# Assessing cognitive conflict in the public goods game: A mouse-tracking analysis

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## Theoretical background

**Spontaneous cooperation in social dilemmas**

- Theoretical proposition by Rand et al. : [1]
  General spontaneous tendency to **cooperate**
  Effortful deliberation required for **defection**
- Empirical tests so far mainly based on (manipulation of) **response times** with mixed results [2,3]
- As response times may reflect influences of different processes, growing trend to test hypothesis using other process measures [2,4]

**Response dynamics**

- Analysis of response dynamics via **mouse-tracking** allows assessing tentative commitment to choice options during decision process [5]
- From this, measures for **cognitive conflict** during decision process can be derived [4]
- If cooperation is spontaneous tendency, there should be less conflict (i.e. less curved mouse trajectories) for **cooperation** than **defection**

**Individual differences**

- Spontaneous cooperation effect found for some individuals while there is no effect for others [1]
- Recent finding: individual differences related to basic **personality traits** [4,6]
- Effect should be stronger for dispositional cooperators as measured through the **Honesty-Humility** (HH) personality trait

## Methods

**Repeated binary public goods game**

- Participants randomly assigned to groups of 4
- They play 10 rounds of public goods game
- In each round, they decide whether to **contribute** vs. **keep** a randomly drawn monetary amount (no feedback provided)
- All contributed amounts are doubled and distributed equally among group members
- Implemented in OpenSesame with Psynteract [7]
- 122 participants, average total payout 4.67 €

**Mouse-tracking**

- Click on start button to display amount
- Decision: click on **contribute** vs. **keep** button (order counterbalanced between participants)
- Mouse movements recorded every 10 ms in OpenSesame using Mousetrap and analyzed using the mousetrap R package [8]
- Conflict assessed via trajectory curvature using the **maximum absolute deviation** (MAD) from idealized path (straight line) (cf. Fig. 1)

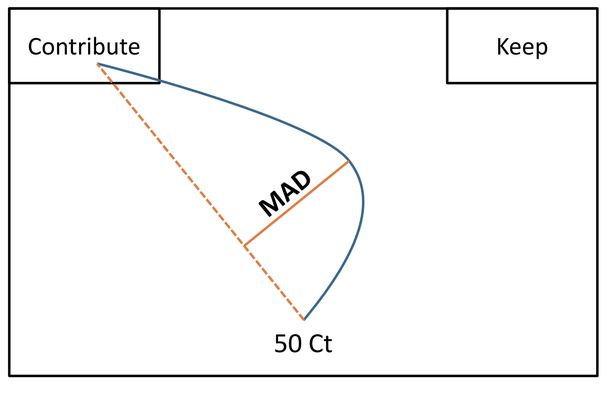


**Fig. 1.** Mouse-tracking example trial. Movement starts in bottom center of screen. Calculation of maximum absolute deviation (MAD) illustrated.

