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Toddlers' eye-movements reflect (un)certainty about their knowledge of a word's meaning

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BACKGROUND

- How children learn the meanings of words in an environment flooded with uncertainty **while receiving very little feedback about their knowledge state**, remains a great puzzle.
- To achieve this feat, it has been suggested that children come equipped with hardwired constraints on what words are more likely to map onto [1] together with the general-purpose ability to keep track of the statistical regularities between word occurrences and the environment [2].
- **Learning, however, cannot be reduced to a passive observational process of the external world**
- There is increasing evidence that **infants actively engage in self-directed learning** to learn about the physical, social and linguistic world surrounding them
 - infants use pointing in an interrogative fashion [3]
 - request information from others when they do not know [4]
 - orient selectively their attention [5]
- But **how do infants decide where to look and what to listen to?**
- In adults, efficient self-directed learning is predicted by accurate epistemic monitoring [6]
- Yet, **it is an open question whether children can monitor the uncertainty of their own knowledge and actively guide their learning behaviour on the basis of this monitoring [7]**

RESEARCH QUESTION

Our focus is on the impact of uncertainty monitoring in guiding information selection during the word learning process. **Can children estimate the degree of certainty they have about word meanings and detect their own errors without relying on external feedback?**

IMPLICIT MEASURE OF (UN)CERTAINTY

While children's knowledge about word meanings can be easily accessed, knowledge about knowledge is not directly observable. We based our approach on a 2-steps procedure used to assess metacognitive sensitivity in animals and infants [8,9].

1. Children perform a choice, which allows for an objective scoring of their understanding of a target word (**Performance**).
2. A secondary behaviour contingent on an evaluation of the initial choice is elicited, in the absence of any external feedback on performance (**Uncertainty monitoring**).

METHOD

Participants: 53 18- to 30-month olds (68 tested)
Procedure: We adapted a version of the post-decision persistence wagering paradigm (see [8] in rats and [9] in infants) with an anticipation eye-movement paradigm using an eyetracker.



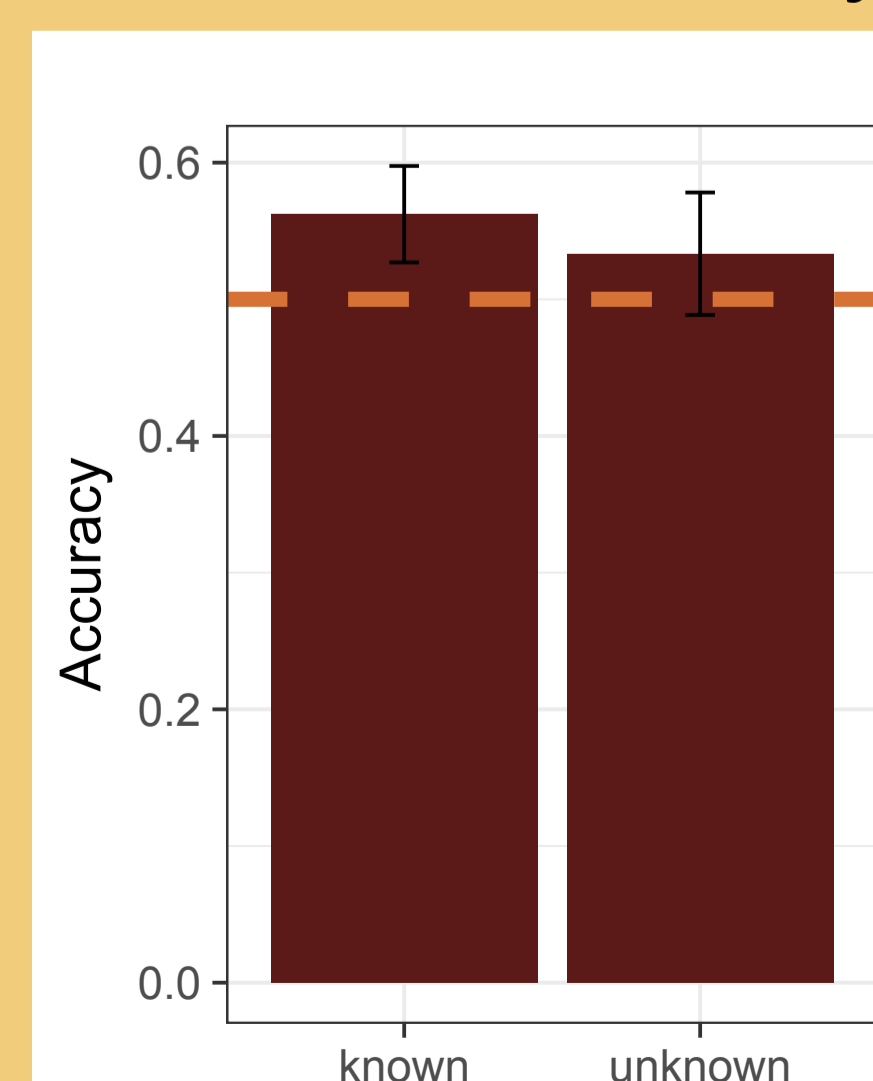
- 5 trials with **known words** (as attested by parental report)
- 5 trials with **unknown words** (e.g., "blicket") (control)

MEASURES AND HYPOTHESIS

- **Performance:** first anticipative look during the delay period
 - **Uncertainty:** children's willingness to persist in looking toward the side of their first gaze.
- If children can evaluate their knowledge about word meanings: we expect a **higher persistence following correct first look as compared to incorrect first look only in cases when the uncertainty is low (known words)**.

