

## Abstract

Children often fail to use top-down information to guide sentence parsing, and subsequently fail to revise erroneous interpretations. One hypothesis is that these abilities develop with improvements in domain-general EF. Alternatively, these changes may reflect cumulative language experience. In the current study, monolingual and bilingual children (ages 5-7) were given an EF battery, measures of language proficiency, and a test of syntactic ambiguity resolution, adapted from Trueswell et al (1999). Preliminary results confirm that monolinguals show higher vocabulary ( $p < 0.05$ ) and grammar ( $p < 0.05$ ) scores. We found **no** bilingual EF advantage in any of our EF tasks. Gaze data demonstrates that bilingual children make better use of contextual information. However, monolingual and bilingual participants do not differ in their actions, producing similar numbers of garden-path errors. We suggest that bilingual children, over the course of language acquisition, may need to rely more on contextual cues making them more aware of how language is influenced by context.

## Introduction

- Speech unfolds in real time, requiring meaning to be built up incrementally. As a result, there are countless ambiguities across various levels of linguistic representation.
- Adults use both bottom-up and top-down information to constrain alternatives and settle on the most likely interpretation of the incoming sentence. Importantly, adults can also revise interpretations that turn out to be incorrect.
- Children as old as 10 have difficulty using top-down information to resolve ambiguity during online sentence comprehension. They also fail to revise their interpretations following inconsistent input.<sup>1,2</sup>

### What drives the development of adult-like ambiguity resolution?

#### Executive Functioning Hypothesis:

Development may reflect improvement in domain-general executive functioning (EF).<sup>3</sup>

#### Language Experience Hypothesis:

Increased language experience may result in more efficient use of top-down constraints.<sup>4</sup>

## Current Study

- Bilingual population offers a great opportunity to evaluate these hypotheses.
  - Previous research has shown a bilingual advantage in inhibitory control.<sup>5</sup>
  - Bilinguals have less experience in any one given language.<sup>6</sup>
- We compare monolingual and bilingual children on resolution of syntactically ambiguous “garden-path” sentences.

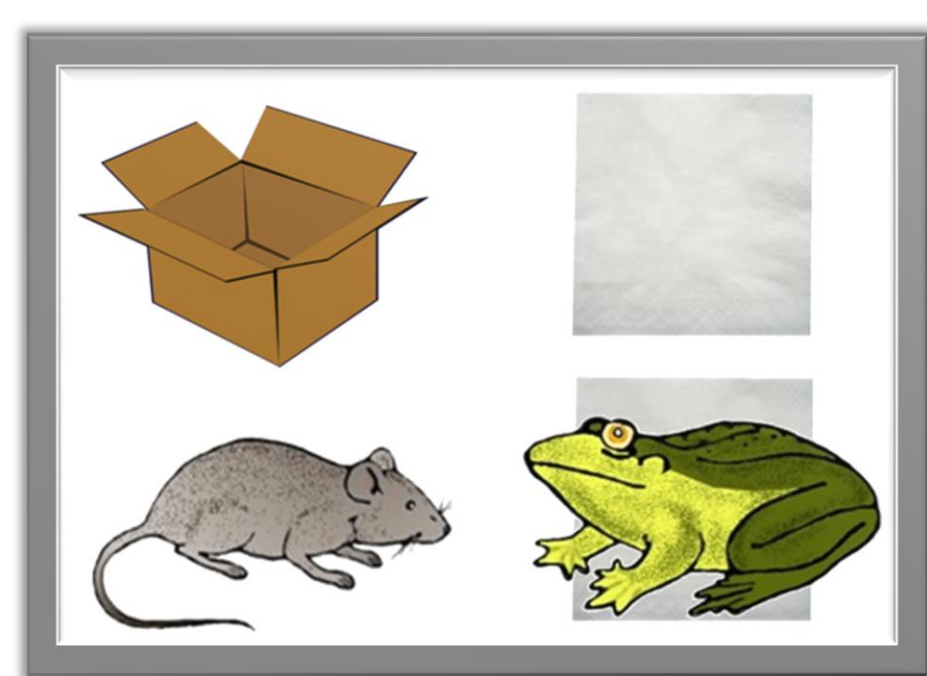
#### Participants:

- Monolingual and bilingual children (ages 5 – 7)

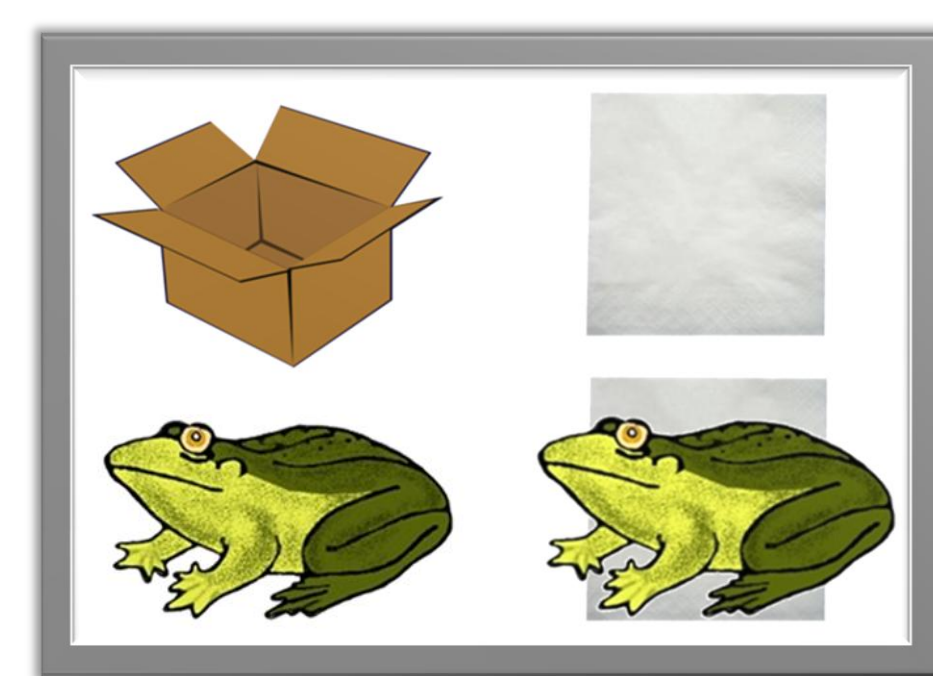
#### Sentence Comprehension Task:

- Adapted from Trueswell, Sekerina, Hill & Logrip (1999)<sup>1</sup>
- Using a Tobii Eye-Tracker, children were shown a visual world containing 4 objects
- Subjects heard either:
  - A) Ambiguous Sentence:** “Put the frog on the napkin in the box”
  - B) Unambiguous Sentence:** “Put the frog that’s on the napkin in the box”

- Critical sentences contain a prepositional attachment ambiguity; the first prepositional phrase (*on the napkin*) can be interpreted as a goal (*onto the napkin*) or as a modifier (*that’s on the napkin*).
- Subjects saw either a 1 Referent or a 2 Referent context



1 Referent: 1 Target Animal (frog)



2 Referent: 2 possible Target Animals (frogs)

- For adults, but not children, a 1 Referent context encourages a goal interpretation of the 1<sup>st</sup> prepositional phrase, while a 2 Referent context encourages a modifier interpretation.<sup>6</sup>

#### Measures of Language Experience:

- Peabody Picture Vocabulary Task (PPVT4)
- Test for Reception of Grammar (TROG2)

#### Executive Functioning Battery:

- Simon’s Arrows Task
- Simon’s Pictures Task
- Flanker Fish Task
- Verbal Stroop

