Antitonicity (Order-Flip) As A Foundational Logical Concept In Infancy

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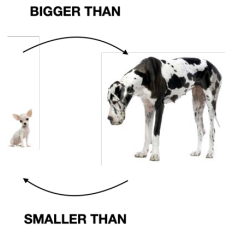
Introduction

Adults' concept learning is affected by logical complexity, where novel categories with higher logical complexity are harder to learn.[1]

Recent studies revealed logical capacities in preverbal infants.[2]

Order-FLIP is a logical building block of many of our concepts and ideas.[3]



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Our Question

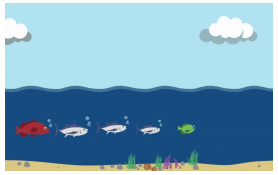
Do preverbal infants use the concept Order-FLIP to learn new concepts?

Our Approach

Across 4 experiments, 64 14-month-olds were habituated to arbitrary order mapping rules and then tested (within-subject) with new exemplars that either corresponded to the rule or violated it.

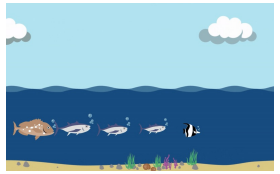
Design of Experiments

Experiment 1: hab to Order-FLIP



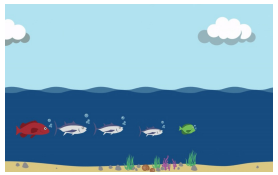
Familiar

Test with Order-FLIP



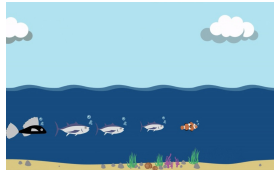
Novel

Experiment 2: hab to Order-MATCH

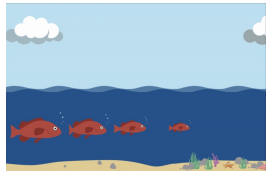


Familiar

Test with Order-MATCH

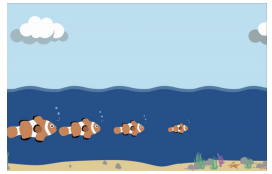


Experiment 3: hab to Order-FLIP



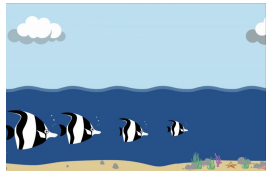
Familiar

Test with Order-FLIP

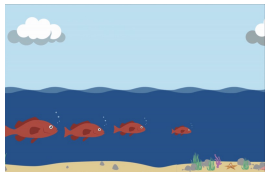


Novel

Test with Order-SHUFFLE_B



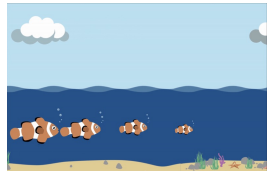
Experiment 4: hab to Order-SHUFFLE_A



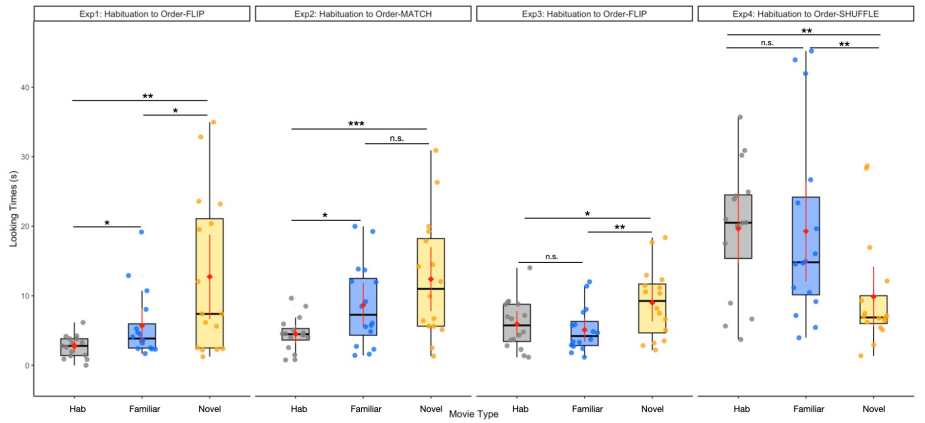
Novel

Familiar

Test with Order-SHUFFLE_A



Results



Note: Wilcoxon signed rank tests: *p < .05; **p < .01; ***p < .001.

Conclusion

- **Experiment 1** suggests that infants can learn an **Order-FLIP** rule different from **Order-MATCH**.
- **Experiment 2**, compared to Experiment 1, suggests that the stronger order manipulation in Experiment 1 resulted in a better learning of the rule.
- **Experiment 3** suggests that infant's representation of the **Order-FLIP** rule is finer grained than **Order-CHANGE**.
- **Experiment 4**, compared to Experiment 3, suggests **that Order-FLIP** is easier to learn **than Order-SHUFFLE**. This supports the hypothesis that infants are not representing the rule by indexing individual ranks, but possibly with an Order-FLIP operation.

Overall, our findings revealed that Order-FLIP may be a core logical concept available to human infants for learning early in life.

References

1. Feldman J. Minimization of Boolean complexity in human concept learning. (2000). Nature.
2. Cesana-Arlotti N, Martín A, Téglás E, Vorobyova L, Cetnarski R, Bonatti LL. (2018). Precursors of logical reasoning in preverbal human infants. Science 359.
3. Icard, T. F. and Moss, L. S. (2014). Recent progress on monotonicity. Linguistic Issues in Language Technology, 9(7).