Patience and Time Consistency in Collective Decisions*

Laurent Denant-Boemont[†], Enrico Diecidue[‡], Olivier l'Haridon[§]

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Abstract

We present experimental evidence regarding individual and group decisions over time. Static and longitudinal methods are combined to test four conditions on time preferences: impatience, stationarity, age independence, and dynamic consistency. Decision making in groups should favor coordination via communication about voting intentions. We find that individuals are neither patient nor consistent, that groups are both patient and highly consistent, and that information exchange between participants helps groups converge to stable decisions. Finally we provide additional evidence showing that our results are driven by the specific role of groups and not by either repeated choices or individual preferences when choosing for other subjects.

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[†]University Rennes 1 - CREM, Place Hoche, Rennes, France, email: laurent.denant-boemont@univ-rennes1.fr.

[‡]INSEAD, Boulevard de Constance, Fontainebleau, France, email: enrico.diecidue@insead.edu.

[§]University Rennes 1 - CREM, Place Hoche, Rennes, France: olivier.lharidon@univ-rennes1.fr.

1 Introduction

1.1 Overview

Economic models usually assume that individuals and organizations are rational in their choices over time. Efficient decisions require that two central conditions on time preferences be satisfied: stationarity and dynamic consistency (Strotz, 1955; Bleichrodt et al., 2009). These conditions are necessary for consistency in the choices both of an individual decision-maker (Halevy, 2015) and of several individuals coordinating on a group intertemporal decision (Jackson and Yariv, 2014), and the same consistency conditions must also be satisfied by any policy maker (Caplin and Leahy, 2004). Households, boards, committees, and teams typify groups that need to deliberate and coordinate their actions on important decisions with a time dimension. Examples of such decisions include retirement and saving decisions, education and health care, investment decisions, providing effort and public goods, and building reputations.

Behavioral research on group decision making has shown that groups are more likely to make rational choices whereas individuals are more likely to behave as if boudedly rational (Cooper and Kagel, 2005; Charness and Sutter, 2012; Maciejovsky et al., 2013). Hence the expectation is that intertemporal decisions are more consistent, and thus more efficient, when made by a group than by an individual. For example, Charness and Sutter (2012) suggest that an individual subject to dynamic inconsistency in saving for retirement might achieve a better retirement outcome through participation in group decision making. Such participation could result in a better intertemporal decision whose benefits might compensate for the costs involved in delegating part of the decision.

There is little empirical evidence on group decision making in intertemporal choice. Even so, numerous theoretical papers are devoted to group decision making and the aggregation of time preferences. Under that aggregation, these papers predict that a collective decision process will most likely result in *inconsistent* choices over time even if group members are individually consistent (Gollier and Zeckhauser, 2005; Jackson and Yariv, 2015). Empirical evidence on the aggregation of time preferences supports this view. For instance, (Jackson and Yariv, 2014) show that a large majority of subjects acting as social planners are present-biased and that only 2% of them exhibit consistent behavior.

The within-subject experiment described in this paper yields new lab evidence on the outcome resulting from individual and collective decisions over time in a within-subject experiment. We combined static and longitudinal experimental methods to address the issue of stationarity and consistency of time preferences. Specifically, we tested four conditions on time preferences at the individual and group level: impatience, stationarity, age independence, and dynamic consistency. For group decisions, we designed a coordination mechanism based on majority voting preceded by a deliberation phase among the participants.

Our main results are as follows. In line with the existing literature on intertemporal choice, individuals were impatient and tended to deviate from consistent behavior. In contrast, groups typically made patient and highly consistent decisions; these decisions were based on majority voting after a long sequence of information exchange between group members through a series of straw polls. We observed that our coordination mechanism helped the groups to converge and to make both stable and dynamically consistent decisions. Because our results could have been driven by several confounding factors, we also implemented a series of additional treatments. These robustness checks showed that no such factors (i.e., repetition, voting, or choosing for others) can explain the high degree of patience and consistency displayed by the groups in our experiment.

1.2 Literature Review

Following Samuelson (1937) and Fishburn and Rubinstein (1982), a large part of the theoretical literature on time preferences builds on discounted utility and additively separable functional forms that assume a separation between value and delay in assessing temporal sequences of outcomes. A typical example is the exponential discounting utility model, which assumes stationarity of time preferences and serves as the workhorse of many economic models. The discounted utility model's representation of time preferences also facilitates the use of empirical measurements. With an extra assumption on the linearity of utility, measures of discount factors and discount rates can be carried out by way of simple experiments (Thaler, 1981; Coller and Williams, 1999). If one instead assumes nonlinear utility then measurements become more sophisticated but also more complex (Andreoni and Sprenger, 2012). All these measures share the potential descriptive limitations of the discounted utility model. If that model misrepresents time preferences, then so do the measurements based on that model. An alternative route is proposed by Rohde (2010) and by Halevy (2015). These authors demonstrate that several basic properties of time preferences - including conditions on stationarity, dynamic consistency, and age independence - can be inferred empirically from direct conditions on preferences and *without* committing to a specific functional representation of preferences. Our experiment follows that route and focuses on the basic conditions of choice over time without assuming any particular functional form.

The empirical literature on time preference has elicited an extremely wide variety of discount rates. Frederick et al. (2002) report elicited discount rates ranging from less than 1% (Thaler, 1981) to more than 1,000% (Holcomb and Nelson, 1992). Moreover, individuals often exhibit present-bias and thereby violate stationarity (Benzion et al., 1989; Kirby and Maraković, 1995; Bleichrodt and Johannesson, 2001; DellaVigna, 2009). Stationarity is the key axiom underlying the discounted utility model's standard hypothesis of a constant discount rate. A decision exhibits 'stationarity' when it does not change in response to receipt periods that are changed by the same delay. Stationarity should be distinguished from 'dynamic consistency', which means that a decision regarding the future made at one time is not changed at a later time. Testing for dynamic consistency therefore requires a longitudinal experimental design (Sayman and Öncüler, 2009), a requirement that explains the relative scarcity of experimental studies devoted to dynamic consistency. Those that do exist report mixed results. Giné et al. (2014) observe that 65% of study participants were dynamically inconsistent in a framework where they were reminded of their past choices and Kang and Ikeda (2014) report non-negligible time-variations in longitudinal survey measures of time preferences. On the other hand, Sayman and Öncüler (2009) find no evidence in favor of time inconsistency for short delays. Halevy (2015) reported that 48% of the subject were time-consistent.

Evidence on group choice over time mainly concerns impatience. Available studies suggests that groups are more patient than their individual members. For example, individuals are more patient when making a joint decision with a partner than when making a decision for themselves. This statement hods whether the group consists of a decision-making real-life couple (Carlsson et al., 2012) or an experimental 'artificial' couple (Shapiro, 2010). Carlsson et al. (2012) also find that couple-made decisions violate stationarity. For larger groups, collective patience has been reported in groups of three to seven people (Shapiro, 2010; Denant-Boemont and Loheac, 2011).

Coordination mechanisms are central to group decision making. The most frequently used mechanisms in experiments are majority voting and unanimity. For example, Denant-Boemont and Loheac (2011) implement an unanimity rule in collective choice over time and find that it generates more patient choices than does majority voting. Unanimity does have some undesirable features, however. First, the length of the decision process is unknown; it changes from group to group and possibly from decision to decision. Accommodation is key to arriving at a unanimous group decision, and the number of rounds needed to reach that stage is indeterminate. Moreover, as shown by Viscusi et al. (2011), the extent of accommodation is greater with majority than with unanimous decisions. Second, Gerardi and Yariv (2007) have shown that unanimity restricts the domain of possible outcomes that can be implemented and eliminates some possible outcomes that could be achieved by other intermediate coordination mechanisms, such as the simple-majority voting rule. In general, majority voting alone will not achieve efficiency. Goeree and Yariv (2011) show experimentally that collective deliberation can affect collective choice under various voting mechanisms. More precisely, voting without deliberation tends to make voters more strategic, in which case voting is more contingent to institutional rules. At the opposite extreme, unrestricted deliberation among group members made communication a more important issue than the issues being voted on. This result suggests that a majority-vote collective decision process with initial communication over voting intentions may help participants coordinate more effectively on a collective choice. Our experiment implements just such a collective decision process for choice over time.

The paper proceeds as follows. Section 2 presents the setting of the experiment and provides a theoretical background on time preferences. Section 3 summarizes the experimental results, and Section 4 concludes.

