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Implicit emotional biases in decision making: The case of the Iowa Gambling Task

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Abstract

Many authors have endorsed the hypothesis that previous emotional experiences may exert a covert influence on behavior, but some findings and replications of the original studies challenged this view. We investigated this topic by carrying out an experiment with the Iowa Gambling Task (IGT), where a dissociation procedure was adopted to successfully isolate possible implicit components. After a typical interaction with the IGT, participants performed a "blind" card selection phase without receiving any feedback. Half of them were instructed to continue choosing as they did before, the other half was told that good card decks turned bad, and vice versa, so that explicit knowledge was necessary to overcome the previously learned deck-outcome associations. The results confirmed the existence of early acquired implicit biases, confirming that previously experienced emotional events may covertly affect subsequent behavior.

Keywords: Emotion; Implicit processes; Decision making; Dissociation procedure

1. Introduction

The hypothesis that emotions can affect higher cognition and overt behavior has received extensive attention and experimental confirmation in recent years (Damasio, 1994; Dolan, 2002; Rolls, 2000; Thagard, 2006). This is particularly apparent in the field of decision making, where choice processes based on emotions and intuition have been fully recognized (e.g., Kahneman, 2003) and where the relationship between emotional disorders and decision-making impairments has become increasingly apparent (Bechara, Damasio, & Damasio, 2003; Camille et al., 2004; Eslinger & Damasio, 1985; Frank, Seeberger, & O'Reilly, 2004; Stout, Rodawalt, & Siemers, 2001).

An influential and paradigmatic account of the relationship between emotions and cognition is given by the Somatic Marker Hypothesis (SMH: Damasio, 1994, 1996). This theory still gives rise to ardent debates among cognitive scientists. A particularly hot issue, for instance, concerns how much of human decision making could be ascribed to the emotional influences that the SMH implies. In turn, this question is related to whether the effect of the somatic markers is implicit or explicit—which is the issue we will address in this paper.

According to the SMH, emotions originate from the subjective perception of changes in the internal somatic representations the brain continuously updates. From this perspective, the hypothesis can be considered as a modern version of the James–Lange theory (James, 1884; Lange, 1885/1912). According to the SMH, a primal set of somatic responses is innate, and induces a corresponding set of primary emotions (Damasio, 1994). In addition, the SMH claims that somatic memories may be associated with the stimuli that caused the somatic change, resulting in a vast set of secondary emotions. These learned somatic reactions may be evoked when re-experiencing similar stimuli, causing the anticipated perception of forthcoming emotions. Adaptively, this anticipation may well work as a decision biasing and an alerting system.

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The effect of somatic markers is supposedly mediated by the ventromedial prefrontal cortex (VMPFC: Bechara & Damasio, 2005; Damasio, 1996). Patients with VMPFC lesions show abnormal emotional reactions: emotionally charged images, for instance, do not elicit in them any physiological reactions, which are detected, instead, in healthy controls (Damasio, Tranel, & Damasio, 1991). Less predictably, and most importantly, the patients' decision-making capabilities are seriously harmed, resulting in an abnormal real-life conduct even when intelligence and cognitive functions are preserved (Eslinger & Damasio, 1985; Saver & Damasio, 1991).

Such a defective behavior was captured experimentally by using an iterated decision paradigm known as the Iowa Gambling Task (IGT: Bechara, Damasio, Damasio, & Anderson, 1994). In the IGT, participants are required to repeatedly pick up a card from one of four decks. Each card selection returns an immediate win whose amount depends on the chosen deck. At times, however, an unexpected loss may follow. Losses are unpredictable, but they are scheduled so that choosing from the decks which give high immediate winnings (the "bad decks") will lead to an eventual failure, while choosing from those that return smaller gains ("good decks") will cause still minor losses, yielding a net profit.

Normal participants usually end up refraining from the bad decks and choosing increasingly from the good ones. On the contrary, patients with lesions in the ventromedial prefrontal cortex stick to the bad decks, apparently insensitive to future dooming consequences (Bechara et al., 1994).

