WCST analysis

Data

Data sources

To run this script, copy-paste the follwing files to "datadir", then then change the path to datadir:

- all the result files from the server (one for each participant): these contain the data from the game (pattern: condition_ID_Results.txt)
- vpn.txt from the server: this contains data from the pre-game questionnaire
- survey.txt from the server: this contains data from the post-game questionnaire
- time.txt from the server: this contains the timestamps of different action from the participants during the experiment (e.g., started game, filled out survey, etc.). This is not used for data analysis, but can be useful to check manually if something is not clear
- prolific_export_5f917030b1ac5a05a2123cac.csv from the Prolific website: this contains the demographic data of participants

We have manually made some modifications to these files to ensure that the data is read correctly:

- We deleted special characters that particpants might have used (e.g. #)
- We deleted empty rows, where participants hit enter in a free text field
- We rewrote characters where participants used letters instead of numbers (e.g., 4o instead of 40 in the age field)
- We copy-pasted survey data for a few participants who claimed that the server froze during their survey and they sent us their answers via messaging

We merged the data from these files into a data frame, called "participantdata".

Variables

For each move participants made during the game we had the following variables:

- Trial number
- Source card
- Target card
- Match: correct or incorrect move
- Total time: the time elapsed between the source card appearing and the source card being dropped
- Move time: the time elapsed between dragging and dropping the source card
- Think time: total time - move time
- Rule: which rule the move conformed to (color, number, shape, index)

For each participant we calculated the following variables:

- Number of moves
- Task time: Time the participant spent with the task (min)
- Experiment time: The the participant spent with the entire experiment, including the surveys (min)
- Mean total time: mean time between moves (ms)
- Mean move time: mean time between drags and drops (ms)
- Mean think time: mean time the participant spent thinking between moves (total time - move time; ms)

Exclusion criteria

We excluded participants who:

- Quit during the first data sheet: 96
- Indicated that they were colorblind: 1
- Did not start the game after filling out the data sheet: 46
- Refreshed the screen during the game or went back to the instructions page after starting the game: 19
- Revoked their consent to use their data: 31
- Played the game more than once, even if they got assigned a different condition after the first time (we still included their first attempt though): 8
- Who gave up during the game, thus never got to the final survey: 26

Those participants who gave up during the game either quit the experiment during the game, before time out, or left their computer and never pressed the "Continue" button after time out. These participants did not complete the survey, but still have some data from the game, which we will analyze separately.

Our participant funnel looked like this:

- The number of experimental sessions started: 548
- The number of participants who gave informed consent and filled out the first datasheet: 452
- The number of participants who indicated that they were not colorblind: 451
- The number of participants who started the game: 405
- The number of participants who did not refresh the game or went back to the instructions page: 386
- The number of participants who did not revoke their consent to use their data: 355
- The number of participants who only played the game once: 347
- The number of participants who did not give up during the game and filled out the last survey too: 321

All-in-all, we excluded 227 initialized experimental sessions and we were left with 321 participants.

We need 78*7 = 546 participants. 546 - 321 = `546 - r nrow(participantdata_inc)` participants needed.

To do on Prolific

Batch approved list (to be copied to Prolific -> Approve by upload):

x

Manualy reject:

- If the same ID shows "quit" and then "played twice", approve anyway. These are probably cases where the game froze and then the participant restarted the experiment.
- Check Messages too, because sometimes participants explain their technical difficulties there.
- Check comments in the survey too, because sometimes it is obvious from their comments that they finished the experiment, even though they have missing data.

prolific_ID	prolific_action

Costs

We estimated that the median time for completing the experiment would be 8 minutes. The suggested hourly rate is 7.5 GBP on the Prolific website. From this, we calculated the fee for the task to be 1 GBP (independently of how long it took for the participant to finish). Together with 33% service fee and 20% VAT of the service fee, each approved participant costs around 1.396 GBP.

The time-out limit was claculated by the website to be 39 minutes for the whole experiment (for the game,

our own time-out was 15 minutes).

499 participants initiated the experiment on the Prolific website. From this:

- 72 participants returned the task
- 9 participants timed-out
- We excluded 24 participants for various reasons (see above)
- We approved and paid the remaining 379 participants
- From these, we could use the data from 321 participants

Sometimes we lost data because of server error. Other times, the browser of participants froze (probably also server error). In these cases, we cannot use the data of these participants, but we still have to pay them, because it was not their fault.

The experiment so far cost 551.51 GBP:

- Participant payments: £394.00
- Service fee (33%): £131.34
- VAT (20% of service fee): £26.27

The pilot experiments cost 73.23 GBP:

- Pilot 1: 33.60 GBP
- Pilot 2: 16.80 GBP
- Pilot 3: 14.01 GBP
- Pilot 4: 8.82 GBP

We transferred 630 GBP to Prolific.

