A New Technique for Studying Implicit Relational Learning in Adult Humans: Multiple-Object Tracking Task

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Abstract

Adult humans readily learn to respond to relations, but it is normally assumed that their ability to verbalize relations plays a critical role. To study relational learning in absence of verbalization, we developed a new technique using a multiple-object tracking task. In this task, participants are told to track four out of eight objects cued at the beginning of the trial. At the end of the trial, a single object is cued, and participants respond whether they tracked it (yes/no task). The display contained two strips of different width but participants were not informed about their presence.

The participants were randomly assigned to Informative and Random conditions. In Informative condition, the location of object cued at the end of the trial predicted the correct response. If the answer was "yes", then the cued object was located next to the narrower strip; otherwise, it was located next to the wider strip (or vice versa). In Random condition, the cued object was located next to either strip, so that its location was not predictive of the correct answer.

Postexperimental questionnaire showed that participants in Informed condition were not aware of predictive role of object location; nonetheless, they were more accurate than participants in random condition, providing evidence of implicit relational learning in this new experimental paradigm. Our results suggest that ability to verbalize relations may not be essential for demonstrating relational learning.

Method

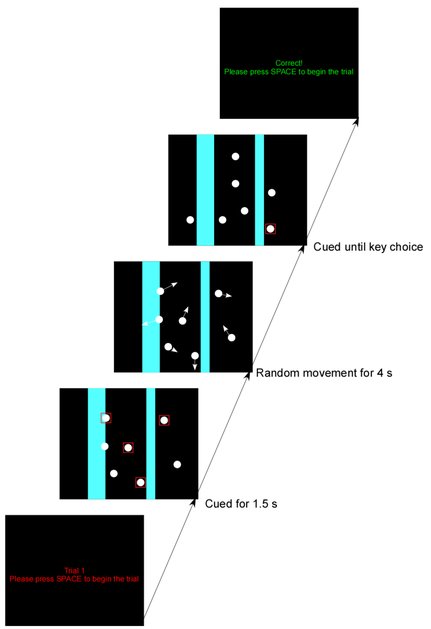


Figure 1. Sequence of events in a course of a trial. At the end of the trial, participants had to respond whether the cued object was one of the four original targets.

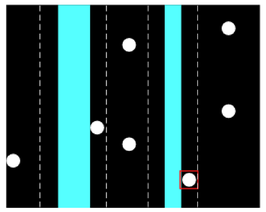


Figure 2. Setup of the choice display. The cued object always landed next to one of the strips. In Informative condition, the location of the cued object was predictive of the correct choice. In Random condition, the cued object was located next to either strip.

Postexperimental questionnaire (given at the end of the experiment)

1. What do you think was the purpose of the task that you just finished?
2. What strategies did you use to keep track of the balls during task?
3. If you lost track of the balls at the end of the trial, how did you get the correct answer? Please choose only one of the alternatives.
   ___ I was quite confident that I could make a correct choice because (explain)…
   ___I was somewhat confident that I could make a correct choice because (explain)…
   ___One just seemed right but I cannot explain why.
   ___I just guessed randomly.
4. Was part 2 of the experiment identical to part 1?
5. Was there anything about position of blue strips and the highlighted ball at the end of each trial that helped you to get the correct answer?
6. Did you notice whether the position of the highlighted ball at the end of each trial depended on the position of one of the strips?
7. If you answered "yes" to Question 5, then how soon into the task did you notice that the position of the highlighted ball depended on the position of one of the strips?
8. If applicable, please indicate how much knowledge you have of implicit learning, transposition, or relational learning .

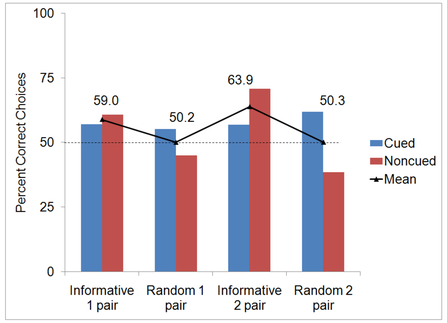
None of the participants in Informative group (n = 15) were aware of experimental contingencies.

Design

- 6 different widths of the strips as discriminative stimuli
- During training (Part 1): 1 vs 2 and/or 5 vs 6 (80 trials)
- During testing (Part 2): 1 vs 5, 2 vs 3, 3 vs 4, 4 vs 5, and 2 vs 6 (108 trials)
- 2 experimental conditions:
  - Informative (nested factor Smaller+ or Larger+; n = 15)
    - One-pair training (1 vs 2 or 5 vs 6)
    - Two-pair training
  - Random (n = 12)
    - One-pair training (1 vs 2 or 5 vs 6)
    - Two-pair training

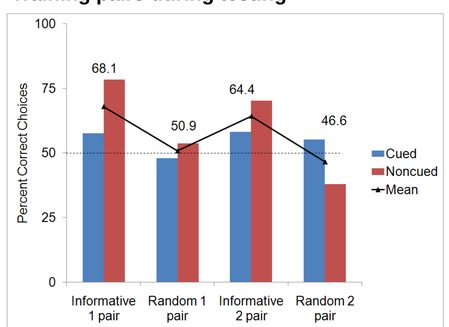
Results

Training



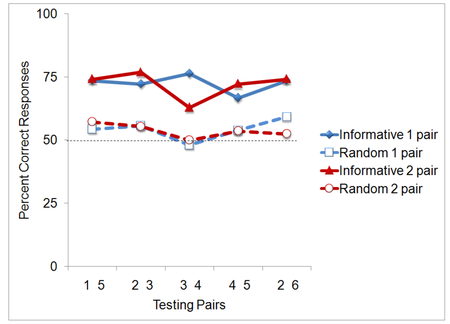
- Participants in Random conditions respond at chance level
  - A bias to respond "cued"
- Participants in Informative condition respond significantly above chance
  - A bias to respond "noncued"
- So far, there is no significant difference between Informative 1-pair and Informative 2-pair

Training pairs during testing



- Participants in Random conditions still respond at chance level
  - Less bias to respond "cued" in Random 1 pair
- Participants in Informative condition stil respond significantly above chance
  - The same bias to respond "noncued"
- Still no significant difference between Informative 1-pair and Informative 2-pair

Novel testing pairs (nondifferentially reinforced)



- Participants in Random conditions respond at chance level to all testing pairs regardless of the number of training pairs
- Participants in Informative condition respond significantly above chance to all testing pairs
- So far, no significant differences between the testing pairs or between 1-pair and 2-pair participants in Informative condition

Summary

- We observe relational learning in absence of explicit awareness
  - Participants in Informed condition are more accurate during training
  - They are also more accurate responding to the novel pairs that are nondifferentially reinforced
  - Yet, they report no awareness of relationship between the width of the strip and the correct choice
- So far, additional training pair does not appear to enhance relational learning

Future directions

- We need to collect more data (we currently have 27 participants out of planned 40)
- Analyze reaction times: do they correspond to choice data?
- Add third training pair: would this increase relational learning?

Acknowledgments

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