2 Background and Experimental Design

The purpose of the experiment was to compare the results achieved by outcomes resulting from collective and individual decisions over time. In a protocol similar to the one used by Halevy (2015) for individual decision making, we combined six indifference tasks to test four conditions on time preferences: impatience, stationarity, age independence, and dynamic consistency. We recruited 60 subjects from University of Rennes, France, and asked them to state their preferences between different pairs of timed outcomes in three regularly spaced experimental sessions. Each pair of timed outcomes proposed a choice between a smaller-sooner option and a larger-later one. Half of the decisions were individual ones and half of the decisions were collective. Experimental instructions are described in Appendix B

2.1 Experimental Tasks

Decisions

We consider the decision maker - either an individual or a group - faced with choosing between timed outcomes. A timed outcome (t, x) results in the receipt of a positive monetary outcome $x \in X^+$ at date $t \in T$, where X^+ represents the set of consequences and T the set of future dates. The purpose of the experimental tasks was to elicit indifference values between a smaller-sooner time outcome and a larger-later one. We therefore use s with reference to the most immediate (smaller-sooner) reward and ℓ with reference to the most delayed reward (larger-later). Indifference values were elicited through a series of choice questions in order to determine the sooner outcome (s, x) for which a subject was indifferent with a later outcome (ℓ, y). This procedure is known to yield more reliable indifference values than do procedures that ask directly for values (Bostic et al., 1990; Noussair et al., 2004). It also corresponds to the usual practice in the literature (for a review, see Takeuchi (2011)). Outcome y was kept constant during elicitation and across sessions, and was equal to €100 in individual decisions and €500 in collective decisions. For each pair of timed outcomes, subjects were faced with a choice between a series of timed outcomes, option A (the larger-later outcome) and option B (the smaller-sooner outcome). Each subject was asked , immediately after switching from one option to the other, to express indifference between the two options. For this purpose, the screen displayed a scrollbar (see Appendix C, Figure 5), that enabled subjects to specify their indifference points up to €1 level of precision.

The elicitation process was repeated for each elicited indifference. Table 1 shows the six indifferences elicited at the levels of individual and of collective decisions across the three experimental sessions (This table is discussed in more detail in Section 2.2.). Indifferences elicited for five-member groups were similar, except for the later €100 outcome, which was multiplied by a factor of 5. To control for order effects between individual and collective tasks, individuals preceded groups in two-thirds of the sessions and the reverse order was implemented in the remaining one-third of sessions.

Session 1 (t)	Session 2 ($t+\Delta$)	Session 3 ($t+2\Delta$)
$(s, x_1^1) \sim_t (\ell, y)$	$(s+\Delta, x_2^1) \sim_{t+\Delta} (\ell+\Delta, y)$	$(s+2\Delta, x_3^1) \sim_{t+2\Delta} (\ell+2\Delta, y)$
$(s+\Delta, x_1^2) \sim_t (\ell+\Delta, y)$	$(s+2\Delta, x_2^2) \sim_{t+\Delta} (\ell+2\Delta, y)$	
$(s, x_1^3) \sim_t (\ell+\Delta, y)$		

Table 1: Elicited indifferences in each session (decision time in parentheses).
Each indifference is elicited by varying the sooner outcome until it reaches the indifference value; $y = 100$, $\Delta = \ell = 4$ weeks, $s =$ day of the first session. Rewards were paid out after a one-day waiting period.

Coordination Mechanism for Group Decisions

Within a given set of sessions, each subject participated in both individual and group decision making. For group decisions, participants were aware from the beginning that any group decision would be reached by a majority rule and would lead to an 'equal sharing of rewards' rule. Each subject was randomly matched with four other subjects at the beginning of the first session. We used a so-called partner-matching design: each group remained the same during the entire experiment. Before reaching a collective decision, group members were allowed to exchange information on their preferences. The procedure took the form of a sequence of four successive straw polls. Before each poll, every subject declared (to the other group members) his own indifference value x such that $(s, x) \sim_t (\ell, y)$; this indifference value corresponds to collective outcomes x and y being equally shared among group members. At each step in the sequence, subjects were informed of all members' indifference values resulting in a straw poll. Group members thus had four opportunities to indicate their favorite option.

The information each subject received at the end of each sequence is displayed in Figure 7 in the Appendix. The identity of each group's member was referred to by a color (brown, blue, purple, grey and beige). The colors remained the same for a given collective choice, but they were changed randomly between sequential vote processes in order to ensure anonymity and preclude any reputation effects.

In the last step of the collective decision process, subjects were required to choose collectively: they had to reach an agreement by majority voting. At the end of the fifth sequence, the indifference amounts for the most immediate reward were ranked (under the majority rule) from the lowest to the highest. The median value — that is, the option preferred by the majority of the group members — was then applied to the entire group.

Incentives

Each subject was paid €20 for participating in three experimental sessions. This appearance fee was paid at the end of the last session to ensure that participants would show up for all three sessions. We also implemented a between-subject, random-task incentive scheme following a Becker - De Groot - Marshak (BDM) procedure. Before starting the experiment, subjects were informed that they might be selected to play one of their choices for real and could win as much as €100 per session depending on their choices. Thus, each subject could win a total amount of €300 over the three experimental sessions.[1] The probability of being selected in each session was independent and identically distributed and was equal to one fifth. Selected subjects played their choice for real at the end of each experimental session. We used a front-end delay to minimize the possibility of perceived differences between the two payoff options with respect to transactions costs and to the risk associated with future payments. This single-day front-end delay was also compatible with the payment scheme. One difficulty for any experiment involving a trade-off between immediate and future rewards is that subjects might not trust the experimenter to provide the promised future rewards in a timely fashion. Toward the end of establishing trustworthiness in the experiment and reducing fears of manipulation, all future payments were warranted - and transferred directly to the subject's bank account - by the National Public Treasury.

2.2 Time Preferences

The experimental tasks allow us to make inferences about some basic properties of time preferences. We assume that the decision maker has preferences over the set of timed outcomes $T \times X^{+}$. Following Halevy (2015), we endow the decision maker with a sequence $[\succsim_t]_{t=0}^{\infty}$ of complete and transitive binary relations defined over timed outcomes. We assume that preferences satisfy the usual continuity and monotonicity assumptions. We use conventional notation to express the preference of the decision maker, letting $\succ_t$, $\succsim_t$, and $\sim_t$ represent the relations of (respectively) strict preference for, weak preference for, and indifference between the sequences of

[1] We could not completely rule out wealth effects. For the individuals who are paid for real at $\ell + \Delta$, previous gains might have affected behavior in Session 3. Since only three subjects satisfied this condition, we can safely assume that wealth effects did not bias our results.

timed outcomes at decision time t. As mentioned previously, we investigate four conditions related to time preferences: impatience, stationarity, age independence, and dynamic consistency. We begin by defining these conditions formally as follows.

Definition 1 $\succsim_t$ *exhibits impatience if for any* x *and every* $t < s < \ell$,

$$(s, x) \succ_t (\ell, x).$$

It follows from Definition 1 that impatience can also be defined as the indifference at date t between a small outcome x received soon (at date s) and a larger outcome y received later (at date ℓ). So in addition to measuring impatience via comparison of x and y, the experiment also manipulates delay ℓ to measure the shape of the decision maker's impatience.

Definition 2 $\succsim_t$ *is stationary if for* x, y *and every* s, ℓ, Δ*:*

$$(s, x) \sim_t (\ell, y) \iff (s + \Delta, x) \sim_t (\ell + \Delta, y).$$

Stationarity means that a decision made at date t does not change when the receipt are delayed by the same amount of time. Under stationarity, then, the choice between two timed outcomes depends only on the time distance $\ell - s$ between them. Stationarity reflects constant impatience, and it has been extensively investigated in the experimental literature (see Frederick et al. (2002)). Decreasing impatience, or *present-bias*, is the individual violation of stationarity most often identified in behavioral economics.[2]

[2]In the discounted utility model, violations of stationarity are not compatible with an exponential discount function; hence they are represented by a wide range of alternative discount functions. Of these, the most widely used are hyperbolic discount functions (Phelps and Pollak, 1968; Loewenstein and Prelec, 1992). However, violations of stationarity can be accommodated also by nonhyperbolic discount functions (Bleichrodt et al., 2009), which have the additional advantage of being more flexible.

In the first two columns of Table 1, comparing the first two rows provides a direct test of the stationarity condition stated by Definition 2 (*without* assuming the discounted utility model). If preferences are stationary, then we should observe $x_1^1 = x_1^2$ in column 1 and $x_2^1 = x_2^2$ in column 2. The farther from zero is the difference $x_j^2 - x_j^1$, $(j = 1, 2)$, the greater are the violations of stationarity.

