

Time is money: Individual differences in risky choice behavior

Anne Lauré Karreman, Nathan van der Stoep, Martijn Mulder

Experimental Psychology, Utrecht University, Heidelberglaan 1, 3584 CS Utrecht, The Netherlands

Introduction

Since *time is money*, people often feel forced to decide quickly. Although the benefit of a fast choice can be attractive, choosing the wrong option might leave you empty handed or could even cost you a fortune. As such, taking time to decide can prevent us from taking risks that result in (financial) problems. Here we investigated how people trade speed for accuracy when a benefit is at stake. We expect that for hard choices, risk-averse participants will have a preference for certainty at the cost of slower responses and lower reward values. In contrast, risk-prone individuals might opt for faster choices with a higher reward values, but at the risk of more errors.

Methods

Participants (n=34, age range = 18-61, 13 female) performed the random dots motion (RDM) task (Figure 1B).

Stimulus strength for hard (~70% correct) and easy (~90% correct) was estimated for each participant by fitting the proportional-rate diffusion model¹ to practice data (6x60 trials).

Time is Money Task. During the experimental RDM trials with hard and easy stimuli (4 blocks, 120 trials each) reward decreased from 40 to 5 points in 1 second, starting at the participants non-decision time (see Figure 1C). The faster the (correct) response, the higher the reward. Points were converted into an extra financial bonus.

DDM & Risk. Individual differences in speed-accuracy-tradeoff (SAT) were measured by fitting the drift-diffusion model (DDM²; see Figure 1A) to the data, using the fast-dm toolbox³. Individual risk-attitude (prone, neutral or aversive) was measured using the Domain-Specific Risk-Taking questionnaire (DOSPERT⁴). A regression analysis was used to test whether individual differences in financial risk-behavior (*risk taking*, *risk perception* and *expected benefit*) was related to individual differences in SAT.

