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# BIASES FOR ACQUIRING INFORMATION INDIVIDUALLY RATHER THAN SOCIALLY

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**Abstract.** We discuss theoretical and empirical arguments for a human bias to acquire information individually rather than socially. In particular, we argue that when other people can be observed, information collection is a public good and hence some of the individual variation in the choice between individual and social learning can be explained by variation in social value orientation. We conducted two experimental studies, based on the game Explore & Collect, to test the predictions that (1) socially and individually acquired information of equal objective value are treated differently, and (2) prosocial subjects tend to spend more effort than selfish subjects on individual acquiring of information. Both predictions were supported.

**Keywords:** individual learning, social learning, self-serving bias, social value orientation, public good

## INTRODUCTION

An important part of human culture consists of good solutions to practical problems. These range from problems of individual survival, like finding food or shelter, to purely social problems like how to entertain one's friends. Information about what options are available and how good they are can come from various sources. In behavioral and evolutionary approaches to culture, a theoretical distinction is commonly made between *individual learning*, which means that an individual explore options on her own, and *social learning*, which encompasses various forms of gaining information from other individuals (cf. LALAND 2004). In practice it may often be impossible to identify such pure strategies, as demonstrated by the popular

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human activity of solving problems in groups, where both elements of social and individual learning are clearly intertwined. Other learning activities that do not fit in the social/individual dichotomy include individuals reevaluating known options in a slightly new situation, or reinventing things they have learnt before, or otherwise adding a touch of individual effort to previously acquired experiences. Indeed, in economics sometimes the term "social learning" is used explicitly for behavioral change caused by evaluation of others' experiences, in contrast to uncritical "imitation" (cf. FOSTER and ROSENZWEIG 1995). Adding to the confusion, the "social learning theory" of social psychology is a complex of ideas based on a general view that "behavior, other personal factors, and environmental factors all operate as interlocking determinants of each other" (BANDURA 1977, pp. 9–10). In this paper we will nonetheless follow the tradition in cultural evolution of making the simple distinction between individually and socially acquired information, because in addition to its theoretical importance this distinction can be implemented unambiguously in the laboratory.

Several mathematical models of gene-culture coevolution aim at describing the evolution of optimal use of social information (ROGERS 1988; BOYD and RICHERSON 1985, 1995; AOKI, WAKANO and FELDMAN 2005; ENQUIST, ERIKSSON and GHIRLANDA 2007; ERIKSSON, ENQUIST and GHIRLANDA 2007). Lately this research has been extended to laboratory studies of how people use individual and social learning. Emerging from these studies is an unexpected pattern of severely suboptimal use of socially acquired information, as illustrated by the following quotes:

"By the end of an experimental farm, only about 20% of participants choose to view social information." (MCELREATH et al. 2005, p. 501)

"Players did not consistently use the social information [...] in any way captured by our models." (EFFERSON et al. 2007, p. 15)

"A considerable number of participants did not use social information" (TOELCH et al. 2009, p. 39)

The latter study is particularly illuminating in that cues about where to find resources were of exactly the same value whether subjects acquired them socially or individually; nonetheless, socially acquired cues were ignored to a much larger extent than were individual cues (TOELCH, personal communication). We must point out that these data are potentially confounded by a design feature of the study in question: following an individual cue always meant making the same choice again, whereas following a social cue always meant making another choice than last time. Still, we find the results from the three abovementioned studies highly suggestive of the possibility of a human bias in favor of individually acquired information and against socially acquired information.

## Possible causes of a bias for individually acquired information

We know of no previous work that explicitly treats the kind of bias we here put forward. It is clearly reminiscent of various self-serving biases identified in social psychological research, such as overconfidence in once own judgments (cf. SOLL and CLAYMAN 2004) and the tendency to think one is better than average (cf. ALICKE et al. 1995), but the only work we have found relating self-serving biases to information search deals with what type of information content one searches for (PYSZCZYNSKI, GREENBERG and LAPRELLE 1985). In contrast, our focus here is not the content but the preferred source of information.

There seem to us that at least three different classes of potential causes of a bias against socially acquired information are worth considering. First, information from others may be regarded as *less trustworthy or less relevant* than information one acquires individually. For instance, this would be expected if high-quality information is difficult to come by and individuals have self-serving perceptions of being more competent than others, but the trustworthiness problem can appear also for other reasons. An agent might fear that other individuals are intentionally deceptive in what they let others observe, or that they are not facing exactly the same problem so that their behavior may not be fully relevant to the agent's own problem. We think the trustworthiness/relevance problem may be very common in situations where both individual and social learning are possible, but we will not pursue it further in this paper. It is worth pointing out that the same mechanism may also serve to increase the interest in socially acquired information, if an individual has reasons to believe that another individual is particularly competent or has access to particularly relevant information. This was the case in a study by MESOUDI (2008) where participants knew the track records of others so that they could choose to observe particularly successful individuals, and participants' interest in observing proven successful individuals remained at high levels throughout the experiment.

