Making the Implicit Explicit: Effects of Verbalization in Decisions from Experience

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Abstract

What do people learn from experience with repeated decisions? Is it merely implicit behavioral tendencies? If so, would articulating or summarizing what is learned change behavior? Online participants (N=126) experienced 100 trials of a decisions-from-experience problem with outcome feedback. Some participants then verbally summarized what they had learned and estimated the probability of the risky gain either for themselves (Self condition) or for another hypothetical player (Other condition); others did not summarize (Control condition). Finally, they faced 20 more decision trials. Verbalizing a social message to another person significantly increased sure choices (that is, decreased risk-taking) in subsequent decision making. In general, participants underestimated the probabilities of both certain and risky prospects, and articulating a summary message (Self or Other) seemed to increase this conservatism.

Keywords: decisions from experience; explicit learning; verbalization; dual process theory

Introduction

In recent decades, research on decisions under risk has focused on two major paradigms, decisions from description and decisions from experience. In the descriptive paradigm, participants receive complete and unambiguous descriptions of available options, potential outcomes of their choices, and the associated probabilities. In the experiential paradigm, participants rely on their personal experience of observing samples of outcome feedbacks repeatedly over time (e.g., Hertwig et al., 2004). In recent years, decisions from experience (DFE) have been found to systematically differ from description-based decisions (DBD). These differences have been termed the "description–experience gap" (Hertwig & Erev, 2009).

There has been growing interest in the field to explore the learning mechanisms behind decisions from experience to help explain the description-experience gap (for a meta-analytic review, see Wulff et al., 2018). One such issue is what types of learning are generated from experience and how such learning affects subsequent choices. Some empirical evidence suggests that experience of outcome feedback can modify choices towards maximization of expected value (EV) (Yechiam et al., 2005). Possible mechanisms that might explain this finding include the implicit learning of more linear decision weights (e.g. Jessup et al., 2008), or the explicit learning of EV-maximizing strategies (e.g. Erev & Barron, 2005; Erev et al., 2017), among others. Chen and Corter (2014) argued that dual-systems account of cognition (e.g., James, 1950; Sloman, 1996; Kahneman, 2003), might be needed to explain the full range of findings.

In the broader research literature on learning and cognitive science, implicit learning is sometimes termed "System 1" thinking, in which individuals learn complex information in an incidental manner, without awareness of what has been learned. In contrast, explicit learning is termed "System 2" thinking, which permits abstract reasoning and hypothetical thinking constrained by working memory capacity, and results in explicit knowledge in the form of verbatim or aggregate representations (Seger, 1994; Evans, 2003).

In particular, two major forms of explicit learning have been well studied. *Self-explanation* during problem solving has proven to be an effective instructional strategy across many domains (Chi et al., 1989; VanLehn et al., 1992; Bielaczyc et al., 1995). When prompted to explain to themselves, participants were more likely to make comparisons and notice subtle distinctions, which then led to the discovery of general rules (Edwards et al., 2014). Meanwhile, *social dialogue* has also been found to promote abstract reasoning and rule formation / use in a category learning task (Voiklis & Corter, 2012), as well as when learning complex systems such as moving gears, biological transmissions, and organisms' living requirements (Schwartz, 1995). In these learning domains, it is argued that social pragmatic constraints of communications compel participants in dialogue to negotiate multiple perspectives to find a shareable representation of the problem, which tended to be abstractions of the deep structure rather than surface features. Such dialogic effects might even underlie well-documented examples of "process gain" in group forecasting and decision making (Kerr & Tindale, 2004) – the so-called "wisdom of crowds".

For these reasons, we hypothesize that explicit verbalizations, especially verbalizations aimed at others, might promote abstraction and enable rule-based or formal reasoning about the decision problem, and thus might yield faster learning towards EV-maximization. To our knowledge no prior study has examined whether verbalization might help in promoting explicit learning in the context of decisions from experience.