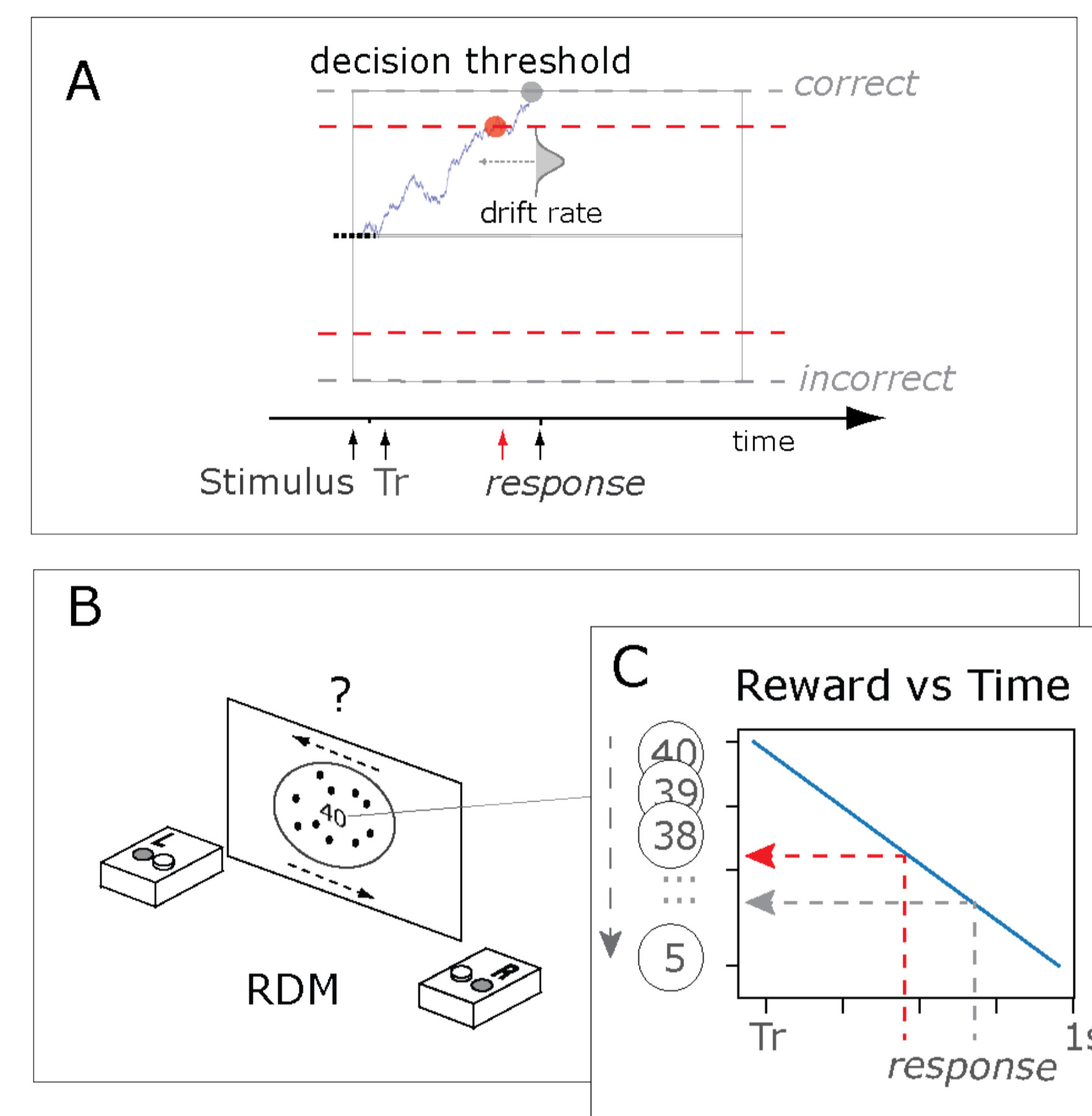


Figure 1. Perceptual decision making, model and task. **A.** The Drift Diffusion Model (DDM, Ratcliff, 1978) represents decisions as an accumulation of noisy sensory evidence over time. Drift rate is the average amount of evidence accumulated per time unit. Non-decision time (T_r) is the time for processes other than the decision process. **B.** The Random Dots Motion task. At each trial, subjects indicated the direction of the moving dots (L = left, R = right). **C.** Reward, per trial, as a function of time. By lowering the decision threshold (red dashed lines in A), participants trade speed for accuracy, resulting in faster responses with a higher reward (red dashed line in C) but with a higher probability of incorrect choices (with no reward).

