

CROSS-COMPARISON OF INDICES OF RISK ATTITUDE FROM TWO DISTINCT EXPERIMENTAL PARADIGMS, IN ADULTS AND ADOLESCENTS.

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Abstract

The Iowa Gambling Task (IGT) has been used to characterize adolescents' decision making under uncertainty. A conclusion often drawn is that, like ventromedial patients, adolescents tend to go on choosing disadvantageous (risky) card decks. In this study, the IGT and a classic paradigm of choice between lotteries were employed with both adolescents and adults. In the lotteries task, probabilities were also initially unknown to the participants. The lotteries paradigm allowed, moreover, estimating specific parameters of attitude toward risk as well as of attention allocated to negative and positive outcomes. Comparison of the results obtained from both paradigms provide a more nuanced and less contrasted view of adolescent's decision making as regards adults.

Adolescents are often described as risk prone in decision making. Contrary to a common idea, the prevalence of risky behaviors in adolescents has been suggested by Reyna & Farley (2006) to be caused by an excess of rational thinking. Under their view, adolescents' decision making is characterized by an overweighting of analytical components along with limitations in intuitive processing, driven by previous affective experience ("gut feelings").

The SP/A theory of L. Lopes is an influential framework which can be used to contrast adolescents and adults decision making regarding their attitudes toward risk (1999). Empirically, it rests on behavioral tasks of "choices between lotteries". It combines two logically and psychologically independent components: (1) "SP", which stands for 'security-potential', and (2) "A", which stands for 'aspiration level'. The SP formula ($h(D) = wD^{qs+1} + (1-w)[1-(1-D)^{qp+1}]$), reflects the notion that subjects may perform either a bottom-up (security minded), a top-down (potential minded) or a mixed (cautiously hopeful) analysis of lotteries. Parameters w and $(1-w)$ index the relative importance of S and P analyses, and thus reflect the kind and degree of attitude towards risk. If $w = 1$, the decision maker is strictly security-minded. If $w = 0$, the decision maker is strictly potential minded. If $0 < w < 1$, the decision maker is cautiously hopeful, to a variable degree. Parameters qs and qp , on their turn, index the way attention is allocated to outcomes as the evaluation proceeds from losses to gains or from gains to losses, respectively. When $qp > qs$ more attention is given to losses, concurrent with a 'safe' attitude; the opposite is true when $qp < qs$, concurring with a potential-minded attitude. According to Reyna and Farley hypothesis, adults should be mostly security-minded (risk averse) or, when cautious-hopeful, lie more on the security pole. Adolescents, on the other hand, should be mainly cautious-hopeful (rather than simply potential-minded).

A second approach to the issue of adolescents' vs. adults' decision making is offered by the «somatic marker» hypothesis (Damasio & Bechara, 1994), which directly addresses the relations between affect/emotion and decision making. Within this framework, decision making is thought of as an emotion-dependent process, so that deficits in emotional processing will lead to poor decision making. The "Iowa Gambling Task" (IGT), which mimics daily life choices under uncertainty, has been commonly used to assess such

‘emotional impairments’ in decision making, first revealed in patients with ventromedial frontal lobe lesions (Bechara & Damásio, 1994, 1997, 1999, 2000, 2001). According to the conjecture that adolescents are more rational and less affect-oriented in their decisions than adults one might thus expect them to perform differently from adults, and closer to Damasio’s ventromedial patients, in the IGT.

Method

Participants

Adults: 14 naïve undergraduate and graduate students at the University of Coimbra (aged 18-27). Adolescents: 20 naive students enrolled at public secondary education schools in the district of Coimbra, Portugal (aged 14 -15)

Design and procedure

Lotteries Task:

Participants were presented with five decks possessing identical expected values, meaning that the average gain was the same in all decks (+10 points per card). They differed however in their underlying distributions, ranging from a NoLoss deck, where participants could never lose points but were unlikely to win many (maximum: 20 Euros), to a Long-Shot deck, offering a small probability of winning 150 Euros and a considerable chance of losing until up to 50 Euros. Thus, the decks primarily differed by (1) their respective variances and by (2) the proportion of cards in each deck yielding a positive outcome (see Sanfey et al., 2003).

