The Development of Real-Time Phonological Competition and Semantic Activation in Adolescence

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growing words

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Background

- **Spoken Word Recognition (SWR)**
  - Spoken words must be processed in real-time
  - Difficulty arises due to temporal ambiguity of the signal
  - As a word unfolds, listeners activate multiple options (target, competitors, etc.)
  - Phonologically related words compete during activation until one wins
  - This can be measured using the Visual World Paradigm (VWP)
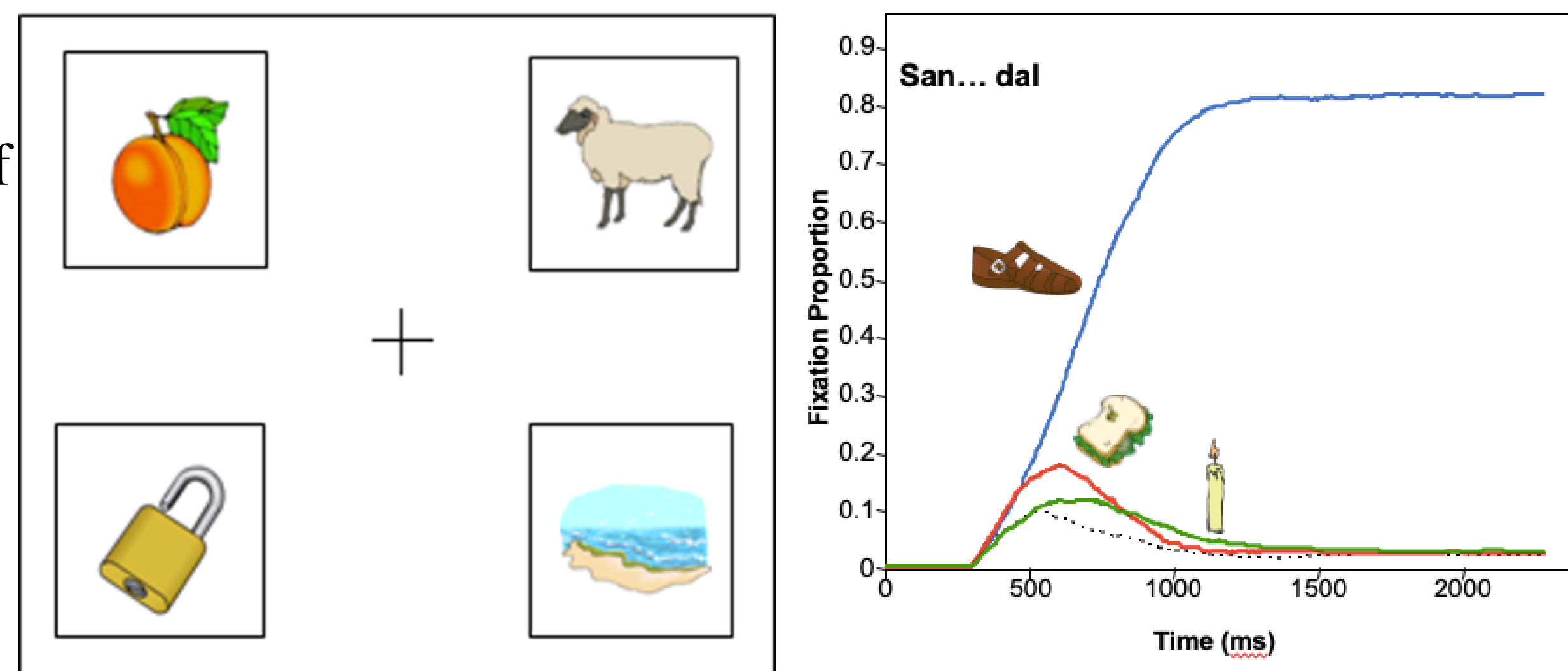
- **Development of SWR**
  - Prior work: real-time word recognition processes stabilize in early childhood (Fernald et al., 2006)
  - Recent work: These processes are protracted throughout adolescence (Huang & Snedeker, 2011; Rigler et al., 2015)

