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Social Norms or Low-Cost Heuristics? An Experimental Investigation of Imitative Behavior

Simona Cicognani and Luigi Mittone

Abstract
This paper extends choice theory by allowing for the interaction between cognitive costs and social norms. The authors experimentally investigate the role of imitation and temporal decisional patterns when participants face a task which is costly in cognitive terms. They identify two main reasons for imitative behavior. First, individuals belonging to a community might want to conform to others to obey to social norms. Second, individuals might be boundedly rational and consider imitation as a decisional device when comparing alternatives is cognitively demanding. In order to empirically disentangle the two effects, the authors present a laboratory experiment in which they model the choice of different alternatives through high or low cognitive costs and feedback information given to subjects. Their results do not provide strong evidence for imitative behavior. They find instead a temporal pattern in the distribution of choices, both in the high-cost and low-cost conditions.

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1 Introduction

In the real world, decision makers frequently face cognitive costs when choosing among different options. Traditional economic theories of rational behavior assume that economic agents process costly information fairly easily, since agents are always able to select the utility-maximizing option among different ones. In contrast, evidence gathered by some psychologists and economists supports the idea that decision makers systematically violate the assumptions of rational choice theory (Tversky and Kahneman, 1975; Camerer, 2003; Bicchieri, 2006). In doing this, economic actors are boundedly rational and use simplifying heuristics when they process information that carries cognitive costs. Hence, rather than obeying to a rational choice theory, agents implement a conscious deliberation, by balancing costs and benefits of alternative conditions (Bicchieri, 2006).

This paper focuses on two cognitive shortcuts faced by decision makers. The first one is related to the timing of experiences. When facing alternatives, decision makers experience utilities, and they attach such utilities to the alternatives present in their memory. Hence, preferences arise from memory representations (Weber and Johnson, 2006). In this context, a central role is played by the timing of the experience, which leads to different memories of experiences (Miron-Shatz et al., 2009). When confronted with cognitive costs, we believe that individuals attach more relevance to memories of experiences occurred later in time.

The second type of simplifying heuristic that decision makers might implement is related to the influence of other agents in their community. A growing strand of literature has argued that many decisions are affected by social interactions, also known as "peer effects"(Bernheim, 1994; Glaeser and Scheinkman, 2001). Peer effects represent the channel through which individuals belonging to a reference group influence the behavior of individuals in the same reference

group, and they can be conceived as "an average intra-group externality that affects identically all the members of a given group" (Calvo-Armengol et al., 2009, p. 1239). In line with the reasoning according to which social norms are a mechanism that allows to economize on decision costs, Hayakawa (2000) presents a theorethical axiomatization of bounded rationality applied to the context of social norms, by supporting the idea of social capital as source of low-cost heuristics: choice decisions made by an individual depend crucially on the organization of her perceptions of available choices. To the extent that such perceptions are affected by social elements, they cannot be considered independently of a particular social environment in which decisions occur. The author takes into account preferences that are not invariant to social and cultural structures of the decision-making environment, and, in such a context, bounded rationality is a tool for the formation of endogenous preferences.

The empirical and theoretical literature on peer effects aims to measure and disentangle endogenous effects and to solve the identification problem: individuals in a group influence each other and it is not easy to state who influences whom.[1] The existence of such an interdependent behavior leads to a simultaneity bias, due to the simultaneous determination of individual and group behavior.[2] The approaches used to overcome this problem range from controlled field experiments (Falk and Ichino, 2006), to natural experiments (Cipollone and Rosolia, 2007), fixed effects (Hanushek et al., 2003), and lately the use of specific social network structures, as for instance the existence of non-overlapping groups of peers as exclusion restrictions (Bramoulle et al., 2009; De Giorgi et al., 2010).

The experimental research on peer effects has been experiencing an increasing interest by economists, since it allows to avoid the identification problem

[1] This issue represents the "reflection problem" introduced by Manski (1993).

[2] According to Krauth (2006), the simultaneity bias is extremely severe in the presence of small groups.

which is present in the field, due to a complete control of the information provided to experimental subjects and the avoidance of self-selection of subjects into groups. While in the field there is a simultaneous influence among subjects, in a laboratory setting the experimenter is able to control for different information scenarios, and hence to control the direction of influence. The approaches differ in terms of experimental task and information about the reference group provided to participants.

Concerning the experimental literature on imitation, Apesteguia et al. (2007) in a a symmetric Cournot game distinguish between participants and roles played by participants: participants can play in three roles and are not told with whom they are matched within groups of nine subjects each. The information provided varies across treatments: it might refer to the actions of participants in the same role but belonging to different groups, or to participants in the same group, or both. The authors find evidence in favor of imitation of more successful individuals: the degree of imitation they find is increasing in the difference between own and other's payoff. Moreover, higher imitating patterns arise with respect to the individuals with whom one interacts, rather than with respect to individuals who play in the same role but in different groups. A result in line with this study is provided by Offerman and Sonnemans (1998), with an experiment about investment decisions, which depend on different states of the world. Rather than imitation of choices, they test for the presence of imitation of incentivized beliefs: least-performing individuals are found to imitate more the judgements and beliefs of more successful subjects. Social interactions are further investigated experimentally in a tax evasion scenario by Fortin et al. (2007): participants are divided into groups and at the beginning of each new period they receive feedback about the amount evaded and the number of evaders among the members of their group. A convergence criterion for partic-

ipants' contribution choices is determined and if this is not reached within 10 periods a new round starts.