Second, a bias may arise from the different *cognitive rewards* of the activities involved in individual and social learning. Individual learning may involve a wider array of sensory experiences and therefore on the whole provide more stimulation, and possibly also yield more learning impact, e.g. in terms of retention in memory of the learnt information, thus to some extent offset any extra costs in terms of time. In education, this is exploited in the "problem based learning" paradigm which, compared to instruction based learning, induces students to retain knowledge much longer and process the information learned more extensively (NORMAN and SCHMIDT 1992, p. 560; on the whole, however, there seem to be educational advantages of guided instruction, see KIRSCHNER, SWELLER and CLARK 2006). It is also of note that a cross-cultural study found, in eight of nine countries studied, that most respondents preferred individual learning to group learning (REID 1987).

Third, prosocial (i.e., cooperative) tendencies in humans could cause a bias for individually acquired information. Information is in effect a public good in standard models of social learning, and the social learners – who do not contribute to the public good by producing new information – are therefore labeled information scroungers (KAMEDA and NAKANISHI 2002, 2003; RICHERSON and BOYD 2005; MESOUDI 2008). The public good character of individual learning has been observed empirically. In particular, a large study of adoption of new agricultural technology found that "farmers tend to free-ride on the learning of others" and that "a farmer can reduce his losses in a given period if he can rely on his neighbors to gain the relevant experience" (FOSTER and ROSENZWEIG 1995, p. 1206). The same phenomenon also appears on the level of organizations: "the best strategy for any individual organization is often to emphasize the exploitation of successful explorations of others. Such a strategy, if followed by all, produces no innovations to imitate and a down ward spiral [...]. The system as a whole underinvests in exploration." (LEVINTHAL and MARCH 1993, p. 104). We believe this idea can shed new light on the results of an experiment by KAMEDA and NAKANISHI (2002) where human subjects played a game involving the possibility of noncostly information scrounging and costly information production. Comparing two conditions with different cost levels, Kameda and Nakanishi found that less information was produced when the cost was higher; however, in both conditions there was a very large variation between individuals, in an approximately continuous spectrum from consistent information scroungers to consistent information producers via various mixes of scrounging and producing. Kameda and Nakanishi did not discuss the source of this variation between individuals, but a consequence of the idea we here put forth is that the variation in information acquiring behavior may be largely attributable to variation in cooperativeness.

In this paper we will present two experiments where individual and social learning are studied using game *Explore & Collect*, which was developed and analyzed in a previous paper (ERIKSSON and STRIMLING, preprint). The first study tests existence of an intuitive bias in favor of individually acquired information (supposedly based on cognitive rewards, since other explanations are ruled out by the design). The second study tests whether cooperative personalities spend more effort on individual acquiring of information. Here we rely on an established framework for individual variation in cooperativeness called social value orientations (MESSICK and MCCLINTOCK 1968; VAN LANGE et al. 1997; VAN LANGE 1999; SIMPSON 2004; BOGAERT, BOONE and DECLERCK 2008).

## MODEL SCENARIO: THE GAME OF EXPLORE & COLLECT

The game called *Explore & Collect* has recently been introduced by Eriksson and Strimling (preprint). It is described by the following rules about options and payoffs and what information is available to players.

## Options and payoffs

The *Explore & Collect* game presents the player with a number ($n$) of options to explore during a number ($a$) of rounds. Options are not equally good; for any option $i$, let $U(i)$ denote the payoff to the player if she picks this option. In each round, the player can choose among all $n$ different options. If she picks an option she has already explored she will obtain exactly the same payoff next time.

## Information available to players

At the start of the game, the player has no other information about the payoffs than that they will be uniformly distributed (i.e., all values between some maximum payoff and some minimum payoff appear with equal frequency). When exploring an option the player can only observe its *relative rank*, i.e., how it compares (better or worse) with all previously explored options. The absolute values of payoffs are not revealed to the player until the end of the game. At this point she receives the sum of the payoffs she has obtained through her $a$ picks of options. See *Figure 1*.

