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Research report

Can you change my preferences? Effect of social influence on intertemporal choice behavior

Cinzia Calluso[a,b,c,*], Annalisa Tosoni[b,c], Gianfranco Fortunato[d,e], Giorgia Committeri[b,c]

[a] Department of Business and Management, LUISS Guido Carli University, Rome, Italy
[b] Department of Neuroscience Imaging and Clinical Sciences, University "Gabriele d'Annunzio" of Chieti-Pescara, Italy
[c] Institute of Advances Biomedical Technologies, University "Gabriele d'Annunzio" of Chieti-Pescara, Italy
[d] CIMeC – Center for Mind/Brain Sciences, University of Trento, Italy
[e] Scuola Internazionale Superiore di Studi Avanzati, Trieste, Italy

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ABSTRACT

The present study presents a novel social observation paradigm to examine whether temporal discounting (TD) can be modulated in a specific direction. In particular, after estimating a baseline discount rate, we exposed subjects to a pattern of choice that was opposite to their baseline preferences, i.e., subjects preferring immediate over delayed rewards were exposed to a farsighted pattern of behavior and vice-versa. The results showed a significant decrease of the discount rate in the discounter group and an increase in the farsighted group. The effect was mainly guided by a modification of the subjective values at short time delays and was stronger in subjects with extreme, compared to mild, baseline preferences. Importantly, the magnitude and direction of the effect predicted the baseline preferences.

These findings have potentially very relevant implications for the prevention and treatment of clinical conditions, such as addition-related disorders, characterized by severe impairments of decision-making mechanisms.

1. Introduction

During intertemporal choices subjects are required to choose between a reward which is immediately available and a larger one but available after a variable time interval. The value of future outcomes is usually devaluated as a function of the delay, a phenomenon known as temporal discounting [1–6].

Based on evidence of a high test-retest reliability [7–9], temporal discounting is normally considered a fairly stable behavioural trait [7–9] but a series of studies have also shown that it can be significantly modulated by contextual factors. For example, a series of manipulations, such those designed to boost the vividness of future events, have been shown to shift the pattern of choices from more impulsive to more patient (reviewed in [10,11]). Such lines of evidence are particularly relevant because impairments of decision making mechanisms during intertemporal choices are associated with a variety of sub-optimal life outcomes, as well as with a wide range of psychiatric conditions [12–16]. Hence, finding strategies and manipulations that can reliably change discounting behaviour represents a particularly relevant pursuit.

Among these manipulations, one of the modulator that is beginning to be more intensively studied is the social context in which the decision process, included the intertemporal choice, takes place. For example, two recent works have shown that the mere presence of peers can increase the frequency of risk-taking behaviours or the selection of the immediate rewards during an intertemporal choice task in adolescents and college-aged youths [17,18]. Notably, as shown by another study along this line, the effect of social influence on discounting could be replicated even when participants were told that they were being observed by an anonymous peer [19].

More relevantly for the present study, it has been recently shown that the observation of impulsive intertemporal choices from a peer (as compared to non-impulsive ones) is associated with an increased selection of the immediate rewards [20]. In this study, however, the observation of impulsive vs. non-impulsive choices was not associated with a significant modulation of the discount rate, thus leaving the question of whether social influence may represent a reliable modulator of discounting behaviour partially unsolved. Here we further explored the possibility to modulate the discounting function via social influence by examining the behavior of a sample of forty-seven participants involved in a social observation paradigm in which intertemporal choices were made after being exposed to the choice pattern of another

* Corresponding author at: Department of Business and Management, LUISS Guido Carli University, Viale Romania 32, 00197 Rome, Italy.
E-mail address: ccalluso@luiss.it (C. Calluso).

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person on the same options. In particular, we examined whether discounting could be modulated in a specific direction by exposing subjects to a pattern of choice that was opposite to their baseline preferences, i.e., subjects preferring immediate over delayed rewards were exposed to a less discounter pattern of behaviour (hereafter called farsighted, in line with our previous studies [21,22]) while an opposite pattern was shown to farsighted subjects. We then compared the resulting discount rates to those obtained in a baseline session in which the same task was performed in isolation. Importantly, we also examined whether the effect of the social manipulation was restricted to specific time delays (short vs. long) or groups of individuals with different baseline discounting preferences (mild or extreme discounter or farsighted) and whether the magnitude and direction of the effect could be predicted by the baseline preferences.

2. Methods

2.1. Subjects

Forty-seven right-handed healthy volunteers (17 males, mean age: 21.34 ± 1.83) participated in the study after providing written informed consent in accordance with the ethical standards of the 1964 Declaration of Helsinki and the study approval by the Ethics Committee of the "G. d'Annunzio" University. The sample size was calculated on the basis of a power analysis [G*Power 3.1.9.2 (www.gpower.hhu.de/en.html)] conducted on the effect size (Cohen's *d*, values varying between 0.23 and 0.38) reported in a previous study on the same topic [20]. We found 45 to be a critical number of participants, since the estimated power remained stable above this number. All participants underwent two behavioural sessions – a baseline session and a social influence session – of an intertemporal choice task. The baseline and the social manipulation sessions were collected in different days with a mean distance of 18.32 ± 4.65 days.

