

Patience predicts within-group cooperation in an ingroup bias-free way

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ABSTRACT

Patience—low delay discounting—has been shown to predict cooperative behavior in environments where cooperation demands the suppression of competitive aspirations. But what about intergroup-conflict situations, where within-group cooperation is importantly motivated by competitive sentiments against other groups? We analyze the connection between delay discounting and performance in two problem-solving tasks with either individual or intergroup competition incentives. We find a positive relationship between a group's mean patience and the within-group *cooperative synergy*, defined as the group members' performance in the intergroup-competition task relative to their performance in the individual task. Furthermore, ingroup bias cannot account for this result: in a follow-up social preferences task, patience relates positively (negatively) to cooperative (competitive) choices toward unknown students but *not* toward ingroup members. However, more patient individuals were more willing to reduce the benefits of their uncooperative group partners and increase the benefits of the cooperative ones in a reciprocal manner.

Keywords: Delay discounting; Patience; Academic performance; Cooperation; Punishment; Social preferences; Intergroup competition

INTRODUCTION

Teamwork is a central pillar of the functioning of modern organizations, whose performance largely depends on the ability of group members to cooperate for the common good. In the last years, the psychological and behavioral underpinnings of group performance have been increasingly studied (e.g., De Dreu & Weingart, 2003; Kozlowski & Ilgen, 2006). However, while it is recognized that people differ in their level of contribution to the group's goals, the sources of these individual differences are not well understood. Recent experimental research has shown that *delay discounting* is correlated with the extent to which people engage in group-beneficial behaviors, and thus is a likely determinant of group performance (Curry, Price, & Price, 2008; Espín, Brañas-Garza, Herrmann, & Gamella, 2012).

Delay discounting, which refers to the subjective devaluation of a reinforcer as a function of its delay, is a temporarily stable characteristic (Kirby, 2009) that displays great inter-individual variability (Frederick, Loewenstein, & O'Donoghue, 2002). In this paper, we use the adjective “patient” to characterize individuals with low delay discounting—often included within the broader class of “self-control” (Rachlin, 2000). A large share of its scientific interest relies on the fact that delay discounting is decisive to explain individual behavioral differences in many areas. In the non-social domain, patience has been related, for instance, to better academic outcomes (Duckworth & Seligman, 2005; Duckworth, Tsukayama, & May, 2010; Kirby, Winston, & Santiesteban, 2005; Mischel, Shoda, & Rodriguez, 1989; Shoda, Mischel, & Peake, 1990) and to a lower propensity for drug abuse (Bickel, Odum, & Madden, 1999; Kirby, Petry, & Bickel, 1999) and other unhealthy behaviors (Chabris, Laibson, Morris, Schuldt, & Taubinsky, 2008; Weller, Cook III, Avsar, & Cox, 2008).¹

An important strand of research has highlighted the relevance of delay discounting for understanding social behavior both theoretically and empirically (Curry et al., 2008; Espín et al., 2012; Rachlin, 2002; Stevens, Cushman, & Hauser, 2005). According to the most widely accepted theories, long-run collective interest—and the future personal benefits it might bring to the individuals involved—is considered to be opposed to short-run self-interest (Dewitte & De

¹ Note that if discounting predicts a particular choice (in the absence of confounding third variables), its decision process must involve some form of intertemporal trade-off, that is, the incentives associated with the available options should differ, at least subjectively, in their time of realization (e.g., Ainslie, 2001; Espín, Exadaktylos, Herrmann, & Brañas-Garza, 2013).

Cremer 2001; Messick & McClelland, 1983; Platt, 1973; Rachlin, 2002; Van Lange, Joireman, Parks, & Van Dijk, 2013). Consequently, cooperative, group-beneficial acts are more likely to be carried out by patient individuals than by impatient individuals (Balliet & Joireman, 2010; Curry et al., 2008; Stevens et al., 2005). Yet recent evidence from economic experiments indicates that such an association is more complex than previously thought (Al-Ubaydli, Jones, & Weel, 2013; Crockett, Clark, Lieberman, Tabibnia, & Robbins, 2010; Espín et al., 2012, 2013). Indeed, the short-run goal during social interaction, at least in some environments, seems to be to outperform others in a competitive fashion rather than selfish payoff maximization (Espín et al., 2012, 2013).

It follows that when successful group cooperation requires the suppression of competitive aspirations, as in typical social dilemmas for instance, patience should predict group-beneficial behavior. This seems indeed to be the case. In social dilemma experiments, patience has been positively associated with cooperative behavior that increases social efficiency (Al-Ubaydli et al., 2013; Curry et al., 2008; Harris & Madden, 2002; Yi, Johnson, & Bickel, 2005; Yi, Buchhalter, Gatchalian, & Bickel, 2007). Relatedly, in introducing punishment in a social dilemma game, Espín et al. (2012) found that patience was characteristic of cooperators who “altruistically” punished free-riders, which may be a group-beneficial behavior in the long run (Gächter, Renner, & Sefton, 2008), but that impatience was characteristic of free-riders who used punishment in a competitive manner. Finally, in the ultimatum game, socially-inefficient competitive behaviors by both responders (i.e., the rejection of disadvantageous offers; Crockett et al., 2010; Espín et al., 2013) and proposers (i.e., the proposal of advantageous offers; Espín et al., 2013) have been found to be associated with impatience.

But what if group performance is also fueled by competitive sentiments as happens during intergroup conflict? When competition is set at the group level, negative feelings toward the members of other groups (“outgroup hate”) can serve as an important catalyst for within-group cooperation (e.g., Brewer, 1999; De Cremer & Van Vugt, 1999). The effects of individuals’ delay discounting on the outcomes of intergroup conflict are therefore uncertain because competitive feelings that can spur within-group cooperation are likely to be related to impatience rather than to patience.

Group selection is discussed in the literature as a possible explanation for the evolution of human cooperation (Henrich, 2004; Nowak, 2006; Rand & Nowak, 2013; Sober & Wilson,

1999). Since groups of cooperators outcompete groups of defectors under a wide range of conditions, group-beneficial behaviors can be favored by natural selection even if they are costly for the individual (Bowles, 2006; Traulsen & Nowak, 2006). In the context of organizational and educational theories, the positive effects of intergroup competition schemes on group performance have long been recognized as well (Ashforth & Mael, 1989; Erev, Bornstein, & Galili, 1993; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Johnson, Johnson, & Stanne, 2000;). However, while intergroup competition relies on *positive interdependence* between the members of a group, its structure imposes *negative interdependence* between the members of competing groups (e.g., Deutsch, 1949; Tajfel & Turner 1979). In this vein, the final effects on collective welfare are controversial because group identity may generate negative externalities that eventually overcome the collective benefits of within-group cooperation (Abbink, Brandts, Herrmann, & Orzen, 2010; Bornstein, 2003; Gould, 1999). Indeed, how societies and organizations can alleviate the negative collateral effects that intergroup competition often imposes on social efficiency while keeping its benefits for within-group cooperation constitutes an enduring research question across disciplines (Ashforth & Mael, 1989; Böhm & Rockenbach, 2013; Dawes, 1980; Johnson et al., 1981).

This study employs the “beta-delta” model of intertemporal preferences (Laibson, 1997; Phelps & Pollack, 1968) to explore the relationship of 96 undergraduate business students’ discounting with (i) their performance in a classroom experiment on problem-solving intergroup competition and (ii) their decisions in a follow-up social preferences elicitation task. Microeconomics problem-solving tasks were performed first under individual competition and, subsequently in the same session, under intergroup competition (in three-person groups) schemes. In both conditions, real incentives were introduced in the form of bonus points for the final course grade in a rank-based way.

For a group to be successful during intergroup competition, cooperation between group members is warranted and, consequently, within-group competition must be suppressed. Therefore, in terms of our experimental design, if patient individuals are more cooperative and less competitive than impatient individuals *toward their interaction partners* (Curry et al., 2008; Espín et al., 2012, 2013; Yi et al., 2005) during intergroup conflict as well, this may be reflected in the level of cooperative synergy generated in the group condition. That is, the relative increase

of group members' performance from the individual competition to the intergroup competition condition, as a proxy of within-group cooperation, should be predicted by the group members' intertemporal preferences: groups of patient individuals must perform relatively better than groups with impatient members, *ceteris paribus*. However, if it is indeed the case that patience is positively associated with within-group cooperation, it might be that patience also goes along with a higher propensity to develop an ingroup bias (i.e., discrimination in favor of one's own group). Such ingroup bias may trigger patient individuals' competitive sentiments toward the outgroup, eventually leading to socially-inefficient destructive behaviors (e.g., Abbink et al. 2010; Benard & Doan, 2011; Hogg, 2000; Tajfel & Turner 1986). On the other hand, if more patient individuals are more cooperative and less competitive *toward the members of other groups*, groups with patient members may perform even relatively worse than groups with impatient members. This might happen if the latter are more likely to seek to enhance within-group cooperation for the sake of outcompeting other groups. In order to investigate the prevalence of these mechanisms, we analyzed the subjects' choices in the follow-up social preferences task in addition to the outcomes of intergroup competition.

