

## Sensation-seeking and impulsivity in young and older adults' decision making

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*The somatic marker hypothesis asserts that decision-making processes involve emotion. Using a gambling task that models real-life decisions, studies showed that old adults perform less efficiently than younger adults, by adopting a strategy that is disadvantageous on the long term. This study aimed at re-examining the age effect on decision making with the same paradigm, and to explore whether differences are related to sensation-seeking and impulsivity traits of personality. Young and older adults were compared on the gambling task (Bechara, Damasio, & Damasio, 2000a), and on questionnaires of sensation-seeking and impulsivity. Results confirmed an age effect on the gambling task performance. Moreover, performance in both young and older adults on this task was correlated to scores on the sensation-seeking scale, but not to the rating of impulsivity.*

### Report

The somatic marker hypothesis posits that decision-making is a process that depends on emotion and that deficits in emotional signaling will lead to poor decision-making (see Bechara et al., 2000a). In fact, this hypothesis proposes that individuals make judgements not only by assessing the severity and the probability of outcomes, but also in terms of their emotional quality. In order to explore this hypothesis, Bechara et al., 2000a developed a card task (known as 'gambling task') that simulates real-life decisions. This task requires the participant to choose cards from four decks. Two decks have high immediate gain but larger future loss, and two other decks have lower immediate gain but lower future loss. During the task, anticipatory somatosensory responses are progressively generated before choosing from a risky deck, which leads normal adults to choose advantageous decks more and more frequently. Using this paradigm, Bechara et al. observed decision-making impairments in different populations (e.g., patients with damage to the ventromedial sector of prefrontal cortices, or substance-dependent individuals). Normal old subjects also performed less efficiently than younger adults (see Bechara et al., 2000a; Reavis & Overman, 2001). Bechara et al. noted that performance on the gambling task was dichotomous, i.e., some old subjects obtained very bad results while others performed very well. Therefore, a question is, why do some normal adults, sometimes young but more often older ones, adopt a disadvantageous strategy?

This study aimed at re-examining the age effect on decisionmaking with the same paradigm and to explore whether age differences or strategy differences are related to sensation-seeking and impulsivity trait of personality. Sensation-seeking is a trait defined by the need for novel sensations and experiences and the willingness to take physical and social risks. Risk-taking also refers to the notion of impulsivity that is usually understood as a lack of response inhibition. The main difference between these dimensions (sensation-seeking and impulsivity) lies in the awareness of the risk taken: the sensation-seeker is aware of risk, while impulsivity refers to a lack of planning and risk-awareness.

### Method and materials

#### *Participants*

A total of 122 volunteers participated in the study. This included 62 undergraduate students between 18 and 30 years of age (31 females and 31 males; mean age = 24.8 years; mean years of education = 14.7) and 60 older adults between 60 and 70 years of age (30 females and 30 males; mean age = 64.9; mean years of education = 14.2). Young and older adults did not differ in terms of years of education ( $P > .05$ ). An age difference was observed on a vocabulary test in favour of elderly subjects:  $M_s = 26.3$  versus 23.2 for older and younger adults, respectively ( $P < .05$ ). For both groups, selection criterion was the absence of a factor potentially affecting the CNS (e.g., history of major

neurological disorder, drug or alcohol abuse), and defective eyesight that was not corrected.

### Behavioural testing

#### Questionnaires

Two questionnaires were administered: Zuckerman's Sensation- Seeking Scale (SSS) and of the Eysenk Impulsiveness Scale (EIS).

- The SSS was a list of 40 paired statements, and each participant was asked to choose the item with which he agreed the most. Four factors were assessed: Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility.
- The EIS assessed self-reported impulsivity. This scale contained 54 yes-no items, divided into 19 impulsivity items, 16 'adventurousness' items, and 19 empathy items used for catching subjects' attention.

#### Decision-making task

A computer version of the Iowa Card Task was administered with 100 trials as described in Bechara et al. (2000b). In summary, the task involved 4 decks of card called A0, B0, C0, D0. Subjects had to pick up one card at the time from one of the 4 decks. In two decks (A0 and B0), picking up a card resulted in high gain of play money (100), but also in unpredictable high money loss in some trials. In the two other decks (C0 and D0), the immediate gain was smaller (50) but the penalty was smaller too. Every 10 cards, the subject encountered a total loss of 1250 in decks A0 and B0 and a total benefit of 250 in decks C0 and D0. Thus, decks C0 and D0 were more advantageous in the long term.