In the present study, we consider how self-verbalizations summarizing experience with outcome feedback (which make the implicit explicit) might affect subsequent risky decision making. Specifically, we examine the effects of verbal summaries generated for others or generated for oneself on learning in the decisions from experience context. Finally, we report some content analyses of the types of verbalizations generated by participants.

Methods

Design

Participants made repeated decisions for a single risky decision problem while experiencing outcome feedback (with no provided description of outcome payoffs and probabilities). Following the verbalization manipulation (described below), they made 20 additional decisions with the same problem.

Overall the experiment had a 3×2 between-subjects design: three types of verbalization conditions and two risky-choice decision problems. Each participant was presented with only one verbalization condition and only one problem.

Participants

126 people, 76 of them male, participated through Amazon's Mechanical Turk website. Participation was restricted to individuals whose location was defined as in the United States. Their ages ranged from 23 to 71, with a mean of 39. All of them were native English speakers and 27% of them had studied statistics or decision-making at some point.

Materials

Two simple decision problems in the gain domain were used: for the risky option, one problem has a high probability of payoff and the other has a low probability of payoff. They were: Problem 1 = ($3, 100%; $7, 60%), Problem 2 = ($3, 100%; $28, 15%). So, for example, Problem 1 offered a choice between receiving $3 with certainty and a 60% chance of receiving $7 (and no reward otherwise).

We used the "minimal information" paradigm from Erev and Barron (2005) – also termed the "partial feedback" paradigm by Camilleri and Newell (2011). Decision problems were shown on the computer screen (Figure 1), with two option buttons side by side, labeled only as "P" and "Q". One button provided the participant with the sure outcome of $3 100% of the time, and the other button was a risky gamble which gave participants either $7 60% of the time or $28 15% of the time, depending on the experimental condition, and $0 otherwise. Sure and risky button positions were left-right counterbalanced between participants.

Procedure

Participants went through a training session of 100 trials and a testing session of 20 trials of the same decision problem, either the high probability problem or the low probability problem.

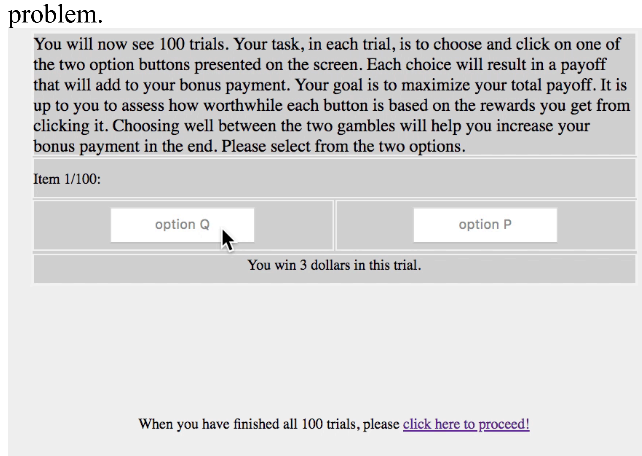

Figure 1: Interface for the training session (first 100 trials): post-trial feedback

In between training and testing blocks, they experienced one of the three verbalization conditions (Other, Self, or Control). In the Self condition, participants summarized for themselves what they had learned (by answering "What have you learned from experience with the 100 trials? What strategy should be used or what choices should be followed in order to maximize total payoff?") and estimated the probabilities of both option payoffs. In the Other condition, participants summarized to another hypothetical player (by answering "Imagine that you have a partner who is about to play this game for 100 trials. What would you advise them in terms of the strategy they should use or the choices they should make, in order to maximize their total payoff?") and estimated probabilities as well. In the Control condition, participants simply answered some demographic questions at this time point, without any requested verbalizations of problem information.

At each trial, once they made a choice using the mouse, the payoff for that selected option was shown. Actual payment for participants varied depending on the outcomes of their decisions. A base payment of $1.50 was adjusted by 0.5% of the participant's total amount of winnings for the total 120 decision trials. Average bonus paid for each participant was US $1.92 (SD = US $0.17).