In the social preferences task, subjects had to choose between different hypothetical distributions of bonus points between themselves and (i) an unknown, randomly chosen classmate (which we will refer to as "the collective") and (ii) each of the other two members of the group during the intergroup competition condition ("the ingroup"). This task allows to infer selfish, competitive/spiteful, egalitarian, efficiency, and altruistic preferences from the subjects (Bartling, Fehr, Maréchal, & Schunk, 2009; Fehr & Schmidt, 2006) for an overview of social preferences models) and to explore the dependence of these outcome-based social preferences on group identity (Chen & Li, 2009; De Cremer & Van Vugt, 1999; Loewenstein, Thompson, & Bazerman, 1989). The first two types of preferences are considered to be "proself" while the remaining three types are "prosocial" (Van Lange, De Bruin, & Otten, 1997; Van Lange, 1999). *Selfish* preferences consist in the maximization of the own payoff (i.e., bonus points); *competition/spitefulness* predicts choices that maximize the decision maker's relative payoff (competitive), which also minimize the counterpart's payoff (spiteful) in our task. *Egalitarian* preferences predict choices that minimize the difference between both players' payoffs; *efficiency* preferences would maximize the sum of both players' payoffs; and *altruism* entails maximizing

the counterpart's payoff (i.e., the inverse of competitive/spiteful choices here). These measures will help us to look into the channels that may be linking patience and group performance.

The remaining sections are structured as follows. The empirical methodology and a description of the tasks used are presented in the next section. The third section presents the results and, finally, the fourth section discusses the results and concludes.

METHODS

A total of 96 first-year, business administration students (65% females, mean age 19.69 ± 0.26 [SEM]) at the University of Granada, Spain, participated in the study, which was presented as an activity for the introductory microeconomics course. Among these, 50 attended morning classes and 46 attended evening classes. The experimental sessions were conducted during a standard two-hour microeconomics class, either in the morning or in the evening.

General protocol and problem-solving tasks

At the beginning of a problem-solving session, students were informed that they would have to solve two problem sets, each containing three microeconomics problems based on the concepts they had been taught during the previous lectures. The maximum time allowed to solve each problem set was 40 min. Scores ranged from 0 to 10 and all three problems of each set carried the same weight in the overall score of the task. Written instructions for the first task were then distributed individually among the students.²

The first problem set was to be solved under rank-based individual incentives. Incentives were introduced in the form of bonus points to be counted toward the final course grade (which also ranged from 0 to 10) in such a way that only those students who obtained the 15 top scores (among 50 students in the morning session and 46 students in the evening session) would receive a bonus. The bonus points were distributed as follows:

- 1 point for each of the three students obtaining the three top scores;
- 0.75 points for the six students obtaining the 4th-9th scores;
- 0.5 points for the six students obtaining the 10th-15th scores.

² An English translation of the instructions of each task can be found in Appendix A1 in the Supplementary materials.

In the event of a tie, the first student(s) to submit the assignment would prevail (the course instructor kept track of the order in which the assignments were submitted). This incentive scheme generates *negative interdependence* among participants, as required for a competitive goal structure (Deutsch, 1949; Johnson & Johnson, 2009). Communication among participants was not allowed.

After the individual competition condition had finished (with no feedback), students were randomly arranged into three-person groups (morning session: 17 groups, evening session: 15 groups; due to the number of students participating in the experiments, one group in the morning session was composed of only two students whereas one four-person group was formed in the evening session). The instructions for the intergroup competition condition and its corresponding problem set were then distributed individually to the participants. Again, assignments were to be submitted individually to the course instructor and 15 students would receive bonus points, but in this case the incentive scheme was based on groups' mean performance:

- 1 point for the three members of the group whose members obtained the highest mean score;
- 0.75 points for the six members of the two groups with the 2nd and 3rd highest mean score;
- 0.5 points for the six members of the groups ranking 4th and 5th.

Students were allowed to communicate only with the members of their group. This incentive scheme creates the *positive interdependence* between group members required for a cooperative goal structure, while keeping *negative interdependence* between members of different groups typical of intergroup competition schemes (Deutsch, 1949).

One week after the problem-solving sessions, the same 96 students were invited to the school's experimental economics lab (GLoBE – EGEO) to fill out a computerized questionnaire during the microeconomics class. All but one student (from the evening session) showed up. Upon arrival to the lab, they were given a list containing the scores obtained by 48 randomly selected students (25 and 23 in the morning and evening session, respectively) in both the individual and the group problem-solving tasks. This feedback manipulation was introduced for a different research project and its effects on decisions are therefore not explored in this paper.

Nonetheless, when analyzing the questionnaire responses we will statistically control for the feedback received by the individual prior to answering the questionnaire.

The first screen informed the participants that (a) the data would be used for scientific purposes only; (b) anonymity would be preserved by randomly assigning a numerical code to identify the participants in the final dataset so that no link between participants' real identities and questionnaire responses could be made (in agreement with Spanish Law 15/1999 on Personal Data Protection); (c) the instructor of the course would not be allowed to access the data until the final course grades had been officially published; (d) unless otherwise stated, there were no correct or incorrect responses to the questionnaire (highlighting this point was important in order to minimize any potential demand effects that could arise due to the fact that the experiment was conducted by the course instructor); (e) the maximum time to complete the questionnaire was 20 min.

The questionnaire started with several questions on socio-demographics and on the students' perception about some features of the course and the problem-solving sessions. Among the latter we are particularly interested in the participants' responses to the question “*On a 5-point scale, where 1 is ‘very uncooperative’ and 5 is ‘very cooperative’, how would you rate the level of cooperation of the other members of your group during the group task?*” This question will provide insight into the participants' perception about their partners' cooperativeness and will therefore help in exploring whether others' behavior during the problem-solving task shape social preferences toward them. After answering these questions, participants were asked to complete the social preferences task and, finally, the delay discounting task. Communication was not allowed.

The social preferences task

After completing the first set of questions, participants were shown the instructions for the social preferences task. In particular, they had to make 12 decisions, divided into three four-decision blocks, on how to allocate hypothetical bonus points between themselves and another participant. A different person received the (hypothetical) bonus points in each block.³ Although the participants' choices would have no real consequences, participants were asked to choose the

³ An English translation of the instructions of the task can be found in Appendix A2 in the Supplementary materials.

option they preferred in each decision, regardless of their choices in the other decisions, as if the bonus points were going to be truly distributed in the way they had decided and one of the 12 trials was going to be randomly selected for “payment”. We discarded the use of real bonus points in this task in order not to alter the incentives of the problem-solving tasks. In any case, hypothetical “payoffs” have been used extensively in social preferences tasks, for instance, within the literature on social value orientation (e.g., Van Lange, 1999).

The four decisions in each block were identical and presented in the same order. The decisions were adapted for this specific experiment from the social preferences task used in Bartling et al. (2009), where, instead of bonus points, options involved money—as is the common procedure in the economics literature on social preferences (e.g., Bolton & Ockenfels, 2006; Charness & Rabin, 2002). In the first block, participants had to choose among different distributions of points between themselves and another randomly selected student from the same class (either morning or evening), that is, the *collective*. In the second and third blocks, they were asked to write the first name of each of their group partners in a blank cell (or leave the cell empty if they did not remember the name) and then proceed to make the same four decisions for each partner, that is, the *ingroup*.

As mentioned, intergroup competition might be detrimental to social efficiency due to the appearance of negative feelings toward the members of other groups that are often associated with irrecoverable conflict expenditures (e.g., Abbink et al., 2010; Bornstein, 2003; Dawes, 1980; Gould, 1999). From participants’ choices in the “collective block” we can infer the strength of such negative, destructive feelings toward other groups (note that the probability of a group partner being the recipient of the points assigned in that block was less than 5% in each session) without explicitly framing the decisions in terms of group identity.

Decision #	You	Other		You	Other
1	0.5	0.5	vs.	0.5	0
2	0.5	0.5	vs.	1	0
3	0.5	0.5	vs.	0.5	1
4	0.5	0.5	vs.	0.75	1

Table 1. Decisions in the social preferences task (identical across blocks)

Table 1 displays the distributions of bonus points to choose from in the social preferences task. In each decision, participants had to choose between the distribution shown on the left-hand and right-hand side of the table. Note that the left-hand option is kept constant across decisions. To characterize subjects' social preferences, we will use the number of choices consistent with each type of preference since different motivations might lead participants to choose the same option in one specific decision (for instance, egalitarian, efficiency and altruistic preferences would lead to prefer (0.5, 0.5) over (0.5, 0) in decision 1; see Corgnet, Espín, & Hernández-González, 2015). For the statistical analyses we will run ordered Probit regressions with the number of choices consistent with each type of preference as dependent variables. *Selfish* preferences predict the choice of the right-hand option in decisions 2 and 4 but being indifferent between both options in decisions 1 and 3; hence there is a maximum of two selfish choices in each block. *Competitive/spiteful* preferences (note that all the choices that maximize the decision maker's relative payoff also minimize the counterpart's payoff in this task) predict the right-hand option in decisions 1 and 2 but the left-hand option in decisions 3 and 4, so there is a maximum of four competitive/spiteful choices in each block. *Egalitarianism* would lead to choosing the left-hand option in every decision, with a maximum of four choices as well. *Efficiency* preferences predict choosing the left-hand option in decision 1 and the right-hand option in decisions 3 and 4 but being indifferent in decision 2, thus leading to a maximum of three choices. Finally, *altruism* predicts exactly the opposite choices than predicted by competitive/spiteful preferences.