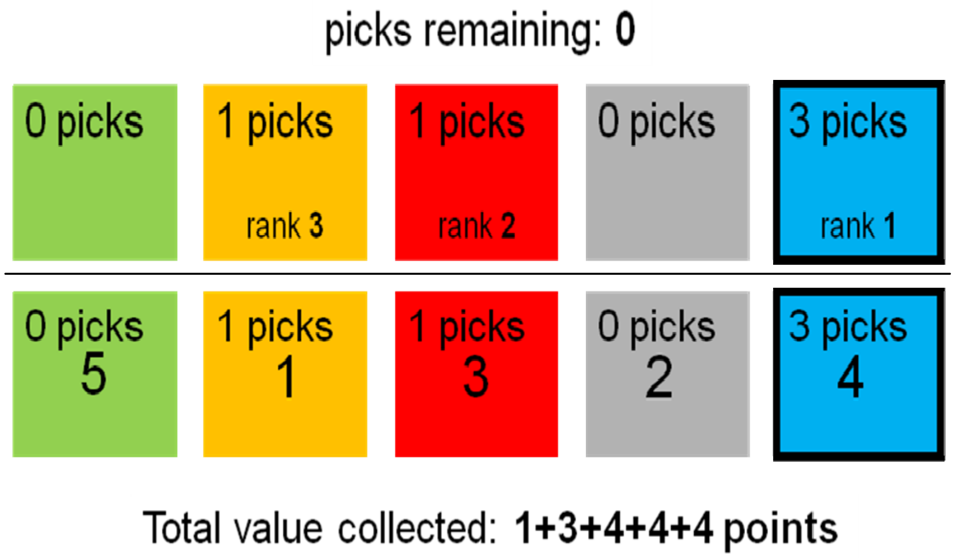


*Figure 1*. Sketch of the information given to players of *Explore & Collect* in a game with $n = 5$ options and $a = 5$ picks. Options are presented as boxes. For each option players can see how many times they have picked it already. Top half: For any option that has been explored (i.e., picked at least once) it is shown how its payoff ranks among all explored options. Bottom half: At the end of the game the absolute payoff values are revealed and the total payoff is calculated.

Eriksson and Strimling (preprint) analyzed what strategy is optimal (i.e., maximizes expected total payoff), and conducted experiments to compare the optimal strategy with people's actual behavior in the game. The optimal strategy is to explore

$$-\frac{3}{2}+\sqrt{2a+\frac{9}{4}} \tag{1}$$

different options and then stick to the best one. In experiments people tended to explore many more options than is optimal, but over the course of repeated play they learn to play more optimally.

### Analysis of Explore & Collect with socially acquired information (SAI)

In Study 1 we will consider a variant of the *Explore & Collect* game with socially acquired information (SAI). Specifically, the player starts with information about $b$ options, as if they had previously been explored by someone else; from this initial position the player gets to make $a$ picks of her own. (See *Figure 2* for an illustration.) This game is of course logically equivalent to the last $a$ moves of a standard *Explore & Collect* game with $b+a$ picks, assuming that the player would explore at least $b$ options in such a game. Any systematic deviation in play between these two logically equivalent games would therefore suggest that individually and socially acquired information have different cognitive impact on players.


*Figure 2*. An example where the player of *Explore & Collect* takes over information about two options and has three picks of her own. This game is logically equivalent to the last three moves of the game in *Figure 1*

### Analysis of Explore & Collect when two players can observe each other

In *Study 2* we will use a two-player version of *Explore & Collect.* In this version of the game the two players both have the same options, and they can observe what options the other player picks (but not how these options are ranked). See *Figure 3*.

The point of introducing this two-player game is that information collection (i.e., exploration) becomes a contribution to the common good, and hence we expect social value orientations to affect exploration strategies as follows. When a player revisits her best explored option, the other player can observe this and infer that this is an option worth exploring; therefore, players are expected to end up with the same best explored option. At this point, we expect prosocial players to be more likely than selfish players to engage in further exploration, because her expected utility of such exploration is higher (i.e., in case she finds a new best option a prosocial player will experience utility also from the increased payoff the other player will be able to gain from this information).

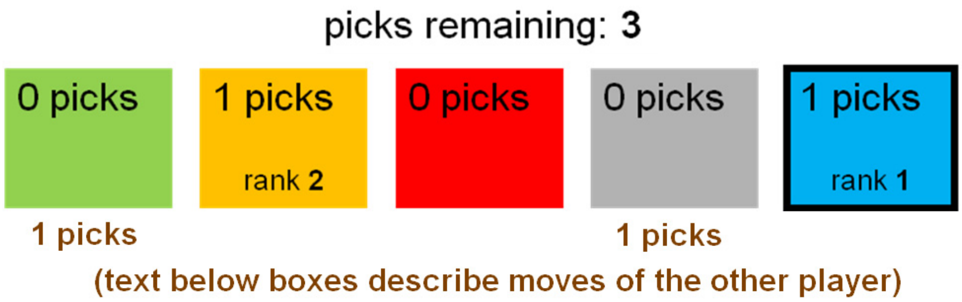


*Figure 3*. The information available to a player of the two-player version of *Explore & Collect*

It is possible to make an analysis of optimal strategies also for this two-player game, but for two reasons we do not do so here. First, such an analysis would depend on the exact forms we assume for the utility functions of prosocial and selfish players, but empirical evidence from experimental economics does not support that other-regarding preferences are sufficiently consistent for such models to have much general validity (BINMORE 2007, pp. 1–22). Second, given that players of the strategically much simpler one-player version of *Explore & Collect* need quite a bit of learning before they come anywhere close to optimal play (ERIKSSON and STRIMLING, preprint), we see no reason to expect players to reach optimal behavior within one session of play. The effect we expect to see is simply that prosocial players will explore more than selfish players, and that this effect will become more pronounced the more they learn to play the game (i.e., as the noise from trial-and-error declines).

