

# Verbal and Nonverbal Cues Activate Concepts Differently, at Different Times

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## Introduction

- Concepts are multimodal, and can be activated from both verbal and nonverbal cues.
- We investigate differences between **category labels** and **natural sounds** as cues to the same concept.
- Previous studies have elicited conceptual priming effects from sounds comparable to those from labels (e.g., Orgs et al., 2006).
- However, label cues result in consistently faster category verification than sound cues, an advantage that holds across multiple delays and in novel learning environments (Lupyan & Thompson-Schill, 2012).
- If labels activate more category-typical representations (Lupyan & Swingley, 2012), what do natural sounds activate?

Labels are “unmotivated” cues

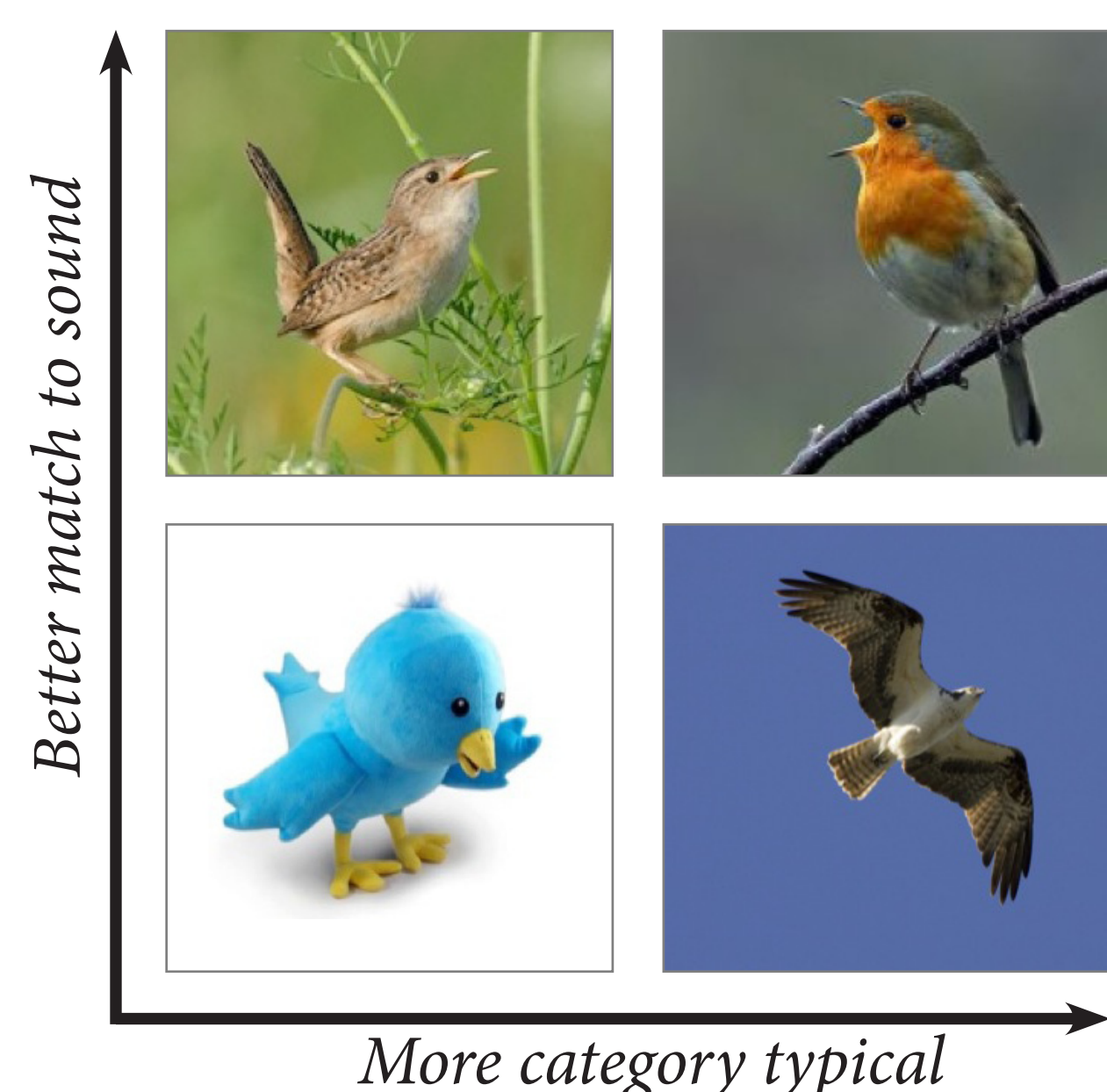
Category labels functionally leave exemplar-level information unspecified.