The delay discounting task

The delay discounting task was adapted from Espín et al. (2013) for this experiment—similar tasks for eliciting intertemporal preferences have been used for instance in Bosch-Domènech, Brañas-Garza, and Espín (2014), Burks, Carpenter, Goette, and Rustichini (2009), Coller and Williams (1999), and Espín et al. (2012). Participants had to make a series of 20 intertemporal choices between hypothetical monetary rewards differing in amount and delay of receipt. Real monetary incentives were not used in this task since previous research indicates that the distribution of choices and even the associated neural activation during decision making in delay discounting tasks do not seem to be significantly altered by the presence of hypothetical versus real payoffs (Bickel, Pitcock, Yi, & Angtuaco, 2009; Coller & Williams, 1999; Johnson &

Bickel, 2002; Lagorio & Madden, 2005). Participants were instructed to choose the option they preferred in each trial independently of their choices in other trials, as if the payoffs were real and one among the 20 trials was going to be randomly selected for payment.

Following the standard procedure, in each trial participants had to choose between a sooner-smaller reward and a later-larger reward. The task comprised 20 questions (trials) of the form “*Do you prefer receiving €30 today or €36 in one month’s time?*” divided into two blocks of 10 questions each: the first block involved choosing between a no-delay option (“today”) and a one-month delay option, while the second block involved a one-month delay option and a seven-month delay option. In both blocks, the sooner-smaller reward was kept constant at €30 while the larger-later reward increased monotonically across trials from €30 to €48 in €2 increments.⁴ This protocol allows us to estimate the parameters of a quasi-hyperbolic beta-delta discount function (Burks et al., 2009; Laibson, 1997; McClure, Laibson, Loewenstein, & Cohen, 2004; Phelps & Pollack, 1968) for each participant. The beta-delta model allows for a possible difference between short-term and long-term discounting and has been shown to predict outcomes better than other formulations (Burks, Carpenter, Goette, & Rustichini, 2012).⁵

The beta-delta model formalizes the individual’s discount function as $V_d = \beta\delta^t V_u$, where V_d is the discounted psychological value of a reward with (undiscounted) value V_u which will be received in t time units. β and $\delta \in (0, 1]$ are the “beta” and “delta” discount factors, respectively. The higher these discount factors, the more patient the individual is, as delayed rewards are valued more (i.e., they are discounted less). The beta discount factor refers to short-term discounting or “present bias”, that is, the value of any non-immediate reward is discounted by a fixed proportion β . The delta discount factor captures long-term discounting in an exponential functional form, that is, for each unit of time that constitutes the delay to delivery, the value of a reward is discounted by δ .

Typically, in each block, a participant begins by choosing the sooner option in the first trial (although this is not always the case) and at some point switches to the later option, which is increasing in amount across trials. We calculate beta and delta for each participant assuming

⁴ An English translation of the instructions of the task can be found in Appendix A3 in the Supplementary materials.

⁵ Other functional forms proposed in the delay discounting literature and a model-free parameterization are also explored for robustness (see below).

indifference between both options in the switching trial.⁶ Seven subjects made inconsistent choices (multiple switching or non-monotonic patterns) in either of the two blocks and will therefore be excluded from the discounting analyses since a discount function cannot be estimated for them. Thus, we obtained reliable discount factors for 88 individuals. Note that in the second block the beta discount factor does not influence choice since both options are delayed. Therefore, we computed a participant's delta from her choices in the second block and then beta from her choices in the first block, accounting for previously calculated delta. The time units were defined in months. We assume that utility is linear over the relevant range. Therefore, using the second-block choices we compute delta from $30 = \delta^6 X$, where X is the amount offered in the later option of the switching trial (from €30 to €50; see footnote 6). Using the first-block choices and the delta discount factor previously obtained, we compute beta from $30 = \beta \delta Y$, where Y is the amount offered in the later option of the switching trial. The mean (\pm SEM) beta discount factor in the sample was 0.888 (\pm 0.010) whereas the mean delta discount factor was 0.936 (\pm 0.002).

RESULTS

Patience and cooperation in the problem-solving task

Figure 1 shows estimated normal distributions for the participants' scores ($N = 96$) in the individual competition condition (dashed line; mean = 3.035 ± 0.254 [SEM]) and the intergroup competition condition (solid line; mean = 5.191 ± 0.252).⁷ While performance was better in the group task—as it seems clear from the figure and is confirmed by a two-tailed paired-sample t -test ($p < 0.001$)—we cannot firmly conclude that social interaction generated positive synergies in our sample since the problem sets were different across conditions (although we tried to keep them equally difficult). Note that in a within-subject design it is not possible to use identical problem sets. However, it is not the aim of this study to validate the benefits of intergroup competition structures for group performance and cooperation but to study the relationship between individuals' patience and the level of synergy—whether positive or not—reached in the

⁶ As in Espín et al. (2012), the indifference point for a participant that never switched from the sooner to the later option is computed as if another €2 increment (i.e., a later reward of €50) would make her indifferent between both options. Different specifications do not qualitatively alter the results.

⁷ Note that the within-group variability of the scores in the group task is nearly inexistent: within-group divergences are observed only in 4 (out of 32) groups. Moreover, these departures are very small and mostly due to typos. Indeed, the maximum distance between a group member's score and the group's mean score is 0.89 points.

group task as a proxy for the level of within-group cooperation. These “cooperative synergies” are calculated at the group level and are therefore comparable across groups. A *group’s cooperative synergy* is defined as $\frac{M_G - M_I}{M_G}$, where M_G refers to the group members’ mean score in the group condition and M_I refers to the mean of the group members’ scores in the individual condition. We conservatively chose to normalize this variable by dividing over the mean score in the group task in order to avoid extreme values that would arise if we normalized by the mean individual-task score (note that this is very close to zero in several groups).

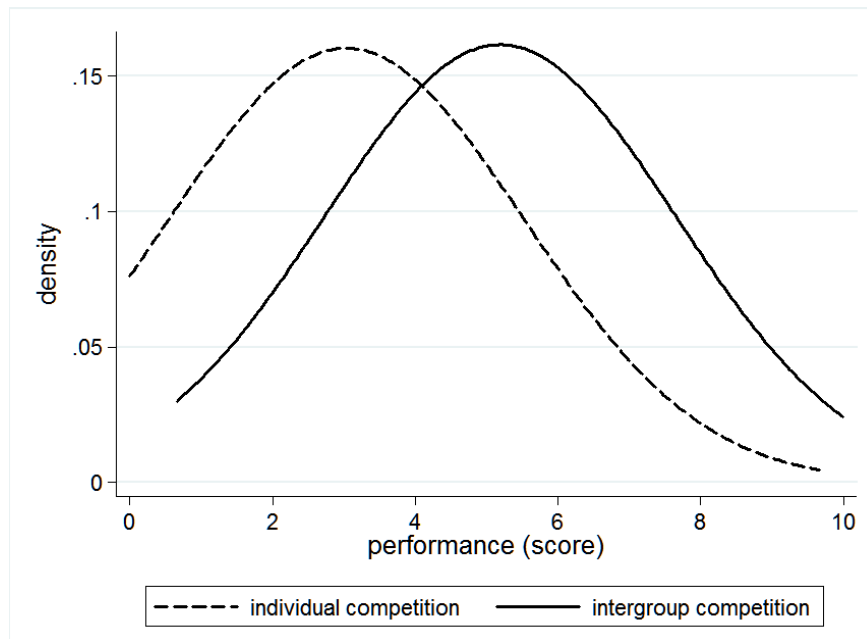


Figure 1. Estimated normal distribution of performance in each condition

Columns 1 and 2 of Table 2 display regressions of individual performance estimated as a function of the beta discount factor, where the dependent variables are the individual’s score in the individual and group conditions, respectively. In Table 3 we report the same regressions for the delta discount factor. For the analysis of performance in the individual condition, we use all the 88 observations for which we obtained reliable discount factors. Robust standard errors clustered on individuals (column 1) or groups (column 2) are shown in parentheses. For the group condition, we also excluded the six observations corresponding to the members of the two groups formed by two/four instead of three students in order to avoid distortions. In both regressions we control for whether the individual belonged to the morning or evening session. As can be observed, we fail to find a direct significant relationship between patience and performance in

either condition at the individual level ($ps > 0.19$).⁸ The session dummy is not significant either ($ps > 0.35$).

dependent vars.:	indiv score (1)	group score (2)	group synergy (3)	group score (4)
beta (group's mean in col. 3)	-2.805 (3.108)	3.208 (2.360)	2.603** (1.172)	3.152** (1.474)
individual score				0.266*** (0.076)
partners' mean beta				6.445* (3.194)
partners' mean indiv. score				0.593*** (0.158)
R²	0.020	0.020	0.228	0.301
F	0.79	0.99	4.65**	5.72***
observations	88	82	29	81