## STUDY 1

In the first study we compare behavior between standard *Explore & Collect* and the version with some socially acquired information, in order to investigate the hypothesis that socially acquired information is valued less by players although logically equivalent to individually acquired information. In preparation for *Study 2*, we also check whether exploration behavior in this game is related to social value orientation (which it should not be here, since a player's behavior affects no one else). We also wanted to control for curiosity, which is a personality trait that could possibly affect behavior in a game like *Explore & Collect,* and used an instrument with items like "I like to explore my surroundings" designed to measure perceptual-epistemic curiosity (LITMAN 2008).

## Subjects and procedure

103 participants (56 men and 47 women, between 18 and 52 years old with mean age 25 years) were recruited from a pool of volunteering students of miscellaneous study programs. Participants were informed that they would be paid according to how many points they earned in the game (average pay was about 100 Swedish kronor). In addition, every participant received a cinema ticket for showing up.

Participants were led to separate cubicles equipped with computers. A questionnaire was handed out on paper (see below). The computer then ran software for the *Explore & Collect* game in both an "individual information" version and a "social information" version, see below. The order of the two versions of the game was randomized for each subject.

***Individual information version*:** This was the standard version of the game with 11 picks to be made by the player. (It is logically equivalent to the social information version once 3 options are explored.) According to formula (1), the optimal strategy is to explore 4 options and then stick to the best one.

***Social information version*:** This was the above-mentioned SAI version of the game, starting with information about 3 options, and with 8 picks to be made by the player. (Subjects were told: "You can see the ranks of 3 random boxes that have already been clicked; you have 8 clicks from this position.") From the equivalence to the individual information version (if the 3 explored options are viewed as picks you have already made) it follows that the optimal strategy is to explore 1 more option and then stick to the best of the 4 explored options.

The computer program started with a tutorial. The complete instructions are given in the Appendix.

## Questionnaire

The questionnaire consisted of two parts measuring social value orientation (SVO) and perceptual-epistemic curiosity (PECI), presented in full in the Appendix.

For SVO we used a standard nine-item questionnaire, where each item has three response alternatives corresponding to a cooperative choice, an individualistic choice, and a competitive choice; subjects who made a majority of cooperative choices were categorized as *pro-social*, whereas subjects who made a majority of individualistic or competitive choices were categorized as *pro-self* (VAN LANGE 1999; VAN LANGE et al. 1997; SIMPSON 2004).

The PECI questionnaire consisted of a ten-item "deprivation type" subscale from an instrument developed by LITMAN (2008). Answers were coded from 1 (almost never) to 4 (almost always) and the sum of these numbers was taken as a measure of perceptual-epistemic curiosity.

*Table 1.* Mean values (standard deviations) of excess exploration and PECI score in *Study 1*, broken down by social value orientation

| | All subjects ($N$ = 103) | Prosocial ($N$ = 57) | Proself ($N$ = 41) |
|---|---|---|---|
| Excess exploration, individual information | 3.93 (2.34) | 3.93 (1.94) | 4.02 (2.69) |
| Excess exploration, social information | 4.46 (1.92) | 4.40 (1.77) | 4.49 (2.10) |
| PECI score | 30.9 (3.9) | 30.8 (4.1) | 31.0 (4.0) |

## RESULTS

Analysis of the SVO questionnaire placed 57 subjects in the prosocial category and 41 subjects in the proself category; the remaining 5 subjects were left uncategorized due to incomplete responses. A summary of the data, for proself and prosocial subjects separately, is given in *Table 1*.

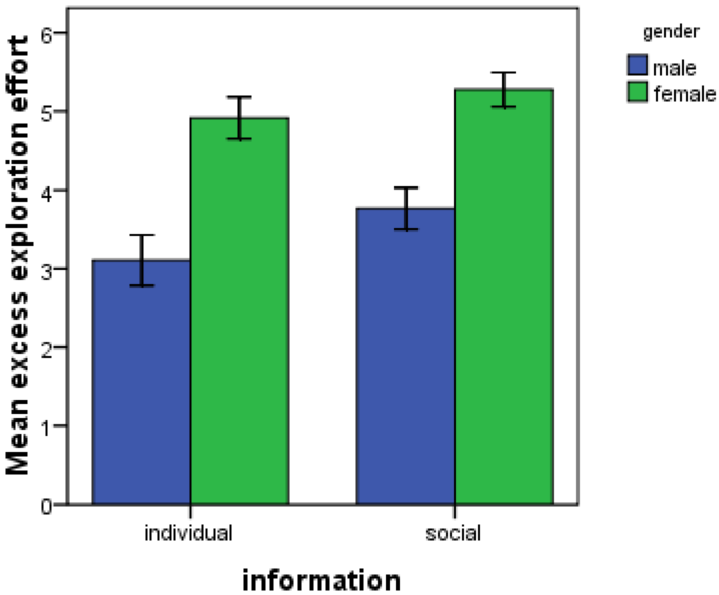


*Figure 4*. Excess exploration in the two versions of *Explore & Collect* in Study 1, for male and female participants separately. Error bars represent ± 1 s.e.