Results

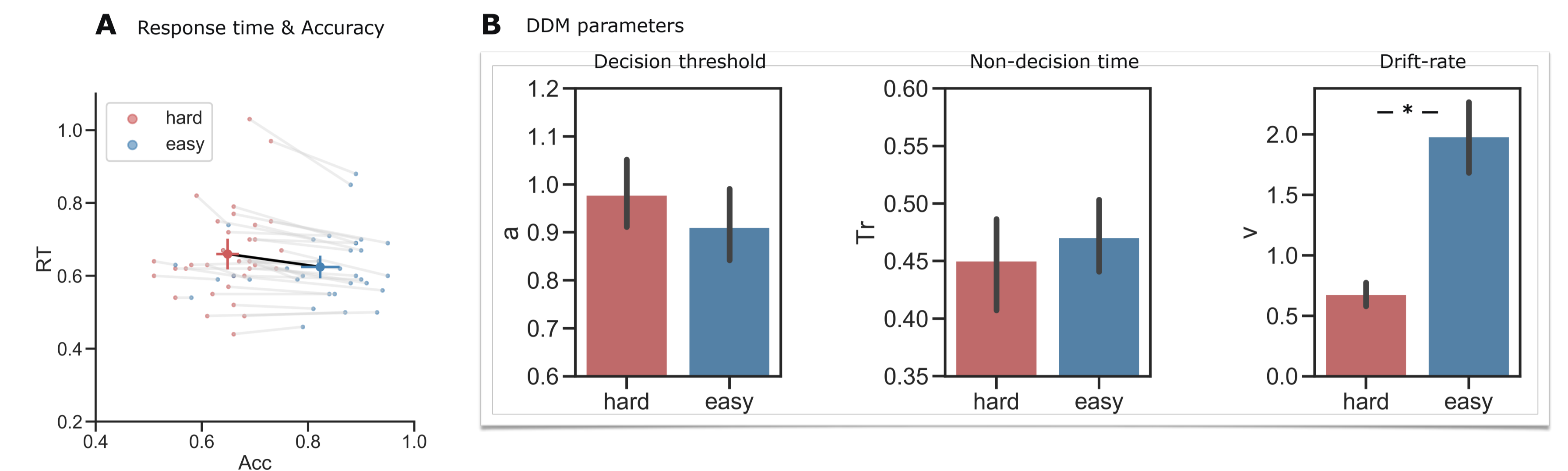


Figure 2. Descriptive and fit results. **A.** Descriptive results. Participants were more accurate for easy compared to hard choices [mean(std) easy vs hard = 0.82(0.10) vs 0.65(0.06), $t(33) = 16.1$, $p < 0.01$]. For RT, participants were faster for easy compared to hard choices [mean(std) easy vs hard = 0.62(0.09)s vs 0.66(0.12)s, ($t(33) = 5.0$, $p < 0.01$)]. **B.** DDM fit results. All participants had larger drift-rates for the easy compared to the hard condition [mean(std) easy vs hard = 1.98(0.88) vs 0.68(0.29), $t(33) = 11.2$, $p < 0.01$].

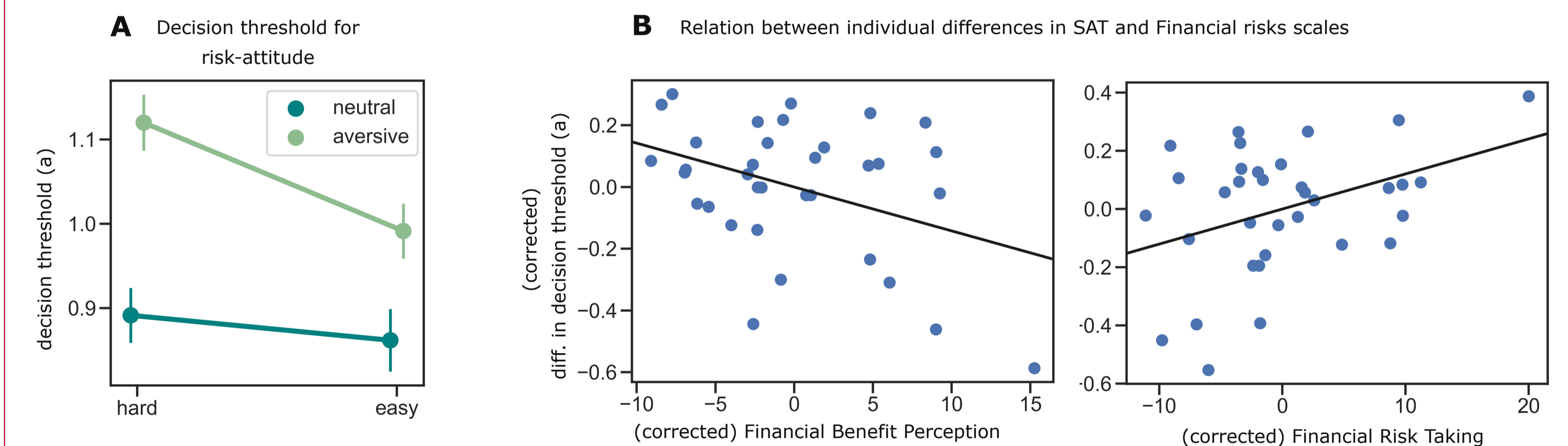


Figure 3. Relation between risk-attitude and decision threshold. **A.** Decision thresholds for hard and easy choices, split by risk attitude (neutral vs aversive). Risk-averse individuals tend to set their threshold higher (ie. being more cautious) compared to risk-neutral individuals (mixed ANOVA, $F(1,32) = 9.486$, $p < 0.01$). **B.** Speed-accuracy tradeoff (SAT, easy-hard) as function of *benefit perception* and *risk taking* scores. Participants that perceive more benefit in a risky choice, tend to increase thresholds (i.e. be more cautious) when decisions are harder ($\beta = -0.014$, $p < 0.05$). In addition, a participant's tendency to take more financial risks, seem to decrease their thresholds when decisions are harder ($\beta = 0.012$, $P < 0.05$). Values represent partial regression effects (corrected).

Conclusion

Results suggest that risk-averse participants are more cautious in balancing the tradeoff between time and benefit, choosing accuracy at the cost of the benefit of time. Furthermore, a stronger perception towards benefit results in a more cautious decision threshold for harder choices, possibly ensuring benefit itself rather than the magnitude of it. Finally, a tendency to engage more in financial risky situations results in a preference for speed over accuracy, with higher rewards, but at the cost of more errors with no reward at all.