Sounds are “motivated” cues

Natural sounds index a specific causal source at a specific time.

## Hypotheses

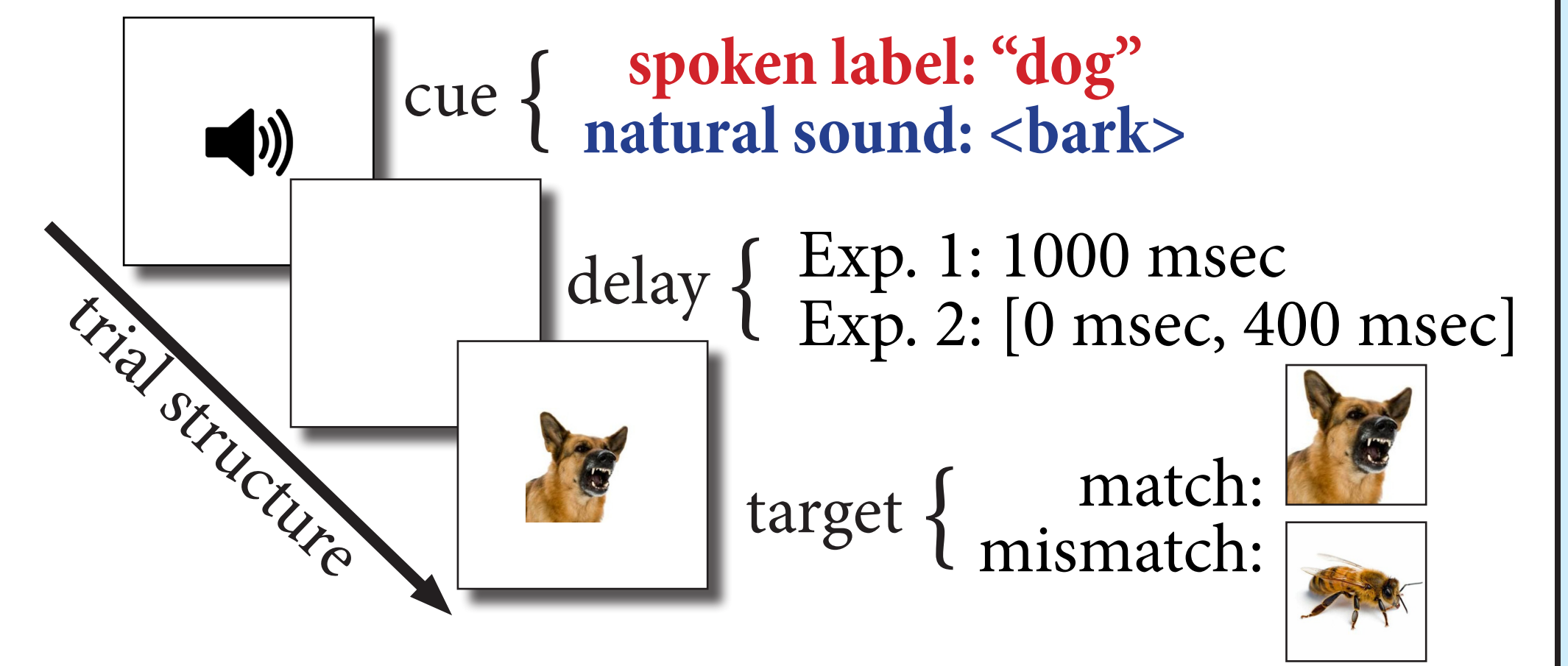
- Label cues** will speed verification of category typical exemplars.
- Sound cues** will speed verification of sound matched exemplars.



- Images were selected to vary in both category typicality and sound match.
- Participants rated images (5-point Likert) in terms of typicality or fit to a natural sound.
- These ratings were normalized (z-scores) and used as predictors of verification times.
- Correlations between ratings:  $r = -0.25$ ;  $+0.27$  for images used in Experiment 1; Experiment 2.