Definition 3 *$[\succsim_t]_{t=0}^{\infty}$ satisfies age independence if for x, y and every s, ℓ, Δ:*

$$(s, x) \sim_t (\ell, y) \iff (s + \Delta, x) \sim_{t+\Delta} (\ell + \Delta, y).$$

Age independence, also called *time invariance* (Halevy, 2015), means that a decision made a date t remains the same at date $t + \Delta$ if all receipts are delayed by the same amount of time. According to this condition, preferences are independent of calendar time. The experimental test of age independence manipulates the choice node by moving the choice date from t to $t + \Delta$ and the front-end delay from s to $s + \Delta$. In each row of Table 1, between-column comparisons provides a direct test of the age independence condition stated by Definition 3. If preferences satisfy age independence then we should observe $x_1^1 = x_2^1 = x_3^1$ in line 1 and $x_1^2 = x_2^2$ in line 2. The larger the absolute differences between the x-values, the greater the violations of age independence.

Definition 4 *$[\succsim_t]_{t=0}^{\infty}$ satisfies dynamic consistency if for x, y and every $t+\Delta < s, \ell$:*

$$(s, x) \sim_t (\ell, y) \iff (s, x) \sim_{t+\Delta} (\ell, y).$$

The state of dynamic consistency obtains provided a decision made at date t for future timed outcomes remains the same for a given pair of timed outcomes when made at date $t+\Delta$. Our experiment therefore moves the choice date from t to $t+\Delta$ while keeping the delay s constant. Sayman and Öncüler (2009) as well as Read et al. (2012) propose similar designs but with a different nomenclature.[3] In both

[3]Our 'stationarity' is their 'cross-sectional time consistency'.

of those papers, dynamic consistency is defined as longitudinal time consistency. In Table 1 within-diagonal comparisons between the first two lines provide a direct test of dynamic consistency. If preferences satisfy dynamic consistency, then we should observe $x_1^2 = x_2^1$ and $x_2^2 = x_3^1$. The farther from zero are the differences $x_1^2 - x_2^1$ and $x_2^2 - x_3^1$ are, the greater are the violations of dynamic consistency.

Definitions 2, 3 and 4 are not independent of one another, as each pair of conditions implies the third. For example, stationarity (Definition 2) and age independence (Definition 3) imply dynamic consistency (Definition 4)(Strotz, 1955). It follows that stationarity and dynamic consistency are equivalent if and only if age independence is satisfied. Definitions 2, 3, and 4 also show that time consistency and age independence together imply stationarity. As a result, violations of dynamic consistency lead to violations of stationarity if one assumes that age independence is satisfied. If age independence is not satisfied, however, then violations of dynamic consistency need not result in violations of stationarity.[4]

2.3 Method

The indifference values elicited in both individual and collective tasks were designed to test the four conditions on time preferences defined in Section 2.2. The first information provided by a given elicited outcome is the amount of revealed impatience. According to Definition 1, if the elicited outcome - that is, the “sooner” value - was strictly lower than (resp., was equal to) the “later” value, then the decision maker was considered to be impatient (resp., patient). The ratio of the elicited outcome to the later outcome yields a simple index of impatience: the lower the ratio, the greater the impatience with respect to a given decision.

By Definition 2, the difference between $x_j^2 - x_j^1$, $j = 1, 2$ provides a test for violations of stationarity. A simple index of violations of stationarity can be constructed

[4]For example, age independence is violated by a man who prefers one apple on his 21st birthday to two apples the day after but in all other situations prefers two apples a day later. Such a decision maker exhibits dynamic consistency but not stationarity.

with this difference (the larger the deviations from zero, the greater the violations of stationarity). The index can be computed either at date t (when $j = 1$) or at date $t+\Delta$ (when $j = 2$). Violations of age independence (Definition 3) are revealed by an index based on the difference $x_2^i - x_1^i$, $i = 1, 2$. This index can likewise be computed from date t (when $i = 1$) or from date $t + \Delta$ (when $i = 2$). Comparing between x_3^1 and x_2^1 yields another index of age independence. Violations of dynamic consistency (Definition 4) can be similarly measured using an index based on the difference between x_j^2 and x_{j+1}^1, $j = 1, 2$. Values greater (smaller) than zero indicate standard (reverse) dynamic inconsistency. In Section 3, we reporting on using two-sided Student tests to check for violations of stationarity, age independence, an dynamic consistency. We checked for robustness via Wilcoxon signed-rank tests and the results were similar. For the sake of comparison between individual and group decisions, we divided the indexes of stationarity, age independence and dynamic consistency by 5 when evaluating decisions made by (five-member) groups.

The experimental tasks also allowed us to measure discount factors - albeit at the cost of assuming the linear discounted utility model. Under that assumption, any indifference $(s, x) \sim_t (\ell, y)$ yields the following equality: $\delta_t(\ell) = \delta_t(s)\frac{x}{y}$. If we use two indifferences whose delays ℓ differ, then the ratio between $\delta_t(\ell)$'s provides an index of the shape of impatience. In particular, that ratio indicates whether the decision maker exhibits decreasing (or constant, or increasing) impatience.

Finally, we present two additional methods for analyzing collective choice. The first method evaluates the efficiency of straw polls as a coordinating device. This measure compares the final vote to the last message sent to the other group members; it corresponds to the measure used by Forsythe et al. (1993) to test voting equilibria. The second method compares the final decisions reached by the group to its members' individual preferences. To assess the cost of deviating from individual preferences, for each collective decision we also simulate the corresponding decision that a benevolent planner would make by aggregating individual indifferences.

3 Results

3.1 Time Preferences

Impatience

Elicited indifference values make for a simple way to characterize the decision behavior of individuals and of groups. Altogether, 42.3% of individual decisions were patient; the proportion rose to 80.6% for groups. Group decisions were more patient than the equivalent individual decisions (binomial test, $p < 0.01$). In order to investigate the pattern of discounting behaviors more thoroughly, we classified individual and groups based on their answers. A decision maker was classified as *impatient* (resp., *patient*) if at least four out of six indifference values yielded an impatient (resp., patient) answer; otherwise, the decision maker was classified as *mixed*. The classification is presented in Table 2, whose portrayal is similar to the one derived from individual decisions. On the one hand, a majority of individual decision makers were impatient, whereas a significant minority (30.4%) were patient; on the other hand, a large majority (83.4%) of the groups were classified as patient. Thus, collective behavior based on majority voting did not mirror individual behavior.

	Impatient	Patient	Mixed
Individuals	55.4%	30.4%	14.2%
Groups	8.3%	83.4%	8.3%

Table 2: Classification of individuals and groups

Stationarity

Stationarity predicts the equality of the elicited values in the upper two rows in Table 1. Table 3 shows the values of the index of violation of stationarity for both individuals and groups (and their significance levels). The greater patience of groups is associated with the *absence* of any violations of stationarity. The vast majority of groups replicated the same patient decision in all of their decisions and behaved as zero-discounting maximizers. The picture is different for decisions made by individuals, whose behavior was incompatible with stationarity. In this respect, the minority of subjects with patient choices coexisted with a majority of impatient subjects violating stationarity.[5]

	Stationarity	
measured	at t	at $t + \Delta$
Individuals	0.883	2.121*
Groups	-0.417	0.583

Table 3: Violations of stationarity for individuals and groups.

Note: Reported figures are the average values of indexes (no violation corresponds to a value of zero). Significance * at 5%.

Dynamic Consistency and Age Independence

Dynamic consistency predicts the equality of the elicited values only for those cases in which the time of the decision changes. Age independence predicts the equality of the elicited values within rows. Table 4 presents the results for the index of dynamic consistency and age independence. There is evidence of both dynamic consistency and age independence being violated by individual decisions but no such evidence regarding collective decisions. Much as what we observed for stationarity, individual decision-making behavior was (for half the measures) incompatible with age independence.

For groups, our findings on dynamic consistency and age independence were compatible with those on stationarity; this result reflects that the the first two conditions together imply the third. In both cases, groups were highly time-consistent.

[5]The figures in Appendix A plot the distribution of the indexes of stationarity, age independence, and dynamic consistency.

For individuals, a comparison of Table 3 and Table 4 shows that violations of either dynamic consistency or age independence predicted violations of stationarity.