- **Profiles: A Balance Between Speed + Flexibility**
  - Some profiles reflect speed: more incremental processing: Quicker uptake and suppression of unnecessary information
  - Others reflect flexibility (ex: in a noisy environment): Slower intake of information and longer consideration of competitors
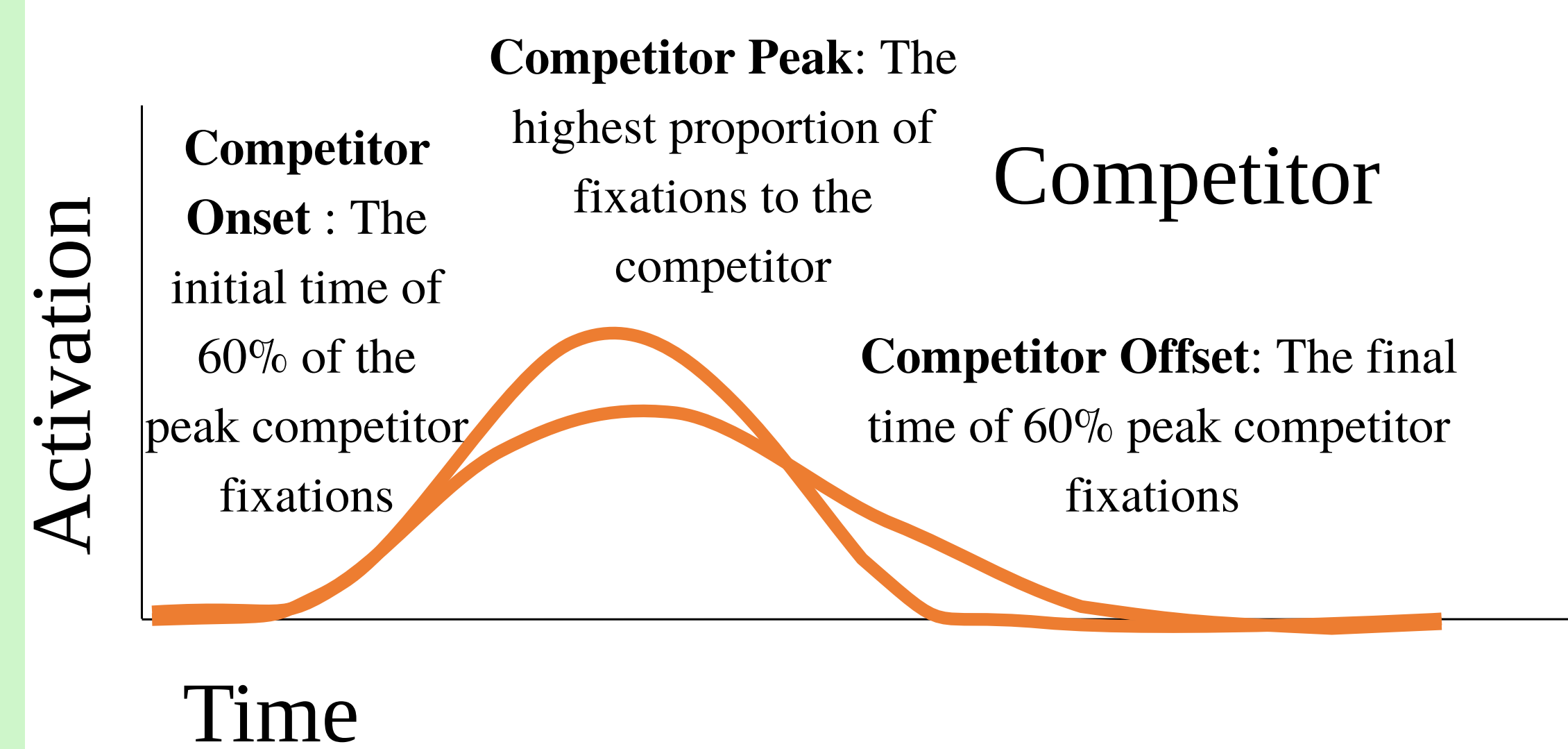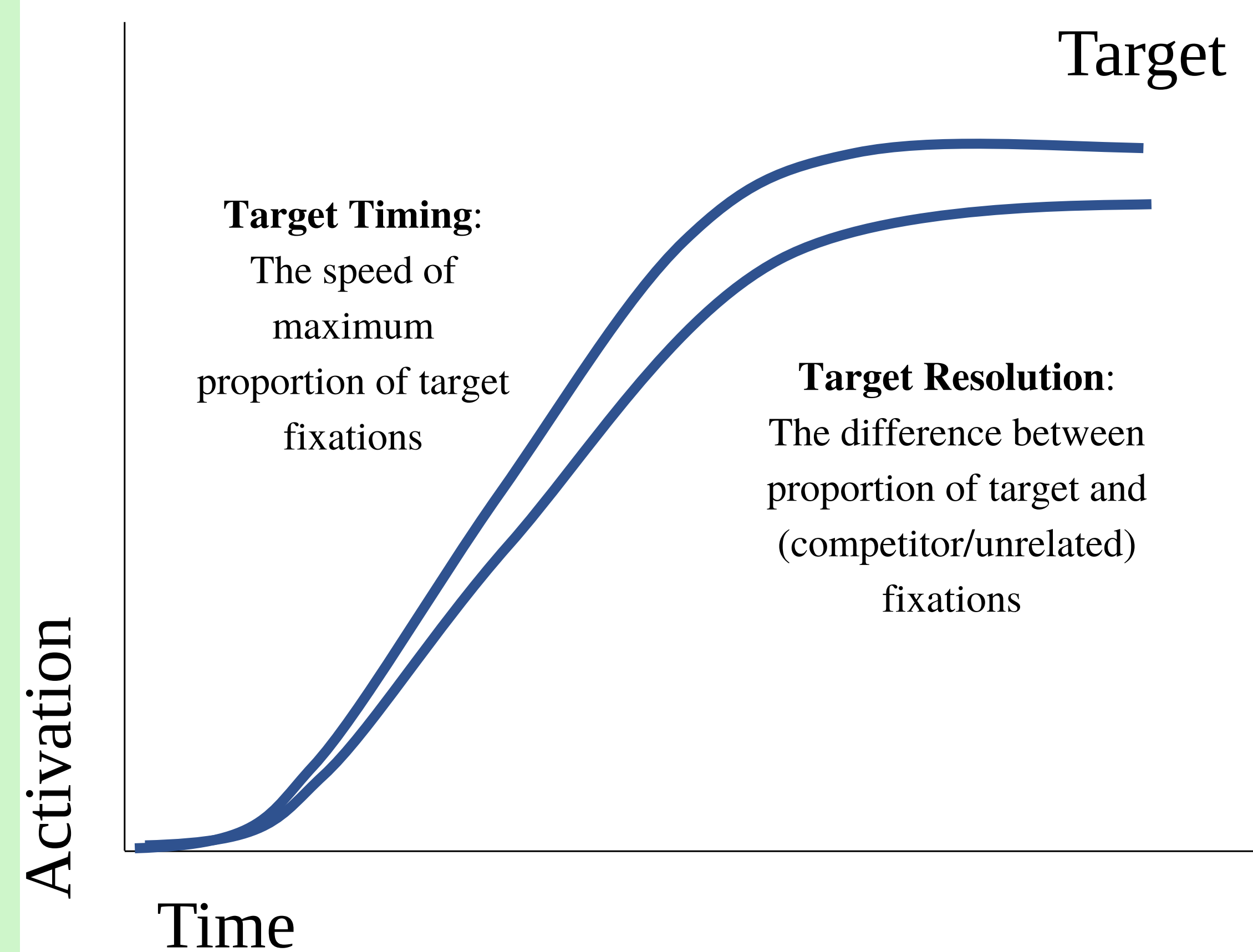
- **Open Questions**
  - What does this development look like with a more gradient age range throughout adolescence?
  - Do these findings hold up in bisyllabic words?
  - Which visual/cognitive processes might underlie this development?
  - Are these developmental changes based on a lexical system or due to domain general changes?
  - Do lower level phonological processes impact higher level semantics?
  - Does semantic processing develop similar to phonological processing?