Table 2. Problem-solving performance as a function of short-term patience (beta). Notes: OLS estimates. Dependent variables are displayed at the top of the columns. Robust SE clustered on individuals (column 1) or groups (columns 2 to 4) are presented in parentheses. All regressions control for session (either morning or evening). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

dependent vars.:	indiv score (1)	group score (2)	group synergy (3)	group score (4)
delta (group's mean in col. 3)	-7.108 (11.772)	1.613 (14.971)	9.335** (4.246)	6.888 (12.631)
individual score				0.262*** (0.081)
partners' mean delta				10.564 (25.115)
partners' mean indiv. score				0.562*** (0.172)
R²	0.013	0.003	0.129	0.237
F	0.59	0.08	5.98***	4.54***
observations	88	82	29	81

Table 3. Problem-solving performance as a function of long-term patience (delta). Notes: OLS estimates. Dependent variables are displayed at the top of the columns. Robust SE clustered on individuals (column 1) or groups (columns 2 to 4) are presented in parentheses. All regressions control for session (either morning or evening). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

⁸ If we keep the 6 students belonging to the groups with two/four members in the regressions that explain group condition performance, the results do not change. Similar conclusions can be drawn if we control for the individual's age and gender in each regression or if we use different delay discounting characterizations (available upon request from the authors).

To explore the relationship between patience and cooperation in the intergroup competition context, we estimate the group's cooperative synergy as a function of the mean discount factor (separate regressions for beta and delta) of the group members while controlling for session (OLS regression with robust standard errors clustered on groups as independent observations). In order to avoid distortions in the estimations from the 32 initial groups, apart from the two groups with two/four members, we also excluded another group because the discount factors of two of its members could not be calculated (inconsistent choices in the discounting task) and thus the mean group patience equals the patience of only one member. The regressions were therefore performed with 29 final observations. Estimates are shown in column 3 of Tables 2 and 3. The effect of the (mean) beta discount factor is positive and significant ($p = 0.035$). A significantly positive effect on group synergy is found for the mean delta discount factor as well ($p = 0.036$), although the model's explanatory power is diminished as indicated by the respective R^2 values.⁹ This indicates that the effects of the two discount factors on group synergy are similar, although short-term discounting (i.e., beta) seems to be a slightly better predictor. The session dummy is not significant in any of the regressions ($ps > 0.38$).

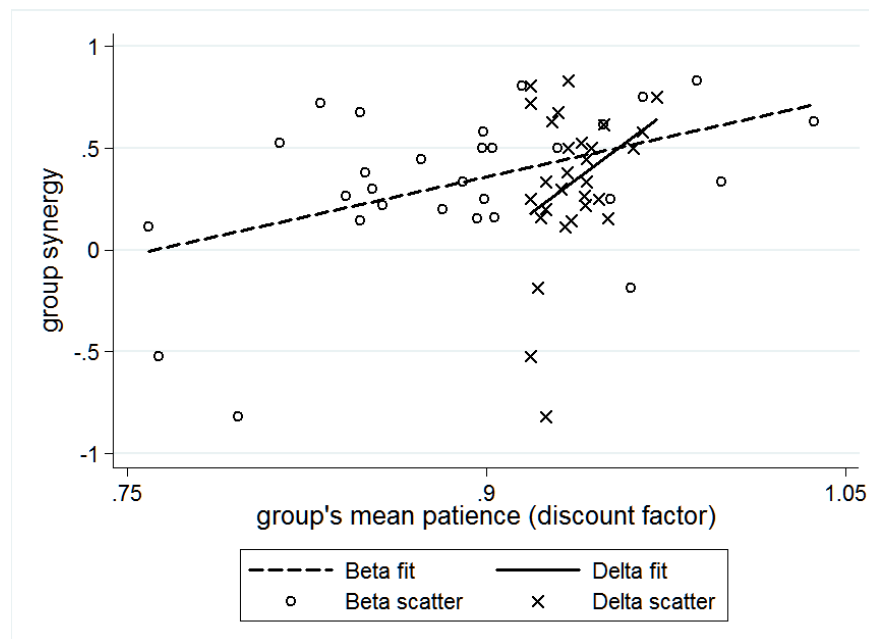


Figure 2. Group synergy as a function of group's mean patience ($n = 29$)

⁹ The results are similar when including the three excluded groups (beta: $p = 0.026$; delta: $p = 0.033$). Using the number of patient responses in the first and second block as a model-free characterization of short- and long-term discounting, respectively (as in Espín et al., 2013), yields very similar results as well. Finally, combining responses in both tasks to obtain a single-parameter discounting characterization—either exponential, hyperbolic, or model-free—leads to identical conclusions. All these analyses are available upon request from the authors.

Figure 2 displays scatter plots and linear fits corresponding to the relationship of group synergy with the mean beta (circle scatter, dashed line) and delta (cross scatter, solid line) discount factors. The graphical method largely corroborates the regression results. Therefore, groups whose members are more patient achieve a higher level of cooperative synergy, that is, they reach a higher group welfare relative to the initial “endowments”.

As a different approach to analyze the gains from group interactions, we estimate an individual’s score in the group condition as a function of (i) her discount factor, (ii) her score in the individual condition, (iii) the mean discount factor of the other two group members, and (iv) the mean score of the other two group members in the individual condition (OLS regression; standard errors are clustered on groups in order to allow for error correlations across individuals belonging to the same group). As before, the regressions control for session. Estimates are shown in column 4 of Tables 2 and 3 for models based on the beta and delta discount factors, respectively.¹⁰ As can be observed, once we account for the subject’s “capacity” (i.e., her score in the individual condition) and her partners’ mean patience and capacity, patience is positively related to performance in the group task. However, this effect is significant only when patience is measured through the beta discount factor ($p = 0.041$) but not when using the delta discount factor ($p > 0.58$). Moreover, the mean patience of the other two group members also exerts a positive effect on an individual’s performance in the group condition but, as before, this is only significant in the case of the beta discount factor (partners’ mean beta: $p = 0.053$; delta: $p > 0.67$).¹¹ Finally, as expected, both her own and her partners’ performance in the individual task are positive and significant predictors of an individual’s performance in the group task ($ps < 0.01$). These findings are consistent with what we showed above at the group level, except for the fact that the effects of long-term discounting are now largely insignificant.

Note, however, that the analyses in the latter statistical approach are not performed at the group but at the individual level. Therefore, patient individuals, although only as measured by the short-term discounting, perform *individually* better in the group condition once we account for the individual’s capacity and the characteristics of the other group members. Nevertheless, we interpret this result with caution (especially the complete lack of explanatory power of the long-

¹⁰ In these analyses, the participant for whose two partners we cannot calculate a reliable discount factor is also excluded.

¹¹ If we control for the subject’s age and gender, the results remain unchanged. The only noticeable variation is that the mean beta discount factor of the other two group members now turns significant at 5% ($p = 0.044$). Gender and age are not significant ($ps > 0.20$).

term discounting, which contrasts with the group-level results) since the incentives in the group task were related to the groups' mean scores, not to individual scores.

Patience and choices in the social preferences task

We have shown that groups of patient individuals performed relatively better than groups of impatient individuals, all else equal. But does this higher within-group cooperation associated with patience also imply that patient individuals are more susceptible to ingroup bias? If this were the case, patience might predict a higher propensity to develop negative preferences toward the members of other groups that lead to socially-inefficient behaviors. In this subsection, we address this issue.

Tables 4 and 5 display the outcomes of a series of ordered Probit regressions (robust standard errors clustered on groups are presented in parentheses) estimating the number of choices consistent with each type of social preference mentioned earlier (i.e., selfish, competitive/spiteful, efficiency and egalitarian)¹² as a function of the decision maker's delay discounting. We show the estimates for individuals' choices toward the *collective* in Table 4. In all regressions we control for session, as before, and for the subject's scores in both conditions. Since we find important effects of gender and age, we also include them as controls in the main regressions and report their coefficients. Finally, we also control for the feedback received by the individual regarding her own and her group partners' scores before completing the questionnaire (see Methods).¹³ However, we do not report the coefficients of the feedback variables because, as mentioned earlier, the analysis of their effects on decisions belongs to a different research project. In any case, although the models' power of fit generally increases with these control variables, their inclusion does not qualitatively affect the results on the relationship between patience and social preferences. Again, we excluded the two groups with two/four group members in order to keep decisions fully comparable across subjects; so the regressions were performed with 82 observations.

¹² Remember that, in this task, the choices predicted by spitefulness (and altruism, but inversely) coincide with those predicted by competitive preferences.

¹³ Specifically, we included one dummy variable taking the value of 1 if neither the subject's own scores nor those of any of her partners were published (zero otherwise) and another dummy taking the value of 1 if her scores were not published but those of any of her partners were (zero otherwise). This was done in order to capture the effect of knowing, at least approximately, her score in the group condition. Thus, the comparison group was composed of those subjects whose own scores were published.