There was no difference in PECI score between proself and prosocial subjects, $t(94) = .27$, $p = .78$. For the two treatments of the *Explore & Collect* game, we measured the excess exploration, i.e. the number of options that a subject explores in excess of the optimal number (4 in the individual information version, 1 in the social information version). The excess explorations in the two games were highly correlated, $r = .68$, $p < .0005$, indicating that subjects are not just guessing at random. There was no correlation between either SVO or PECI and excess exploration in either game, all $p > .7$.

As predicted, excess exploration was higher in the social information version than in the individual information version, mean difference = 0.52, $t(102) = 3.0$, $p = .003$. The difference in excess exploration was not correlated with either SVO or the PECI score, both $p > .6$. However, an analysis by gender revealed an unpredicted gender difference, as illustrated in *Figure 4*. Female participants' excess exploration was greater than that of male participants ($p < .0005$ in both versions of the game). Since females were farther from optimal behavior they also earned less than males on average in this experiment (12 percent less, $t(101) = 3.5$, $p = .001$).

## DISCUSSION

We found that people explore a smaller number of further options after having individually acquired information about three options, compared to when they had socially acquired the same information. This result supports our hypothesis that individually acquired information has greater cognitive impact than socially acquired information.

As expected, social value orientation had no impact on behavior in this game where cooperativeness was not an issue. We foresaw a need to control for curiosity, but our results suggest that the PECI curiosity measure we used is uncorrelated with behavior in the *Explore & Collect* game (and therefore we did not include it in *Study 2*). However, we found a large gender difference that we had not predicted. Women explored much more than men on average in this experiment, possibly suggesting some kind of cognitive sex difference triggered by this game.

## STUDY 2

In the second study we test our hypothesis that in the two-player version of *Explore & Collect* prosocial players will explore more options than proself players (at least after they have had some experience with the game).

## Subjects and procedure

122 participants (69 men and 53 women, between 19 and 52 years old with mean age 27 years) were recruited from a pool of volunteering students of miscellaneous study programs. Participants were informed that they would be paid according to how many points they earned in the game (again, average pay was about 100 Swedish kronor). In addition, every participant received a cinema ticket for showing up.

Each participant was led to a separate cubicle with a computer. The computer first delivered the SVO questionnaire, and then ran software for the *Explore & Collect* game in the previously discussed two-player version. Subjects were paired up randomly by the computer (under the constraint that as many pairs as possible had one prosocial and proself subject as categorized by the SVO questionnaire). In these pairs subjects played 15 rounds of the game, with 22 picks in each round.

About the other player in the pair, participants were told only that it was another participant in the lab playing the same game, and that both players in the pair get the same information about each other's plays. The complete instructions are presented in the Appendix.

## Results

Analysis of the SVO questionnaire placed 55 subjects in the prosocial category and 67 subjects in the proself category.

By a player's *exploration effort* we will mean the number of different options the player explores during a round of the game. The exploration efforts of players in the same pair in the same round are highly correlated, $r = 0.36$, $p < 0.01$, indicating that there is substantial imitation in strategy between players that observe each other.

*Figure 5(a)* shows how the mean exploration changed over the course of the 15 rounds, broken down by social value orientation. Prosocial players consistently make a greater exploration effort than proself players and the difference becomes larger by the end of the game. As shown in *Figure 5(b),* there is also a gender effect that we did not predict: on average, females make greater exploration efforts than males. Within each gender we see the predicted effect of SVO. In order to analyze whether this effect is statistically significant we set up a linear multi-level model to predict the exploration effort of individual $i$ at backward time $t$ (defined as the number of rounds remaining, i.e., ranging from 14 in the first round to 0 in the last round):

$$\text{effort}_{ti} = c_0 + c_1 \,\text{othereffort}_{ti} + c_2 \,\text{gender}_i + c_3 t + c_4 \,svo_i + c_5 t \times \text{svo}_i + c_6 t \times \text{gender}_i + e_i + e_{ti} \tag{2}$$