Two experimental studies that explicitly exploit network structures among participants are Falk et al. (2013) and Beugnot et al. (2013). Falk et al. (2013) consider a coordination and a public goods game. In their set-up, each individual is simultaneously part of two neighborhoods, who represent two economically identical environments and differ only for their group members. Their results lend support to the existence of strong social interactions, since a majority of individuals choose according to their respective neighbors' behavior. In Beugnot et al. (2013), participants in the baseline treatment perform a multiplication task without calculators and pens. In the recursive treatment each participant has one or two peers (belonging to the previous baseline treatment) and receives information at the beginning of the session about peers' personal information; moreover, at the beginning of each period, subjects are informed about peers' average piece-rate and performance in the task. In the simultaneous treatment, interactions occur in real time among players, in order to recreate real-like working situations. Overall, individuals are found to be significantly influenced by others' performance.

The contribution of this paper is twofold. First, we incorporate cognitive costs in an experimental setting of imitation choices. To the best of our knowledge, this is the first study that investigates experimentally social interactions from a cognitive perspective. In a cognitively demanding context, this paper estimates the impact of two possible short cuts for decision making: the reliance on choices made by a majority of subjects or the saliency of more recent memories. Moreover, we implement an original experimental task whose solution is not the result of computations or counting (for instance, see Pokorny (2008)), but which entails a more complex kind of reasoning that is more similar to mod-

ern and dynamic decisional contexts. We show participants a set of abstract figures, and we model the difficulty of such figures into high or low. In these two different scenarios, we test for the impact of information available to participants: whether they know or not the choices of a majority of subjects who took part in a previous session of the experiment.

We do not find that strong evidence in favor of imitative behavior, but the majority is believed to choose better when the task to perform presents higher cognitive costs. Moreover, we find that in scenarios cognitively demandign, subjects opt for choice objects more recently inspected.

The paper is organized as follows: Section 2 outlines the experimental design, the procedures followed during the experiment and the behavioral hypotheses; Section 3 presents the data and results from the experiment; Section 4 discusses and draws conclusions.

2 Design, procedures and behavioral predictions

2.1 Design

The novel feature of our experimental design is that participants do not face a typical experimental game, nor a mechanical counting or computational task.[3] Rather, on their computer screens, they face covered cards which contain on their inner side abstract figures composed of black squares.[4] Participants' aim is to select the card containing the figure which most closely resembles the figure appearing on the top left of the screen. In doing so, they can either uncover and inspect the cards that appear covered on the screen, or they can choose a covered card representing a default option, which is placed on the bottom right of the screen. The default card carries a different amount of information according to

[3] For an overview of real-effort tasks, see Gill and Prowse (2013).

[4] We are deeply indebted to Paolo Crosetto for the programming of figures through Python.

treatments. Indeed, in the DEFAULT treatments, participants are informed that the default card is one of the best 8 cards (among 16) appearing covered on the screen, while in the MAJORITY treatments they are told that the default card (in this case called majority card) has been chosen in a previous experimental session by the majority of participants, and that, moreover, it represents one of the 8 best cards appearing covered on the screen. The task is implemented both under a high-cost and a low-cost scenario, both considered in cognitive terms: in the former the resolution of figures is higher than in the latter. The rationale of the task is to offer subjects an environment in which, while searching the solution, they do not have a reference point, either computational or logical: the assignment is not related to an univocally clear solution, characterized by normative determinants. Our approach aims indeed to resemble a dynamic social environment, in which available options must be discovered, but it is not straightforward which is the best one.

The implementation of the design entails participants to face a screen with one card on the top left (also known as target card), and 16 covered cards below, divided into rows of 4 cards each. Cards are randomly distributed on the screen for each subject and each treatment, so that the distribution of cards is different for each unit of observation (the individual). Each card carries an abstract figure on its covered side. For the initial 10 seconds all cards are uncovered, and hence the figures portrayed on them are visible. As previously mentioned, the aim of the game is to choose the card most similar to the target card within a time constraint of 10 minutes. After the 10 initial seconds, all cards get covered: comparisons between any of the 16 cards and the target card can be carried out by participants by clicking on each card which is chosen for the comparison. After clicking on one of the 16 cards, the selected card is shifted next to the target card and both become uncovered. Participants can keep the selected card

beside the target card, for a visual comparison, for as much time as they wish, within the 10 minutes of time constraint of the whole experiment. In order to place the card back to its initial position, it is necessary to click again on the card (see Figure 1).

[Figure 1 about here]

Moreover, after the 10 initial seconds, a default card appears, covered, on the bottom right of the screen, according to the type of treatment.[5] If one of the 16 cards is inspected and then placed back in its original position among the other 15 cards, its boundaries get red. Participants are informed that within the time limit of 10 minutes they have to select either one of the 16 cards or the default/majority card. The 16 cards provide 16 different payoffs, ranging from 0.25 to 4 Euros, depending on the fitness of the figure represented on the chosen card with respect to the figure in the target card, that is the similarity between the chosen and the target card. Participants also know that the default/ majority card represents one of the 8 best cards in terms of fitness among the 16 cards (hence leading to an earning from 2 to 4 Euros). If the default/ majority card is selected, it represents the final choice: in this case participants can no longer explore the other cards appearing on the screen and they will receive the outcome attached to the card chosen. In case no card is selected within 10 minutes, participants simply receive the show-up fee of 2.5 Euros. The countdown of seconds available is displayed at the bottom right of the screen. At the beginning of each session, participants are endowed with a printed page consisting of the contours of the 16 cards divided into rows of four, as they appear on each computer screen. The idea is to facilitate subjects in remembering the fitness of the cards, by allowing them to take notes related to them. An example of the page is provided in Figure 2.