## Results

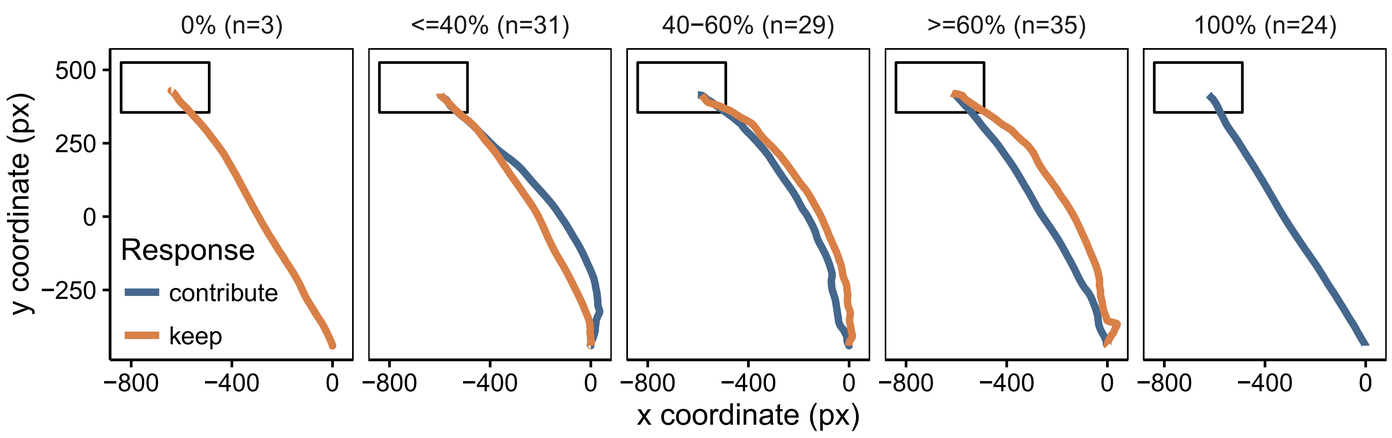


**Fig. 2.** Average mouse trajectories per response separately for groups of participants with different contribution levels. Trajectories were remapped to the left and time-normalized. Contribution level is percent of total money contributed.

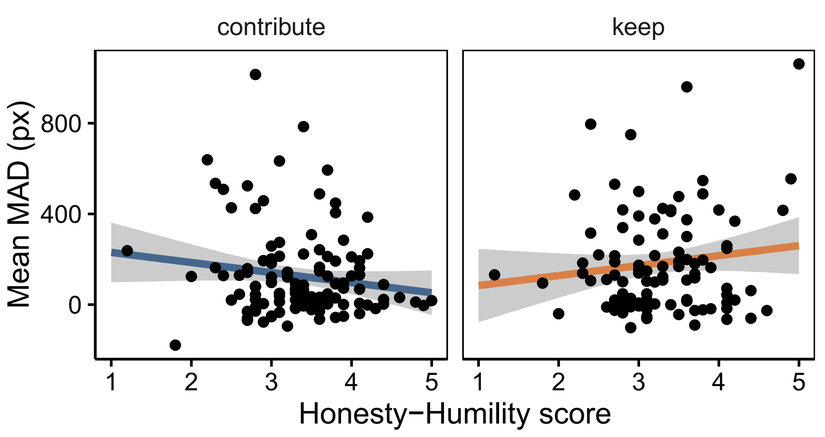


**Fig. 3.** Mean MAD per response predicted with Honesty-Humility. Linear regression line including 95% confidence band is displayed.

**General analysis procedure**

- Linear-mixed model predicting trial level MAD allowing for a random intercept per participant
- Comparable results for aggregate data and other measures for trajectory curvature

**Analysis I**

- Predictors: response ($p < .001$) , contribution level ($p = .98$) and interaction ($p < .001$)
- Higher MAD for **keep** than for **contribute** trials
- Interaction with contribution level (cf. Fig. 2)

**Analysis II**

- Predictors: response ($p = .03$), HH (assessed before game) ($p = .72$) and interaction ($p = .005$)
- With increasing HH, MAD increases in **keep** and decreases in **contribute** trials (cf. Fig. 3)

## Discussion

**Summary**

- Development of binary public goods game with mouse-tracking allows assessing conflict associated with **cooperation** vs. **defection**
- On average more conflict when defecting
- However, this varies considerably between participants and can be predicted with situational and dispositional cooperativeness

**Analytical challenges**

- Several participants always choose contribute (or keep). If they are excluded, mean difference between **contribute** and **keep** no longer significant but individual difference findings replicate
- Distribution of raw MAD values is skewed, alternative analysis procedure with MAD type classification leads to comparable results

**Relation to previous research**

- Extends previous mouse-tracking study [4] from dyadic to group social dilemmas leading to comparable results with simplified paradigm (more suitable for mouse-tracking)
- Contributes to ongoing debate about spontaneous cooperation emphasizing need to investigate and explain interindividual differences

## References

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[7] Henninger, F., Kieslich, P. J., & Hilbig, B. E. (in press). Psynteract: A flexible, cross-platform, open framework for interactive experiments. *Behavior Research Methods*. https://github.com/psynteract/psynteract-os

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