#### Control Measures:

- Non-verbal Intelligence (K-bit)
- Socio-economic status

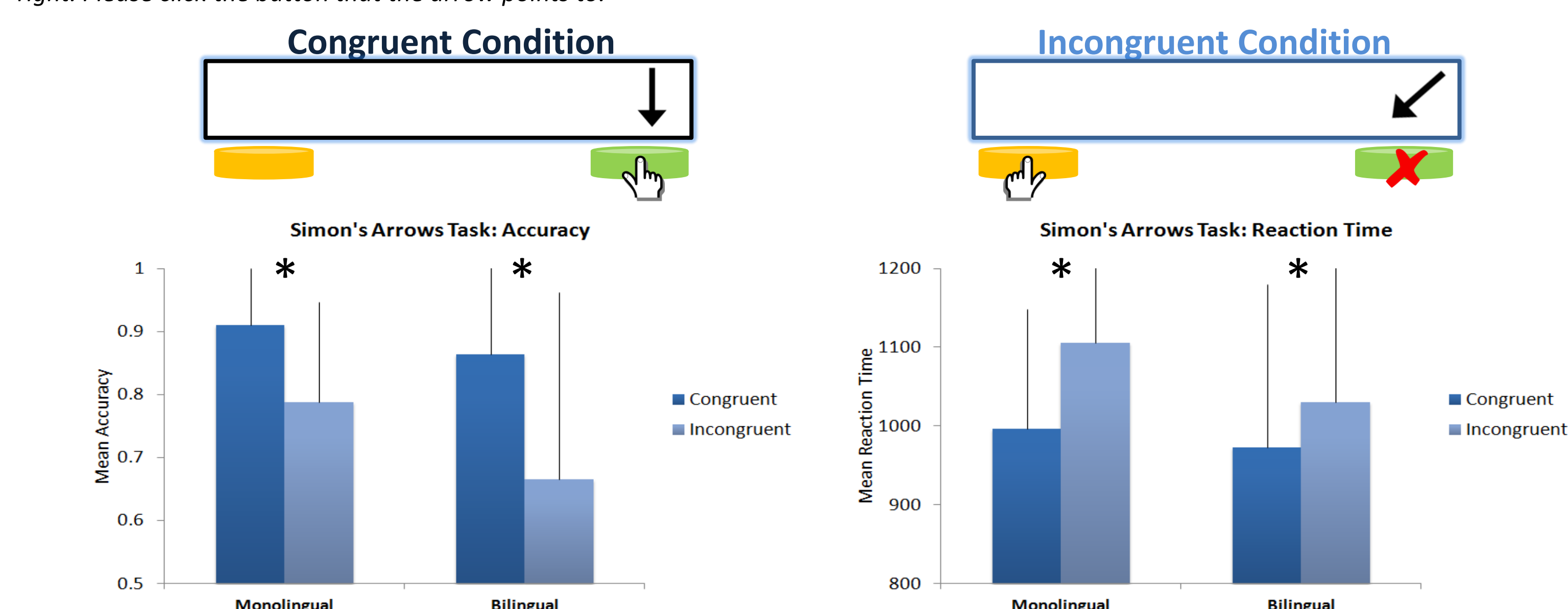
	Monolinguals	Bilinguals	
Age (m(sd))	5.91 (0.5), N=20	6.10 (0.6), N=20	n.s.
K-BIT (m(sd))	106.75 (16.2), N=16	106.75 (14.4), N=12	n.s.
PPVT (m(sd))	123.95 (15.4), N=20	112.13 (12.9), N=15	$p < 0.05$
TROG (m(sd))	113.10 (11.7), N=20	97.50 (24.8), N=14	$p < 0.01$

## Results

### Executive Functioning Battery

Example Task from Battery: Simon’s Arrows Task

Instructions: “You will see a series of arrows and will be asked to press either the yellow button on your left, or the green button on your right. Please click the button that the arrow points to.”