Bechara, Tranel, Damasio, and Damasio (1996) demonstrated that, in healthy individuals, disadvantageous card selections are anticipated by increases in skin conductance responses, while such increments are absent in patients. These results are in agreement with the existence of a somatic marker mechanism that pre-alerts participants pondering on options previously experienced as harmful, and biases their behavior towards long-term good selections.

1.1. Unconscious effect of somatic markers?

Using a verbal questionnaire, Bechara, Damasio, Tranel, and Damasio (1997) assessed the participants' knowledge during the IGT. Their data suggested that behavioral choices in favor of the advantageous decks followed the appearance of anticipatory skin conductance responses, but preceded the formation of explicit knowledge of the task. The authors claimed that somatic markers were effective *before* (and, therefore, *without*) conscious awareness, and were driving the participants' behavior towards options detected as advantageous in the long run.

Much of the following debate questioned the supposed role of implicit somatic markers in directing rational decisions, questioning either the interpretation of the skin conductance responses (Tomb, Hauser, Deldin, & Caramazza, 2002) or the exact nature of patients' impairments in decision making (Fellows & Farah, 2003, 2005). Crucially, Maia and McClelland (2004) repeated Bechara et al. (1997) experiment, and replaced the original open questions with a structured questionnaire. When assessed with this more sensitive instrument, explicit task-relevant knowledge appeared before previously claimed, and correlated positively with participants' performance. The authors questioned the existence of somatic markers and their necessity to explain the results of the IGT.

In fact, the debate about the unconscious nature of somatic markers has been clouded by some conceptual difficulties. The first one is methodological. Some means for assessing implicit knowledge are intrinsically weaker than others. In particular, the direct use of participants' verbal answers was strongly criticized (e.g., Shanks & St. John, 1994) and later dismissed in favor of more reliable and indirect criteria.

The second one is epistemological. The existence of explicit knowledge does not rule out implicit components. Participants may indeed rely on explicit task knowledge when answering the questionnaire with their behavior being affected, however, also by implicit sources. It has been reported that patients do persevere in disadvantageous selections even when conceptually aware of the underlying selection rules (Bechara et al., 1997). Furthermore, participants may have *incorrect* explicit representations of the task, which should be assessed as well.

A third problem is the plausibility of the assumed implicitness of knowledge within the IGT. Although Damasio and coworkers made bolder claims (e.g., Bechara, Damasio, Tranel, & Anderson, 1998; Damasio, Bechara, & Damasio, 2002), originally they only suggested that somatic markers could unconsciously bias the explicit processing of decision-making options (Bechara, Damasio, & Damasio, 2000; Bechara et al., 1997). In fact, any complex activity requires the recruitment of large amounts of knowledge, of which only some might be implicit. Therefore, a true disconfirmation of the SMH would require the demonstration that either no implicit processes are present, or that somatic markers do not have any effect on decision making.

It is reasonable to assume that *part* of the decision making process could be implicitly biased by somatic markers. We explored this possibility through a computational model (Fum & Stocco, 2004; Stocco, Fum, & Zalla, 2005), which captures the idea that somatic markers are implicitly used for associating deck selections and ensuing outcomes, facilitating cued retrieval of bad outcomes and making it easier to detect the disadvantageous choices. The model provides an explanation for many experimental findings, including those apparently contradicting the SMH.

1.2. Assessing implicit knowledge

To assess implicit knowledge, researchers have been developing quite sophisticated criteria which often make use of indirect tasks whose accomplishment requires the explicit use of knowledge about the main task (Cleeremans, Destrebecqz, & Boyer, 1998).

Some of these methods, like those designed to map the so-called *subjective threshold* (Dienes & Berry, 1997), rely on indirect introspective access to knowledge, but usually require an unambiguous criterion of performance correctness (e.g., proper classification of stimuli). Others tap the capacity of voluntary control (Cleeremans & Jiménez, 2002), which can be tested with *dissociation procedures* in which a main task is followed by a new one whose accomplishment is possible only with explicit knowledge of the former, while any implicit component would result in overt response biases. The second task is designed so that implicit and explicit knowledge are forced to exert opposite effects. The presence of implicit knowledge is revealed by any difference between the experimental group and a control group whose participants perform a shallow version of the second task.