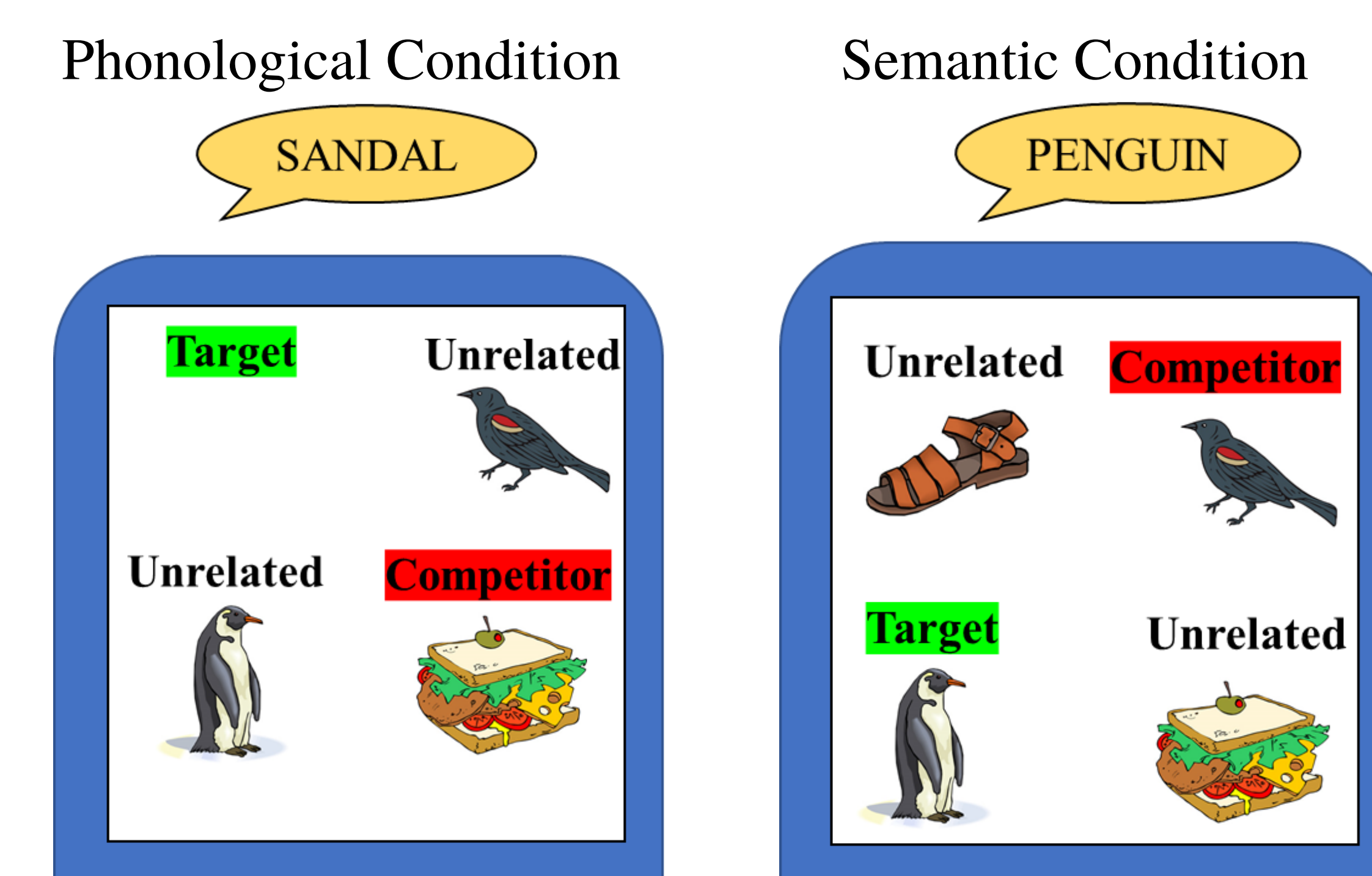## Approach

Visual World Paradigm (VWP)

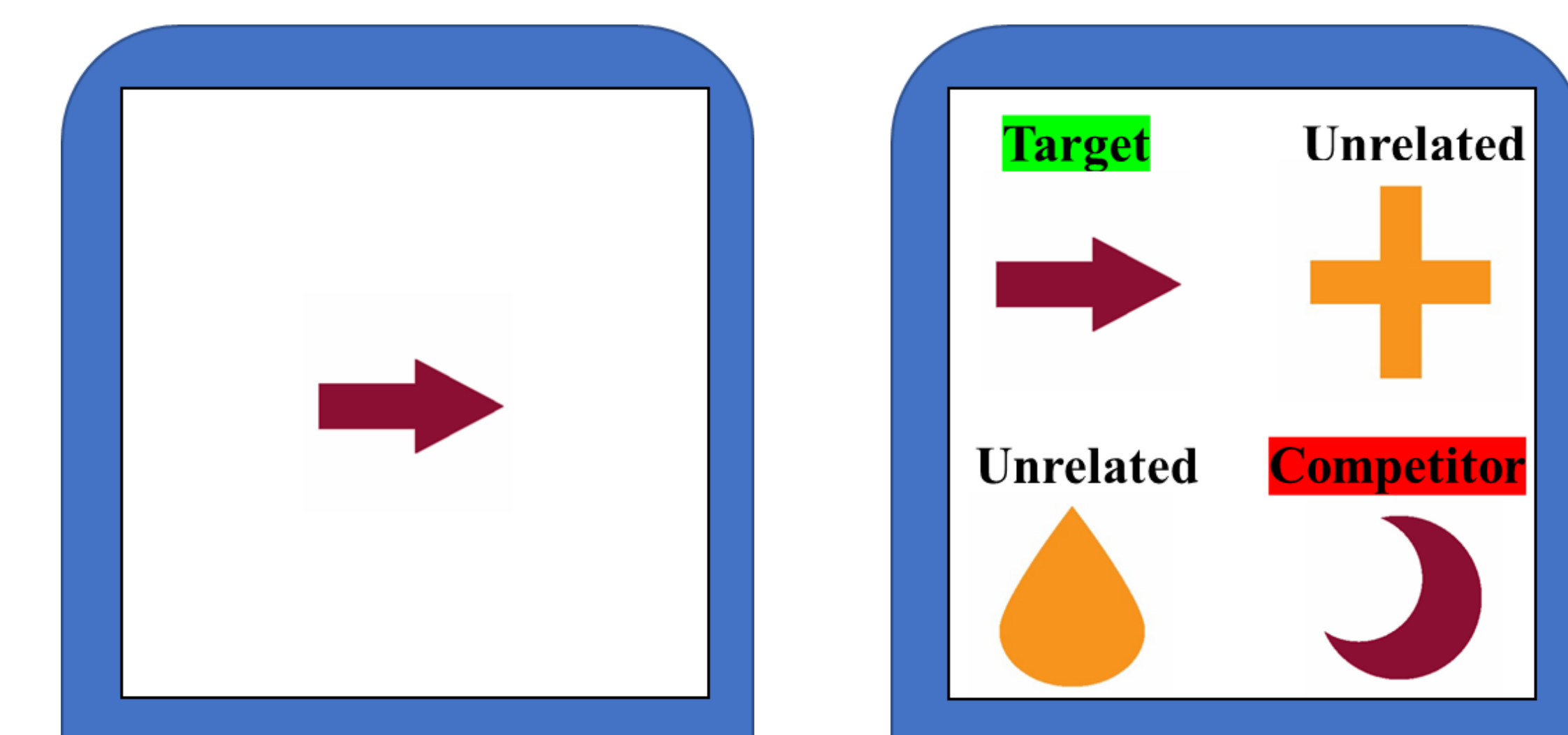- Tracks fixations over time as a spoken word unfolds