[5] In the MAJORITY treatments, the default card is called majority card, since it represents the choice of a majority of participants in a previous experimental session.

[Figure 2 about here]

After the completion of the choice, an incentivized belief elicitation task takes place: one additional Euro is earned, at the end of the experiment, if the participant guesses the fitness of the default/majority card. In addition, at the end of each session, participants were asked to fill out an anonymous ex-post questionnaire. This questionnaire aimed at gathering information about the perceived difficulty of the task, impressions about what the figure represented, as well as a series of demographics data such as age, gender and college major.

What we mean by "measure of fitness" is the number of black squares composing the figures that differ between the selected and the target card. This measure changes across the high-cost and low-cost treatments. In the low-cost scenario, the target figure is made up of 100 black squares. Each of the 16 cards differs from the target for 5 to 20 squares that moved position with respect to the target figure. The idea for the high-cost scenario is that of increasing the number of "pixels" composing the figures, that is the resolution: the target figure in this case consists of 400 black squares and each of the 16 cards differs from the target card for 20 to 80 squares that moved position. In practice, each black square of a low-cost figure corresponds to 4 black squares in a figure in the high-cost scenario. Hence, in the belief elicitation task, participants are asked to choose the number of squares that they believe differ between the target card and the default card (all the options, according to the treatment, are presented and participants are asked to tick on one of them). Figures 3 and 4 provide examples of figures in the low-cost and high-cost treatments, respectively. We believe that the increase in the number of squares composing the figures leads to an increased complexity in the task, and hence to higher cognitive costs.

[Figures 3 and 4 about here]

The 2 x 2 experimental design develops across two dimensions of treatments.

A first dimension is represented by cognitive costs: in the low-cost treatment figures are made up of 100 black squares, while in the high-cost treatment figures have a higher precision, since they include 400 squares. The second dimension of treatments involves the information given to participants about the default/majority card. In the default treatment, the card on the bottom right is called DEFAULT CARD and participants are informed that it is one of the 8 best cards among the 16, in terms of fitness with the target card. In the majority treatment, the card on the bottom right is denominated MAJORITY CARD and participants are notified that it is one of the 8 best cards and, in addition, that it was chosen by the majority of participants from a previous experimental session. The rationale of providing information also in the default treatment is that of preserving a certain degree of comparability with the majority treatment. In this way, the communication of the fitness of the cards, in other words the expected value, remains invariant across treatments. What changes is the additional information of the choice implemented by a previous majority, that in our approach aims to represent a social interaction component which participants may decide to follow when facing a cognitive cost. Table 1 provides an outline of the four treatments.

[Table 1 about here]

The 2 x 2 experimental design hence allows us to disentangle the role played by the availability of a social influence in a high-demanding scenario in cognitive terms versus a low-demanding one. Moreover, also the temporal patterns of participants' decisions can be investigated from different perspectives and dimensions.

2.2 Procedures

A baseline session without the availability of a default/majority card was previously run with 20 participants in order to gather data on the majority card used in the following majority treatments. The low-cost treatment was administered to 10 subjects, and the high-cost treatment was conducted on the remaining 10 subjects. The best card in terms of fitness with the target card was chosen by the majority of participants in both treatments. Following this baseline initial session, 154 subjects took part in the experiment, divided into 12 sessions.[6] 40 participants took part in each of the four treatments, except in low-majority treatment in which the number of participants was 34. The experiment was fully computerized and it was performed through a between-subject design. Participants were volunteer undergraduate and graduate students from different humanities and technical faculties from the University of Trento. Each session lasted around 30 minutes and it was conducted at CEEL (Cognitive and Experimental Economics Laboratory, Trento) between April and June 2013. A show-up fee of 2.5 Euros was given. The average earning per participant was of 5.7 Euros, and it was paid privately and anonymously in a separate room at the end of the experiment. Subjects could not participate in more than one session.

Upon their arrival at the laboratory, participants were randomly allocated to cubicles inhibiting interaction with other participants. Each participant could read the instructions for the experiment on the computer screen placed in the cubicle, and she was invited to read them privately. Later, a member of staff read the instructions aloud and participants were given the opportunity to privately ask staff members for clarifications. A set of computerized control questions was administered to subjects in all treatments, in order to verify their understanding

[6] Among a total of 166 participants, 154 selected a final choice, while 12 run out of time. For the analysis, we decided to consider only data about the 154 subjects who finalized a choice.

of the task.

The experiment consisted of four treatments, as depicted in Table 1. Three sessions per treatment were run.

2.3 Behvaioural Predictions

A first conjecture arises related to the task administered to subjects. We believe that our approach in designing the figures that participants have to visually compare entails a higher cognitive cost in case of a higher amount of resolution of the figure in the card, which consequently involves a lower performance rate. Therefore, we believe that increasing the cognitive cost implies lower performance choice rates.

In this study we are interested in analyzing what kind of behavioral shortcuts do individuals put into practice when they face decisions which are cognitively demanding and do not present a clear cut solution.