- There were **no** Language Group differences in **any** task in the EF battery.
- No evidence for a bilingual executive function advantage

## Results

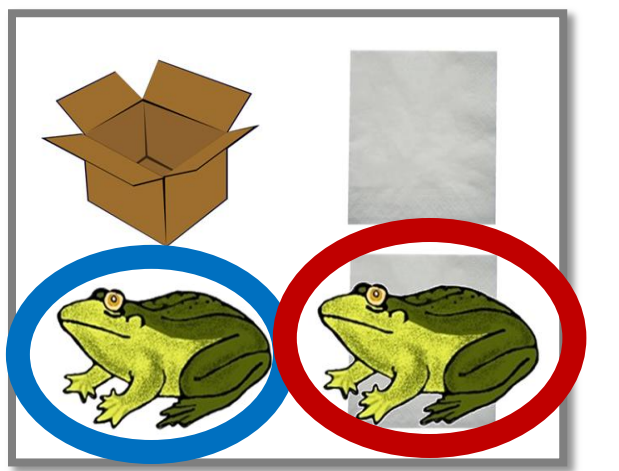
### Sentence Comprehension Task

#### Resolution of Referential Ambiguity: Use of Context

##### Eye Gaze Analysis

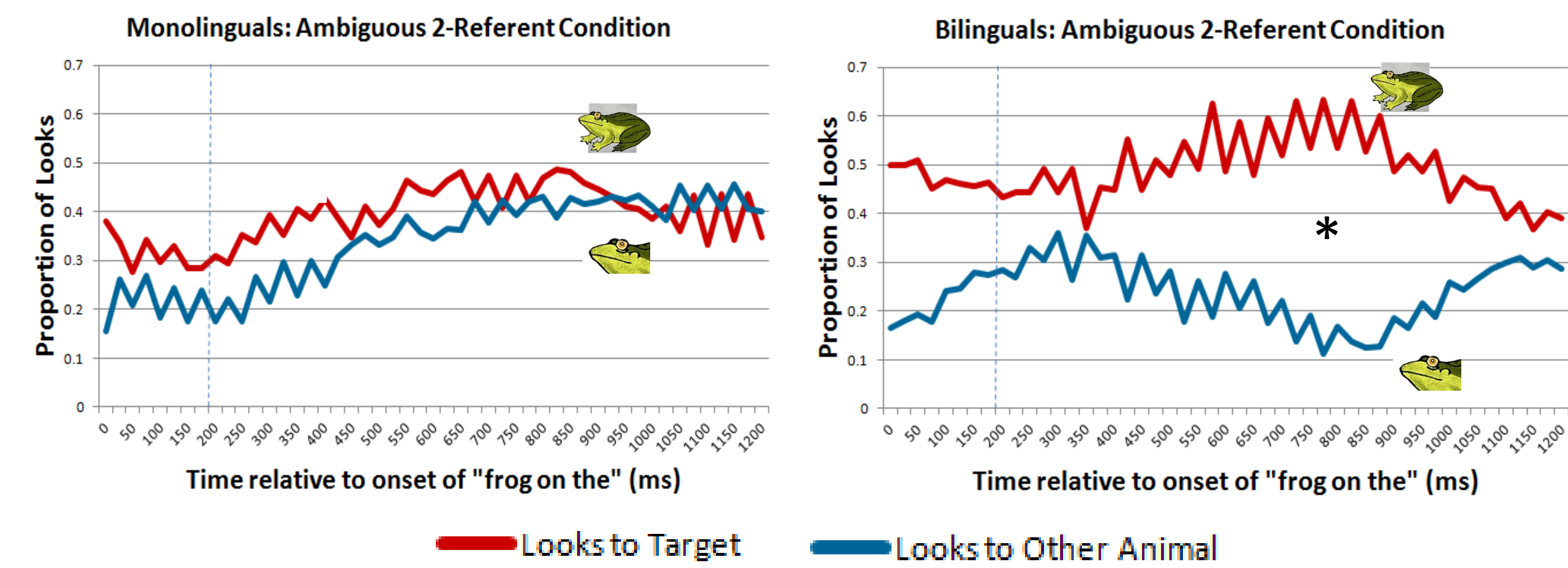
Critical analysis window: “Put the **frog** on the napkin in the box”