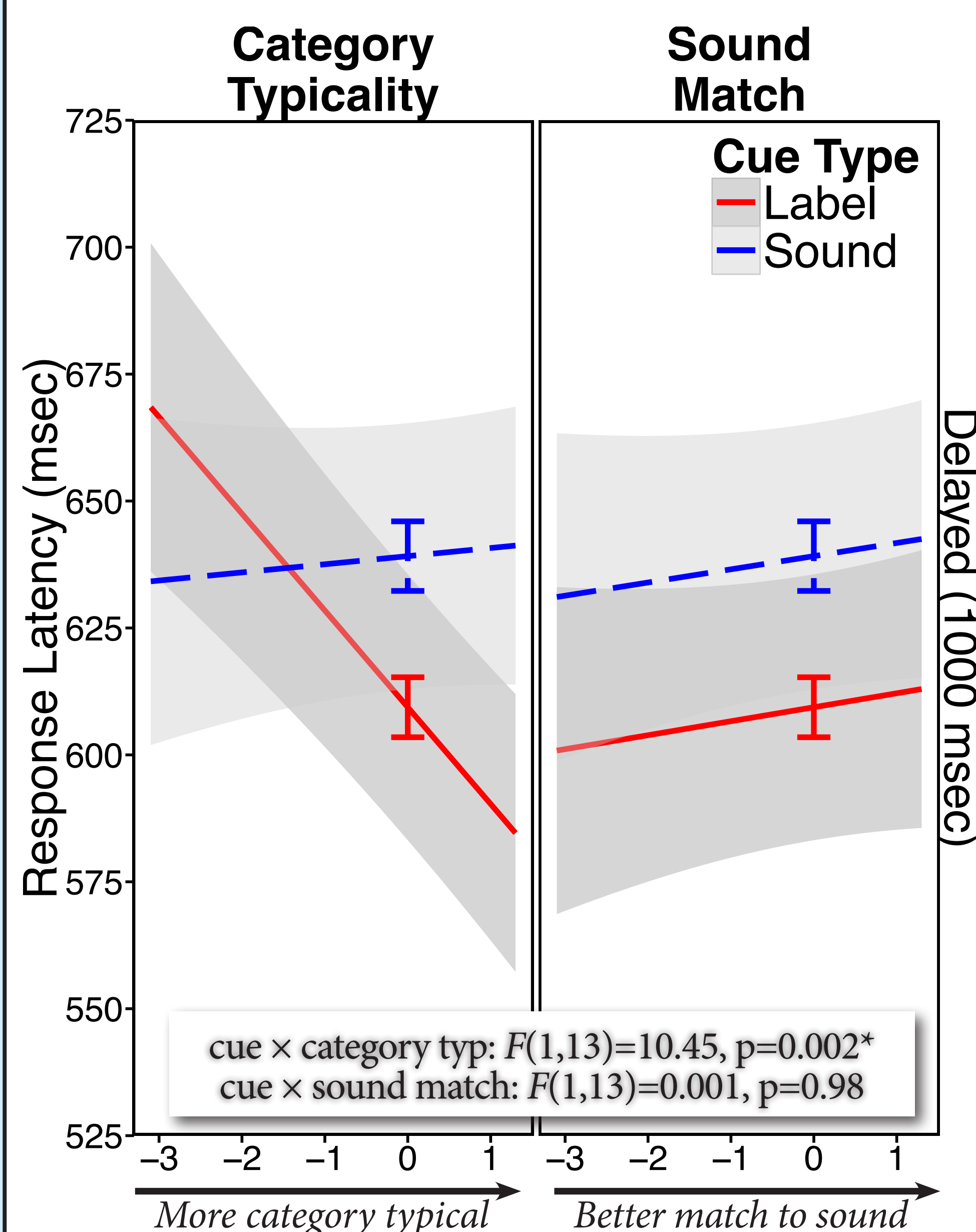
## Methods

- Participants were UW-Madison undergraduates:  $N=14$  in Exp. 1; 56 in Exp. 2
- Participants completed a sound-to-picture category verification task.
- Categories were familiar animals and artifacts with distinctive sounds: *baby, bee, bird, bowling ball, cat, car, chainsaw, dog, keyboard, river\*, scissors, toilet\** (\* categories in Exp. 1 only)



## Experiment 1

Do labels and sounds speed verification of different types of images?



Category-typical exemplars were recognized faster following a spoken label but not a natural sound.

- We fit response times to matching trials with linear mixed regression.  
Confidence bands =  $\pm 1$  SE of model predictions.  
Error bars =  $\pm 1$  SE of main effect of cue type.
- Responses to **label cues** were reliably faster than responses to **natural sound cues**.
- The effect of cue type was moderated by typicality (*left*), but not by sound match (*right*).

Why didn't natural sound cues speed verification of exemplars that were better matched to that sound?