Analyses

Summary of conditions

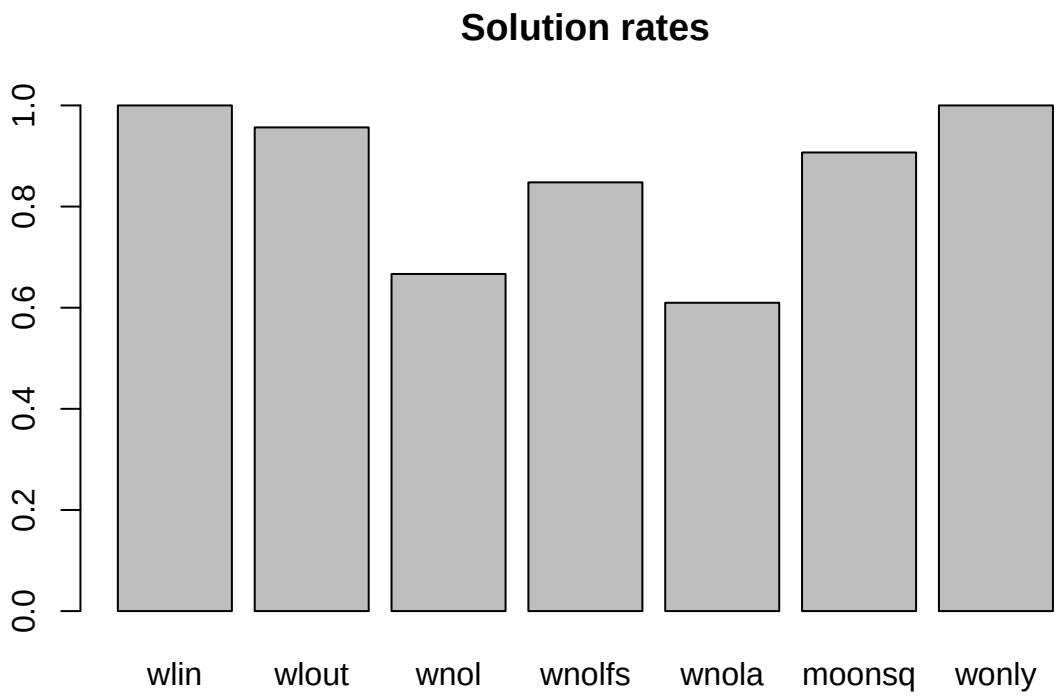
Condition	Number of participants	Aha rate of solvers	Failure rate	Avg task time	Avg number of moves
wlin	56	0.768	0.000	1.672	30.571
wlout	46	0.955	0.043	4.033	67.717
wnol	36	1.000	0.333	8.951	161.111
wnolfs	46	0.872	0.152	7.229	131.978
wnola	41	0.880	0.390	8.848	212.317
moonsq	43	0.718	0.093	4.576	90.721
wonly	53	0.547	0.000	0.922	19.604

Participant plots

Difficulty of the task

Solution rate: Fisher's exact tests

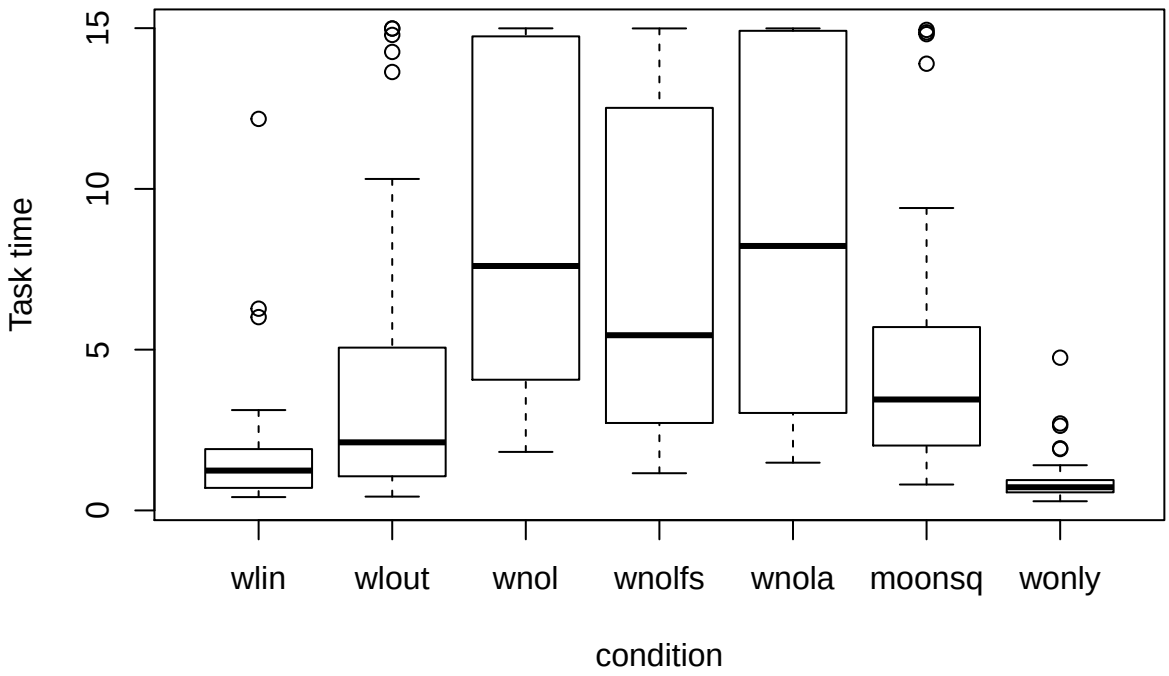
We analyzed the contingency table containing the number of solvers and non-solvers in pairs of conditions. A $p<0.05$ means that the row/column association is statistically significant.



Solution time: ANOVA

We checked whether the data was normally distributed with Kolmogorov-Smirnoff test:

If the data is normally distributed, we use ANOVA, if it is not, we use Wilcoxon.


Task time
0
5
10
15
wlin
wlout
wnol
wnolfs
wnola
moonsq
wonly
condition

Binary logistic regression

Aha feelings: Fisher's exact test