Results

In this study, we hypothesized that explicit verbalizations of strategies would lead to more accurate probability estimates of option payoffs and a decrease in subsequent sure choices (consistent with EV-maximization), especially when participants were verbalizing to someone else. Thus, the main dependent variables were 1) the proportion of sure choices, calculated as the average proportion of times that participants selected the sure option in the testing session (last 20 trials) (see b11 and b12 in Figure 2); and 2) participants' estimated payoff probabilities for the sure and the risky options.

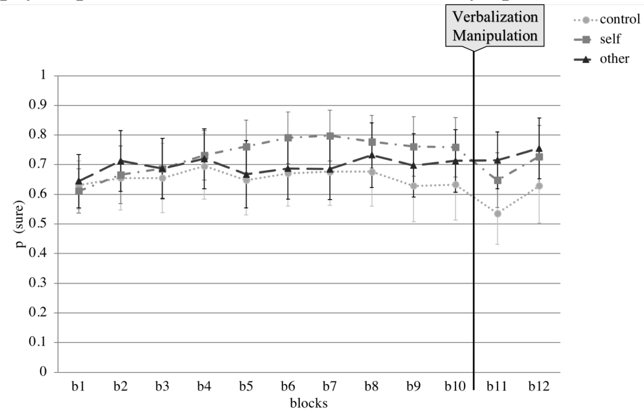

Figure 2: Sure choice proportions over the total 120 trials. Error bars: ± 2 standard errors.

Behavioral Effects: testing session (last 20 trials)

Analysis of covariance (ANCOVA) was conducted to evaluate the effects of verbalization conditions while controlling for the variations among participants' learning experience in the training session. The proportion of sure choices for last 50 trials of training, before the verbalization manipulation, was used as the covariate.

Results showed significant effects of the explicit verbalization manipulation on the proportion of sure-thing choices in the last two blocks (Figure 3), $F(2,119) = 3.80$, $p=.025$. However, the effects were not consistent with our hypothesis of increased maximization in the two verbalization conditions. Rather, in the Control and Self-Verbalization conditions a transient increase in risk-seeking (alternatively, in maximization) was observed (apparent in Figure 2), indicated by a sudden drop in sure choices after the pause between training and testing blocks, mean P(sure) = .641 and .623, respectively. This may indicate a transient increase in exploratory behavior. Participants in the Other-Verbalization condition maintained a relatively consistent high level of sure-alternative choices, P(sure) = .744. Planned contrasts showed that the proportion of sure choices in the last 20 trials after verbalization were significantly higher in the Other-Verbalization condition compared to that in the Control and Self-Verbalization conditions, $t(80)=2.23$, $p=.027$; $t(82)=2.53$, $p=0.013$, respectively.

Subjective Estimates

Participants were quite conservative in their probability estimates, underestimating probabilities of both the sure option (Figure 4) and the risky options (Figure 5). Such probability underestimation is particularly surprising for the sure events, because any sample of a sure option must consist of 100% payoff outcomes. One way to explain this is to note that in this partial-feedback paradigm, when a participant chooses the risky option, the outcome for the button associated with the sure-thing distribution is not revealed. Thus, the participant may believe that some non-payoff outcomes could be occurring for what we know to be the sure-thing option on these "blind" trials. And in any small sample of trials, it is difficult to distinguish a sure-thing from a high-probability event, just as it is known that in decisions from experience people frequently fail to distinguish between low-probability and zero-probability events (see, for example, Kunreuther et al., 2001; Hertwig et al., 2004).