Importantly, we do not find any significant effect when using the beta discount factor to characterize individuals' patience ($p > 0.10$ in all regressions; see Tables A1 and A2 in the Supplementary materials). For reasons of space, we only show the results of the regressions based on the long-term, delta discount factor in the main text.¹⁴

It can be seen from Table 4 that patience correlates significantly with only two types of social preferences when assigning points to the *collective*. Specifically, delta predicts negatively the number of *competitive/spiteful* choices ($p = 0.002$, column 2) that maximize the decision maker's relative standing by minimizing the counterpart's payoff,¹⁵ and positively the number of *efficiency* choices ($p = 0.018$, column 3) that maximize the joint surplus (i.e., social efficiency). On the other hand, neither *selfish* ($p > 0.69$, column 1) nor *egalitarian* ($p > 0.40$, column 4) choices are associated with patience.

dependent vars.:	selfish	compet/spite	efficiency	egalitarian
	(1)	(2)	(3)	(4)
delta	2.522 (6.415)	-14.957*** (4.771)	15.045** (6.339)	-5.829 (6.999)
group score	-0.058 (0.039)	-0.125* (0.069)	0.073 (0.060)	0.041 (0.045)
individual score	0.067 (0.059)	0.088 (0.070)	-0.072 (0.071)	-0.055 (0.059)
gender (male)	0.949*** (0.271)	-0.837*** (0.279)	1.324*** (0.268)	-0.784*** (0.222)
age (yr)	-0.120** (0.058)	0.025 (0.041)	-0.092** (0.041)	0.102** (0.051)
pseudo R²	0.132	0.126	0.171	0.109
chi²	30.484***	29.531***	65.124***	49.277***
ll	-76.550	-93.407	-78.397	-98.814
observations	82	82	82	82

Table 4. Patience (delta) and social preferences toward the collective. Notes: Ordered Probit estimates. Dependent variables are displayed at the top of the columns (number of choices consistent with each type of preference; *selfish*: up to two; *compet/spite* and *egalitarian*: up to four; *efficiency*: up to three). Robust SE clustered on groups are presented in parentheses. All regressions control for session (either morning or evening) and the feedback received regarding scores. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

¹⁴ When using either a model-free (given by the number of times the individual chose the larger-later reward in that block) or a hyperbolic characterization of long-term discounting, all the results reported below remain qualitatively similar. These analyses are available upon request.

¹⁵ Analogously, patience is positively associated with the number of *altruistic* choices that maximize the counterpart's payoff.

Given that some specific choices can be predicted by different types of preferences in our task, we checked the robustness of these results by controlling for other preferences in the regressions that explain a particular type of preference (the complete analyses are available upon request). When including the number of selfish and egalitarian choices as controls, the relationship of patience with both competitive/spiteful ($p = 0.003$) and efficiency ($p = 0.003$) choices remains significant. However, when controlling for efficiency (competitive/spiteful) choices, the relationship between patience and competitive/spiteful (efficiency) choices becomes insignificant ($ps > 0.44$). The latter result makes sense since in our task the choices predicted by these two types of preferences have considerable overlap (although in the opposite direction). Thus, we may conclude that patient individuals are both more cooperative and less competitive toward the collective than impatient individuals in the social preferences task. These results suggest that the negative feelings against the outgroup leading to socially-inefficient outcomes during intergroup competition are *less* prominent among patient individuals.

A visual impression of the nature of these relationships is given in Figure 3, where subjects are categorized according to the number of choices consistent with each type of preference toward the collective. The figure displays the mean delta discount factor for each category (error bars represent robust SEM clustered on groups). For visual clarity, categories with low frequencies are combined with the adjacent categories. Specifically, those subjects who never chose as predicted by competitive/spiteful (six subjects) or efficiency (three subjects) preferences are included in one category with those who made only one choice consistent with that particular preference (14 and 39, respectively). In addition, the three subjects who chose four times (i.e., everywhere) according to the predictions of competitive/spiteful preferences are combined with those making three such choices (19 subjects). The number of observations within each category is shown on top of the bars (note that no individual chose the unequal distribution—option B—in the four decisions, so there are no observations with zero egalitarian choices). For the combined categories we show the number of observations in each subcategory. It can be seen that mean patience decreases with the number of competitive/spiteful choices (red bars) and increases with the number of efficiency choices (blue bars), thus supporting the regression results. No clear pattern is observed for either selfish (yellow bars) or egalitarian (green bars) choices.

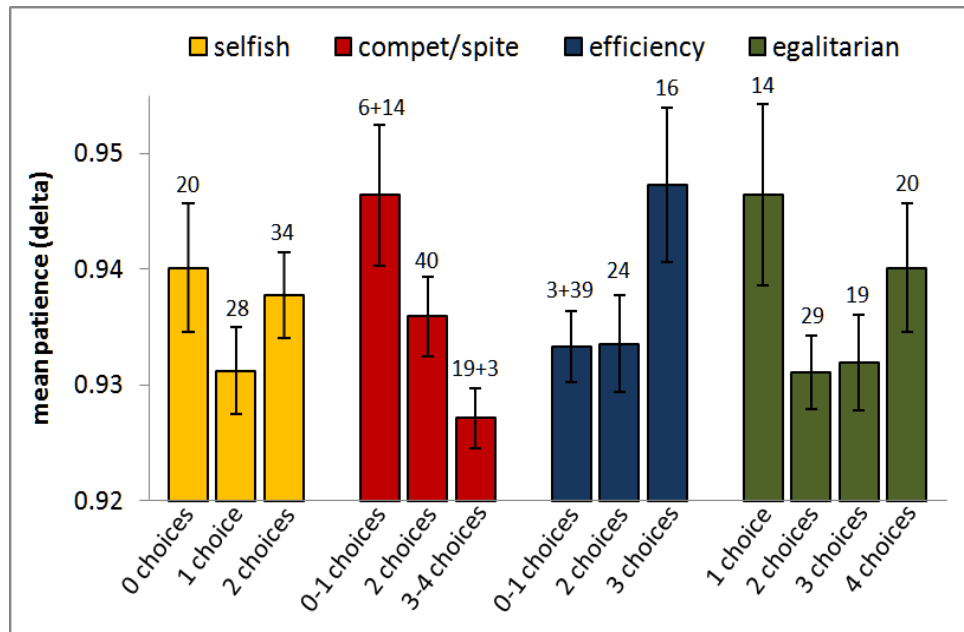


Figure 3. Patience (delta) and social preferences toward the collective

Regarding the control variables, Table 4 shows that the individual’s score in the group task is (marginally) significantly and negatively related with the number of competitive/spiteful choices, indicating that subjects who obtained higher scores treated the collective—and, implicitly, the outgroup—less negatively. In addition, gender and age are significant predictors in almost all regressions. Compared to females, males made more choices consistent with selfish and efficiency preferences and less choices consistent with competitive/spiteful and egalitarian preferences. However, when controlling for other preferences as a robustness check, only the effects of gender on competitive/spiteful and efficiency choices remain. Thus, we can conclude that, in our task, males are less competitive and more cooperative than females toward the collective. This result is in contrast to recent advances in evolutionary psychology (McDonald, Navarrete, & Van Vugt, 2012; Van Vugt, De Cremer, & Janssen, 2007; Van Vugt, 2009). Yet understanding the reasons behind such apparent deviation from the predictions of the “male warrior hypothesis” observed in our sample requires a more systematic analysis. Age, on the other hand, is negatively related to the number of selfish and efficiency choices and positively related to the number of egalitarian choices. Interestingly, the effect of age on competitive/spiteful choices is not significant. This indicates that, although these considerably overlap with (non-) efficiency choices in our task, the variables that explain one type of

preference do not necessarily explain the other type. Yet, none of these effects are fully robust to controlling for other preferences.

Table 5 replicates the regressions of Table 4 except for three differences. First, the dependent variables refer now to the choices consistent with each type of preference when assigning points to the *ingroup*. Since group partners were the recipients of the bonus points in two blocks of the task, the maximum number of choices consistent with each preference are twice those in the previous regressions. Second, the decision maker's rating about the cooperativeness of her group partners (i.e., *partners' cooperation*, from 1 "very uncooperative" to 5 "very cooperative"; see Methods) is now added to the regressions as a potentially important variable that may capture the reciprocal nature of decisions. Third, we present two regressions for each type of preference. The first regression (columns "a") captures the main effect of patience once controlling for the above variables, whereas we include the interaction between patience and partners' cooperation in the second regression (columns "b").

Before analyzing the effects of individuals' discounting on their choices toward the ingroup, let us note that the impact of group identity is indeed noticeable in our sample. Subjects turned significantly less selfish (mean choices per recipient: 0.902 ± 0.093 [SEM] vs. 1.171 ± 0.088 , SE of the difference [SED] = 0.074; $p = 0.001$, two-tailed signrank test), less competitive/spiteful (1.750 ± 0.094 vs. 1.988 ± 0.102 , SED = 0.098; $p = 0.007$) and more egalitarian (2.787 ± 0.124 vs. 2.549 ± 0.115 , SED = 0.085; $p = 0.004$) toward the ingroup compared to the collective. Interestingly, the mean number of efficiency choices is identical for ingroup and collective recipients (1.646 ± 0.092 in both cases, SED = 0.066; $p = 1.000$). Thus, subjects clearly adapted their decisions according to the identity of the recipient in the expected direction. Unexpectedly, however, this differential behavior toward their group partners does not directly translate into a larger number of efficiency choices that maximize the joint payoff.