The most acknowledged exemplar of these techniques is probably Jacoby's (1991) *process dissociation procedure* which, originally proposed for implicit memory, was successfully adopted for more complex tasks (Destrebecqz & Cleeremans, 2001; Long & Prat, 2002). Anderson, Fincham, and Douglass (1997) and Fincham and Anderson (2006) independently devised an analogous procedure for discriminating procedural from declarative knowledge. Similar methods do not depend on correct representations of the task and rely solely on the differences between experimental and control groups. Therefore, the dissociation procedure was adapted to the IGT to assess the existence of decision biases whose effects were compatible with the activity of somatic markers. In particular, it was hypothesized that implicit factors should force participants to persevere with their previously preferred choices even after they have become inappropriate following the application of the dissociation procedure.

The time course of acquisition of implicit biases is also an important factor. The skin conductance data reported in Bechara et al. (1997) implies that somatic markers develop gradually and become stronger over consecutive blocks of selections, eventually giving room to explicit knowledge. The results from Fellows and Farah (2005), on the other hand, suggest that implicit association between actions and rewards might be acquired very early, and subsequent practice is only needed to re-learn them. In this case, implicit biases should be found even with little practice with the Gambling Task.

2. The experiment

To distinguish between these alternatives and to test for the possibility of implicit biases in the IGT, we manipulated in our experiment two independent variables: (a) the duration of interaction with the IGT before the dissociation procedure was applied, and (b) the kind of behavior requested to the participants as a result of its application.

As far as the first factor is concerned, we should remind that IGT sessions typically span 100 card picks. Different authors agree that, by the end of this period, participants should have reached explicit knowledge of the task (e.g., Bechara et al., 1997; Maia & McClelland, 2004). In the very early stages (around 20 selections), on the other hand, many participants have not yet sampled the decks for a number of times sufficient to experience consistent losses (Bechara et al., 1997). The critical period for the acquisition of implicit biases should therefore be comprised between 40 and 80 selections.

2.1. Method

Participants went through two consecutive phases of interaction with the IGT. In the first phase participants received immediate visual and acoustic feedback about their wins and losses after each choice. The duration was limited to 40, 60 or 80 card choices.

In the second ("blind") phase, participants were invited to perform 20 consecutive selections on the basis of what they had previously learned, but without receiving any feedback. This allowed a performance measurement similar to the first phase without inducing any further learning. Crucially, our second experimental manipulation occurred in this blind period. Half of the participants were instructed to continue choosing as they did before. This was the *Shallow* condition. The other half was told that good decks turned bad, and vice versa, so that they should choose now from the decks they had avoided before. This was the *Reversed* condition, where explicit knowledge was necessary to overcome the previously learned deck-outcome associations.

2.2. Participants

Participants were 130 students (aged 18–49, $M = 25$, 77 females) from the University of Trieste, Italy. Each of them was randomly assigned to one of the six conditions obtained by crossing the two factors.

2.3. Procedure

Experimental sessions were held individually. After reading the instructions, participants underwent a first phase of interaction with the IGT. The task was performed on a specially developed computer application. This software was a custom-made replica of the original program developed by Bechara, Tranel, and Damasio (2000). Decks were visually presented in the lower part of a 15 in. LCD screen, and participants used a mouse device to point and select the deck they had chosen. Immediately after each card selection, the amount of money won (and possibly lost) was displayed visually in the upper half of the screen. The presentation of wins and losses lasted 6 s, during which the decks were grayed out and no card could be selected. The running total of money was always visible in the uppermost part of the screen and updated after each selection.

Upon completion of the first phase, the experimenter gave new written instructions to participants and ascertained their comprehension. Participants then completed their second phase of interaction with the IGT. No wins or losses were presented after any card selection, but the decks were still grayed out for the same amount of time to keep the interaction consistent with the previous phase. Once the second phase was over, participants were asked to rate on a seven-point scale how much they were confident of having performed well in the last phase.