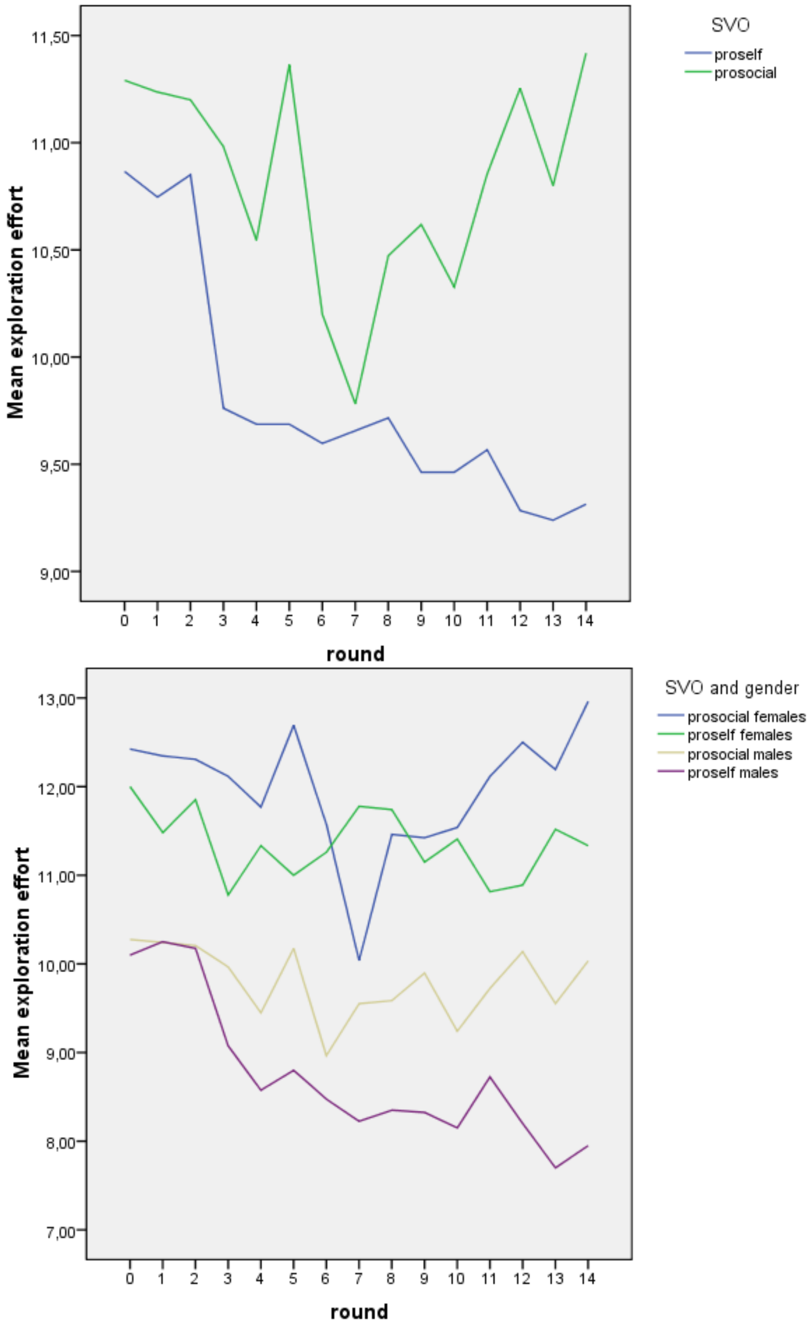


*Figure 5.* Mean exploration effort for each round, broken down by (a) top: social value orientation, (b) bottom: social value orientation and gender

*Table* 2. Estimated multi-level model of exploration effort as a function of observed exploration effort of other player, bacward time, SVO, and interaction of backward time and SVO

| Effect | Estimate (S.E.) | DF | t value | Pr > \|t\| |
|---|---|---|---|---|
| intercept | 6.57 (0.52) | 1704 | 12.48 | < 0.001 |
| othereffort | 0.14 (0.02) | 1704 | 5.91 | <0.001 |
| gender | 2.77 (0.62) | 119 | 4.48 | < 0.001 |
| backward time | 0.13 (0.02) | 1704 | 6.23 | < 0.001 |
| SVO | 1.55 (0.61) | 119 | 2.52 | 0.013 |
| backw. time × SVO | –0.09 (0.03) | 1704 | –3.36 | < 0.001 |
| backw. time × gender | –0.08 (0.03) | 1704 | –3.00 | 0.003 |

The variables of the model are: intercept; the other player's exploration effort in the same round (i.e., the imitation effect); the player's gender and social value orientation (dummy coded 0 for male resp. proself, 1 for female resp. prosocial); backward time and its interactions with social value orientation and gender; error term for between-individual variation, and residual error term. Maximum likelihood estimation of coefficients (using the R package) yields the results in *Table 2*. All effects are significant. In particular, the positive effect of SVO and the negative interaction between backward time and SVO say that prosocial subjects explore more options than proself subjects, and that this difference is smaller the earlier it is in the game.

## Discussion

We found that people who are categorized as having a prosocial SVO explore a greater number of options than those categorized as being proself. This result supports our hypothesis that an individual's social preferences will affect how much she engages in individual acquiring of information when acquired information becomes public.

