Compositional Thought Before Compositional Language: Evidence From 9–11-Month-Olds

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Background

Human thoughts are **compositional**: we can generate complex thoughts by systematically combining simple elements. (Ex: "big red cube")

Does compositional thought:

- Emerge only **after** children acquire an **external compositional system** (i.e., language)?[1]
- Appear **earlier** (supporting a more general **language of thought**)?[2]

Current Study

Can infants compose nonlinguistic functions before they begin to comprehend compositional language? [3-4]

- Requires nontrivial composition where **order matters**, $f(g(x)) \neq g(f(x))$
  Ex: (1 + 2) × 3 ≠ (1 × 3) + 2
- Grounded in **intuitive physics**
  (lower task demand than learning novel functions[5])
- Direct test of composition on a **single object**
  (eliminates potential confounds with mult. obj. tracking[6])

Methods

- 9–11-mo infants (n_1 = 16, n_2 = 32)
- Zoom experiment
- Violation-of-Expectation paradigm
- Test condition (Push-First vs. Smash-First): between-subject
- Test outcome (Intact vs. Smashed): within-subject

References: 1. Spelke & Tsivkin (2001), 2. Fodor (1975), 3. Hirsh-Pasek & Golinkoff (1996), 4. Pomiechowska et al. (2024), 5. Piantadosi et al. (2018), 6. Dautriche & Chemla (2025)

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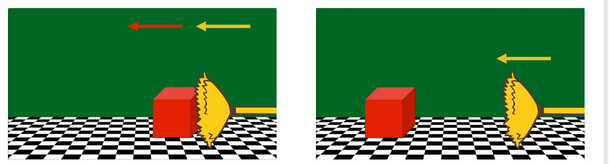
Procedure

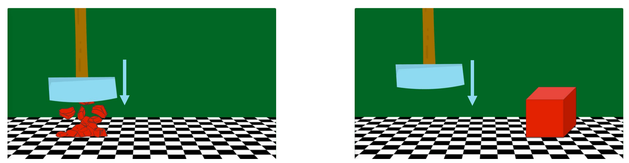
Phase 1: Training on Single Functions

Function A: Push



Obj pushed to the other side | Obj already on the other side

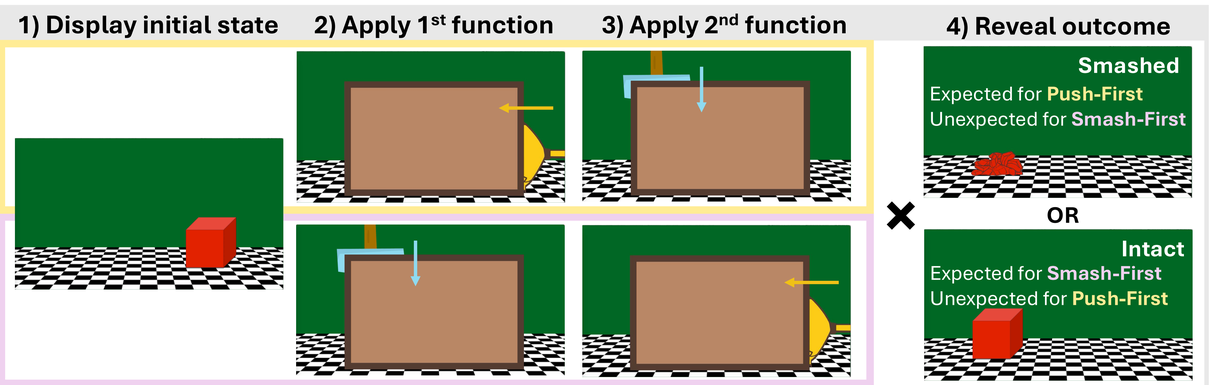
Function B: Smash



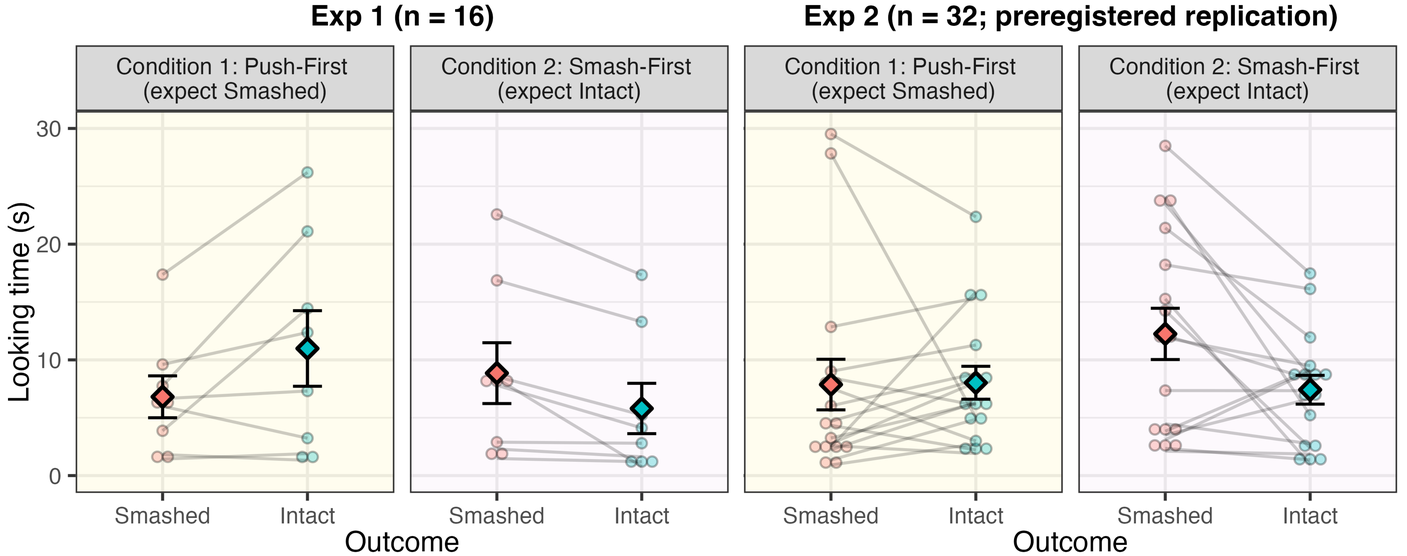
Obj on smasher's side, smashed | Obj not on smasher's side, intact

Phase 2: Testing on Function Composition

(2 × 2 design)



Results



a. Significant condition × outcome interaction (p = .024*)
b. Trending outcome effects (Cond1: p = .22; Cond2: p = .067)

a. Significant condition × outcome interaction (p = .040*)
b. Trending outcome effects (Cond1: p = .28; Cond2: p = .076)

Linear mixed-effects models for each exp:

a. Full model on all data:
log_look ~ condition × outcome + (1|subj)

b. Within-condition comparison:
log_look ~ outcome + (1|subj)

Scan for more info!

Discussion & Conclusion

- 9–11-mo infants anticipate different outcomes based on the order of function application.
  → suggests that compositional thought does not require learning an external language but instead reflects a more general language of thought
- Stronger evidence in Smash-First than in Push-First → baseline preference, WM constraints, etc.?