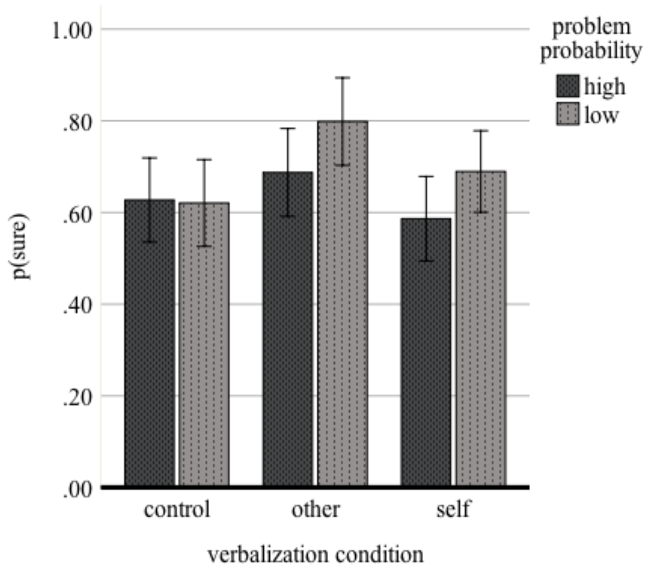

Figure 3: Sure choice proportions across three verbalization conditions in the testing session (last 20 trials). Error bars: ± 2 standard errors.

Furthermore, articulating a summary message (to Self or Other) significantly increased this underestimation of the 100% probability of the sure option, $F(2,123)=10.270$, $p=.012$, again contrary to our hypothesis that verbalization would increase accuracy. However, when participants estimated the probability of payoff for the risky option, this drop in the subjective estimate (an increase in conservatism, again resulting in lower accuracy) due to verbalization was only marginally significant for the high-probability problem $F(2,59)=2.943$, $p=.061$, and was not significant for the low-probability problem, $F(2,59) = 2.222$, $p=.117$, perhaps due to a floor effect, or because conservatism in this case would mean estimating the probability as less extreme (i.e. farther from 0).

Verbalization Content

The above results demonstrate that the explicit verbalization manipulation has an effect on subsequent decision choices as well as on subjective estimates. However, the verbalization manipulations did not increase the accuracy of the subjective estimates as we expected, and even decreased it in some cases.

To explore why, we conducted a content analysis of the strategies reported by participants in the two verbalization conditions (40 statements in the Other condition, 44 statements in the Self condition). Specifically, we were interested in examining the detailed content, both as a manipulation check and to explore the major concepts and terms used by participants in communicating the problem information. We used two raters to categorize the verbalizations (initial κ=0.66), who discussed the disagreements until they reached full agreement, κ ≥ .99.

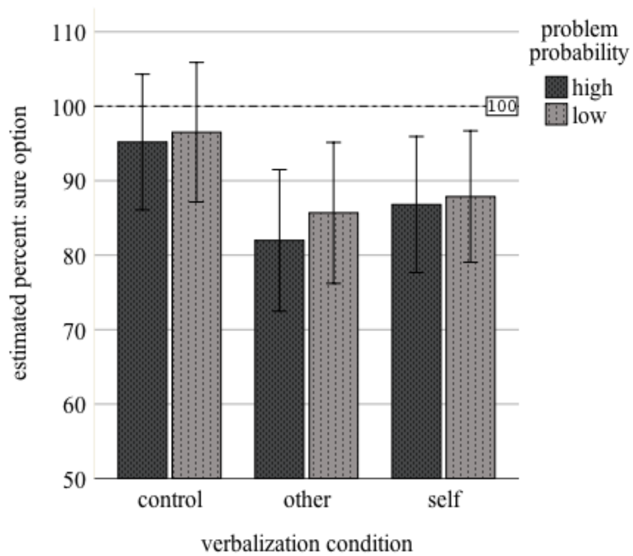

Figure 4: Estimated payoff percent for the sure option (objectively = 100% in both high- and low- probability problems). Error bars: ± 2 standard errors.