	Dynamic Consistency		Age Independence		
measured	at $t + \Delta$	at $t + 2\Delta$	from t (1)	from t (2)	from $t + \Delta$
Individuals	1.103	-3.357**	2.017	-1.161	3.224*
Groups	-0.683	-0.950	-1.100	-0.367	-0.100

Table 4: Violations of dynamic consistency for individuals and groups.

Note: Reported figures are the average values of indexes (no violation corresponds to a value of zero). Significance: * at 5%; ** at 1%.

3.2 Discount Factors

When we compare discount factors for indifference values elicited at the same date for a delayed outcome with delays $\Delta = 4$ weeks and $2\Delta = 8$ weeks, the result gives us information about the shape of impatience in our experiment. If the discount factor for a eight-week delay was proportionally higher than (equal to, lower than) the elicited discount factor for a four-week delay, then the decision maker was said to show decreasing (constant, increasing) impatience. Decreasing impatience is the usual finding in the experimental literature. Table 5 classifies individuals and groups in terms of these three possible impatience shapes.[6]

	Increasing Impatience	Constant Impatience	Decreasing Impatience
Individuals	15.0%	26.67%	58.33%
Groups	8.3%	91.7%	0%

Table 5: Classification of individuals and groups in terms of shape of impatience

[6]In this classification, a patient decision maker is characterized by constant impatience. Therefore, if we assume linear utility, then the patient decision maker is one with a monthly discount rate lower than 1.21%, corresponding to a large higher bound for market interest rates.

Decreasing impatience was dominant for individual decisions. We also observed a proportion of choices characterized by increasing impatience. In line with the results presented previously, *constant* impatience was dominant for collective decisions.

3.3 Coordination Mechanism

Efficiency of Straw Polls

The efficiency of straw polls in achieving coordination was assessed by comparing the final vote with the last message sent to the other group members. Overall, efficiency was high: 87.5% of the final votes were strictly identical to the intentions declared in the last straw poll. Efficiency declined between experimental sessions from 92.8% in session 1 to 81.9% in session 2 and 82.1% in session 3. Nonetheless, we found no differences between the values cast as final votes and the intentions declared in the last straw poll (all $p > 0.22$, t-tests). Figure 1 graphs the relation between values casted in the last straw poll and the final votes. Only a small portion of votes were above (7.7%) or below (4.8%) the value cast in the last straw poll.

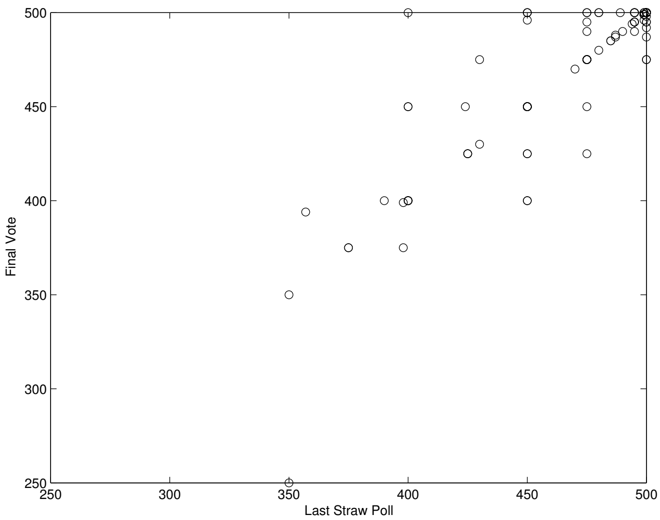

Figure 1: Efficiency in coordination: Cast values x in last straw poll plotted against final votes

Distance to Individual Preferences

In order to compare collective decisions and individual preferences, we first evaluated the distance between the outcome of collective decisions and the elicited individual values. Overall, 35.8% of the final group decisions were identical to those made by individuals. This percentage was stable across sessions, which suggests that reaching a collective decision in choice over time may be nonnegligibly more expensive than relying on individual preferences. Among the final decisions, 97% corresponded to patient choices; even so, votes differed from individual values (all $p < 0.01$). Slightly more than half (54%) of decision choices were made more patiently by groups than by individuals. For a minority (8%) of choices, the collective decision was actually more impatient than the corresponding individually preferred decision. According to Table 2's classification of individuals, for 78% of patient individuals more than four out of six final decisions were in line with their individual preferences; this percentage was zero for impatient individuals.

One can also measure the distance to individual preferences by simulating the equivalent values that a benevolent planner would select for each decision. The simulation assumes that the planner can perfectly observe the elicited values at the individual level and aggregate them at the group level.[7] The results are shown in Table 6. We found that, on half of the measures, this planner would implement a decision that is incompatible with stationarity. Dynamic consistency and age independence were also violated by simulated choices of this type. These results replicate Jackson and Yariv's (2014) findings that the benevolent social planners do not make consistent choices. Our social planner results are strongly consistent with individual results and indicate that collective decisions differ from decisions based on criteria that sum up and/or average indifferences. These results show also that the composition of each group has no effect on the extent to which stationarity, age independence, or dynamic consistency were violated.

[7] Two subjects dropped out after session 1 and two more after session 2. The resultant missing data precluded our simulating a utilitarian criterion for three of the groups. That is why results from the simulation are given only for nine of the twelve groups.

	Stationarity		Dynamic Consistency		Age Independence		
measured	at t	at $t+\Delta$	from t (1)	from t (2)	from $t+\Delta$	at $t+\Delta$	at $t+2\Delta$
Planner	0.800	2.533*	0.689	-3.844*	1.489	-1.311	3.222*

Table 6: Violations of stationarity, age independence and dynamic consistency: Utilitarian planner.

Note: Reported figures are the average values of indexes (no violation corresponds to a value of zero). Significance: * at 5%.

3.4 Robustness

Several confounding factors might have played a role in our results. First, as shown by Luhan et al. (2009), the mere effect of repetition and learning can change individual behavior. To address this issue, we set up a REPETITION treatment that replicates the experiment with $N = 20$ individuals. This treatment was identical to the main experiment except that subjects undertook twice the individual decisions, across all three sessions, and were not involved in any collective decision (See Appendix D for the instructions). We found no individual-level differences between the two repeated decisions in any of the three sessions ($p = 0.34$).

Second, the group decisions in our experiment result from a combination of voting and signaling through straw polls. To disentangle the effects of voting and signaling, we ran two additional treatments to elicit indifference values x_1^1, x_1^2, x_1^3, with $N = 60$ individuals each. We began by setting up a VOTING treatment based on majority voting without straw polls. In this treatment, we asked subjects to vote on a collective decision but *without* any additional information on the others' preference for that decision. We then set up an INFORMED PLANNER treatment in which subjects individually decided for the whole group. In this treatment we provided subjects with one single straw poll before asking them to decide alone, as a planner, for the group. The VOTING treatment, which consists in a vote without straw polls, allows us to identify a pure effect of voting on collective decisions.

The INFORMED PLANNER treatment, which consists of decisions being made for the group after a single straw poll, reveals the effect of providing some information on individual preferences. In this treatment, individuals decide alone for the whole group; hence economic rationality prescribes the alignment of preferences for group outcomes with individual preferences irrespective of the consequences for other group members. If collective choice differs from individual choice, then we can expect subjects to take into account the consequence their choices' consequences for others. We also implemented an UNINFORMED PLANNER treatment (with $N = 20$ subjects) to check for the possible existence of other-regarding considerations that could play a role in group choices. In this treatment, subjects were asked to decide for the whole group without *any* information on the others' preferences. If subjects are concerned about group outcomes, then their collective choice should be different from their individual choice. We found small support for this hypothesis ($p = 0.45$).[8]

We also ran several Probit regression models to measure the difference between the main experiment and the additional treatments. The first amounted to estimating a Probit model of impatience. For that purpose, the decision maker was classified as impatient (patient) if at least two of the three indifference values (x_1^1,x_1^2, x_1^3) yielded an impatient (patient) answer. We next estimated a probit model on stationarity; here the decision maker's behavior satisfied stationarity when x_1^1 was equal to x_1^2. Each Probit model was estimated both for individuals and for collective decisions. Table 7 reports results in the form of marginal effects (with the main experiment as the reference level).

