

## 8 CONCLUSION

Through a series of interchange intervention experiments, we have mapped the end-to-end underlying mechanism responsible for the processing of partial knowledge and false beliefs in a set of simple stories. We are surprised by the pervasive appearance of a single recurring computational pattern: the lookback, which resembles a pointer dereference inside a transformer. The LMs use a combination of several lookbacks to reason about nontrivial belief states. Our improved understanding of these fundamental computations gives us optimism that it may be possible to fully reveal the algorithms underlying not only the theory of mind, but also other capabilities in LMs.

## 9 ETHICS STATEMENT

This work involves experiments conducted exclusively on synthetic text generated by the authors. No human subjects, personal data, or sensitive user information were collected or analyzed. The models we analyze are publicly released LLMs (Llama-3-70B-Instruct and Llama-3.1-405B-Instruct). All interventions and analyses were performed locally without querying proprietary APIs. We acknowledge that research on ToM in LMs may be misinterpreted as suggesting human-like cognition or intentionality. We explicitly caution that our findings demonstrate internal computational mechanisms, not conscious reasoning, and should not be construed as evidence of sentience or moral agency in LMs. Our causal intervention techniques reveal latent structures within pretrained models but do not modify the underlying weights or enable novel capabilities. Nevertheless, reverse-engineering latent belief representations could, in principle, be misused for behavioral steering or manipulation. To mitigate this, we provide our code strictly for transparency and further scientific audit, rather than for application in deployed systems.

## 10 REPRODUCIBILITY STATEMENT

To facilitate reproducibility, we release the full *CausalToM* dataset, including all story templates and the code used to generate the various story instances that serve as counterfactual variants in our experiments. The repository, that can be accessed at <https://belief.baulab.info>, contains all scripts required to construct the dataset, extract activations, perform interchange interventions, and compute causal mediation metrics, along with the hyperparameters and random seeds used for subspace identification via DCM. All experiments were conducted using publicly available open-weight models (Llama-3-70B-Instruct and Llama-3.1-405B-Instruct). The interchange intervention experiments can be reproduced either by hosting these models locally or by using remotely hosted instances via NDIF (Fiotto-Kaufman et al., 2025), if sufficient local compute is not available.

## 11 THE USE OF LARGE LANGUAGE MODELS

We used LLMs as a writing assistant to correct grammatical and typographical errors; beyond this, they did not contribute to any stage of the research.

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