Target Timing: The speed of maximum proportion of target fixations

Target Resolution: The difference between proportion of target and (competitor/unrelated) fixations

Competitor Onset : The initial time of 60% of the peak competitor fixations

Competitor Peak: The highest proportion of fixations to the competitor

Competitor Offset: The final time of 60% peak competitor fixations

Design and Method

- **VWP Tasks**
  - **Lexical-semantic Visual World Paradigm (VWP) experiment**

Phonological Condition — SANDAL

Semantic Condition — PENGUIN

Age Group	N (Total=117)
7-8 years	45
11-12 years	42
16-17 years	30

  - **Non-linguistic VWP task**

Additional Measures
- WJ: Oral Comp and Sentence Repetition subtests
- Cognitive Control tasks: (Go/No-Go, Spatial Stroop, novel inhibition

- Hierarchical Regressions of age and language ability, cognitive control,
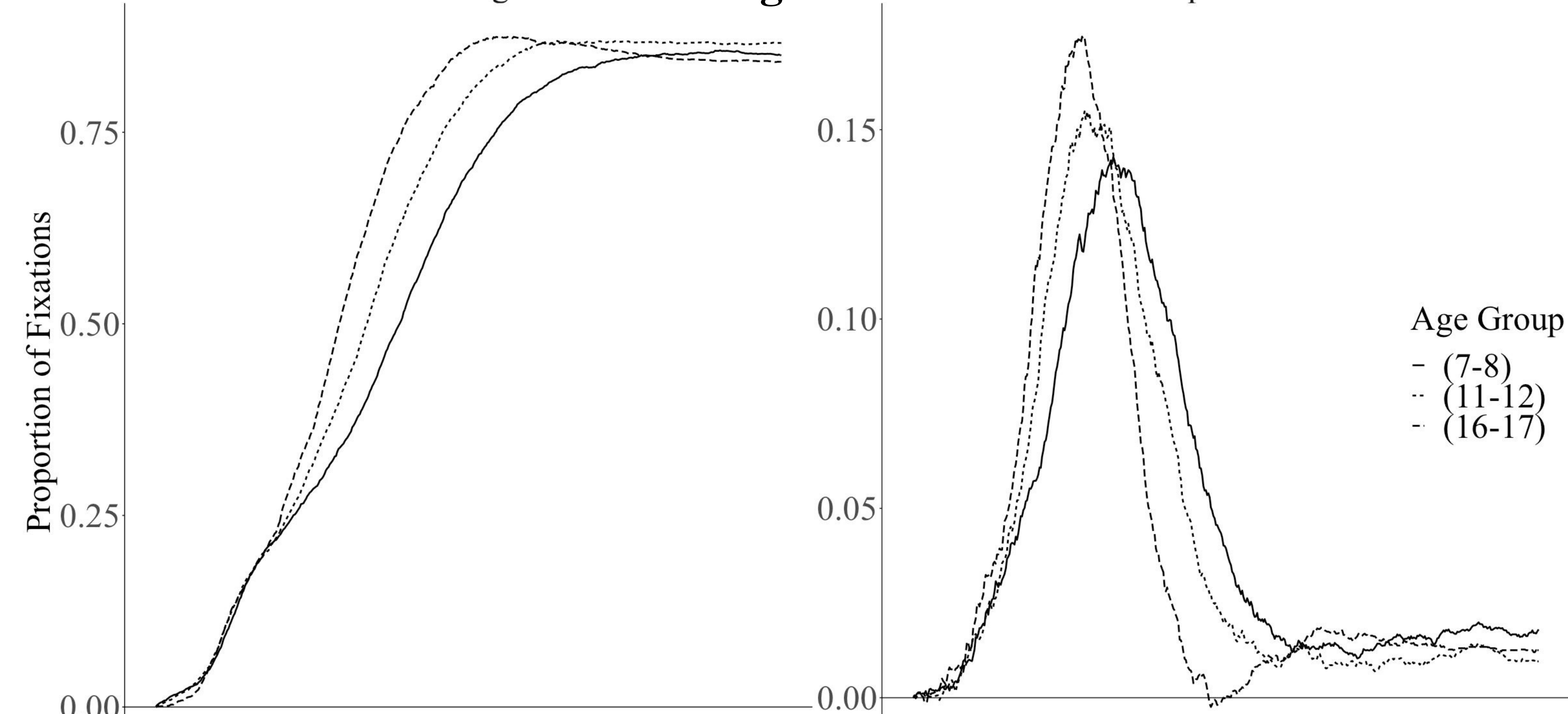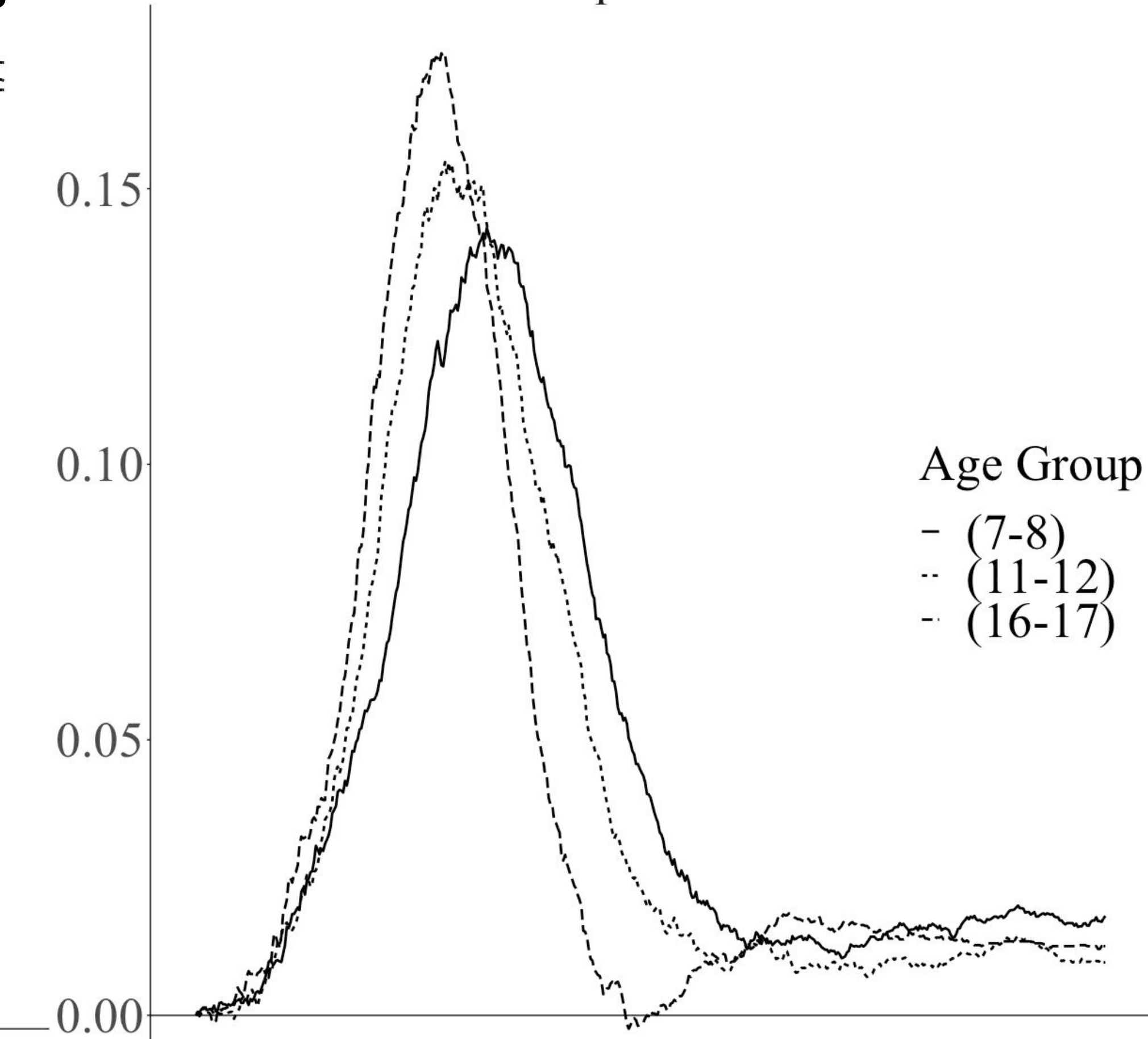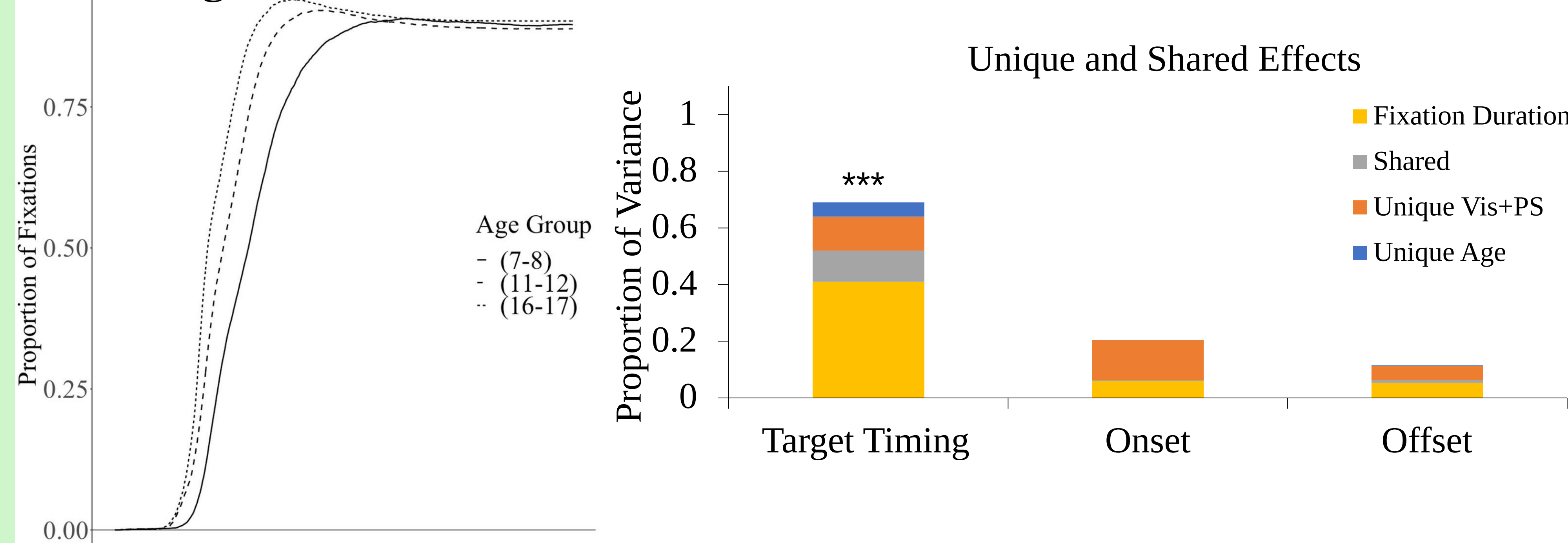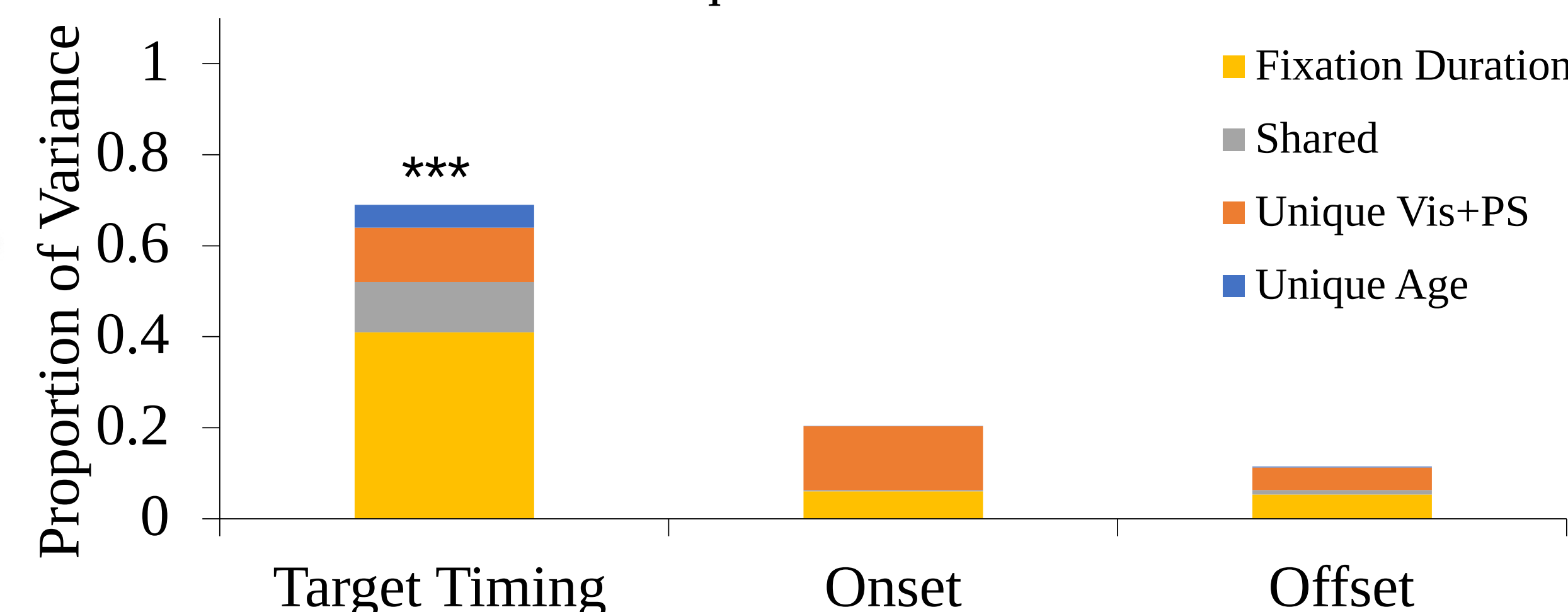- Commonality analysis with non-linguistic task indices and age