A first kind of reasoning may be related to social norms. When facing a new task, which is neither mechanical nor computational, subjects might conform to the norms deriving from the majority of members of their community. According to Bicchieri (2006, p. 5), "to efficiently search our memory and group a new event with previously encountered ones, we use cognitive shortcuts. Cognitive shortcuts play a crucial role in categorization and the subsequent activation of scripts and schemata.(..)In the *heuristic* route, behavior is guided by *default rules* stored in memory that are cued by contextual stimuli. Norms are one class of default rules." Referring to what has already been chosen by other subjects in the same decisional environment may represent a channel through which saving on cognitive costs. This type of social shortcut may be increasingly relevant when decisions are more demanding in cognitive terms. Another line of argument refers to the different timing of experiences faced by subjects. Indeed,

cognitive processing could be related to memory capacity, so that more recent events become more salient when we experience cognitively demanding tasks (see, for instance, Hastie and Dawes (2010)). This enables us to formulate the following two testable predictions:

Hypothesis 1 People imitate more in contexts highly demanding in cognitive terms

Hypothesis 2 More recent memories have a greater impact on choices

3 Results

In this section, we first present descriptive statistics of the sample of participants, with bivariate tests. We then discuss econometric results related to the research hypotheses we aim to test.

3.1 Descriptive statistics and *prima facie* evidence

Table 2 reports means, standard deviations, minimum and maximum values of the main variables used in the analysis.

[Table 2 about here]

Most subjects are young and females slightly outnumber males. The variable "payoff" is the total payoff from the experiment for each subject, while for the variable "net payoff" it is subtracted the additional Euro gained in case of a correct guess of the belief about the default/majority card (out of 154 participants, 45 guessed the belief correctly).

On average, subjects complete the task in almost 7 minutes and they uncover 22 cards. The average difficulty declared at the end of the session is approximately

5, on a scale from 1 to 10, ranging from easy to difficult. The variable "belief default" is the ratio between the real difference in black squares between the target and the default card, and the believed corresponding difference in black squares declared at the end of each session by subjects. Since in both low-cost and high-cost treatments the default/majority card is the one with the smallest amount of different squares with respect to the target card (5 over 20 in the low-cost treatment vs 20 over 80 in the high-cost treatment), it follows that the "belief default" values range between 0.25 and 1, in case of the worst and best belief about the default card, respectively. Therefore, a higher value for "belief default" represents higher expectations about the goodness of fit of the default/majority card. In our data set, participants' average belief falls almost in between the worst and the best belief.

Taking into account these variables across treatments, we can see a more detailed picture of the underlying patterns of the experiment in Table 3.

[Table 3 about here]

As we can note, the payoff is always lower in the high-cost treatments, with respect to the corresponding low-cost treatments, and it is lowest in absolute terms in the case of the high-default setting. The result is mirrored by the net payoff variable. We find a statistically significant lower payoff in the high-cost treatments compared to the low-cost treatments, both in case of the payoff and net payoff variables (Wilcoxon rank-sum test, $z = 5.492$, $p = 0.00$; $z = 6.859$, $p = 0.00$, respectively[7]). This is corroborated by looking at Figure 5, in which we can notice that median payoff values for the high-cost treatments are always below median payoff values for the low-cost treatments, and also that there is greater dispersion in payoffs when the task involves figures with higher resolution.

[7]Throughout the paper, treatment means are used for statistical two tailed tests, unless otherwise specified.

[Figure 5 about here]

This result supports our experimental approach and sheds light in favor of the presence of higher cognitive costs in case of figures with higher resolution, since the net payoff is a clear measure of performance (higher payoffs are associated to higher goodness of fit of the chosen card with respect to the target card). This preliminary evidence is verified in the ordinary least-squares regression analysis which investigates the determinants of the performance reached by the 154 participants in the experiment (see Table 4). The dependent variable in the model is the payoff in the experiment. A positive sign for the dependent variable identifies a higher performance, while a negative sign identifies a lower one.

[Table 4 about here]

The dependent variable is regressed on the following explanatory variables: *info* is a dummy variable equal to 1 if the treatment provides information about the majority (low-majority and high-majority treatments), and it is equal to 0 otherwise (low-default and high-default treatments); *cost* is equal to 1 if the treatment is highly costly in cognitive terms, and it is equal to 0 otherwise; *male* is equal to 1 if the participant is a male, and to 0 in case of females; *difficulty* is the perceived difficulty declared by subjects in a post-experiment questionnaire (it ranges from 1, easy, to 10, difficult); *seconds* is the amount of milliseconds employed for the completion of the task.

The regression output reported in Table 4 confirms what previously discussed, as can be noticed from the negative and highly significant coefficient of *cost*. The positive and statistically significant coefficient of the dummy information might be due to the higher choice of default in the majority treatments: the default choice was attached to the highest payoff, even if participants were not aware of this. Males, *ceteris paribus*, seem to perform slightly better than

females. Furthermore, the perceived difficulty declared at the end of the experiment does not seem to predict the performance of participants, while the more time spent completing the task is significantly associated to a higher payoff. This evidence leads to the following result, which confirms the validity of our experimental task:

Result 1 *Figures with a higher resolution are associated to higher cognitive costs and hence lower performance rates.*

Following the descriptive statistics of Table 3, in the majority treatments participants employ the smallest amount of seconds, especially in the high-majority one. On the other hand, the maximum number of uncovered cards is found in the low-default treatment. This might be due to the low difficulty of the task, so that participants are more willing to inspect the 16 cards on the screen. Nevertheless, and quite surprisingly, the lowest difficulty declared for the task is related to the high-majority treatment. Concerning the beliefs about the goodness of fit of the default/majority card, they improve in the case of the high-cost treatments with respect to the low-cost ones, while the information setting does not seem to influence subjects' beliefs (Wilcoxon rank-sum test, z = -2.261, p = 0.0238; z = -0.618, p = 0.5369, respectively). This enables us to derive the following result:

Result 2 *High-cost treatments present higher beliefs about the default/ majority card.*

3.2 Imitative dynamics

Table 5 reports the frequencies of subjects who chose either the default or the majority card.