The table shows the impact of these additional treatments on individual and collective decisions. First, group decisions displayed significantly more patience and more stationarity in the main experiment than in the additional treatments. Neither voting or choosing alone, as a planner, for the whole group can explain the highly consistent decisions observed in the main experiment. Yet we found that individual preferences were little affected by additional treatments. Individual stationarity, when measured at the subject level, does not differ significantly between the main

[8]In one of the three tasks of session 1 (viz., elicitation of x_1^3), we found decisions for the group to be more patient than individual decisions ($p = 0.04$).

treatment	Impatience Individual	Impatience Groups	Stationarity Individuals	Stationarity Groups
Repetition	0.233*	-	-0.083	-
	(0.091)	-	(0.127)	-
Voting	0.133	0.475**	-0.117	-0.454**
	(0.080)	(0.075)	(0.090)	(0.076)
Informed planner	0.167*	0.392**	-0.167	-0.420**
	(0.078)	(0.079)	(0.088)	(0.077)
Uninformed planner	0.083	0.525**	-0.033	-0.338**
	(0.114)	(0.102)	(0.129)	(0.120)
N	220	220	220	220

Table 7: Probit regressions on impatience and violations of stationarity for individual and collective decisions

Note: Reported figures are the marginal effects. Significance: * at 5%; * at 1%.

experiment and the additional treatment. Individual impatience differed between the main and two specific treatments: the REPETITION treatment and the INFORMED PLANNER treatment. In the latter, the higher degree of impatience observed when deciding alone for the group - based on one straw poll of member preferences - might well be due to a composition effect. As described previously, subjects in the INFORMED PLANNER treatment were individually more impatient than in the main experiment. It is therefore possible that the information included in the straw poll might have reduced the impatience of group outcomes to a greater extent than what we observed in the INFORMED PLANNER treatment. The observed difference in impatience between the main experiment and the repetition treatment is the most difficult to explain, because their respective designs were identical (except that one excluded group decisions). In particular, both treatments required that each subject come to the laboratory three times at regularly scheduled intervals. If the scheduling ability of subjects led to our experiment suffering from a selection bias as regards impatience, then we should have observed *no* difference between the main experiment and the repetition treatment as well as *significant* differences between the main experiment and the other additional treatments; however, that did not occur. Finally, we remark that collective decisions in the INFORMED PLANNER treatment replicate Jackson and Yariv's (2014) finding that the decisions made by a benevolent planner does not satisfy stationarity when the planner is affected by the decision.

4 Discussion and conclusions

This paper presents a within-subject longitudinal laboratory experiment on collective time preferences. We are the first to study four properties of time preferences—impatience, stationarity, age independence, and dynamic consistency—for both individuals and groups. In addition, we have designed a collective mechanism that helps groups coordinate on a decision. Our main findings are that: (i) individuals were impatient and tended *not* to behave in a manner consistent with constant discounting; (ii) groups made patient and highly consistent decisions; and (iii) the decision process made subjects converge to dynamically consistent decisions that satisfied both stationarity and age independence. Furthermore, the patient decisions made by groups indicate that the discount factors for groups are more in line with market interest rates than are the discount factors for individuals.

Our results show that individuals moved toward a patient decision when placed in an environment broader than one delineated by purely individual decisions. This finding was robust to all decision contexts that we implemented. First, when facing our coordination mechanism based on majority voting preceded by a deliberation phase, nearly all individuals moved toward a patient vote regardless of the composition of their groups and of their own preferences. The robustness experiments showed that, absent the deliberation phase, simple majority voting was also characterized by increased patience in collective choice as compared with individual choice (although the effect was weaker in that context). The shift toward patience was evident also when subjects served in the social planner role—whether informed or uninformed about others' preferences. This result speaks to the long-standing debate over the ethics of social discounting and to more recent results from evolutionary theory. For instance, Robson and Szentes (2014) argue that individuals exhibit more patience when decisions are made collectively owing to a difference in the evolution of individual and group selection.

One limitation of this research is that the experimental design we implemented could have influenced the main results. A typical drawback in experiments that elicit time preferences is the uncertainty of future payoffs (Halevy, 2015; Augenblick et al., 2013). Having uncertain prospects could raise the impatience levels for subjects, whose time preferences may then begin to incorporate a risk premium (Halevy, 2008; Epper et al., 2011; Baucells and Heukamp, 2012; Epper and Fehr-Duda, 2012). We took such uncertainty out of play by offering high monetary payoffs and guaranteeing payment through bank transfers by the National Public Treasury. Although that approach could have tilted the scales toward behavior that is *more* patient, we believe that the benefits of this incentive structure outweigh its drawbacks. Some of the results reported here could be explained by a selection bias. In our experiment - much as in any experiment involving longitudinal measures - subjects were asked to commit to three sessions over a time span of eight weeks. Our subjects thus share the ability to schedule time commitments (Frederick, 2005; Dohmen et al., 2010; Perez-Arce, 2011). Yet the proportion of dynamically consistent individual choices that we found is no higher than what has been reported in the literature.[9] Moreover, the additional treatment used to test the effect of repeated decisions was based on an identical scheduling of sessions and likewise failed to reveal any such selection bias. Consider also that this selection bias would likely affect all decisions to a similar extent and so would have little effect on the *difference* between individual and collective decisions.

In our experiment, we adopted majority voting as a procedure for establishing a group decision after a deliberation phase. In this context, majority voting cor-

[9] Giné et al. (2014) find that 50% of the choices satisfied stationary and 35% of them satisfy dynamic consistency. Sayman and Öncüler (2009) study 1, find no evidence favoring time inconsistency: 58% of the choices were dynamically consistent. Halevy (2015) reported that 48% of time-consistent subjects and 56% of all subjects exhibit stationary preferences.

responds to a coordination game and theoretically leads to multiple equilibria. To help participants coordinate their choices on a unique equilibrium and avoid dominated equilibria, we added a deliberation phase based on successive straw polls. In a different setting, Brandts and Cooper (2006) show that feedback on other preferences could help overcome coordination failures. Our results show that choosing collectively patient choices made coordination easier—not only for the groups in which most subjects agreed upon patience from the beginning but also for those in which patience was not initially the dominant opinion. This finding constitutes evidence that information exchanges during the deliberation phase played a specific role in the final group outcome. Specifically, sharing information on voting intentions might have led individuals to vote against their own preference (a finding that can be explained by strategic voting; see Myerson and Weber (1993)). Our result is consistent also with existing psychological evidence on group decisions (Stoner, 1968; Moscovici and Zavalloni, 1969; Schkade et al., 2000) as well as with the literature on information exchange (Viscusi et al., 2011) and more recent theoretical and empirical papers (Glaeser and Sunstein, 2009; Luhan et al., 2009; Sobel, 2014) on polarization. Under polarization, more extreme group decisions are made as compared with the preferences of individual group members. Our results would lead us to explain that finding in terms of subjects who are relatively more patient having the strongest influence on the final decision.

Finally, our coordinating device allowed groups to quickly converge towards a given decision. In this respect, our results have implications for how boards and committees can achieve consistent decisions. A natural consequence of this coordinating device is that we observe shifts from individual preferences. Almost all shifts were in the direction of increased patience - a tendency that was confirmed in the additional treatments. Moreover, in contrast to individual decisions, the most frequent collective decisions produced a consistent sequence of preference relations over time.

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Appendix A Indexes

This appendix shows the distribution of the indexes of violation of stationarity (Figure 2), dynamic consistency (Figure 3), and age independence (Figure 4). Each figure shows the distribution of the indexes for individuals (left panel) and groups (right panel). There is never any violation that corresponds to a zero value. To facilitate comparisons, left- and right-panel x-axes are identical.