Turning to the main effects of patience on preferences toward the ingroup, it can be observed from Table 5 that delta is a significant predictor in three out of four cases. Delta impacts positively on the number of *selfish* ($p = 0.032$, column 1a) and *efficiency* ($p = 0.029$, column 3a) choices and negatively on the number of *egalitarian* ($p = 0.010$, column 4a) choices. Interestingly, now patience does not significantly predict *competitive/spiteful* choices, although the sign is negative as before and is close to significance ($p = 0.105$, column 2a). When

controlling for egalitarian choices, however, the significant relationships of patience with the number of both selfish and efficiency choices vanish ($ps > 0.17$). Additionally, when the number of selfish (efficiency) choices is included as a control, the relationship between patience and efficiency (selfish) choices turns insignificant ($ps > 0.14$). Indeed, the only main effect of patience that survives the robustness checks is that on the number of egalitarian choices: it remains significant when controlling for either selfish, competitive/spiteful or efficiency choices ($ps < 0.05$). We can therefore conclude that patient individuals showed less egalitarian behavior than impatient individuals when assigning points to their group partners. Using the same format of Figure 3, Figure 4 provides a graphical representation of the relationship between patience and preferences toward the ingroup. It can be observed that the most patient subjects are indeed concentrated in the category that reflects the weakest egalitarian concerns.

dependent vars.:	selfish		compet/spite		efficiency		egalitarian	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
delta	16.111** (7.492)	-11.930 (15.546)	-7.793 (4.813)	37.943*** (10.940)	12.440** (5.685)	-31.608** (13.402)	-19.323*** (7.505)	4.453 (15.738)
partners' cooperation	-0.190* (0.113)	-7.203* (3.952)	-0.333*** (0.127)	11.355*** (3.176)	0.240** (0.117)	-11.053*** (3.943)	0.279** (0.113)	6.282* (3.645)
delta X part coop		7.476* (4.168)		-12.479*** (3.400)		12.057*** (4.204)		-6.397* (3.844)
group score	-0.025 (0.071)	-0.039 (0.075)	0.028 (0.051)	0.049 (0.043)	-0.029 (0.040)	-0.050 (0.039)	0.007 (0.060)	0.016 (0.061)
individual score	-0.071 (0.070)	-0.091 (0.074)	0.004 (0.042)	0.033 (0.047)	-0.029 (0.053)	-0.058 (0.056)	0.066 (0.064)	0.082 (0.069)
gender (male)	1.372*** (0.247)	1.458*** (0.274)	-0.687** (0.299)	-0.860*** (0.331)	1.133*** (0.270)	1.319*** (0.295)	-1.388*** (0.230)	-1.468*** (0.249)
age (yr)	-0.121*** (0.046)	-0.141** (0.055)	0.049 (0.045)	0.081* (0.048)	-0.094** (0.039)	-0.126*** (0.043)	0.135*** (0.042)	0.153*** (0.049)
pseudo R²	0.169	0.180	0.081	0.103	0.117	0.139	0.139	0.144
chi²	51.265***	41.772***	29.529***	39.443***	52.124***	47.644***	86.537***	82.682***
ll	-74.156	-73.193	-128.004	-124.943	-111.297	-108.518	-127.537	-126.741
observations	82	82	82	82	82	82	82	82

Table 5. Patience (delta) and social preferences toward the ingroup. Notes: Ordered Probit estimates. Dependent variables are displayed at the top of the columns (number of choices consistent with each type of preference; *selfish*: up to four; *compet/spite* and *egalitarian*: up to eight; *efficiency*: up to six). Robust SE clustered on groups are presented in parentheses. All regressions control for session (either morning or evening) and the feedback received regarding scores. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Arguably, the latter results say little about the reasons why groups with patient members achieved higher levels of synergy than groups of impatient individuals. It might be, however, that patience also impacts group behavior through reciprocity. Indeed, we find several significant main effects of the variable capturing the decision maker's perception about the cooperativeness of her partners during the task (i.e., *partner's cooperation*), thus indicating that reciprocity is an important driving force behind subjects' choices toward their group partners. Specifically, the more cooperative the group partners, the fewer the selfish and competitive/spiteful choices (although only marginally significant in the former case; columns 1a and 2a, respectively) and the more efficiency and egalitarian choices (columns 3a and 4a, respectively) toward them.

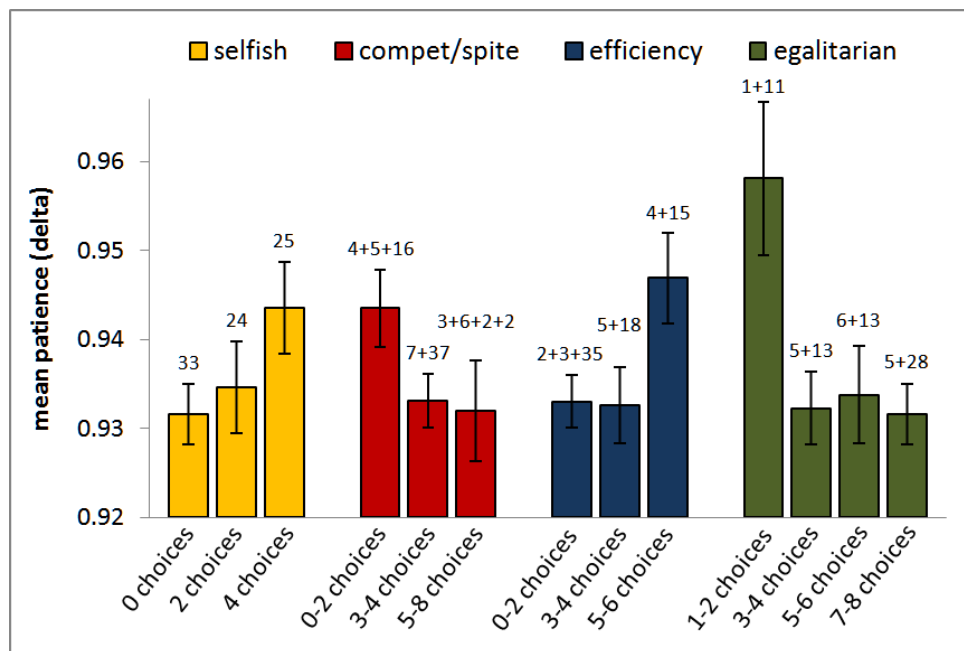


Figure 4. Patience (delta) and social preferences toward the ingroup

In order to explore whether patient individuals' choices are more or less based on reciprocal concerns than those of impatient individuals, we interacted delta with the cooperativeness of the group partners. The interaction term yielded significant estimates in all four regressions. The interaction effect is highly significant in the regressions estimating the number of competitive/spiteful ($p < 0.001$, column 2b) and efficiency ($p = 0.004$, column 3b) choices, but it is only marginally significant in explaining selfish ($p = 0.073$, column 1b) and egalitarian choices

($p = 0.096$, column 4b).¹⁶ Indeed, the first two effects are robust to controlling for selfish and egalitarian choices ($ps < 0.012$) but, as before, not to controlling for each other ($ps > 0.19$). Once we control for either competitive/spiteful or efficiency choices, however, the interaction effect on selfish and egalitarian choices turns insignificant ($ps > 0.19$). So, from now on, we focus on the former significant interaction effects (on compet/spite and efficiency) since the latter (on selfish and egalitarian) are not robust.

Wald tests performed on the interaction coefficients of Table 5 reveal that the partners' cooperation does not significantly affect the number of either competitive/spiteful or efficiency choices made by the most impatient subjects (i.e., $\text{delta} = 0.918$; compet/spite: $\text{coeff.} = -0.105$, $p > 0.43$; efficiency: $\text{coeff.} = 0.020$, $p > 0.88$) but that it is a strong predictor of the number of such choices made by the most patient subjects (i.e., $\text{delta} = 0.989$; compet/spite: $\text{coeff.} = -0.990$, $p < 0.001$; efficiency: $\text{coeff.} = 0.875$, $p < 0.001$). Therefore, only sufficiently patient individuals are responsive to the cooperativeness of their partners when assigning points to them, thus apparently showing a reciprocal disposition. Moreover, when the partners had been very uncooperative (i.e., partners' cooperation takes the value of 1), delta predicts positively the number of competitive/spiteful choices—so it predicts negatively the number of altruistic choices—($\text{coeff.} = 25.464$, $p = 0.001$) and negatively the number of efficiency choices ($\text{coeff.} = -19.550$, $p = 0.040$). On the other hand, when the partners had been very cooperative (i.e., partners' cooperation takes the value of 5), delta is associated negatively with the number of competitive/spiteful choices ($\text{coeff.} = -24.450$, $p = 0.001$) and positively with the number of efficiency choices ($\text{coeff.} = 28.679$, $p = 0.002$). In sum, patient individuals seem to be more willing than impatient individuals to punish uncooperative partners (negative reciprocity) and reward cooperative partners (positive reciprocity). Since both negative and positive reciprocity are considered to be important catalysts for the establishment of human cooperation (Fehr & Gächter, 2002; Rand, Dreber, Ellingsen, Fudenberg, & Nowak, 2009; Rand & Nowak, 2013), we argue that such a reciprocal disposition might indeed constitute a key mechanism underlying the positive effect of patience on the synergies of group interactions.