RESULTS: PERFORMANCE

Mean accuracy of the first anticipative look



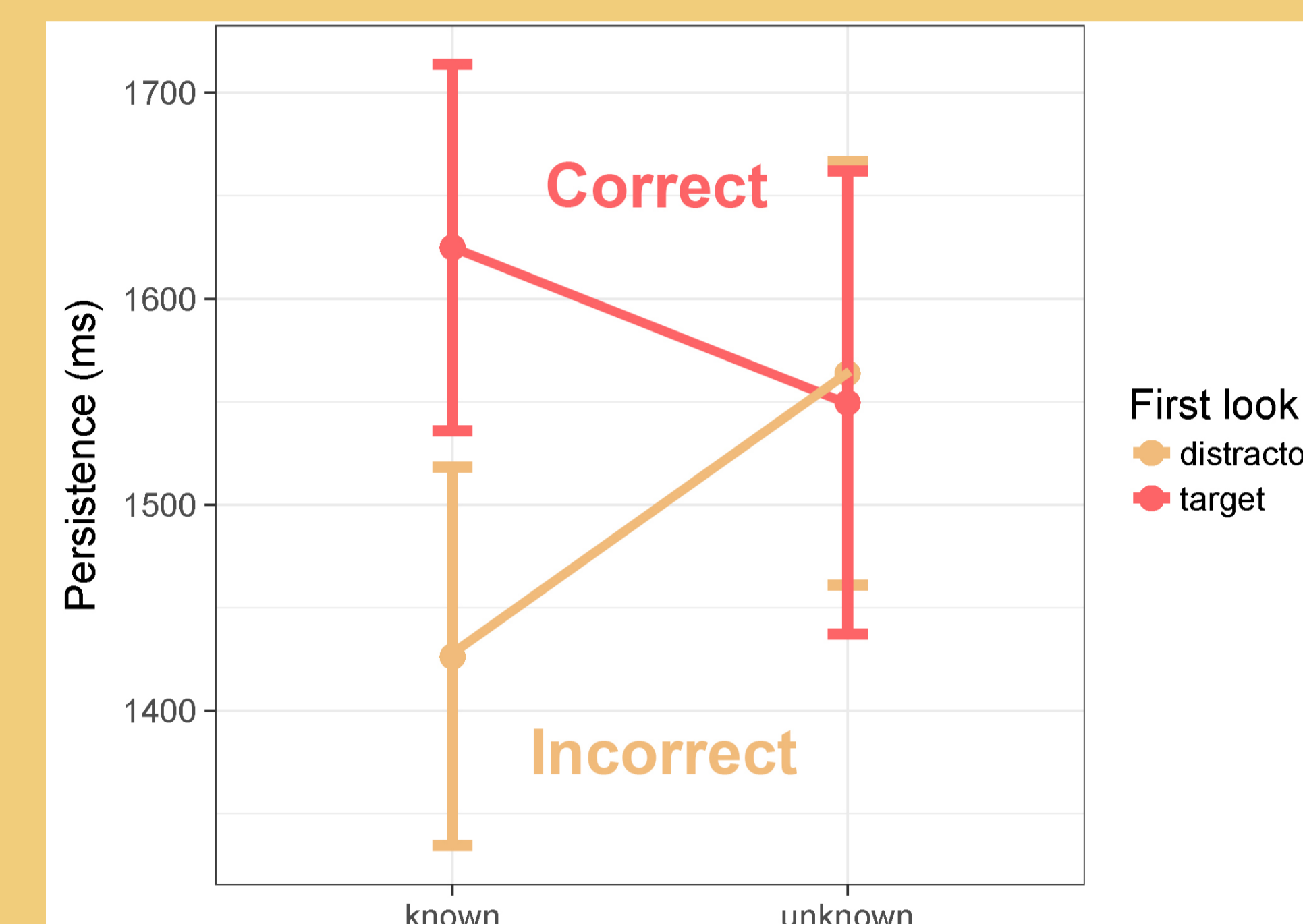
First anticipative look seems to be a **poor indicator of performance**:

- no difference between known and unknown words
- marginal above chance performance for known words

Possible reason: First look measured from target word onset, this may not leave sufficient time for children to process the word and retrieve the correct location.

RESULTS: (UN)CERTAINTY

Relationship between persistence and accuracy depending on word type



Children showed increased persistence in their initial gaze after making a correct as compared to an incorrect gaze only when the meaning of the word was known, suggesting an appropriate evaluation of their knowledge.

CONCLUSIONS

- Persistence times seem to capture children's knowledge about word meanings but are not indexed on their objective performance
- **On-going work:** modification of the paradigm to improve first-look performances
- **Future work:** how persistence times are influenced by **graded uncertainty about word meanings?**

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