

Logic in Psychology: With applications to false-belief tasks

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I'll start by making some general remarks on the relation between logic and psychology, considering both model-theory and proof-theory, and the associated schools in the psychology of reasoning.

I'll then move on and consider two case studies: In the first case study I use a proof-system for hybrid modal logic to formalize the first-order and second-order Sally-Anne tasks. The first-order version is perhaps the most well known false belief task. Second-order false belief is a more advanced component of theory of mind, underlying complex social behavior such as idiom understanding, irony and peer coordination.

In the second case study I use modal logic to analyze four second-order false belief tasks. The logical analysis shows that all four tasks share a common logical structure: all are based around a principle of inertia, which says that an agent's beliefs are preserved over time, unless the agent receives information to the contrary. A deeper logical analysis reveals that the four tasks exemplify all four possibilities inherent in the two dimensions of

- i) **being-deceived** versus **not-being-deceived** and
- ii) **change-in-world** versus **change-in-belief-only**.

Finally, I will present some preliminary empirical results on the effects of the two logical dimensions on second-order reasoning ability. The empirical results are part of a correlation and training study of higher-order social reasoning competency in children with Autism Spectrum Disorder.

The work on second-order false beliefs is joint work with Patrick Blackburn and Irina Polyanskaya.