals are more likely to converge towards their respective group's preferences post-collaboratively compared to more certain individuals. This could be accomplished in many ways, either by probing uncertainty through self-report and entering it as a covariate, or by experimentally inducing uncertainty in participants prior to the Collaboration phase. Future research that explores this and related issues will help shed light on the psychological and social processes that allow collaborative intertemporal decision making to alter individuals' preferences.

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