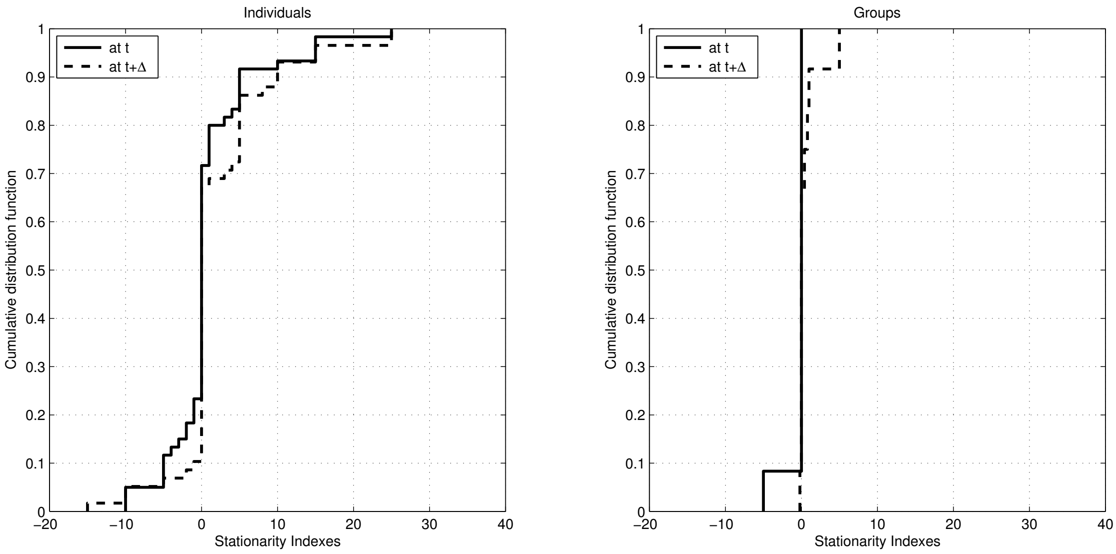


Figure 2: Distribution of stationarity indexes

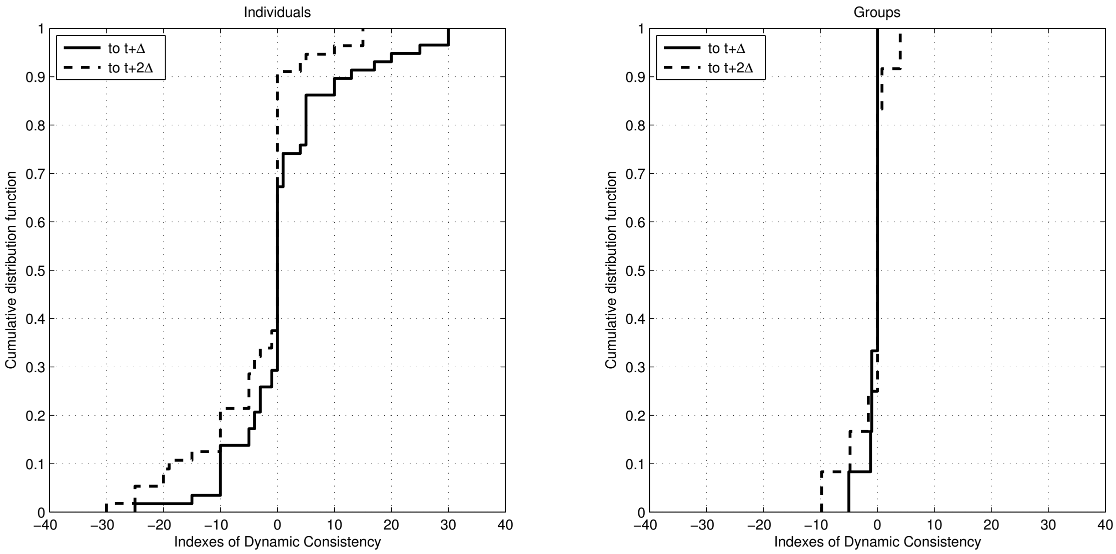


Figure 3: Distribution of dynamic consistency indexes

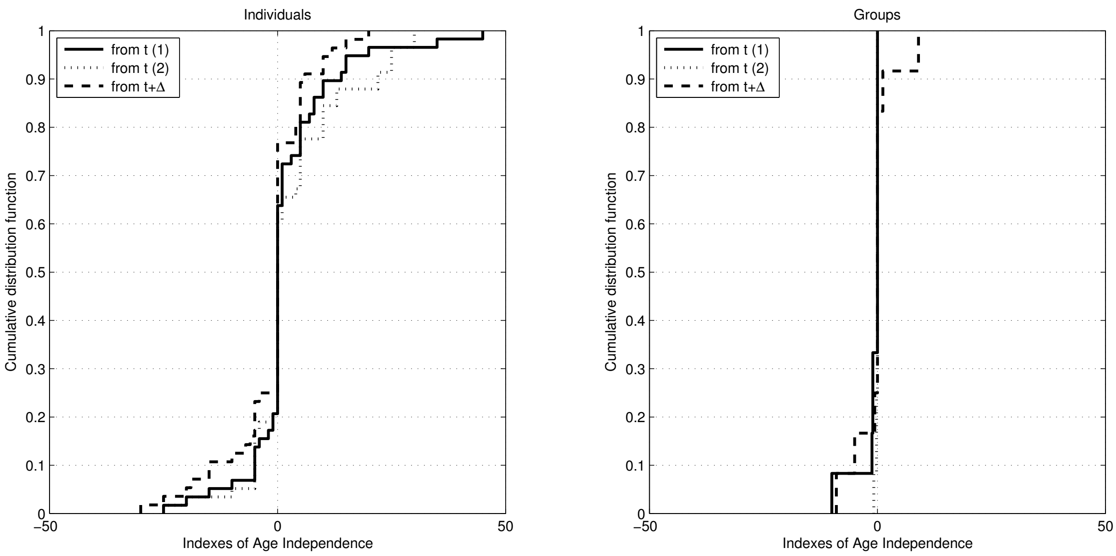


Figure 4: Distribution of age independence indexes

Appendix B Experimental Instructions

The experiment was conducted from January to March 2012 at LABEX-EM, the experimental lab of the University of Rennes. Subjects were recruited using the ORSEE (Greiner, 2004) software, and the experiment was run using a purpose-written software coded in Z-tree (Fischbacher, 2007). In the recruitment phase, subjects were informed that they would be required to participate in three successive experimental sessions scheduled at regular (four-week) intervals. Before entering the lab, subjects had to confirm their willingness to make that commitment. The rest of this appendix translates into English the instructions given to participating subjects.

General Instructions

Thank you for participating in our experiment. During this experiment, you will have to make decisions involving various amounts of money. If you follow the instructions, you could win a quite a large amount of money. All your responses will be converted into anonymous data after the experiment. During the experiment, you must answer a series of choice questions. There are no right or wrong answers to these questions. We are interested in your preferences: the only right answer to a choice task is the choice that you prefer.

Twenty people will participate in this experimental session. During the session, you will have to make decisions individually and collectively. Therefore, you will decide alone on some decisions and will interact with other participants on other decisions. For reasons of anonymity, you will not have access to the other participants' identities.

The experiment consists of two parts:

- in the first [second] part, you will decide as an individual;
- in the second [first] part, you will make a decision in common as a member of a group of five people (i.e., you and four other people).

Gains and Payment

Your final payment will be determined by the choices you made during the experiment. For your participation, you will receive a show-up fee of €20. The show-up fee is conditional on your participation in the three experimental sessions. The show-up fee will be paid at the end of the third experimental session only if you attend all three of the sessions.

During the experiment, you will be asked to answer a series of choice questions regarding different amounts of money available at different dates. The display represented in Figure 5 gives an example of one such series. Option A offers a fixed amount of €100 to be obtained in four weeks' time. Option B offers a series of six amounts, equally ranged between €50 and €100, to be obtained tomorrow. For each of the six amounts, you will be asked to indicate whether you would like to choose option A or option B. Once you have switched between option A and option B, a scrollbar will appear on the screen. The scrollbar allows you to refine the amount of money at which you switch your choice from A to B. For instance, suppose you switch at €72.

If you switch at €72, do you agree that you prefer to choose option B at a higher amount than €72? (Y/N). Do you agree that you prefer to wait four weeks and choose option A at prices lower than €72? (Y/N). If you have any questions, please feel free to ask the experimenter.

The payment will be implemented as follows. At the end of each experimental session, four participants will be selected at random from among the twenty participants attending the session. For each of these participants, the computer will select one decision at random. For that decision, the computer will select one possible choice at random. Let's take the decision represented in Figure 5 as an example. For that decision, an integer between 50 and 100 will be selected at random.

If the computer draws 63, then the selected choice is between €63 tomorrow and €100 in four weeks' time. Do you agree? (Y/N). If you chose €72 as a switching point, then your selected choice is therefore €100 in four weeks' time and you will receive your payment directly by bank transfer from the National Treasury within four weeks. Do you agree? (Y/N).

Suppose that instead the computer draws 83; then the selected choice is between €83 tomorrow and €100 in four weeks' time. Do you agree? (Y/N). If you chose €72 as a switching point, then your selected choice is therefore €83 tomorrow and you will receive your payment directly by bank transfer from the National Treasury tomorrow. Do you agree? (Y/N). If you have any questions, please feel free to ask the experimenter.

At the end of the experimental session, you will get a receipt from the University of Rennes 1 for the payment.