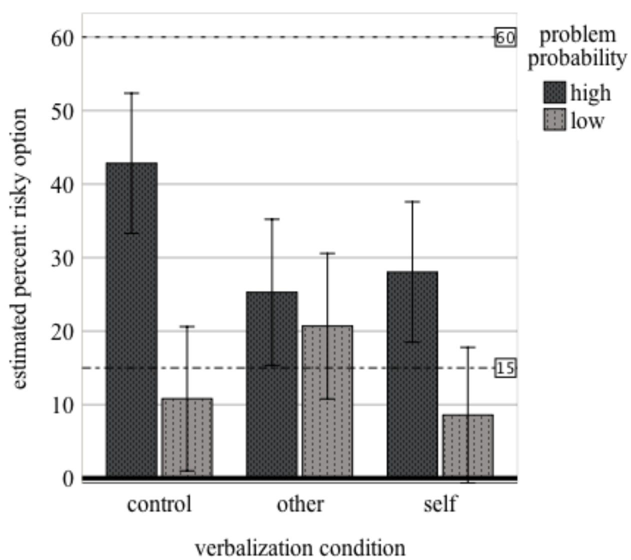

Figure 5: Estimated payoff percent for the risky option (objectively = 60% in the high-probability problem, = 15% in the low-probability problem). Error bars: ± 2 standard errors.

We divided the analysis into two phases. An initial classification suggested ten categories of utterances (which we will refer to as "strategies", for convenience): *no strategy/intuition/luck, payoff value, payoff frequency, temporary switch, sequence, risk-reward tradeoff, probability and EV estimate, recommend the sure option, recommend the risky option,* and *recommend mixed options*. Next, we tested the association of specific strategies with subsequent decision making (specifically, with the proportion of sure option choices after the verbalization manipulation), using one-way analysis of variance.

In general, participants verbalized a wide range of strategies, ranging from 1 to 5 when verbalizing to Others and from 1 to 6 when verbalizing to Self. And a majority of participants in each condition verbalized at least 2 strategies. The two verbalization conditions seemed to have very different profiles of strategy use (Figure 6). Participant who verbalized to themselves were significantly more likely to describe payoff frequency (75%), compared to those verbalized a social message (48%), $\chi^2(1; N=52) = 6.719$, $p= .01 < .05$. Participants tended to simply recommend the sure option more often when they were writing a social message (55%) compared to verbalizing to themselves (43%), however this difference did not reach significance. In both conditions, only a few participants mentioned calculating probability or expected value (5% in Other-Verbalization and 14% in Self-Verbalization), although more mentioned reasoning about tradeoffs between risk and reward.

Consistent with previous findings, mentions of switching between options to learn about payoff patterns or follow a sequential pattern were observed. Examples include: *"the first option had a pattern between getting 0 and 7 dollars while the other was 3 every time. I thought I could discern the pattern and only hit the first option when I thought the 7 would be there." "Keep pressing the left button until you get more than 2 zeros in a row. Then press the right button about 2 or 3 times, then go back to pressing the left button.").* In the Other-verbalization condition, 15% of participants mentioned switching or sequential dependencies in outcomes, compared to 9% in the Self-Verbalization condition. Some of these utterances may be taken as indicating that a participant exhibits some form of the gambler's fallacy, in which they believe a run of wins will tend to end, or the hot hand fallacy, where they believe such runs tend to continue (Bar-Hillel & Wagenaar, 1991). A number of participants also recommended mixed options as a better strategy than sticking to one option (cf. Chen & Corter, 2006).

Overall, more (85%) Social messages (compared to Self messages) tended to prescribe an action to be taken (example: *"Go with the three dollars most of the time, but occasionally try your luck to get the 7 dollars, since it has fairly good odds."*), $\chi^2(1; N=44) = 32.574$, $p < .001$; while Self messages were more likely (75%) to simply describe the past experience (example: *"Second option had consistent payoff. I am risk averse so I only tried the other a couple of times and* *hit zero so I stayed with the sure thing.")*, $\chi^2(1; N=45) = 17.058$, $p < .001$ (following "prescriptive rule" vs "descriptive rule", Bell et al., 1988).