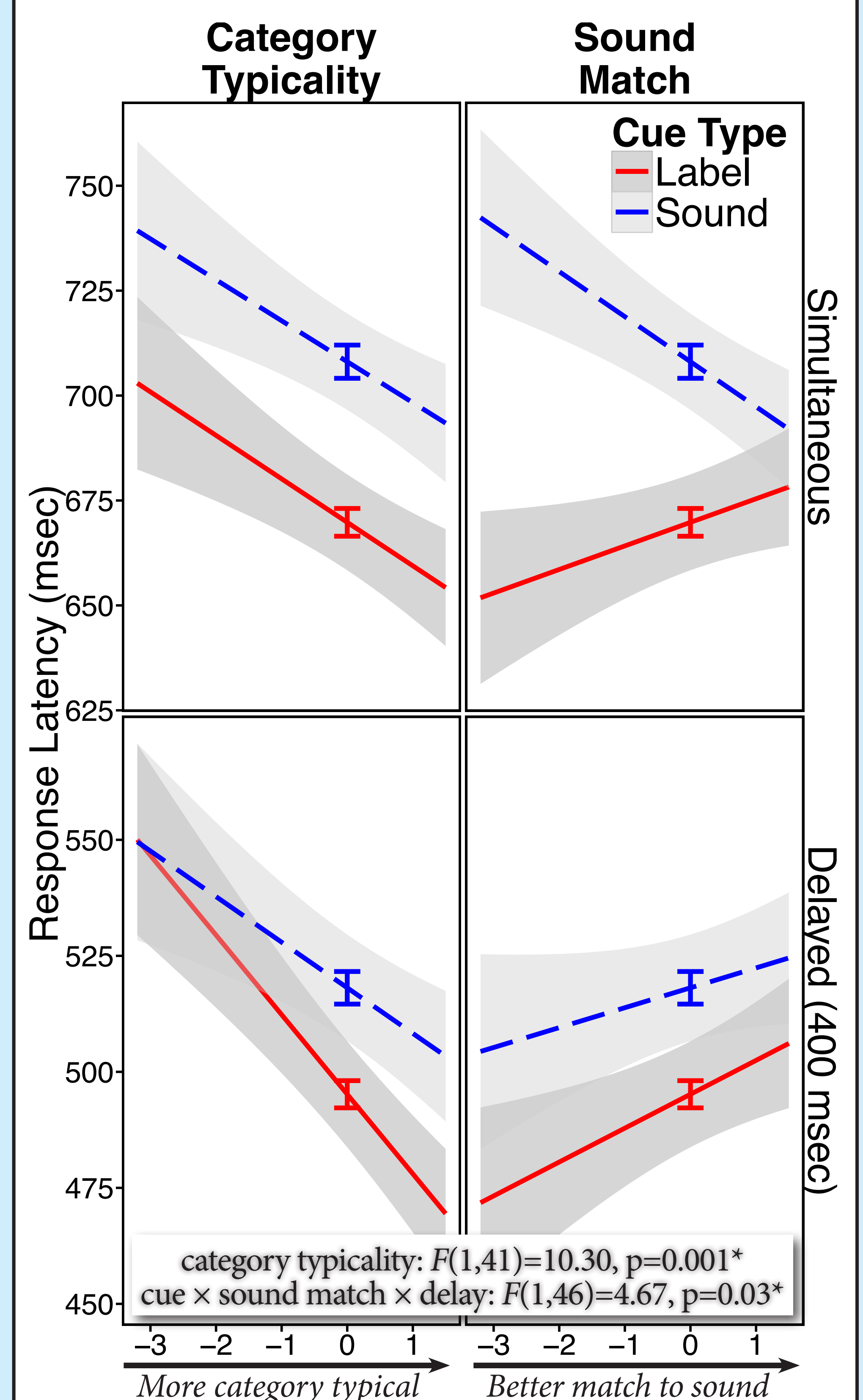
- Are motivated cues time sensitive?  
→ compared delayed to simultaneous trials
- Are sound-matched images harder to identify?  
→ increased variability in stimulus set

## Work Cited

- Lupyan, G., & Swingley, D. (2012). Self-directed speech affects visual search performance. *The Quarterly Journal of Experimental Psychology*, 65(6).
- Lupyan, G., & Thompson-Schill, S. L. (2012). The evocative power of words: Activation of concepts by verbal and nonverbal means. *JEP: General*, 141(1).
- Orgs, G., Lange, K., Dombrowski, J.-H., & Heil, M. (2006). Conceptual priming for environmental sounds and words. *Brain and Cognition*, 62.

## Experiment 2

Do labels and sounds speed verification of different images at different times?



Sound-matched exemplars were recognized faster following a natural sound only when the cue and target were presented simultaneously.

- Category typicality was a reliable predictor of RTs for both cue types across both image delays (*left*).
- Sound match was a reliable predictor of RTs following **natural sound cues** when the cue and target were presented simultaneously (*right*).

## Conclusions

- Verbal and nonverbal cues systematically differ in activating conceptual information, as indicated by speed of category verification.
- In a replication of previous findings, spoken labels activate category-typical representations more effectively than natural sounds.
- Unlike labels, natural sounds index a particular source *at a particular time*.
- We will continue to investigate the proposed role of sensory integration in “motivated” cues.