[Table 5 about here]

As we can see, the frequencies of subjects choosing the default/ majority option are very low: out of 154 individuals, only 8 adopted a decisional shortcut. The highest frequency of default choices is in line with our imitation hypothesis: people decide for a shortcut in case the task is more costly in cognitive terms and a majority outside option is available, but differences across treatments are not statistically significant (two-sample test of proportions with respect to cost and information treatments, respectively: z = -0.6135, p= 0.5395; z = -0.8400 p= 0.4009).

A closer examination of the elicited beliefs across treatments requires us to undertake pairwise comparisons. If we compare average beliefs between low-default and high-default treatments, we do not find any statistically significant difference (Wilcoxon rank-sum test, z = -0.483, p = 0.6290). The same result holds when we compare average beliefs between the low-default and the low-majority treatments (Wilcoxon rank-sum test, z = 1.030, p = 0.3029). A different pattern arises concerning beliefs in the high-majority treatment. Participants in this condition have higher beliefs related to the default card both with respect to the low-majority treatment and the high-default treatment (Wilcoxon rank-sum test, z = -2.636, p = 0.0084; z = -1.748, p = 0.0804, respectively). This points towards the directions that a certain majority, considered as social component in our experiment, is considered to implement better decisions in the presence of high cognitive costs. If we investigate participants' beliefs, we can argue that the decisions of the majority represent a focal point in the presence of higher cognitive costs. Hence, we can conclude that:

Result 3 *Beliefs about the choice of a majority of individuals are higher with respect to a setting with lower cognitive costs and with respect to a setting in which there is no information about the choice of a majority.*

3.3 Temporal patterns of decision

As regards the time distribution of choices, our data set enables us to track the sequence of cards uncovered by subjects, as well as the amount of seconds they spend looking at each card they inspect. On average, subjects uncovered 22 cards each: this means, since the available cards for inspection on their screen are 16, that they often uncover the same card more than once. Therefore, whenever this was the case, we decided to consider as timing of choice the last moment the chosen card was uncovered. For instance, if a subject uncovers the chosen card as the third card in his sequence of uncovered cards, but also as tenth card, we consider that the subject selects the tenth uncovered card as her final choice. Of course, this criterion pushes the distribution of choices towards the right tail, but we believe it is more realistic than other criteria (for example, considering the first time in which the chosen card was uncovered or a point in between the first and the last time in which it was uncovered). Given this assumption, we construct the variable "timing of choice" by normalizing the order in which the chosen card was uncovered by the total number of uncovered cards for each subject. Figures 6 and 7 display the frequencies for the timing of choices of participants in the high-cost and low-cost treatments, respectively.

[Figures 6 and 7 about here]

From a first visual comparison, we can note that in the high-cost treatment there is a higher frequency of participants choosing among the recently uncovered cards. This is confirmed when we perform a Wilcoxon rank-sum test on the average timing of decision, comparing low-cost and high-cost scenarios ($z = -1.662$, $p = 0.0965$). When looking at the patterns in which the cards were uncovered and then chosen, we notice that all subjects, except one, uncovered the best card among the 16 present in the screen. We hence analyze the distance, in terms of number of cards uncovered, between the the best card and

the card chosen and we normalize it for the total amount of uncovered cards by each subject. We compare this distance across the high-cost and the low-cost treatments and we find it is significantly higher in case of high-cost treatments ((Wilcoxon rank-sum test, z = -2.437, p = 0.0148). Also this finding corroborates our Hypothesis 2:

Result 4 *More recent memories have a greater impact on choices, especially in scenarios with higher cognitive costs.*

4 Conclusion and discussion

This paper investigated the role played by cognitive costs in decisions involving social interactions. Imitation is a very frequent determinant of real world behaviors but it has been limitedly examined by economic theory. Imitation is crucial in the transmission of knowledge and represents one of the main sources of learning. We investigated the role of imitation in decision making through an experiment on choice behavior, and it disentangles different contexts according to different levels of cognitive costs. Indeed, we provide participants with an innovative task to solve which is not purely mechanical like for instance counting tasks. Results show that our experimental task is able to implement a scenario with low cognitive costs and one with high cognitive costs, characterized by lower performance levels. Moreover, we analyzed temporal decisional patterns since in scenarios with cognitive costs they might represent heuristic in decision making. In our experiment, imitation, conceived as a cognitive shortcut, does not seem to be present in participants' choices, but we find higher expectations concerning the goodness of choice of a majority of subjects from a previous experimental session, if the task to be performed has higher cognitive costs. There is therefore some evidence of imitation in favor of a majority as concerns beliefs. A possible explanation of our weak finding could be identified in the

way in which the imitative component has been introduced in the experiment (i.e., by providing participants information about what a majority did in a previous experimental session): this indeed might have been too weak to generate some imitative behavior. For this reason, further research could point towards an endogenous imitation pattern within the experiment: the majority could be formed during the experiment and feedback about it would be provided during the game. Another stream for future research might be represented by modeling differently the social component, and by strengthening it. This would be achievable by incorporating an in-group/ out-group framework in the experimental design. In this paper we also provide empirical evidence that in the presence of high cognitive costs subjects implement decisional heuristics in order to find a solution to the task. More specifically, they attach more relevance to more recent memories. We are aware of the concerns related to the external validity of laboratory experiments, and of the limitations of letting individuals to interact with reference groups exogenously imposed. Nevertheless, our approach might mimic those situations in which there is decisional default option such as in Internet contexts, in which frequently the most popular item is signalled and individuals might choose to opt for it instead of individually looking at its characteristics.