In a one-way ANOVA testing if participants' choice behavior differed on the basis of their verbalized content (Figure 7), we found that the proportion of sure choices were significantly higher if participants recommended the sure option, $F(1, 82)=7.063$, $p=.009 < .05$; while significantly lower if they depended on no strategy or pure intuition and luck, $F(1, 82)=4.032$, $p=.048 < .05$, mentioned a temporary switch, $F(1, 82)=4.601$, $p=.035 < .05$, or recommended the risky option, $F(1, 82)=5.296$, $p=.024 < .05$.

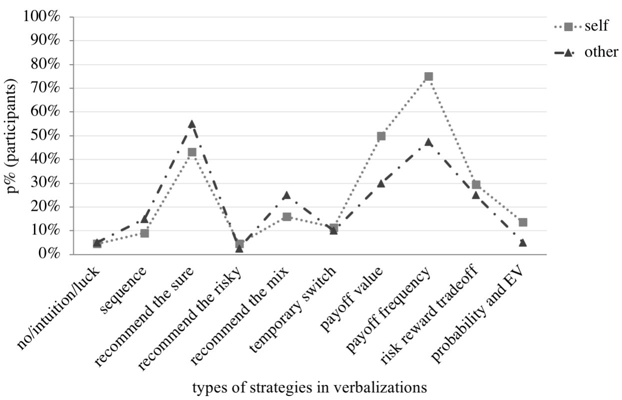

Figure 6: Verbalized content profiles by participants' verbalization condition

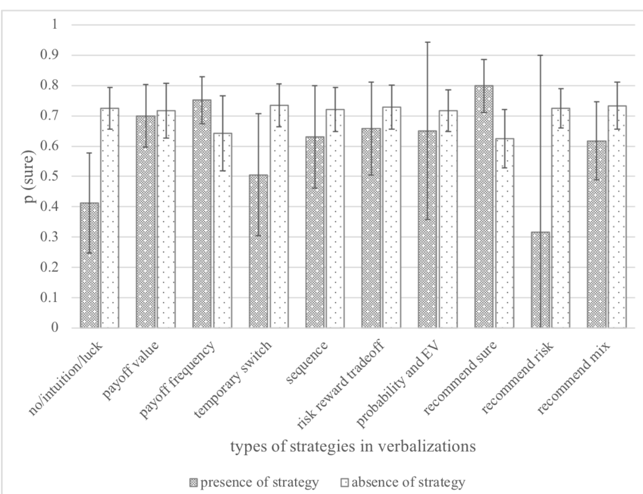

Figure 7: Sure choice proportions in the testing session (last 20 trials) by type of participants' verbalization. Error bars: ± 2 standard errors.

Discussion

In this study, we asked participants to articulate what was learned from experience, either to themselves or to others. We did not find evidence to support the original hypothesis that explicit verbalization, especially verbalizing to someone else, promotes abstract rule reasoning and thus yields better learning towards EV-maximization. Indeed, the data revealed a very different pattern. Delivering a social message tended to increase the underestimation of the subjective probability estimates (a form of conservatism), and subsequently led to less EV-consistent decision making, compared to the purely implicit learning condition in which no verbalization was prompted.

We also had hypothesized that the verbalization manipulation may tend to shift people from implicitly motivated behavior to the use of explicit strategies. These strategies can be either rational and effective, such as drawing on memory for outcome feedback and reasoning about tradeoffs, or heuristic in nature, such as choosing a simple strategy or prescribing the same. However, very few participants in either verbalization condition reported calculating probability or expected value. Instead, in Self summaries they tended to simply describe past learning experience, especially summarizing frequency information; while in summaries for Others, they often simply prescribed strategies (positive or avoidance) to others.

