

From goal-directed actions and their costs, adults jointly infer what agents know, and what they think they can discover

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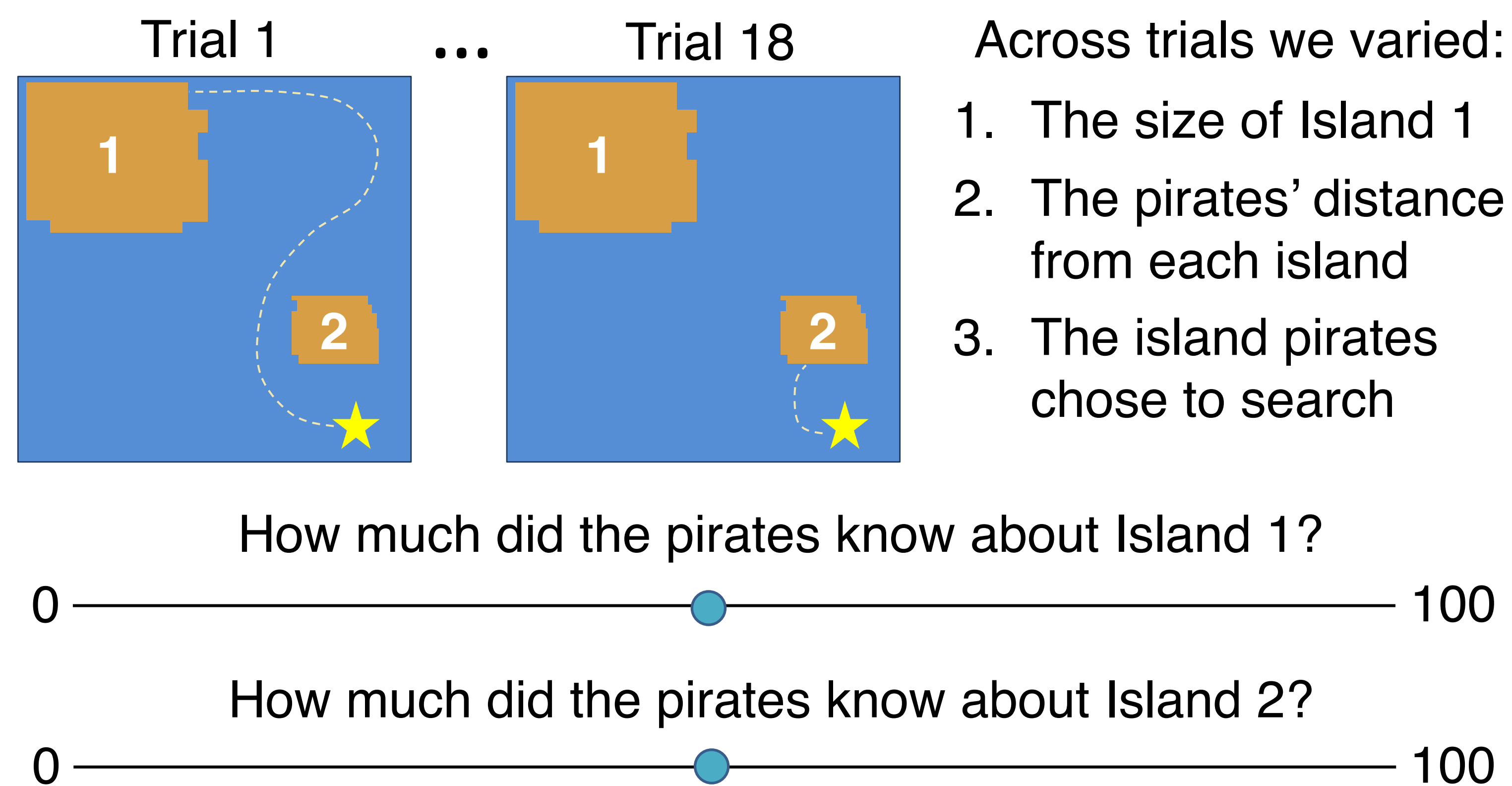
Introduction

From others' actions, we make rich intuitions about what they know, don't know, want to know, and expect to learn. How do we make such inferences? And how do they related to existing accounts of mental-state inference which explain how we infer others' intentions, goals and desires from their actions? We present a computational model of epistemic inference, operating under an assumption that agents quantify and maximize epistemic utilities.