Individual Decisions

For these decisions, you will have to reply alone to a series of choice questions regarding different amounts of money available at different dates. The display represented in Figure 5 shows an example of a series of questions. Option A offers a fixed amount of €100 to be obtained in four weeks' time. Option B offers a series of six amounts, equally ranged between €50 and €100, to be obtained tomorrow. For each of the six amounts, you will be asked to indicate whether you would like to choose option A or option B. Once you will have switched between option A and option B, a scrollbar will appear. The scrollbar allows you to refine the amount of money at which you switch your choice from A to B.

Once you will have selected a switching point, you can continue by clicking on "OK". You can also cancel your choice. When you click on "OK", a confirmation screen will appear and you can proceed with the next decision.

Collective Decisions

For collective decisions, you will have to reply in groups of five to a series of choice questions regarding different amounts of money available at different dates. For these decisions, a display similar to the one represented in Figure 7 will appear. This display will allow you to communicate with the other members of the group before deciding as a group. All the collective amounts will be shared equally among the group members. For collective decisions, the majority rule will apply: for each choice, whenever at least three of the five members agree, their choice will be adopted by the group. The decision will be made after four successive displays of voting intentions for each group member and a final vote. Groups will remain the same for all decisions; in other words, you will make a group decision with the same people each time. For reasons of anonymity, you will be identified by a color for each decision. Colors will be reshuffled randomly between each decision.

For the first trial, you will be presented with a display similar to the one represented in Figure 6. Option A offers a fixed amount of €500 to be obtained by the group in four weeks' time. Option B offers a series of six amounts, equally ranged between €250 and €500, to be obtained by the group tomorrow. For each of the six amounts, you will be asked to indicate whether you would like the group to choose option A or option B. Once you have switched between option A and option B, a scrollbar will appear. The scrollbar allows you to refine the amount of money at which you switch your choice from A to B. Suppose you switch at €350.

If you switch at €350, do you agree that you prefer the group to choose option B at a higher amount than €350? (Y/N). Do you agree that you prefer the group to wait four weeks and choose option A at a lower amount than €350? (Y/N). If you have any questions, please feel free to ask the experimenter.

Once you have selected a switching point, you can continue by clicking on "OK". When you click on "OK", your opinion will be sent to the other members of the group and you will get their opinions.

The results of the trial will be displayed along with the next decision to be made (Figure 7).The display will enable you to see the opinions of the other members of the group. The results of the previous trial will show you, for each possible choice between option A and option B, whether or not a majority has been reached. After four successive trials, the decision you make will be the final vote for your group. After that decision, the result of the vote will appear (Figure 8). The screen shows you the votes of each member, the group switching point, and your share. Suppose that the decision of your group led to a switching point of €349.

If your group switches at €349, do you agree that a majority of members prefer to choose option B at a higher amount than €349? (Y/N). Do you agree that, if the selected amount is lower than €349 amount, you would get your share which is 100 euros in 4 weeks times? Do you agree that a majority of the members would prefer to wait 4 weeks and get option A at a lower amount than 349 euros? (Y/N). Do you agree that, if the selected amount is equal to €472 (higher than €349), you would get your share, which is €83.6 tomorrow? If you have any questions, please feel free to ask the experimenter.

Once your group has made a decision, you can proceed with the next decision.

Appendix C Displays

This appendix shows the typical displays used in the experiment. Figure 5 shows the multiple-choice list used to elicit indifference points; Figure 6 shows the equivalent multiple-choice list used to elicit indifference points for the first straw poll. Figure 7 displays the information each subject received at the end of each sequence. Figure 8 shows the final screen presented to the subject after a vote.