Results

Phonological Trials

A. Target

B. Competitor Effect

Age Group
- (7-8)
- (11-12)
- (16-17)

Non-Linguistic VWP Task

Age Group
- (7-8)
- (11-12)
- (16-17)

Unique and Shared Effects

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- Fixation Duration
- Shared
- Unique Vis+PS
- Unique Age

- Older kids are quicker to fixate the target and are quicker to initiate and resolve fixations to the phonological competitor ($p's<.05$)

- Higher WJOC predicted earlier phonological onset ($p=.01$)

- Better conflict suppression predicted faster target timing ($p<.01$)

- Unique and shared effects of both age and non-linguistic indices ($p's<.05$)

- Commonality analyses of age, fixation duration, processing speed and cognitive control

- Main effects of fixation duration and unique effects of visual cognitive skills on all indices ($p's<.05$)

- Unique effect of age on target timing ($p<.001$)

Semantic Access

Age Group
- (7-8)
- (11-12)
- (16-17)
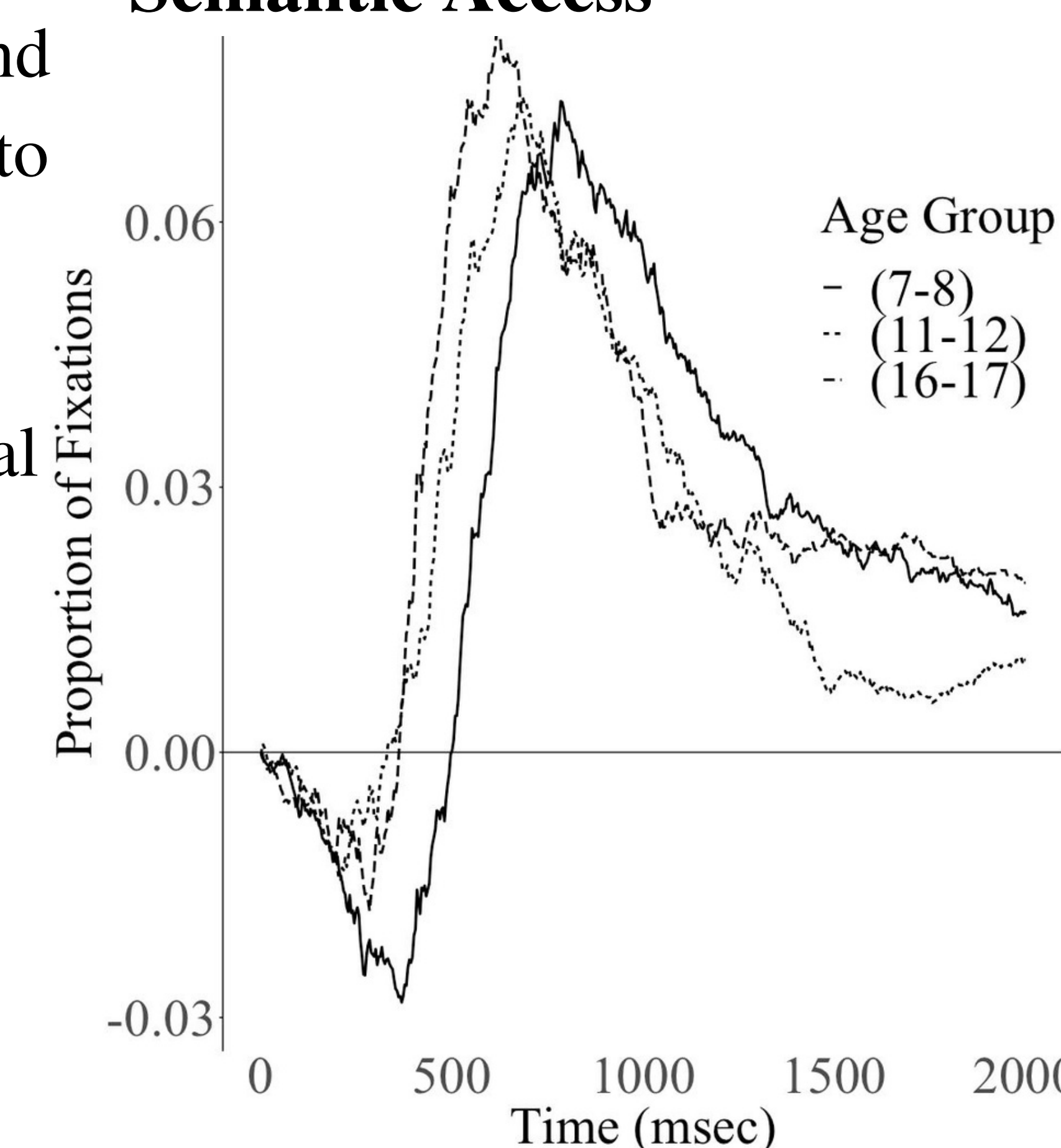
- Older kids are quicker to initiate and resolve fixations to the semantic competitor, and exhibited a higher peak ($p's<.05$)

- No effects of language ability or cognitive control

- *Is this development all jsut a consequence of phonological processes?*

- All developmental changes were predicted by target timing on phonological trials

Conclusions

- As kids age, they more quickly suppress phonological competitors and more quickly activate the target word

- This development is also due to a combination of development of visual/cognitive skills and language processing

- Basis of semantic network seems to be established early and doesn't change much