In addition to, and independent of, this predicted effect of social value orientation we found an unsurprising imitation effect. Unexpectedly, but replicating the gender difference in the one-player game in Study 1, we found that women made a greater exploration effort than men also in the two-player version of the game.

## GENERAL DISCUSSION

In the introduction we pointed to an emerging pattern in empirical data suggesting that people nonetheless often prefer individual learning. We speculated in three potential classes of causes for such a bias: a potential trustworthiness/relevance problem associated with socially acquired information; potentially superior cognitive effects of individual learning compared to social learning; and cooperative aspects of individual learning. In this paper we found, first, that varying the source, individual or social, of information seems to affect its impact (*Study 1*), and second, that when information is a public good cooperative players seem to engage more than selfish players in information gathering, i.e., individual learning (*Study 2*).

Regarding the first result, we think it will be very interesting for future research to investigate its scope and details. Let us just mention a couple of questions that ought to be investigated (without any claim that this should necessarily be done by extending the *Explore & Collect* design). For instance, how do effects of information source interact with the type of content of the information? This question is related to the finding of MESOUDI, WHITEN and DUNBAR (2006) that social transmission works better for information of a social character (like gossip) than for asocial types of information. Another question concerns how the impact of information paves the way for cumulation of knowledge; recall the recent spectacular finding that a strong form of social learning like imitation, although conveying more detailed information, is not superior to simple emulation of end results for cumulative culture to emerge (CALDWELL and MILLEN 2009).

The result from Study 2 seems to us to add a crucial component to our understanding of behavior in experiments on social and individual learning like those of KAMEDA and NAKANISHI (2002), MCELREATH et al. (2005), EFFERSON et al. (2007), and TOELCH et al. (2009). Our results suggest that behavior in such experiments will depend on participants' social value orientation. SVO has been extensively studied (VAN LANGE et al 2007); among other things it has been shown to be related to family size, in particular the number of sisters, and to attachment style, suggesting that childhood environment is an important determinant of prosociality. However, prosocial behavior is also sensitive to framing (reviewed by LINDENBERG 2006). We think this is illustrated in the study of MESOUDI (2008), where participants could set access costs for others to access their private information and successful individuals typically set these costs so high that efficient social learning was blocked. We believe that the price-setting frame emphasized the competitive element, thereby decreasing prosocial information sharing. In any case, we believe that our results in *Study 2* clearly indicate that future research on social learning should take prosociality into account.

Our experiments also yielded the unpredicted finding that in the *Explore & Collect* scenario women tend to make a larger exploration effort than men. We do not see that this phenomenon is predicted by any established theory on cognitive sex differences (cf. HALPERN 2000). Nonetheless, the phenomenon seems robust;

we found it also in experiments on *Explore & Collect* in the original asocial version (ERIKSSON and STRIMLING 2009). It may be a fruitful area of future research.

Finally, let us briefly discuss our results in relation to mathematical models of cultural evolution. Depending on the purpose of the model, we think it is sometimes important to incorporate aspects that may affect a bias for individual learning. Such aspects include that agents may be trying to solve slightly different problems (so that the same behavior is not equally relevant for everyone), that agents may be able to gain access to information about the competence of other individuals, that agents may be deceptive, that individually learnt information may be better retained than socially learnt information, and that there may be mechanisms promoting cooperation.

Simple models of diffusion of information through social learning in person-to-person interaction (rather than, say, broadcasting) typically result in prevalence changing over time according to an "S-shape," i.e. slow-fast-slow, and ending with the entire population having the information (LAVE and MARCH 1975; HENRICH 2001). Empirical studies of diffusion of innovations often find S-shaped patterns of change (ROGERS 1995), but it seems there is often no end-state of cultural homogeneity: not everyone drives a car, not everyone reads Harry Potter, etc. Indeed, once several cultural variants are established in a population, we typically see them fluctuate in prevalence in a way that bears no relationship to S-shaped trends towards homogeneity. Fluctuations readily come to mind whether we are talking about fashion, political attitudes, use of means of transportation, use of drugs like alcohol or tobacco, etc. One explanation for the lack of cultural homogeneity, recently put forward in this journal, is that the social influence of minorities is disproportionately large, effectively resulting in a bias against conformity (ERIKSSON and COULTAS 2009). A bias for own explorations, such as we have suggested here, clearly provides another potential factor working in favor of heterogeneity.