5 Tables

Table 1: Treatments

		Cognitive costs	
		Low Cost	High Cost
Information on the majority	No	*low-default*	*high-default*
	Yes	*low-majority*	*high-majority*

Table 2: Descriptive statistics

	Mean	Std. Dev.	Min	Max
Sex (male = 1)	0.46	0.50	0	1
Age	23.42	3.29	19	41
Payoff	5.71	1.00	2.75	7.5
Net payoff	5.42	0.95	2.75	6.5
Seconds	417.23	162.96	0.001	581.67
N. uncovered cards	21.80	8.74	1	49
Difficulty declared	5.38	2.23	1	10
Belief default	0.72	0.23	0.25	1

Notes: Difficulty is expressed on a scale from 1 (easy) to 10 (difficult); Belief default is 0.25 if participants believe that the default/ majority card is the worst, in terms of similarity with the target card, and it is equal to 1 in case they believe it is the most similar card with respect to the target.

Table 3: Means across treatments

	Low-default	High-default	Low-majority	High-majority
Payoff	6.12	5.09	6.14	5.56
Net payoff	5.87	4.84	5.93	5.11
Milliseconds	453786.1	411323.2	405916.3	396203.5
N. uncovered cards	22.75	22.53	20.26	21.43
Difficulty declared	5.33	5.83	5.59	4.8
Belief default	.6967347	.7139879	.6493709	.7947086

Notes: Difficulty is expressed on a scale from 1 (easy) to 10 (difficult); Belief default is 0.25 if participants believe that the default/ majority card is the worst, in terms of similarity with the target card, and it is equal to 1 in case they believe it is the most similar card with respect to the target.

Table 4: Regression model of the determinants of performance

Payoff ∼	Coeff.	Std. Errors
(Intercept)	5.776173	(.2897312)***
info	.2867096	(.1468653)°
cost	-.7882182	(.145829)***
male	.2504396	(.146718)°
difficulty	-.0510903	(.0330326)
seconds	8.73e-07	(4.55e-07)°
Number of Observations: 154		
Significance levels: *** 0.001; ** 0.01; * 0.05; ° 0.1		

Notes: The dependent variable in the model is the payoff in the experiment; *info* is a dummy variable equal to 1 if the treatment provides information about the majority, and it is equal to 0 otherwise; *cost* is equal to 1 if the treatment is highly costly in cognitive terms, and it is equal to 0 otherwise; *male* is equal to 1 if the participant is a male, and is equal to 0 in case of females; *difficulty* is the perceived difficulty declared by subjects in a questionnaire at the end of the experiment (it ranges from 1, easy, to 10, difficult); *seconds* is the amount of milliseconds employed for the completion of the task.

Table 5: Frequencies of default options

	Low-default	High-default	Low-majority	High-majority
Frequencies default	1	2	2	3
N. of subjects	40	40	34	40