2.2. Intertemporal choice task

During both the baseline and the social influence session participants performed a series of hypothetical intertemporal choices between a fixed and immediately available amount of money of 10€ and one varying in amount between 15€ and 60€ (seven amounts) and available after a variable time delay (six time intervals) varying from 7 to 180 days (see [21,22] for the same task design). This design produced a total of 42 different choice contingencies, each repeated 10 times (420 total trials per session). At the beginning of each trial participants were shown a "starting window" and were instructed to press the "START" button in order to visualize the available choice options. Then, participants expressed their choice by clicking on the corresponding response button (e.g., "NOW" or "LATER") using the computer mouse (see Fig. 1). At the beginning of the experiment participants were informed that the task only involved hypothetical choices but they were strongly encouraged to consider each choice as realistically as possible. During the baseline session participants performed the task in isolation (Fig. 1A) while during the social influence session they were instructed to express their choice after observing those of another person on the same options. Participants were told that they had been paired with another participant and that they would observe his/her choices before expressing their own preference. Again, participants were encouraged to consider each choice as realistically as possible. As shown in Fig. 1B, after the presentation of the choice options, an observation window was shown to the participants displaying a moving mouse trajectory and they were told that it was a pre-recorded choice from another participant on the same option. Crucially, each participant was exposed to a pattern of choices that was opposite to his/her baseline behavior. In particular, based on a median split of the discount rates estimated during the baseline session participants were classified as discounter or farsighted subjects (discounter: $k >$ median, farsighted: $k <$ median), and during the social manipulation session, discounter subjects were exposed to a farsighted pattern of behavior (observed farsighted log-transformed $k = -1.39$) and vice versa (observed discounter log-transformed $k = -0.64$). To simulate real mouse movements, the trajectories shown in the observation window started from the "START" button and reached one of the two response buttons ("NOW" vs. "LATER") and were obtained using 23 frames at a presentation rate of 14.29 Hz (total presentation time = 1609.52 ms) through an in-house Matlab algorithm computing a normally-distributed Gaussian randomization (mean = 0; s.d. = 5e-6) of a dataset of real trajectories ([22]; i.e., the fake trajectories were always different from one another but similar to real trajectories, increasing the believability of the paradigm). At the end of the social influence session, participants were verbally debriefed in order to investigate the believability of the social manipulation. Such inspection revealed that all participants believed that the observed choices were real pre-recoded decisions from another participant on the same options.

2.3. Behavioural analysis

Subject-specific discount rates (k) were estimated by fitting individual data with the well-known hyperbolic function [23], using a standard routine also employed in previous works [4,21,22,24,25]. Specifically, we first calculated – for each time delay – the fraction of times in which the participant selected the delayed option over the immediate one as a function of the objective amount of the delayed reward. These data were then fitted with a logistic function to estimate the point of subjective equivalence (pse), i.e., the amount at which the immediate and the delayed option were selected with equal probability. Then, subjective values (SV) were calculated, for each time delay, as the

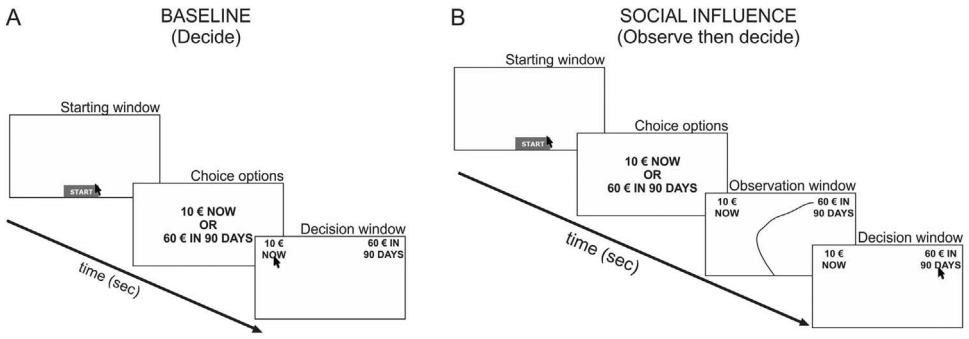

Fig. 1. Behavioral Paradigm. (A) Baseline session: at the beginning of each trial participants were instructed to press the "START" button positioned at the central bottom of the screen in order to visualize the choice options. Participants were subsequently instructed to express their preference by clicking on the corresponding response button. (B) Social influence session: as in the baseline session participants were firstly instructed to press the "START" button to visualize the choice options. In this session, however, before computing the choice, participants were exposed to the choice of another person on the same options through an observation window displaying a moving mouse trajectory starting from the "START" button and reaching one of the two response buttons.

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