## Results

### Card task

As in previous studies (e.g., Bechara et al., 2000b), we subdivided the 100 card selections into 5 blocks of 20 trials each. Then, we calculated a net score for each block (total of cards selected from advantageous minus disadvantageous decks): negative scores indicated a disadvantageous selection strategy and positive scores indicated an advantageous strategy. Globally, results showed that 35% of young and 45% of older subjects adopted a disadvantageous strategy, but the difference was not significant ( $\chi^2 = 2.1$ ,  $p = .15$ ). Secondly, results

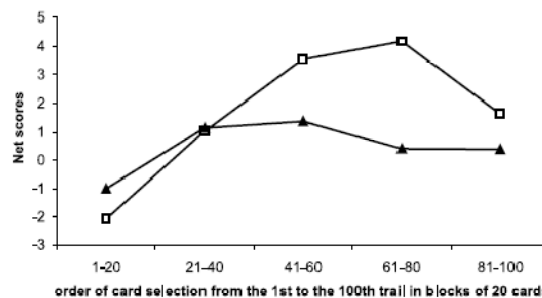


Fig. 1. The figure shows net scores  $[(C' + D') - (A' + B')]$  of cards selected by old subjects (filled triangles) and younger subjects (open squares) across different blocks expressed as mean. Positive net scores reflect advantageous performance whereas negative net scores reflect disadvantageous performance.

showed that young subjects selected an average of 55 cards from the good decks versus 45 cards from the bad decks. Older subjects selected an average of 51 cards from the good decks versus 49 cards from the bad decks. Note that, following Bechara et al.

(1998), the selection of more than 50 cards from bad decks was defined as a cut-off point to determine a disadvantageous strategy. In addition, we observed that young subjects gradually shifted their preference towards the good decks. Indeed, an ANOVA carried out with the five blocks as a repeated measure raised an effect of blocks on scores ( $F(4, 484) = 5.3$ ,  $p < .001$ ). With the same analysis, we observed that this response shift was not observed in older participants

( $F(4, 256) = 1.1$ ,  $p = .37$ ). See Fig. 1.

### Questionnaires

#### Sensation-seeking

First, young subjects scored significantly higher than older adults on all factors ( $P_s < .001$ ).

Second, across all participants, the global score on the SSS positively correlated with scores in the card task ( $R(121) = .26$ ,  $p = .04$ ). This positive correlation was observed both in young ( $R(61) = .20$ ,  $p < .05$ ) and older ( $R(59) = .30$ ,  $P = .03$ ) adults. Regarding the factors assessed by this scale, only adventure seeking and disinhibition correlated positively with scores ( $R(121) = .25$ ;  $p = .05$ ,  $R(121) = .28$ ,  $p = .02$ , respectively), both in old and younger subjects.

Third, in comparing older subjects with advantageous and disadvantageous strategy, a 4 X 2 (SSS factors X strategy groups) ANOVA showed a factors effect ( $F(3,171) = 246.7$ ,  $p < .001$ ) and a significant interaction ( $F(3,171) = 3.1$ ,  $p = .016$ ). More precisely, older adults using an advantageous strategy had

higher scores in adventure seeking ( $F(1,58)=6.01$ ,  $p=.02$ ) and disinhibition ( $F(1,58)=6.01$ ,  $p=.02$ ) factors than the old subjects with disadvantageous strategy. On the contrary, a similar analysis carried out in young subjects revealed no difference between subjects with advantageous and disadvantageous strategy ( $p > .01$ ).

#### *Impulsivity*

First, young subjects scored significantly higher than older subjects on all factors ( $P_s < .001$ ).

Second, total scores on the EIS were not significantly correlated with scores in the card task in young or older subjects ( $p > .10$ ). Regarding factors assessed by this scale, only the adventuresomeness factor was positively correlated with net scores ( $R(121) = .17$ ,  $P = .05$ ).

Finally, there was no difference between subjects using advantageous or disadvantageous strategy on this scale (all  $P_s > .10$ ).

#### **Discussion**

First, there was evidence of an age effect on the decision-making task performance. In fact, older adults showed an initial typical selection from the bad decks a and b, but contrary to younger adults, they did not switch to more and more selections from the good decks c and d. These results confirm previous observations (see Bechara et al., 2000a; Reavis & Overman, 2001).

Second, self-reported impulsivity was not correlated with card task performance. These data might show that disadvantageous decision making in card task is not the consequence of simple impulsivity. In contrast, and surprisingly, we observed that, on the one hand, the adventure seeking and disinhibition factors in the Sensation-Seeking Scale, and on the other hand, the adventuresomeness factor in the Impulsivity Scale both correlated positively with decision-making performance in young and older adults. Using the same paradigm for exploring potential sex effects on decision-making, Reavis and Overman (2001) recently observed similar results.

Third, young subjects scored higher than older subjects on sensation-seeking scale and impulsivity scales, and this was true for all factors correlated with decision-making performance (disinhibition and adventure seeking).

Fourth, like Bechara et al. before, we noted that young and older adults' performance on

card task was dichotomous, i.e., some subjects adopted advantageous strategy while others followed very disadvantageous options. This was more clearly the case in older adults. In addition, older adults who chose favorable card decks at a high rate were also subjects with the highest SSS scores.

To conclude, this study replicated the previously observed age effect in the gambling task. Nevertheless, our findings raise an important question, namely why older high sensation-seeker perform better in the gambling task than other older adults. More studies are obviously needed to clarify the relationships between sensation-seeking and performance on the gambling task.

#### **References**

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