6 Figures

Figure 1: Example of a screenshot during the comparison

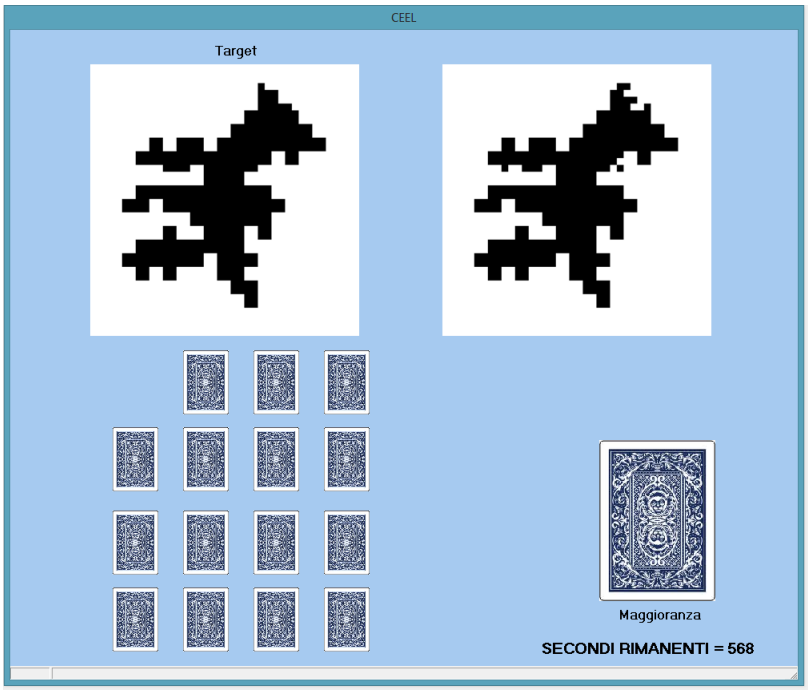


Figure 2: Example of the annotation page

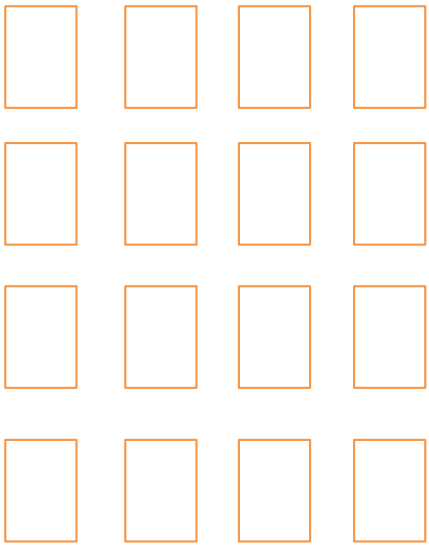


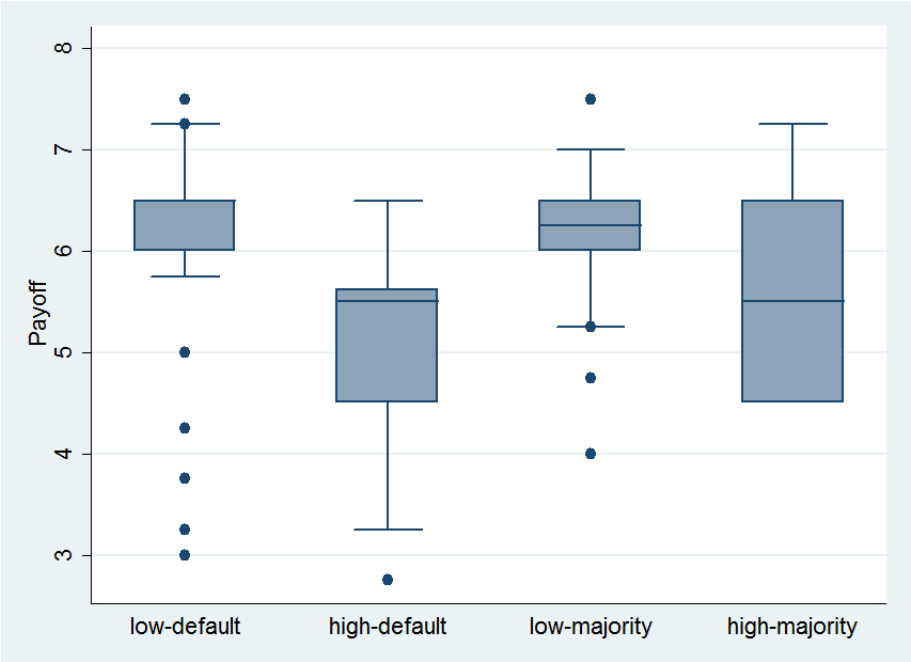
Figure 3: Example of figure in the low-cost treatments

Notes: In red it is represented the dimension of a square.

Figure 4: Example of figure in the high-cost treatments

Notes: In red it is represented the dimension of a square.

Figure 5: Payoff per each treatment



Notes: Middle bars correspond to median values, the edges of the boxes comprise the inter-quartile range between the 25th and the 75th percentiles, whiskers correspond to 1.5 times this range and circles characterize any other observation.

Figure 6: Time distribution of choices: high-cost treatments

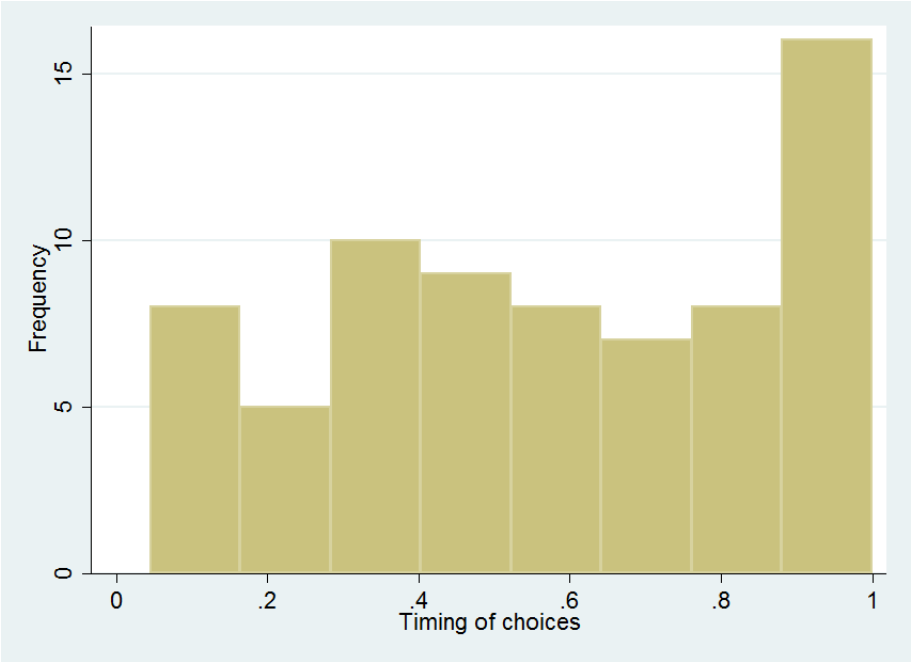
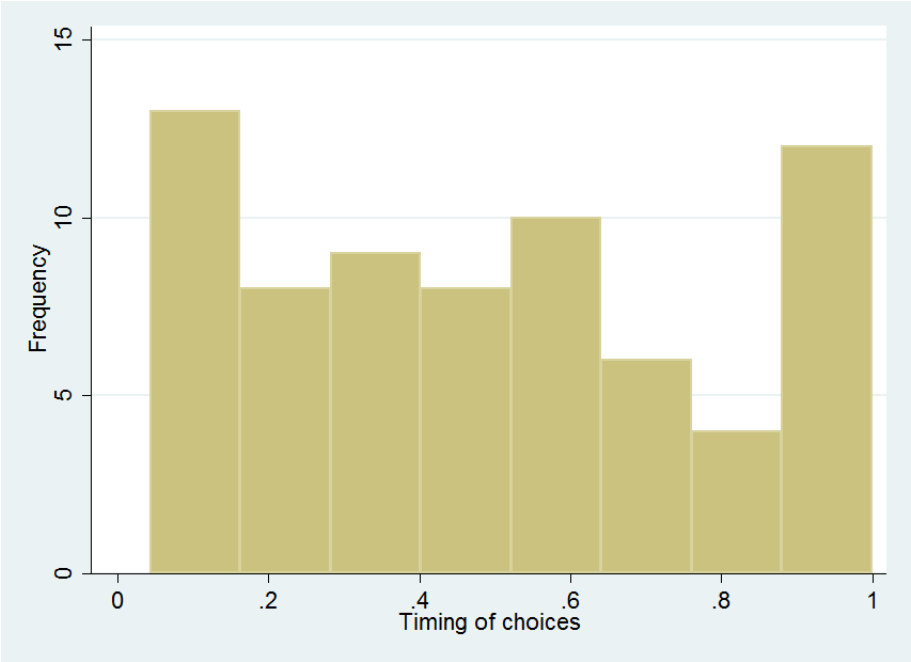