The chosen payoff matrix for the IGT was the $A'B'C'D'$ version described by Bechara et al. (2000): it seems to favor both normal controls and frontal patients, providing a stricter test for our hypothesis.

2.4. Data analysis

As it is usual for the IGT, participants' performance was measured by dividing each phase into blocks of 20 consecutive card selections, and calculating the difference between good and bad choices within each block. It follows that performance varies between -20 (only bad selections) and $+20$ (only good selections).

Because explicit knowledge does not necessarily lead to good card selections, detecting decision biases in participants' performance required special care. Let us suppose that a participant does not realize how good or bad a given deck is, and simply goes on choosing from it. In the Reversed condition, a former bad deck becomes good, and a good deck turns bad. This means that below-average scores would tend to become above-average, and vice versa, possibly resulting in an undetectable effect in group performance. To overcome this difficulty, a *continuance* index C was defined as follows. Let P_1 denote performance in the last part (20 trials) of the first phase, and P_2 be the performance in the following blind phase, then C is:

$$C = \begin{cases} P_2 - P_1 & \text{if } P_1 < 0 \\ P_1 - P_2 & \text{if } P_1 > 0 \end{cases}$$

So defined, C indicates how much participants persevere in choosing from previously preferred decks during the blind period, independent of its actual performance. So, if a participant was consistently picking up cards from the good decks in the first phase (i.e., $P_1 > 0$), but insisted to select from them after they have turned bad ($P_2 < 0$), the continuance index will be positive. It will be positive also if a participant used to select from the bad decks ($P_1 < 0$) and insisted on them after they have turned good ($P_2 > 0$). On the contrary, if participants successfully switch to the decks they were not selecting in the first phase, P_1 and P_2 will have a similar value, and C will be close to zero.

If the participants base their selections on explicit knowledge, they should successfully reverse their preferences, and C should be around zero for both groups. On the other hand, any implicit bias towards those decks that were previously preferred would make C greater than zero in the Reversed group, but would not affect the Shallow one—where no bias should be evidenced.

3. Results

Before searching for differences between the performance of the Reversed and the Shallow participants during the blind period, an analysis was performed to make sure that the basic learning effect was replicated. A repeated measures ANOVA found a significant effect of Block on performance in all the three groups ($F(1,40) = 12.28$, $p = .001$; $F(2,84), = 4.86$, $p = .01$; and $F(3,135) = 4.71$, $p = .004$, respectively), confirming that participants learned to avoid the disadvantageous decks (see Fig. 1, left).

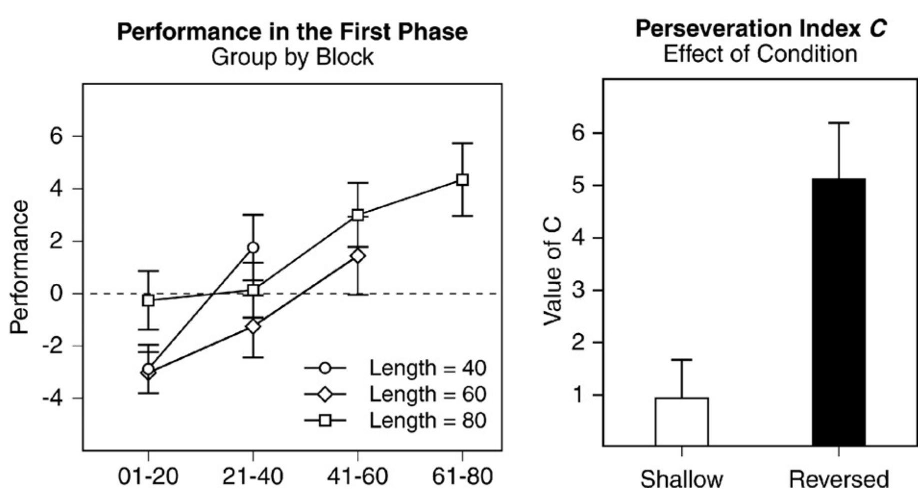

Fig. 1. Left: mean performance (±standard error) in the first phase across subsequent blocks, plotted separately for the three groups of participants who performed 40 (white circles), 60 (white diamonds) and 80 card selections (white squares). Right: mean value (±standard error) of the continuance index C for participants in the *Shallow* (white) and the *Reversed* (black) conditions.