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# APPENDIX

## Social value orientation questionnaire

In this set of questions, we ask you to imagine that you have been randomly paired with another person, whom we will refer to simply as the "other." Other is someone you do not know and that you will not knowingly meet in the future. Both you and Other will be making choices by circling either the letter A, B, or C. Your own choices will produce points for yourself and Other. Likewise, Other's choice will produce points for him/her and for you. Every point has value: The more points you receive, the better for you, and the more points Other receives, the better for him/her. Here's an example of how this task works.

| | A | B | C |
|---|---|---|---|
| You Get | 500 | 500 | 550 |
| Other Gets | 100 | 500 | 300 |

In this example, if you chose A you would receive 500 points and Other would receive 100 points; if you chose B, you would receive 500 points and Other 500; and if you chose C, you would receive 550 points and Other 300. So, you see that your choice influences both the number of points you receive and the number of points the other receives. Before you begin making choices, keep in mind that there are no right or wrong answers – choose the option that you, for whatever reason, prefer most. Also, remember that the points have value: The more of them you accumulate, the better for you. Likewise, from the Other's point of view, the more points s/he accumulates, the better for him/her. For each of the following nine choice situations, circle A, B or C, depending on which column you prefer most. Please proceed in the order the choices appear.

1.

| | A | B | C |
|---|---|---|---|
| You Get | 480 | 540 | 480 |
| Other Gets | 80 | 280 | 480 |

2.

| | A | B | C |
|---|---|---|---|
| You Get | 560 | 500 | 500 |
| Other Gets | 300 | 500 | 100 |

3.

| | A | B | C |
|---|---|---|---|
| You Get | 520 | 520 | 580 |
| Other Gets | 520 | 120 | 320 |

4.

| | A | B | C |
|---|---|---|---|
| You Get | 500 | 560 | 490 |
| Other Gets | 100 | 300 | 490 |

5.

| | A | B | C |
|---|---|---|---|
| You Get | 560 | 500 | 490 |
| Other Gets | 300 | 500 | 90 |

6.

| | A | B | C |
|---|---|---|---|
| You Get | 500 | 500 | 570 |
| Other Gets | 500 | 100 | 300 |

7.

| | A | B | C |
|---|---|---|---|
| You Get | 510 | 560 | 510 |
| Other Gets | 510 | 300 | 110 |

8.

| | A | B | C |
|---|---|---|---|
| You Get | 550 | 500 | 500 |
| Other Gets | 300 | 100 | 500 |

9.

| | A | B | C |
|---|---|---|---|
| You Get | 480 | 490 | 540 |
| Other Gets | 100 | 490 | 300 |

## Perceptual-Epistemic Curiosity questionnaire

Ten statements that people use to describe themselves are given below. Read each statement and then choose the appropriate answer (*1 = Almost Never; 2 = Sometimes; 3 = Often; 4 = Almost Always*) to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe how you generally feel.

1. I like exploring my surroundings.
2. I enjoy exploring new ideas.
3. I like to discover new places to go.
4. I find it fascinating to learn new information.
5. I like visiting art galleries and art museums.
6. I enjoy learning about subjects that are unfamiliar to me.
7. I like to listen to new and unusual kinds of music.
8. When I learn something new, I would like to find out more about it.
9. I enjoy trying different kinds of ethnic foods.
10. I enjoy discussing abstract concepts.

## Instructions to experiment in Study 1

*Individual information version (modifications for social information version within brackets)*: On the screen you see a large number of boxes. In this game you will collect points by clicking at these boxes. Each box has a hidden value that you receive when clicking the box. You can click the same box several times. You have a total of 11 [8] clicks. Every box shows how many times you have clicked it. On the screen you are also told how many clicks you have left. The last box you clicked is always marked with a bold frame. About the hidden values you know the following: All values between some maximum value and some minimum value appear with equal frequency. You will also be able to see how the boxes you click rank relative each other; at any point in the game, the box ranked 1 has the highest value of all boxes you have clicked so far. [You can see the ranks of 3 random boxes that have already been clicked; you have 8 clicks from this position.]

You will first get to play a trial run of the game. At the end of the run, you will see the hidden values of all the boxes and the total number of points you earned. If you then have any questions, please call on the research assistant. You will then play again (with new hidden values) with points exchangeable for money at the end of the experiment.

## Instructions to Study 2

You will play a game for 15 rounds. On the screen you see a large number of boxes. In this game you will collect points by clicking at these boxes. Each box has a hidden value that you receive when clicking the box. You can click the same box several times. You have a total of 22 clicks in each round of the game. Every box shows how many times you have clicked it. On the screen you are also told how many clicks you have left. The last box you clicked is always marked with a bold frame. About the hidden values you know the following: All values between some maximum value and some minimum value appear with equal frequency. You will also be able to see how the boxes you click rank relative each other; at any point in the game, the box ranked 1 has the highest value of all boxes you have clicked so far.

Another player in the lab is playing the same game, with the same boxes and the same values. For each box you can also see how many times it has been clicked by this other player. The other player gets the same information about which boxes you click.

At the end of each of the 15 rounds you will be able to see the hidden values of all the boxes and the total number of points you earned. These points are exchangeable for money at the end of the experiment. Each round has new hidden values.

If you have any questions, please call on the research assistant.

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