Cross-cultural differences in playing centipede-like games with surprising opponents

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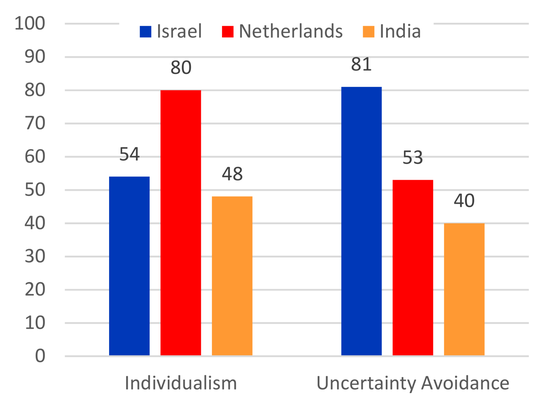
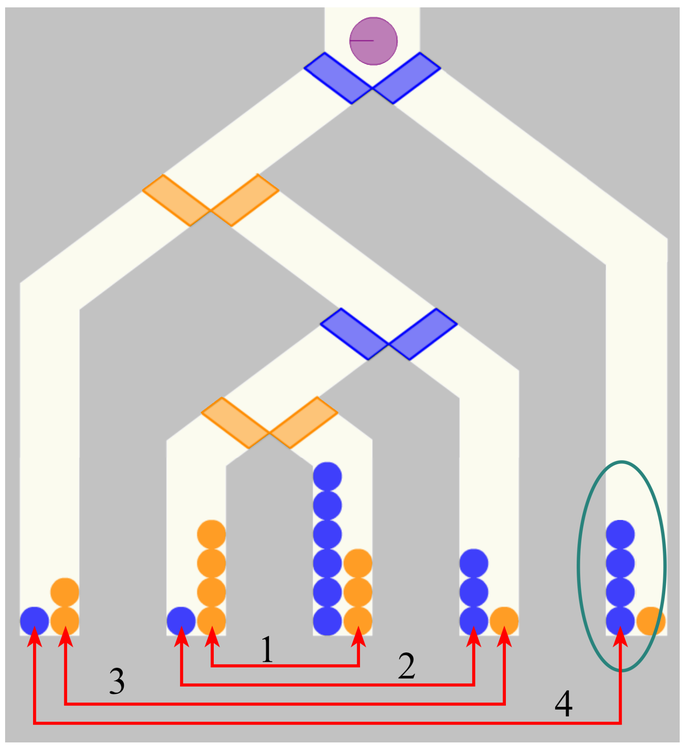
Introduction

- Cognitive science is not only concerned with universal patterns of cognition, but also variations in those patterns, induced by relevant factors such as culture.
- There has been a lot of interest in the possible differences between people from different countries with respect to adherence to game-theoretic predictions (Camerer, 2011).
- We provide a cross-cultural empirical study to investigate certain aspects of strategic reasoning in centipede-like games: (i) adherence to strategies defined in game theory, (ii) degree of risk-taking, and (iii) cooperative versus competitive tendencies.
- We compare participants from India, Israel, and the Netherlands, who are expected to differ in their levels of individualism and uncertainty avoidance (Hofstede, 1991).