Second, it was ascertained that Reversed and Shallow participants did not perform differently in the first phase. A 2 by 3 ANOVA, using Condition (Reversed vs. Shallow) and Duration (40 vs. 60 vs. 80 selections) as factors and performance in the last block of the first phase as the dependent variable, failed to uncover any significant main effect of Condition ($F(1, 124) = 1.50$) or interaction ($F(2, 124) = 0.97$), confirming that the two group's performance was comparable, and that the effects in the second phase could be attributed to the dissociation procedure.

A Condition (Reversed vs. Shallow in the second phase) by Duration (40 vs. 60 vs. 80 selections in the first phase) ANOVA was then performed using C as the dependent variable. The main effect of Condition turned out significant ($F(1, 124) = 10.89$, $p = .001$). Duration, however, was not significant ($F(2, 124) = 0.94$), nor was their interaction ($F(2, 124) = 2.42$). The effect of Condition confirms the existence of implicit biases, while the lack of effect of Duration suggests that these biases were acquired very early during the first phase, and were not substantially modified by any additional interaction with the task.

Since duration was not a significant factor, the first phase data were collapsed over it. As expected, a t-test confirmed that the mean value of C in the Shallow group ($C = 0.94$, $SD = 5.88$) was not significantly different from zero ($t(63) = 1.27$, $p = .21$), meaning that Shallow participants maintained their performance level. In the Reversed group, however, the value of C (5.12, $SD = 8.74$) was significantly larger ($t(128) = 3.19$, $p = .002$, $d = 0.56$), and was also significantly greater than zero ($t(65) = 4.76$, $p < .0001$). These results are summarized in the right plot of Fig. 1.

The difference between the two groups could be possibly accounted for by the Reversed condition being intrinsically more difficult that the Shallow one. An analysis of confidence ratings, however, showed no reliable difference between the two groups ($M = 2.73$, $SD = 1.43$ for the Shallow group, and $M = 2.45$, $SD = 1.49$ for the Reversed group: $t(128) = 1.09$, $p = .28$, $d = 0.19$), implying that the Reversed participants were as confident as the Shallow ones about the quality of their own performance. This indicates that the decision biases were not due to factors participants were explicitly aware of. Consistently with the so-called zero-correlation criterion (Dienes & Berry, 1997), the implicit nature of this bias was also confirmed by the lack of correlation between confidence ratings and the value of C ($r = 0.02$, $t(130) = 0.23$).

A crucial consequence of the implicit nature of this bias is that participants' perseverance (as measure by C) should be larger for those whose performance was in either the top or in the bottom tier. This is because stronger implicit biases, in either direction, should result in both larger preferences for either the good or the bad decks (and, therefore, more extreme values of P_1) and stronger perseveration (and, therefore, larger values of C). On the contrary, if performance depends on explicit knowledge, then stronger preferences in the first phase should not result in correspondingly larger perseverations.

This prediction was tested by examining the two groups of participants whose performance in the last 20 trials of the first phase was either in the first ($P_1 \leqslant -2$, $N = 48$) or in the fourth quartile ($P_1 \geqslant 8$, $N = 37$). As expected, performance of Reversed and Shallow participants was identical at the end of the first phase for both groups, but participants in the Reversed condition diverged largely in the subsequent blind phase (Fig. 2). A Phase (last 20 trials of the first phase vs. second phase) by Condition (Reversed vs. Shallow) ANOVA was performed on both groups. Both factors were significant (Phase: Bottom, $F(1, 46) = 23.43$, $p < .0001$; Top, $F(1, 35) = 6.82$, $p = .01$; Condition: Bottom, $F(1, 46) = 9.26$, $p = .004$; Top: $F(1, 35) = 7.24$, $p = .01$). Their interaction was significant for the Bottom