As a final exercise, the effects that survived the above robustness checks on ingroup choices (i.e., the main effect on egalitarian choices and the interaction effect on

¹⁶ Due to the complex interpretation of interaction effects in non-linear models (Ai & Norton, 2003), we replicated the interaction regressions with OLS: the significance levels remain nearly identical.

competitive/spiteful and efficiency choices) are checked again by controlling for the number of choices the individual made toward the collective that are consistent with that specific type of preference. Both the interaction effects on competitive/spiteful ($p = 0.003$) and efficiency ($p = 0.011$) choices and the main effect on egalitarian choices ($p < 0.001$) remain significant.

Finally, regarding the control variables, Table 5 shows that the effects of gender and age are very similar to those found in Table 4. Hence, these variables do not seem to reflect the differences between subjects' choices toward the ingroup and those toward the collective. The subjects' scores in the individual or the group task do not yield significant estimates.

DISCUSSION

We find no direct relationship between patience and performance (scores) at the individual level in any of the competition conditions. However, there is a positive relationship between the mean patience of the members of a group and the group's cooperative synergy. This finding indicates that patience works as a spur to the synergetic benefits of group interactions also during intergroup conflict. Additionally, we find evidence that an individual's score in the group task, *once* the individual capacity (as measured during the individual task) of the three group members is accounted for, is predicted independently and additively by the individual's and partners' patience. While the group-level significant result holds for both elicited discount factors, the latter result, at the individual level, is significant only for the short-term, beta discount factor (i.e., present bias) and not for the long-term, delta discount factor.

Arguably, the incentive structure and the rules of the intergroup competition task may make the essence of group interactions more similar to a repeated social dilemma game, where repetition can coordinate individual and group interests in the long-run (e.g., Axelrod, 1984; Fudenberg & Maskin, 1986) than to a one-shot game where individual and group interests are clearly confronted. Whether within-group cooperation in our task is really an individually costly behavior is therefore unclear but, in any case, sufficient patience seems to be required to suppress within-group competition in order to achieve such a long-run coordinated outcome. In this sense, our results may resemble Al-Ubaydli et al.'s (2013) observation that the mean patience of a playing pair positively covaries with the ability of its members to coordinate on the cooperative, socially-efficient outcome during a finitely *repeated* stag-hunt game. Similarly, Harris and

Madden (2002), and Yi et al. (2005, 2007) found that patience predicts cooperation in a finitely *repeated* prisoner's dilemma versus a tit-for-tat strategy. Extending the present findings to the typical experimental design of social dilemma games with intergroup competition, where the players' individual contributions to the group can be scrutinized and the length of the interactions can be manipulated, is an interesting endeavor for future research.

We also show that patience is positively associated with the number of efficiency and altruistic choices when assigning points to unknown classmates (the collective) in the social preferences task. This result suggests that the relationship between patience and the collective interest (i.e., cooperation) is not merely related to the expectation of future personal returns linked, for instance, to others' reciprocal behavior. This is possibly in line with Curry et al.'s (2008) finding that patience correlates positively with contributions in a *one-shot* public goods game. Yet this does not imply that impatience predicts more selfish choices but rather more competitive/spiteful choices that reduce social welfare. Similar results have been found using non-student samples in a *one-shot* ultimatum game (Espín et al., 2013) and a *one-shot* public goods game with punishment (Espín et al., 2012), where impatience appears to be related to competitive, but not selfish behavior. Thus, our findings are consistent with the view that the intertemporal conflict underlying the connection between discounting and social behavior is not merely based on a trade-off between immediate and delayed material rewards: the psychological satisfaction that people derive from non-material values (which arguably function as a motivational driver of social decision making; see Ruff and Fehr (2014) for a recent overview) linked to competitive short-run goals and prosocial long-run goals may also play a crucial role (Espín et al., 2012, 2013).

From the subjects' choices in the social preferences task we infer that the negative collateral effects of intergroup competition (i.e., outgroup hate that eventually leads to destructive, socially-inefficient behaviors; see Abbink et al. (2010), Brewer (1999), Goette, Huffman, Meier, and Sutter (2012), among others) are more evident among impatient than patient individuals. In other words, the positive effects of patience on within-group cooperation during intergroup conflict seem to be emanating from factors other than an enhanced ingroup bias.

When assigning points to the ingroup, patience is associated negatively with the number of egalitarian choices and, if the other group members had been uncooperative (cooperative) during

the group task—as self-reported by the decision maker—associated positively with the number of competitive/spiteful (altruistic and efficiency) choices. The latter result is in line with Espín et al.'s (2012) finding that patient individuals are more likely to engage in “altruistic” punishment of cheating group members in a *one-shot* public goods game. Peer punishment is considered to be a powerful instrument to enforce human cooperation and therefore a group-beneficial behavior (e.g., Fehr & Gächter 2002, Gächter et al., 2008). Indeed, there is evidence that the effectiveness of peer punishment for benefiting the group may increase in environments of intergroup competition (Sääksvuori, Mappes, & Puurtinen, 2011). More patient individuals might thus be more willing to use reciprocal or “strongly reciprocal” (Gächter & Herrmann, 2009; Gintis, 2000) strategies to enforce within-group cooperation, even if this goes against strict within-group equality. To put it differently, the use of equity versus equality norms to allocate resources among group members might distinguish patient from impatient individuals.

The negative relationship between patience and egalitarian choices toward the ingroup, which to the best of our knowledge has not been documented before, is of great interest since it suggests that the short-run goals associated to social interaction (Espín et al., 2013) may dramatically change when group identity is made salient. Future research is warranted to examine the possible mediating or interacting role of social identity on the relationship between delay discounting and social behavior in different scenarios, such as the ultimatum game or the public goods game with punishment. For instance, if these results can be extended to the one-shot ultimatum game, then the competitive/spiteful behavioral patterns observed among impatient subjects in both roles of the game (i.e., rejecting low offers as responder *and* proposing low offers as proposer) when playing against an unknown partner (Espín et al., 2013) might become equality-seeking patterns with an ingroup counterpart.

Importantly, however, subjects' behavior in the social preferences task is predicted by the long-term, delta discount factor but not by the short-term, beta discount factor. It would be interesting for future research to provide an in-depth analysis of such differential effects, which might have to do with the presence or absence of a prepotent response/impulse that has to be inhibited (behavioral inhibition guided by executive control appears to be related to short-term but not long-term discounting measures; see Figner et al., 2010).

Taken together, these results corroborate a general tendency of patient individuals to engage in cooperative/non-competitive acts but, at the same time, they also underscore the complexity of the relationship between intertemporal preferences and social behavior. In sum, from the social preferences findings we infer that the channels through which patience improves group performance during intergroup competition may importantly rely on reciprocity-based behaviors such as punishing defectors and/or rewarding cooperators. Nevertheless, such positive effects of patience on within-group cooperation are apparently *not* linked to a more prominent ingroup bias.

Apart from the aforementioned implications for our understanding of the psychological underpinnings of intergroup conflicts, these findings can also be useful from the point of view of organizational design and applied educational research. Our results suggest that managers and educators may improve the efficiency of teamwork by allocating individuals into groups with optimal composition in terms of members' delay discounting. Finally, in light of the abundant empirical and theoretical literature indicating that cooperative classroom interactions enhance educational attainment (Johnson, Johnson, & Smith, 2007; Johnson & Johnson, 2009; Kyndt et al., 2013; Slavin, 1983), we conjecture that patient individuals' successful involvement in cooperative academic endeavors may in part mediate the widely documented relationship between patience and academic performance (Duckworth & Seligman, 2005; Duckworth et al., 2010; Kirby et al., 2005; Mischel et al., 1989; Shoda et al., 1990). Confirming this causal relationship, however, requires the use of longitudinal methods able to avoid third-variable confounds (Duckworth et al., 2010).