The goal for subjects was to maximize the number of Euros won. They were not informed about the decks distributions. On each trial, two decks were highlighted and the participant selected one of them via a mouse click. The chosen card was then “turned over”, revealing the number of points won or lost. Each possible pair of decks was shown 20 times, for a total of 200 trials (10 possible pairs).

IGT:

The first task involves four decks of cards: A, B, C, and D. For decks A and B, choosing a card is usually followed by a high gain but, at unpredictable points, by a very high penalty: in the long run these decks are disadvantageous. For decks C and D the immediate gain is smaller, but the upcoming loss is also smaller, so that in the long run these decks are advantageous. The total number of card selections (trials) was set at 100.

To rule out hypersensitivity to reward another variant of the IGT was used (decks E, F, G, and H) which reverted the order of reward and punishment (punishment became immediate and reward delayed). In the variant task the advantageous decks (E and G) were set to be those with high immediate punishment and higher future reward. The disadvantageous decks (F and H) provided low immediate punishment, but a much lower future reward (see Bechara & Damasio, 2002)

Results

The SP/A model was fitted with the solver function of Microsoft Excel, using the root-mean-squared-deviation (R.M.S.D.) as a measure of fit.

Table 1. Estimated parameters for the three different groups

Group	w	qs	qp	R.M.S.D.
Adults	0.69	0.64	1.84	0.071
Adolescents safe	0.65	0.69	1.58	0.093
Adolescents risky	0.36	1.74	0.58	0.046

Parameters were estimated on the basis of the last 10 selections made for each pair. Estimates for each group are given in table 1. Parameters were also estimated for each participant individually. These individual estimates were moreover cluster analyzed within each group (adults and adolescents), revealing two distinct subgroups of adolescents. Statistical comparisons between groups (between-subjects ANOVA) disclosed overall main effects for the three parameters ($p < 0.01$). Further pairwise comparisons revealed that one of the clusters of adolescents (hereafter labeled “risky”) scored significantly lower on the security-potential parameter (w) than any of the other groups, which did not differ among themselves.