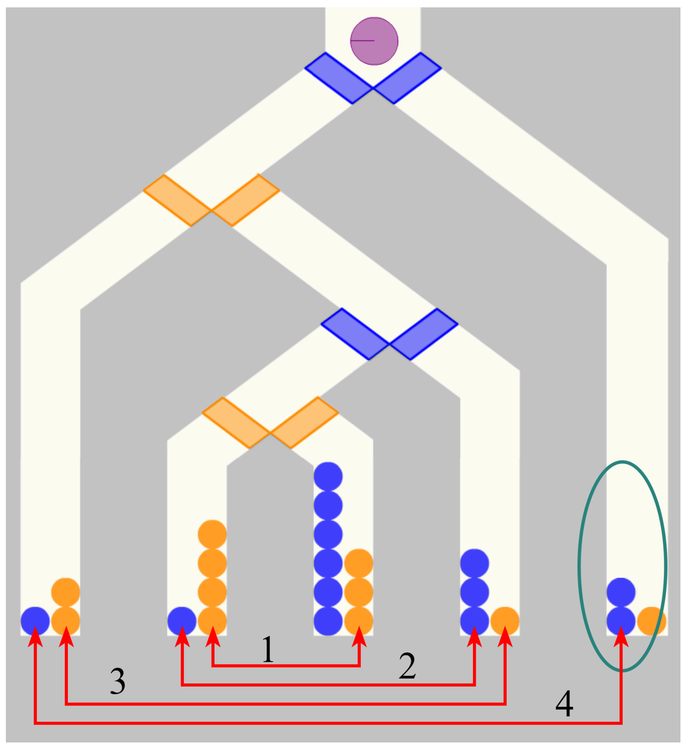


Experimental games

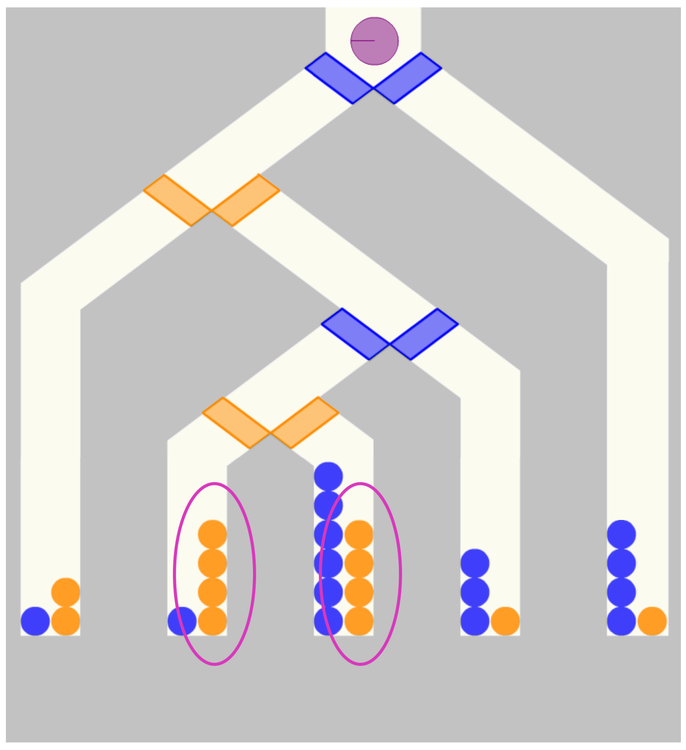
- Participants play two-player repeated Marble Drop games (Meijering et al., 2011). The computer is the other player.
- The participant P and the computer **C** determine the path of a purple marble by controlling orange and blue trapdoors, respectively. The participant's goal is that the purple marble drops into a bin with as many orange marbles as possible; the computer's goal is similar, with respect to blue marbles.
- In Game 1 and Game 2, the game-theoretic best move is to end the game immediately. In Game 3, any move at any node is justifiable.
- The computer often first chooses to continue the game to the next set of trapdoors. We investigate how participants react to this surprising move.



Game 1



Game 2



Game 3

Uncertainty Avoidance

Backward induction reasoning starts at endpoints in Game 1 (see red arrows):

1. $4 > 3$, so P opens bottom left trapdoor;
2. $\mathbf{3} > \mathbf{1}$, so **C** opens lower right trapdoor;
3. $2 > 1$, so P opens upper left trapdoor;
4. $\mathbf{4} > \mathbf{1}$, so **C** opens top right trapdoor.

If the computer does choose to go left at the start, this is surprising. But in backward induction, participants do not take the past into account and will still stop by opening the upper left orange door.
Always stopping at their first move could also be a sign of **risk-averse** behavior: **uncertainty avoidance** and backward induction reasoning lead to the same first participant choice.

Forward induction reasoning participants interpret the computer's surprising choice to go left at the top as a sign that it wants to reach more blue marbles than the rightmost bin contains:

- In Game 1, this means the computer would not choose right at the middle blue trapdoors because $\mathbf{3} < \mathbf{4}$.
- In Game 2, this means that the computer may choose right at the middle blue trapdoors because $\mathbf{3} > \mathbf{2}$.

So participants using forward induction reasoning are expected to continue (right) in Game 1, but may stop (left) in Game 2.

Risk-seeking participants would show similar behavior at their first choice in Game 1.

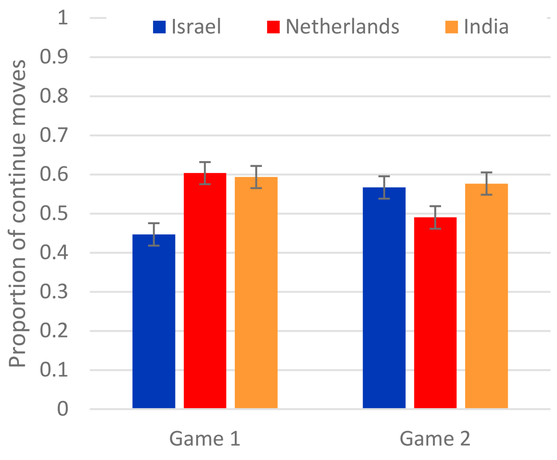
Individualism

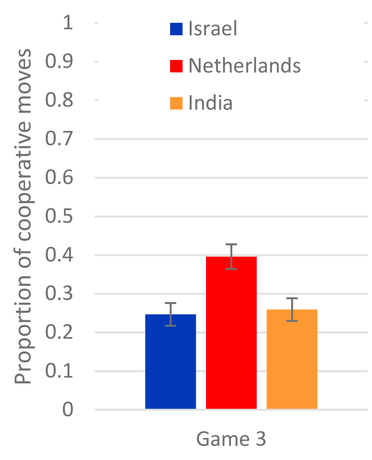
In Game 3, the final choice for the participant does not affect the number of orange marbles they receive: 4 (see purple ellipses). The number of blue marbles that the computer receives are however different. The participants may therefore choose to:

- be **cooperative**, non-individualistic, and let the purple marble drop in the bin with 6 blue marbles; or
- be **competitive**, more individualistic, and leave the computer with only 1 blue marble.

Participants are truthfully told that the computer opponent does not learn from the participant's moves in previous games, including their final cooperative or competitive move.

Results and discussion





- Despite differences in uncertainty avoidance across countries, on average, we find mostly risk-seekers across nationalities.
- Dutch participants behave consistently with **forward induction** reasoning, possibly, risk-seeking.
- Israeli participants behave contrary to forward induction reasoning, possibly indicating higher levels of distrust.

- Participants behaved highly competitively across nationalities.
- Contrary to predictions based on individualism across nationalities, Dutch participants were most likely to behave cooperatively.

- Additional information such as eye tracking data, reaction times, or cognitive modeling could shed further light on these findings.