Figure 7: Time distribution of choices: low-cost treatments



Appendix A. Instructions for the "high cost - default" treatment (translated from Italian) [8]

Welcome to this experiment!

You will receive 2.5 Euros as a showing-up fee for coming on time to the experiment. We kindly ask you to read the instructions carefully. During the experiment it is forbidden the communication with other participants. If you have any doubts and you want to ask a question, please raise your hand, an experimenter will come to you and will answer your question. If you don't respect these rules we will have to exclude you from the experiment and you will not be paid.

You are taking part to an economic experiment on decision-making. You can earn an amount of Euros depending upon your decisions during the experiment. Both your choices and other participants' choices will remain anonymous and will never be attached to your name.
Initially, for 15 seconds, it will appear on your screen:

- a card, on the top left. This card is called "TARGET" card. It contains a figure composed of many squares. As a square we mean the part represented in red in the figure below:

- below the TARGET card you will find 16 cards containing figures. Each figure differs from the figure contained in the TARGET card according to a different amount of squares.

Your aim is to find the card which contains the figure more similar to the figure contained in the TARGET card, **that is with the smallest amount of squares placed in a different position with respect to the figure in the TARGET card.**
Your final earning will be as greater as smaller is the amount of squares that differ from the figure of the card you chose and the figure on the TARGET card.

Your earning will be equal to the show-up fee plus:

- 4 Euros, in the case in which the card you chose is the best one, that is the most similar to the TARGET figure;
- 0.25 Euros, in the case in which you chose is the worst one, that is the least similar to the TARGET figure;

[8] Other instructions are available upon request. In Italics are the parts related to the majority treatments, for which DEFAULT card should always be replaced by MAJORITY card.

- the intermediate cards, between the best and the worst one, will provide you intermediate earnings between 0.25 and 4 Euros, with increases of 0.25 per card.

At the end of the initial 15 seconds, during which both the TARGET card and the 16 cards underneath are visible, all cards will be covered. On the bottom right of the screen will appear a covered card, called DEFAULT card. This card represents one of the best 8 cards (more similar to the TARGET card among the 16 you find covered. *[Majority treatments only] On the bottom right of the screen will appear a covered card, called* MAJORITY *card. This card has been chosen by the majority of participants in a preceding session of the experiment and moreover it represents one of the best 8 cards (more similar to the* TARGET *card among the 16 you find covered.* You can choose whether to select this card as your final choice, or to uncover and inspect the other 16 cards that appear on the left of the DEFAULT card.

In case you choose the DEFAULT card, this represents your conclusive choice and you will not be able to uncover it and then inspect the other 16 cards. Your earning in case you choose the DEFAULT card depends on the similarity of the DEFAULT card with respect to the TARGET card. About the DEFAULT card you are only informed that it is one of the best 8 cards among the 16 present on its left. *[Majority treatments only] About the* MAJORITY *card you are only informed that it has been chosen by the majority of participants in a preceding session of the experiment and moreover that it represents one of the best 8 cards among the 16 you find covered.* **If you choose it, this represents your conclusive choice.**

If you choose to inspect one of the 16 cards, you have to click on it. The card will be enlarged and displayed beside the TARGET card. Once you decide to conclude the visual comparison between the selected card and the TARGET card, in order to bring back to the initial position the selected card you must re-click on it. In this way, the card you have just compared will return to its initial position and and its border will become red, to indicate that the card has already been inspected.

You can decide whether to choose this card as you definitive card, and in this case you must re-click on it, or to proceed with the visualization of another card. In case you want to visualize again a card which has already been inspected (therefore with the red border), you can re-click on it. The computer will ask you whether you want to select this card as your final choice or if you simply want to visualize it again.

If you choose to inspect one or more of the 16 cards, at any moment you will be able to interrupt your search and to choose the DEFAULT card. In this case the experiment ends and your earning will depend on the similarity between the DEFAULT card and the TARGET card.

The time available to you is 10 minutes, starting after the reading of these instructions. **When the time expires, if you haven't selected any card yet, your final earning will be equal to the 2.5 Euros of the show-up fee.**

Once you have selected your conclusive card, we ask you to remain seated and silent, while waiting for the other participants to complete the experiment. After you made your choice (either one of the 16 cards or the DEFAULT card), the computer will ask you to specify the amount of squares for which you think the DEFAULT card) (that you cannot visualize) differs with respect to the TARGET card. In case your answer is correct, you will receive an additional 1 Euro to your final earning.

Your final earning will paid to you in cash and privately, so that the other participants to the experiment will not know your earning.

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