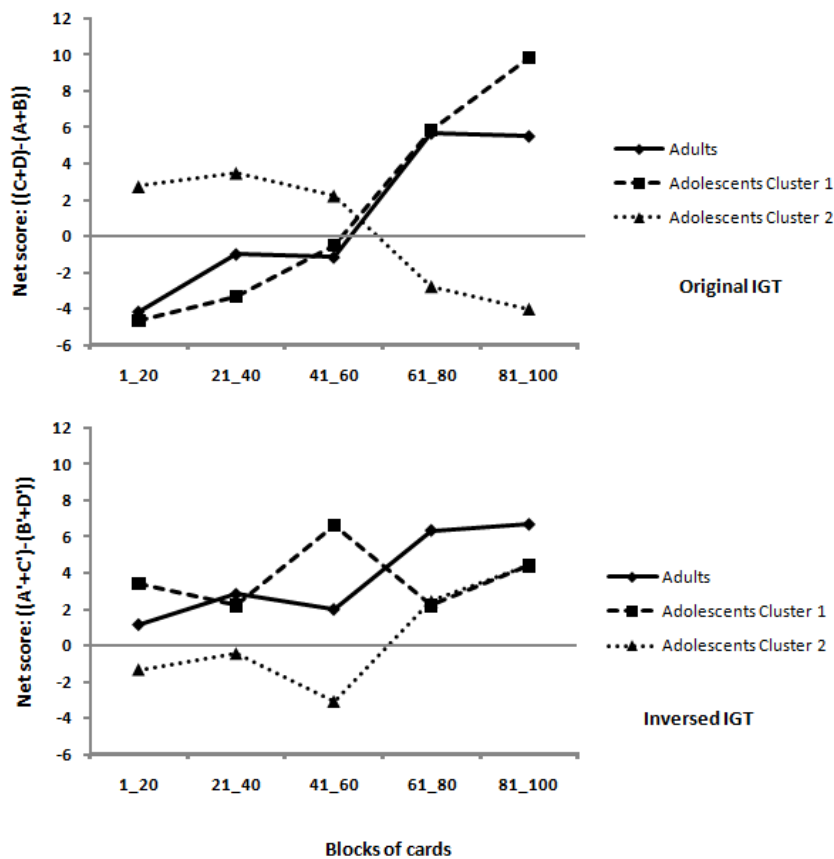


Figure 1. Net scores $((C+D) - (A+B))$, derived from the direct IGT, and $(E+G) - (F+H)$, derived from the inverse IGT as a function of consecutive blocks of 20 trials. Positive net scores reflect an advantageous performance.

Concerning the IGT (data presented in Figure 1), a hierarchical cluster analysis of the net scores similarly revealed two clusters of adolescents in both the direct and the inverse versions. Repeated measures ANOVAs disclosed significant main effects of Block ($p < 0.006$) and significant Group \times Block interactions ($p < 0.031$) in both the IGT tasks.

Discussion

Both the Lotteries and the IGT tasks underline the importance of individual differences in adolescents, signaled by the emergence in all cases of two distinct clusters of participants. Parameters w , qs and qp all offer a consistent characterization of the “risky cluster” of adolescents in the lotteries task. As for the IGT, the distinctive pattern exhibited by Cluster 2 (dotted line) in the direct variant is qualitatively close to the one observed with ventromedial patients. However, this is not the case for any of the clusters found in the inverse variant of the task. Overlap between the “risky” clusters in the Lotteries and in the IGT tasks (which were performed by the same subjects) is, on the other hand, far from perfect. This suggests that the characterization of attitudes toward risk through SP/A parameters and by means of the net scores obtainable from IGT may be tackling distinct facets of the decision making process. Overall, the cross-referencing of results arising from these two distinct paradigms mainly suggest a more nuanced and less contrasted view of adolescent's decision making as regards adults than the one propounded in Reyna and Farley's conjecture.

References

- Bechara A, Damasio H, Damasio AR, Lee GP.(1999) Different contributions of the human amygdala and ventromedial prefrontal cortex to decision-making. *Journal of Neuroscience*; 19:5473–81
- Bechara A, Damasio H, Damasio AR. (2000) Emotion, decision-making, and the orbitofrontal cortex. *Cerebral Cortex*; 10:295–307.
- Bechara A, Damasio H.(2002) Decision-making and addiction (part I): Impaired activation of somatic states in substance dependent individuals when pondering decisions with negative future consequences, *Neuropsychologia*, 40, 1675-1689.
- Bechara A, Damasio (2002) H. Decision-making and addiction (part II): Myopia for the future or hypersensitivity to reward?, *Neuropsychologia*, 40, 1690-1705.
- Crone, E. & van der Molen, M. (2004). Developmental changes in real life decision making: Performance on a gambling task previously shown to depend on the ventromedial prefrontal cortex. *Developmental Neuropsychology*, 25, 3, 251-279.
- Damáσιο, A (1994) *Descartes' Error: Emotion, Reason and the human Brain*. New York: Avon Books
- Lopes, L. L., & Oden, G. C. (1999). The role of aspiration level in risky choice: A comparison of Cumulative Prospect Theory and SP/A theory. *Journal of Mathematical Psychology*, 43, 286-313.
- Reyna, V. & Farley, F. (2006). Risk and rationality in adolescent decision making: implications for theory, practice, and public policy. *Psychological Science in the Public Interest*, 7,1, 1-44.
- Sanfey, A.G, Hastie, R, Colvin, M.K., & Grafman, J. (2003). Phineas gauged: Decision Making and the frontal lobes. *Neuropsychologica*, 41, 1218-1229
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