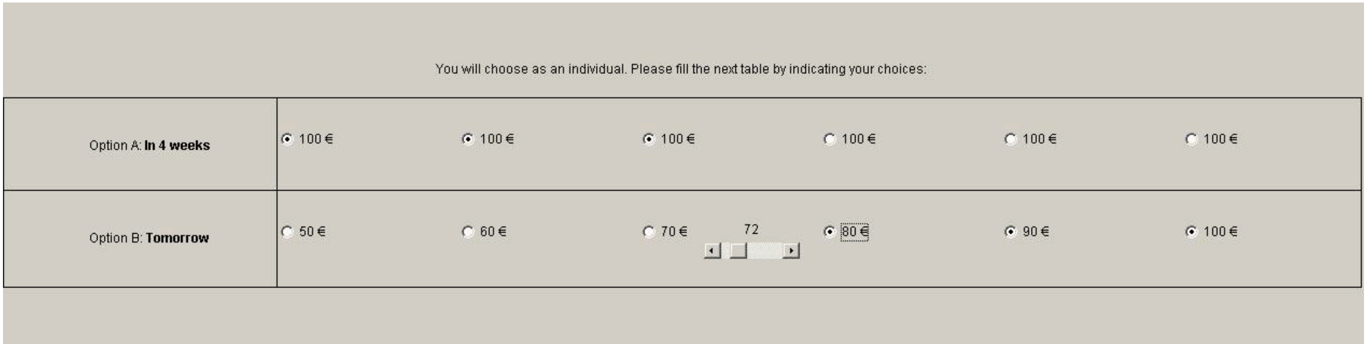


Figure 5: Presentation of choice list in individual decisions

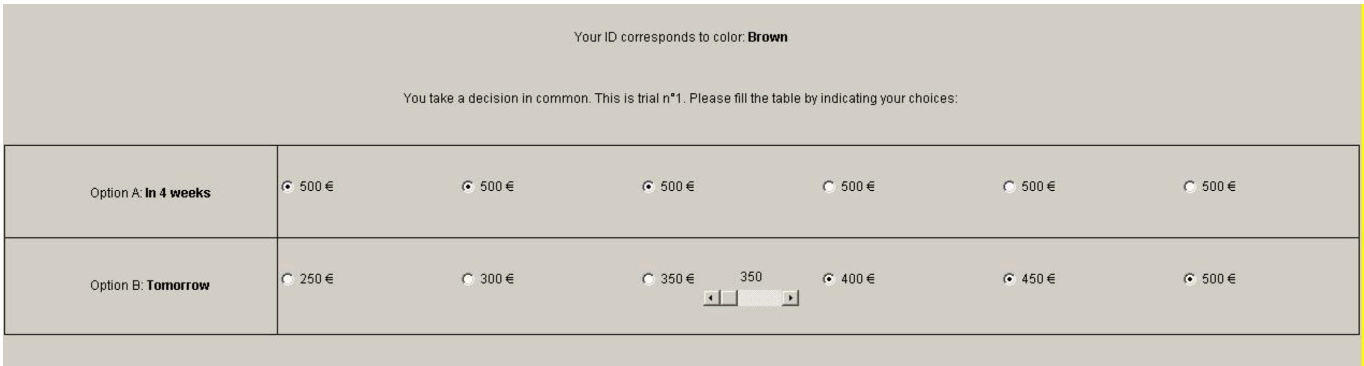


Figure 6: Presentation of choice list in collective decisions: First straw poll

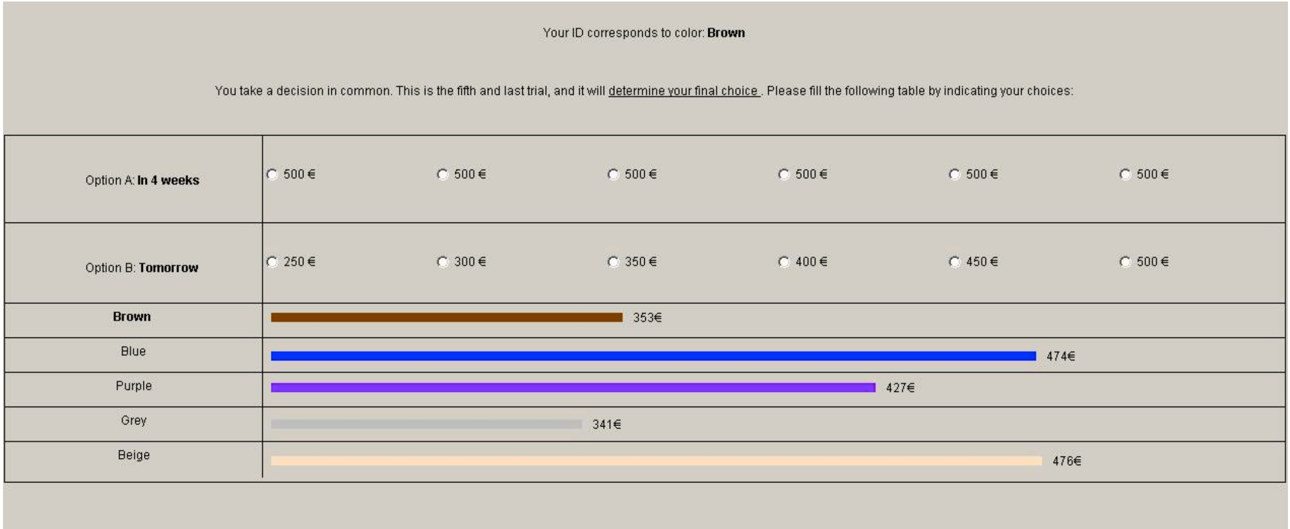
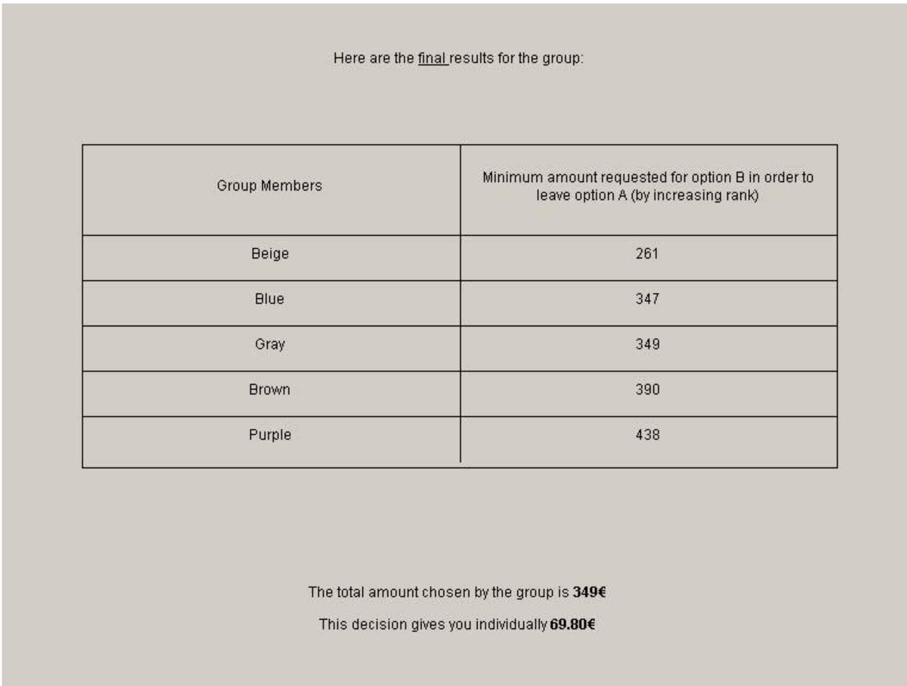


Figure 7: Information given about other member preferences during the group decision process.



Here are the final results for the group:

Group Members	Minimum amount requested for option B in order to leave option A (by increasing rank)
Beige	261
Blue	347
Gray	349
Brown	390
Purple	438

The total amount chosen by the group is **349€**

This decision gives you individually **69.80€**

Figure 8: Presentation of a collective decision

Appendix D Experimental Instructions: Additional Treatments

The instructions in the additional treatments were based on the instructions described in Appendix B. Changes in the instructions for each treatment are listed next.

REPETITION treatment

- lines 17 - 25: *Twenty people will participate in this experimental session. During the session, you will have to make decisions individually.*
  The experiment consists of two parts:
  - *in the first part, you will decide as an individual;*
  - *in the second part, you will decide as an individual.*
- lines 84 -130: deleted.

VOTING treatment

- lines 33 - 36: *For your participation, you will receive a show-up fee of €4*
- lines 86 - 88: deleted
- line 91: deleted
- line 96: *For the first trial* deleted
- lines 109 - 116: *The decision you make will be the vote for your group. Once you have selected a switching point for the vote, you can continue by clicking on "OK".*

INFORMED PLANNER treatment

- lines 17 - 25: *Twenty people will participate in this experimental session. During the session, you will have to make decisions individually for yourself and for a group. Therefore, you will decide for yourself on some decisions and for you and other participants on other decisions. For reasons of anonymity, you* *will not have access to the other participants' identities.*

The experiment consists of two parts:

- *in the first* [*second*] *part, you will decide as an individual;*
- *in the second* [*first*] *part, you will decide for a group of five people (i.e., you and four other people).*

- lines 33 - 36: *For your participation, you will receive a show-up fee of €4*
- lines 84 - 85: *For collective decisions, you will have to reply for a group of 5 to a series of choice questions regarding different amounts of money available at different dates.*
- lines 88 - 92: ... *before making a decision for the group. All the collective amounts will be shared equally among the members of the group. Each member of the group will make his/her choice for the group. Payments will be based on the decision of one member of the group chosen at random. The decision will be made after one display of opinions for each group member.*
- line 96: *For the first trial* deleted
- lines 114 - 119: *After this display, the decision you take will be your decision for the group. After that decision the result of your choice will appear.*
- lines 121 and 125: *you* replaces *a majority of members*
- line 130: *Once you have made a decision, you can proceed with the next decision.*

UNINFORMED PLANNER treatment

The changes for this treatment are the same as those just described for the INFORMED PLANNER treatment *plus* the following changes for lines 84 - 119.

- lines 84 - 92: *For collective decisions, you will have to reply for a group of five to a series of choice questions regarding different amounts of money available at different dates. All the collective amounts will be shared equally among the members of the group. Each member of the group will make his/her choice for* *the group. Payments will be based on the decision of one member of the group chosen at random.*

- line 96: *For the first trial* deleted
- lines 110 - 119: *After your decision, the result of you choice will appear.*

Appendix E Results for the Additional Treatments

For the REPETITION treatment, a decision maker was classified as impatient (resp., patient) if at least four out of six indifference values yielded an impatient (resp., patient) answer; otherwise, the decision maker was classified as mixed. For the remaining additional treatments (VOTING treatment, INFORMED PLANNER treatment, UNINFORMED PLANNER treatment), a decision maker was classified as impatient (patient) if at least two out of three indifference values yielded an impatient (patient) answer. The classifications are presented in Table 8. Tables 9 to 12 show additional results on stationarity, dynamic consistency, age independence, shape of impatience and distance to individual preferences.

Treatment	Condition	Impatient	Patient	Mixed
REPETITION	initial answer	80%	15%	5%
	repeated answer	75%	15%	10%
VOTING	individual	80%	20%	-
	group	75%	25%	-
INFORMED	individual	83.3%	16.7%	-
PLANNER	for the group	67.7%	33.3%	-
UNINFORMED	individual	75%	25%	-
PLANNER	for the group	80%	20%	-

Table 8: Classification of answers; additional treatments

Treatment	Condition	*measured* at t	*measured* at $t + \Delta$
REPETITION	initial answer	3.35	1.47
	repeated answer	0.50	0.105
VOTING	individual	0.10	-
	group	4.73*	-
INFORMED	individual	0.35	-
PLANNER	for the group	3.34**	-
UNINFORMED	individual	-0.65	-
PLANNER	for the group	0.09	-

Table 9: Violations of stationarity.

Note: Reported figures are the average values of indexes (no violation corresponds to a value of zero). Significance: * at 5%; ** at 1%.

	Dynamic Consistency		Age Independence		
measured	at $t + \Delta$	at $t + 2\Delta$	from t (1)	from t (2)	from $t + \Delta$
Initial answer	-4.210	1.790	-0.421	2.842	3.263
Repeated answer	-1.053	2.053	-0.790	1.368	2.158

Table 10: Violations of dynamic consistency and age independence in the repeated treatment.

Note: Reported figures are the average values of indexes (no violation corresponds to a value of zero).

Treatment	Condition	Increasing Impatience	Constant Impatience	Decreasing Impatience
REPETITION	Initial answer	5%	10%	85%
	repeated answer	20%	10%	70%
VOTING	Individual	30%	13.3%	56.7%
	Group	16.7%	16.7%	66.7%
INFORMED PLANNER	individual	28.3%	16.7%	55%
	for the group	15%	30%	55%
UNINFORMED PLANNER	individual	40%	20%	40%
	for the group	25%	20%	55%

Table 11: Classification of individuals and groups by shape of impatience

Treatment	Identical decisions	More patient	Less patient
VOTING	22.2%	51.1%	26.7%
INFORMED PLANNER	31.7%	57.2%	11.1%
UNINFORMED PLANNER	28.3%	46.7%	25%

Table 12: Distance to individual preferences