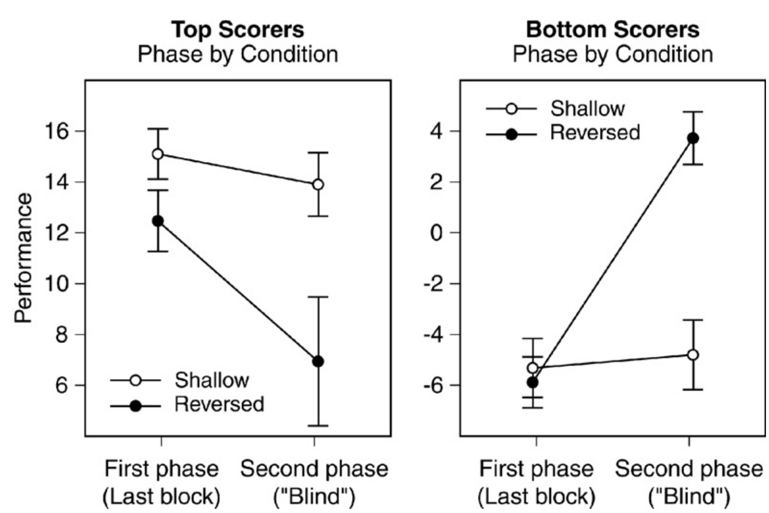

Fig. 2. The effect of the blind phase dissociation in the *Top* (left) and in the *Bottom scores* (right). Participants in the *Reversed* condition (black circles) inverted the performance levels they reached at the end of the first phase. On the other hand, participants in the *Shallow* condition (white circles) maintained the very same level of performance through both phases. Points represent mean values, whiskers represent standard errors.

scorers ($F(1,46) = 18.85$, $p < .0001$), and was marginally significant for the Top ones ($F(1,35) = 2.82$, $p = .1$). In both groups, Tukey HSD post hoc tests confirmed that the performance in the blind phase for Reversed participants was significantly different from all of the other performances ($p < .03$ for all contrasts), which did not differ significantly from each other.

4. Conclusions

In our experiment participants successfully learned to avoid the disadvantageous decks during the first phase but those in the Reversed condition showed a significant tendency to persevere in their previous selections during the no-feedback phase, being incapable of completely adjusting their choices to the newly arranged contingencies. This provides evidence that implicit decision-making biases exist in the IGT. Their implicit nature is further confirmed by the lack of significant difference in the confidence ratings given by the two groups at the end, and by the lack of correlation between confidence ratings and bias magnitude (as measured by the index C).

Our results are broadly consistent with the SMH, and support Bechara et al.'s (1997) claim that the effect of emotional biases on decision making might be unconscious. They do, however, depart from this framework in two respects. First, the duration of the first phase did not interact with the blind phase dissociation, suggesting that these biases were acquired quite early and were not substantially affected by further practice. This fact is potentially conflicting with the gradual increase of anticipatory skin conductance responses that Bechara et al. (1997) suggested as correlates of somatic markers. The early onset, on the other hand, has the advantage of making it less probable that biases were due to the development of automatic procedures, which depend crucially on time and practice.

Second, and most importantly, our results indicate that unconscious decision biases are present in both good and bad decision makers. The early discovery of a connection between emotional impairment and hazardous decision making (Eslinger & Damasio, 1985; Saver & Damasio, 1991) might have biased subsequent research in assuming that emotional biases always exert positive effects on decision making. Our analyses, however, shows that implicit biases do not selectively orient decisions towards the advantageous decks.

Our pattern of results is consistent with the idea that decision biases simply reflect associations between deck selections and their consequences, which might be acquired very early. In particular, this constitutes evidence in favor of Fellows & Farah's (2003, 2005) and Rolls' (2000) view that the orbitofrontal cortex plays a central role for the acquisition of action–reward associations, and that VMPFC patients are impaired in re-learning them after an initial acquisition. In this perspective, patients' inappropriate decision making in the IGT might not be due to an overall inability in decision making, but to the structure of the tasks itself, where the disadvantageous decks are initially alluring, and can be recognized as harmful only later on.

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