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Supplementary materials for

**Patience predicts within-group cooperation in an ingroup
bias-free way**

Antonio M. Espín, Manuel Correa & Alberto Ruiz-Villaverde

Appendix Tables

dependent vars.:	selfish (1)	compet/spite (2)	efficiency (3)	egalitarian (4)
beta	-1.597 (1.384)	1.500 (1.302)	-2.284 (1.408)	0.770 (1.128)
group score	-0.045 (0.040)	-0.138* (0.076)	0.101 (0.067)	0.030 (0.049)
individual score	0.062 (0.059)	0.092 (0.071)	-0.081 (0.073)	-0.050 (0.061)
gender (male)	0.916*** (0.277)	-0.787*** (0.273)	1.252*** (0.280)	-0.763*** (0.219)
age (yr)	-0.142** (0.056)	0.050 (0.049)	-0.126*** (0.044)	0.118** (0.048)
pseudo R²	0.138	0.098	0.151	0.106
chi²	35.304***	24.311***	47.186***	50.122***
ll	-76.056	-96.339	-80.263	-99.177
observations	82	82	82	82

Table A1. Patience (beta) and social preferences toward the collective. Notes: Ordered Probit estimates. Dependent variables are displayed at the top of the columns (number of choices consistent with each type of preference; *selfish*: up to two; *compet/spite* and *egalitarian*: up to four; *efficiency*: up to three). Robust SE clustered on groups are presented in parentheses. All regressions control for session (either morning or evening) and the feedback received regarding scores. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

dependent vars.:	selfish		compet/spite		efficiency		egalitarian	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
beta	-0.658 (1.528)	-11.836 (8.414)	-0.426 (1.110)	0.343 (6.193)	-0.048 (1.012)	-4.623 (5.921)	0.691 (1.302)	10.722 (9.101)
partners' cooperation	-0.204* (0.111)	-2.569 (1.740)	-0.316** (0.125)	-0.151 (1.336)	0.208* (0.116)	-0.766 (1.274)	0.296*** (0.111)	2.434 (1.889)
beta X part coop		2.613 (1.868)		-0.181 (1.428)		1.076 (1.359)		-2.361 (2.044)
group score	-0.009 (0.073)	-0.010 (0.070)	0.026 (0.061)	0.026 (0.061)	-0.019 (0.048)	-0.020 (0.047)	-0.013 (0.063)	-0.013 (0.060)
individual score	-0.078 (0.075)	-0.086 (0.075)	0.002 (0.042)	0.003 (0.043)	-0.028 (0.056)	-0.031 (0.056)	0.073 (0.070)	0.079 (0.070)
gender (male)	1.257*** (0.253)	1.279*** (0.262)	-0.691** (0.294)	-0.692** (0.299)	1.113*** (0.270)	1.124*** (0.278)	-1.275*** (0.261)	-1.297*** (0.270)
age (yr)	-0.141*** (0.048)	-0.151*** (0.056)	0.051 (0.043)	0.052 (0.044)	-0.104*** (0.034)	-0.108*** (0.037)	0.159*** (0.042)	0.170*** (0.050)
pseudo R²	0.134	0.144	0.074	0.074	0.097	0.099	0.103	0.109
chi²	45.357***	48.687***	29.614***	29.525***	65.247***	64.199***	46.784***	47.908***
ll	-77.296	-76.400	-128.997	-128.992	-113.736	-113.561	-132.826	-131.992
observations	82	82	82	82	82	82	82	82

Table A2. Patience (beta) and social preferences toward the ingroup. Notes: Ordered Probit estimates. Dependent variables are displayed at the top of the columns (number of choices consistent with each type of preference; *selfish*: up to four; *compet/spite* and *egalitarian*: up to eight; *efficiency*: up to six). Robust SE clustered on groups are presented in parentheses. All regressions control for session (either morning or evening) and the feedback received regarding scores. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix A1

Practical class session.
Units 5,6 and 7.

Degree in Business Administration

Today's class will be divided into two sessions. The instructions for session II will be provided later once session I has finished.

INSTRUCTIONS FOR SESSION I

On the back of this sheet you will find a list of 3 numerical exercises corresponding to units 5, 6 and 7 of the course syllabus. While performing this activity you must not communicate with any of your classmates. You have 40 minutes to provide your results.

You will be able to earn a bonus of up to 1 point toward your overall final grade in the course. Here are the rules:

Once the exercises have been scored, a ranking will be made. The **top 15 students with the best scores** will get a bonus. The distribution of bonus points will be as follows:

- (*) 1 point for each of the three students obtaining the top three scores
- (*) 0.75 points for the six students obtaining the 4th-9th scores
- (*) 0.5 points for the six students obtaining the 10th-15th scores.

In the event of a tie, the order in which the assignments are submitted will be considered for the ranking.

Please do not turn over the page until instructed by your teacher.

Good luck!!

Microeconomics

Business Administration

Practical class session.
Units 5,6 and 7.

Degree in Business Administration

INSTRUCTIONS FOR SESSION II

On the back of this sheet you will find a list of 3 numerical exercises corresponding to units 5, 6 and 7 of the course syllabus. For this session, students will be randomly arranged into three-person groups. While performing this activity you can communicate only and exclusively with the members of your group. You have 40 minutes to provide your results.

You will be able to earn a bonus of up to 1 point toward your overall final grade in the course. Here are the rules:

(* The three members of the group whose members' achieved the highest mean score will earn 1 bonus point.

(* The six members of the two groups with the 2nd and 3rd highest mean score will earn 0.75 bonus points

(* The six members of the groups ranking 4th and 5th will earn 0.5 bonus points.

In the event of a tie, the order in which the assignments are submitted will be considered for the ranking.

Please do not turn over the page until instructed by your teacher.

Good luck!!

Microeconomics

Business Administration

Appendix A2

PART III – BONUS ASSIGNMENT

In the next part of the questionnaire, you must make a series of 12 decisions on how you would assign bonuses for you and other students to be counted toward the overall final grade.

The decisions are completely independent from each other and there are no right or wrong decisions. You must make the decisions that you really prefer in every situation, regardless of what you have decided or are going to decide in the others.

The decisions that you are going to make are fictitious: they have no real consequences. However, please respond as honestly as possible, as though the consequences of your decisions were real.

Your decisions, like the rest of the questionnaire, will be treated anonymously and will not be disclosed under any circumstances to other students.

This part consists of 3 blocks of questions. It is 3 groups of 4 identical decisions, in which only the recipient of the bonus points you assign varies.

Mark the option you prefer in each decision

BLOCK 1

In this block, another student chosen randomly from the class will receive the bonus points.

Decision 1

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 0 bonus points for the other student

Decision 2

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 1 bonus point for you and 0 bonus points for the other student

Decision 3

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 1 bonus point for the other student

Decision 4

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.75 bonus points for you and 1 bonus point for the other student

BLOCK 2

In this block and the following one, one out of the two students from your working group will receive the bonus points.

Please, type the name of the student who is going to receive the bonus points in the next four decisions:_____ (leave the space blank if you do not remember the person's name)

Decision 1

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 0 bonus points for the other student

Decision 2

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 1 bonus point for you and 0 bonus points for the other student

Decision 3

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 1 bonus point for the other student

Decision 4

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.75 bonus points for you and 1 bonus point for the other student

BLOCK 3

In this block, the other member of your working group will receive the bonus points.

Please, type the name of the student who is going to receive the bonus points in the next four decisions:_____ (leave the space blank if you do not remember the person's name)

Decision 1

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 0 bonus points for the other student

Decision 2

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 1 bonus point for you and 0 bonus points for the other student

Decision 3

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.5 bonus points for you and 1 bonus point for the other student

Decision 4

- 0.5 bonus points for you and 0.5 bonus points for the other student
- 0.75 bonus points for you and 1 bonus point for the other student

Appendix A3

PART IV – ADDITIONAL INFORMATION (1)

In the next part of the questionnaire, you must take a series of 20 decisions on whether you would prefer to receive an amount of money sooner as opposed to later.

The decisions are completely independent from each other and there are no right or wrong decisions. You must make the decisions that you really prefer in every situation, regardless of what you have decided or are going to decide in the others.

The decisions that you are going to make are fictitious: they have no real consequences. However, please respond as honestly as possible, as though the consequences of your decisions were real.

Your decisions, like the rest of the questionnaire, will be treated anonymously and will not be disclosed under any circumstances to other students.

Mark the option you prefer in each decision

BLOCK 1

Decision 1

Receive €30 today OR €30 in 1 month's time

Decision 2

Receive €30 today OR €32 in 1 month's time

Decision 3

Receive €30 today OR €34 in 1 month's time

Decision 4

Receive €30 today OR €36 in 1 month's time

Decision 5

Receive €30 today OR €38 in 1 month's time

Decision 6

Receive €30 today OR €40 in 1 month's time

Decision 7

Receive €30 today OR €42 in 1 month's time

Decision 8

Receive €30 today OR €44 in 1 month's time

Decision 9

Receive €30 today OR €46 in 1 month's time

Decision 10

Receive €30 today OR €48 in 1 month's time

BLOCK 2

Decision 1

Receive €30 in 1 month's time OR €30 in 7 months' time

Decision 2

Receive €30 in 1 month's time OR €32 in 7 months' time

Decision 3

Receive €30 in 1 month's time OR €34 in 7 months' time

Decision 4

Receive €30 in 1 month's time OR €36 in 7 months' time

Decision 5

Receive €30 in 1 month's time OR €38 in 7 months' time

Decision 6

Receive €30 in 1 month's time OR €40 in 7 months' time

Decision 7

Receive €30 in 1 month's time OR €42 in 7 months' time

Decision 8

Receive €30 in 1 month's time OR €44 in 7 months' time

Decision 9

Receive €30 in 1 month's time OR €46 in 7 months' time

Decision 10

Receive €30 in 1 month's time OR €48 in 7 months' time