One potential reason for this lack of benefit from explicit verbalizations is that prior studies showing learning benefits from social dialogue (e.g., Schwartz, 1995; Voiklis & Corter, 2012) examined situations where participants took many rounds to negotiate multiple perspectives and generate abstractions and rules. In contrast, the one-way, single-round verbalizations in this study may induce considering another's perspective to some degree, but perhaps not enough to spur abstraction and use of explicit or formal strategies. This is consistent with the finding from research on collective intelligence that the equality in distribution of conversational turn-taking is correlated with a higher collective intelligence factor (Woolley et al., 2010). Moreover, relatively naïve participants may lack expert knowledge or language to convey sophisticated strategies like expected value in the risky decision domain.

We found that verbalizations, especially in the form of a social summary message to another person, led to a higher level of sure choices in subsequent decisions, perhaps by "freezing" the recommender's strategy and inhibiting further exploration of decision options (see discussion below). Also, verbalization seemed to increase underestimation of probabilities (for both certain and risky events), perhaps indicating a form of "social conservatism", as if the participants were cautious about their limited information acquired from experience and discounted their judgments to communicate a "safer" message socially. This is consistent with Benjamin and Budescu's (2015) findings about advice giving, in which an implicit learning mode (decisions from experience) resulted in more risk aversion and acknowledgement of information uncertainty.

Moreover, some previous studies using the repeated decisions with description paradigm seem to show that choice behaviors are mainly affected by experience while explicit descriptions are considered only when they carry novel or inconsistent information that cannot be inferred from the feedback (Barron et al., 2008; Weiss-Cohen, et al., 2016); more often the descriptions seem to be neglected (Jessup et al., 2008; Lejarraga & Gonzales, 2011). When participants were writing a social message to others, they might be more conscious of the utility of information, assuming that their verbalizations would be taken into consideration. It may be that in this situation, underestimation of payoff probabilities (a "sin" of omission, in a sense) is seen as less undesirable than overestimation of payoff probabilities (a "sin" of commission).

As noted, in the Control and Self-Verbalization conditions, the final 20 test trials elicited a period of exploratory behavior, but not in the Other-Verbalization condition. Furthermore, participants in the Self condition tended to describe their past experience with the 100 trials (i.e. payoff frequency and value) while those in the Other condition tended to prescribe a future action (i.e. recommend one option or mixed options). This may indicate a social motive to seem consistent when giving advice, in line with the behavior consistency principle (Cialdini, Trost, & Newsom, 1995), well established by dissonance and balance theories, (Festinger 1957; Heider 1958) and the "foot-in-the-door" effect (Freedman & Fraser 1966). According to Group-Centrism (Kruglanski et al., 2006), the need for cognitive closure within the group induces pressures to opinion uniformity, rejection of deviates, resistance to change, conservatism and the perpetuation of group norms, and results in reduced information exchange and "premature consensus" or "early closure" (Kruglanski & Webster, 1996), and process losses that leads to less optimal group performance (Steiner, 1972). Furthermore, the bias towards shared information, once explicitly formed, can also lead to misinterpretation of new information that is inconsistent with already formed bias (Kerr & Tindale, 2004). Social context, here in the form of a social probe to verbalize strategies explicitly, might also exacerbate individuals' desire to be consistent in their explicit strategy verbalizations, probability estimates, and subsequent behaviors.

In conclusion, our results do show verbalization effects on implicit learning in decisions from experience. This evidence can be seen as supporting accounts that recognize an explicit learning aspect in decisions from experience as well as the importance of social contexts, and also as supporting dual-process accounts of repeated decisions with outcome feedback. Further exploration of the verbalization effect and of the interplay between experience and abstractions of experience might consider a broader range of factors that contribute to rule abstraction, to better understand how people can make informed decisions that combine explicit reasoning and implicit experience. This future research might find a way to integrate research on mental representations in decisions from experience (Camilleri & Newell, 2009), advice giving in decision making (Benjamin & Budescu, 2015) and information shareability in the general learning domain (Freyd, 1983).

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