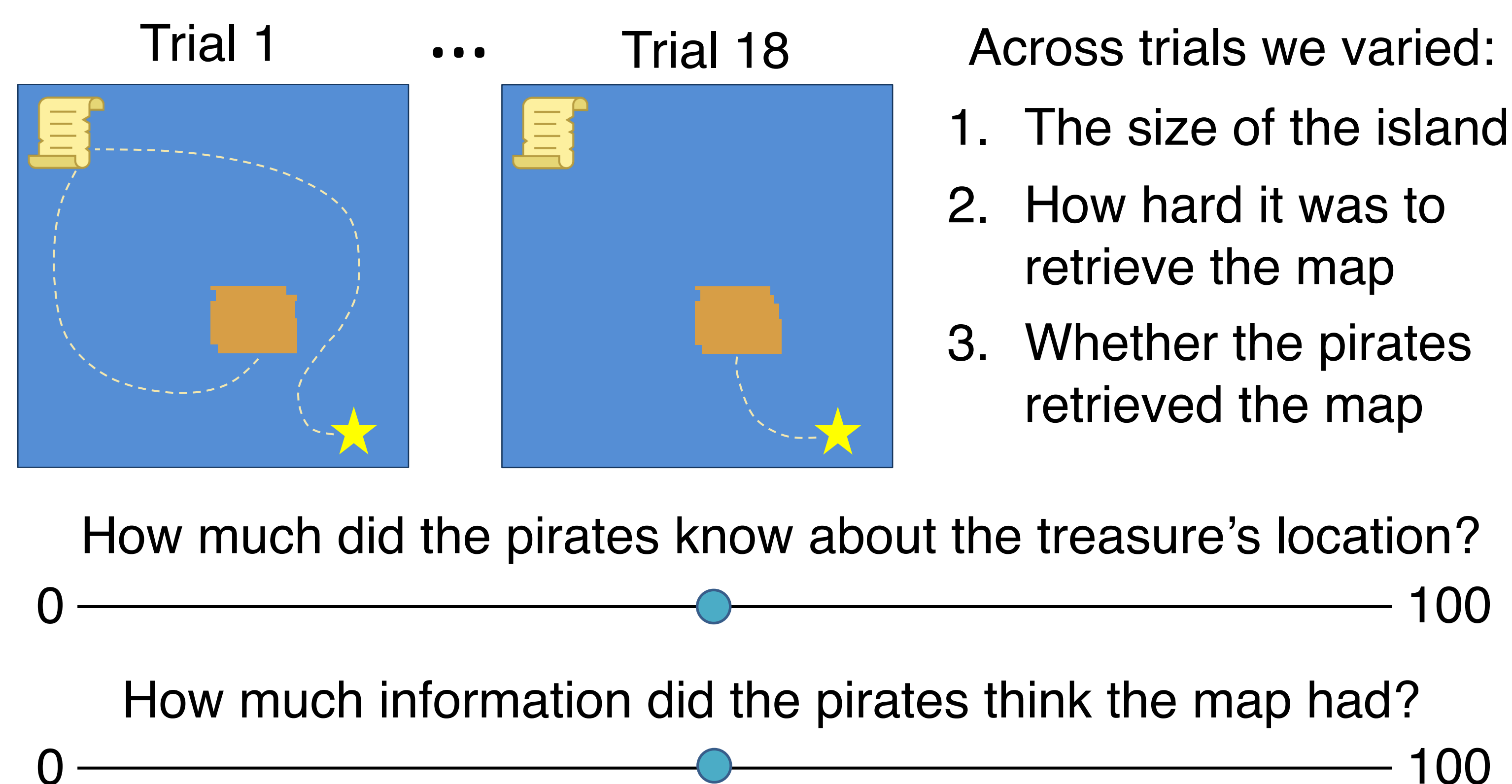
Procedure

Participants watched pirates search for treasure, observing pirates' actions and their costs. From these, participants judged what pirates knew, and believed they could discover.

Experiment 1: Joint epistemic inference



Experiment 2: Joint epistemic and belief inference



Computational Framework

Assuming agents maximize their utilities allows us to infer their goals, desires, and intentions from their actions. Formally, given cost and reward functions C and R , the utility of action plan (p) with relation to outcome (o) is given by:

$$U(p, o) = R(p, o) - C(p, o)$$

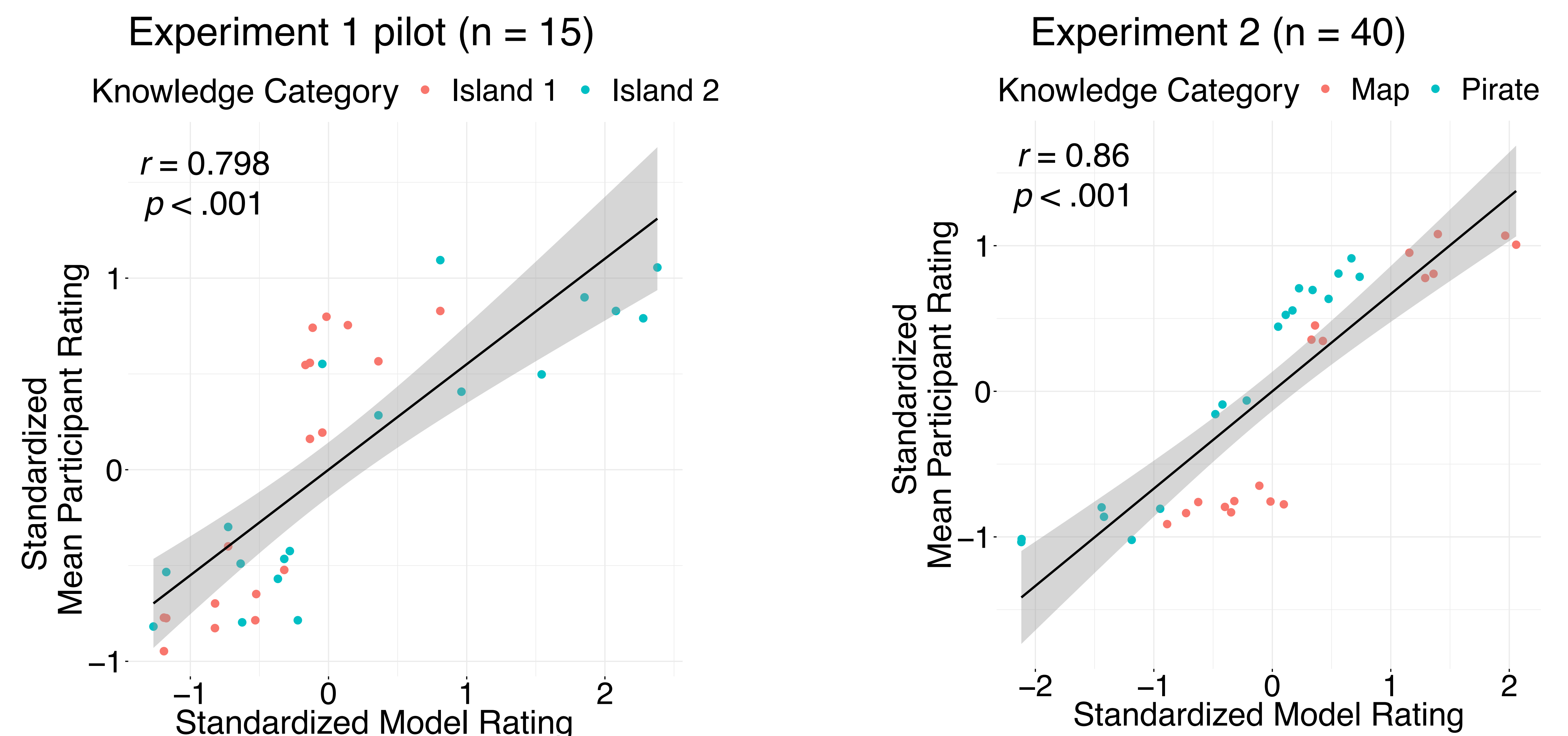
But often, costs are at least partially determined by knowledge (e.g., it's easier to assemble a dresser if you know all the steps). Expanding this model, costs now depend at least partially on agents' epistemic state K . We test this account in Experiment 1.

$$U(p, o) = R(p, o) - C_K(p, o)$$

Further, sometimes we can seek added knowledge. While this knowledge may come at a cost, it can then modify the cost of our original action plan (e.g., it might be time-consuming to read the instructions, but it'll probably make assembling the dresser easier). We expand the model to capture both aspects of added knowledge $+K$, and test this account in Experiment 2.

$$U(p, o) = R(p, o) - C_{+K}(p, o) - C(+K)$$

Results & Discussion



- Expanding upon current accounts of action understanding, we find that an expectation that others maximize utilities enables adults to infer not just whether someone knows, but also how much they know and believe they can learn.
- We find that adults' epistemic inferences are precise and graded with relation to agents' actions and their costs.
- These results provide strong evidence that adults infer what others know or think they can learn by considering the utility of their goal-directed actions.
- Future work will test whether our model can explain even more complex epistemic inferences.