Measure: Proportion of looks to the Target and non-Target animal



Monolingual: n = 18  
Bilingual: n = 17

#### 2 Referent, Ambiguous condition



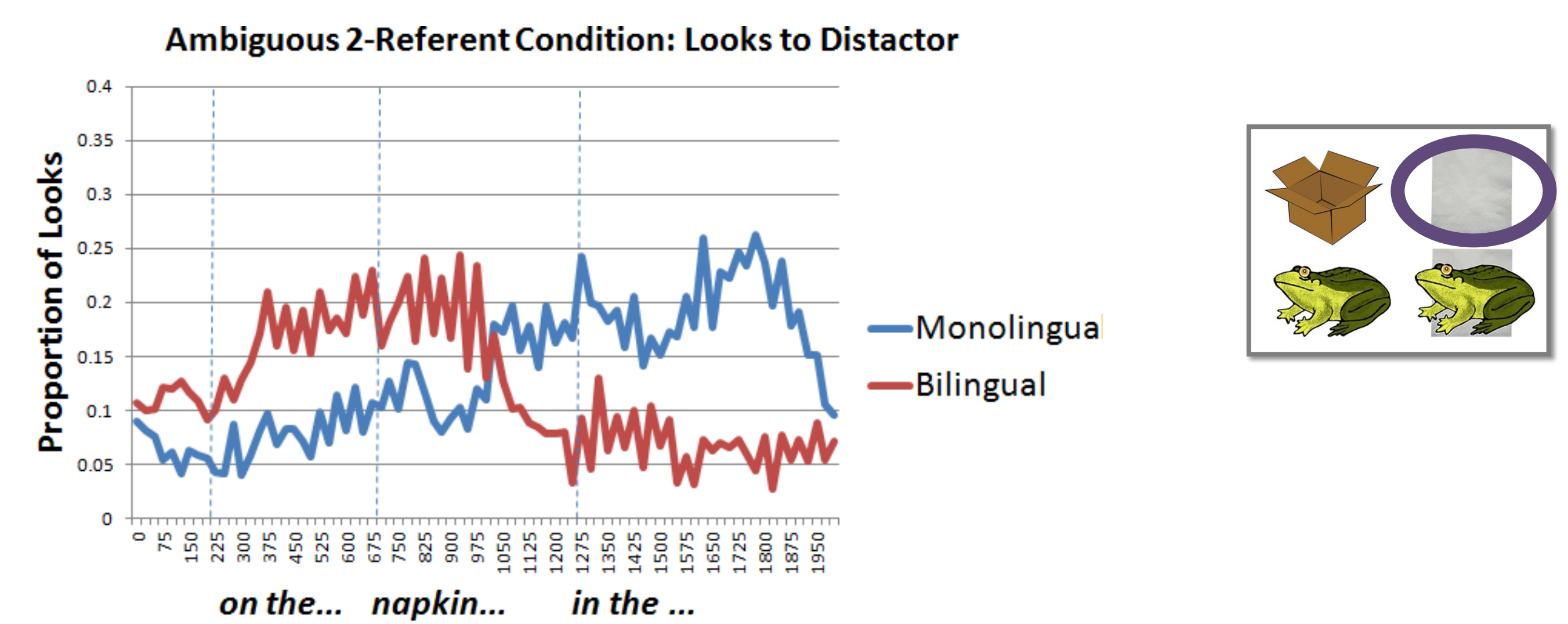
- Monolingual children fail to use contextual cues to determine the correct referent (see also <sup>6</sup>).
- Bilingual participants show an adult-like ability to use contextual cues in order to identify the most likely target referent.

#### Garden Path Misanalysis and Revision

##### Eye Gaze Analysis

Critical analysis window: “Put the frog **on the napkin** in the box”

Measure: Proportion of looks to the Distracter Destination (the empty napkin).

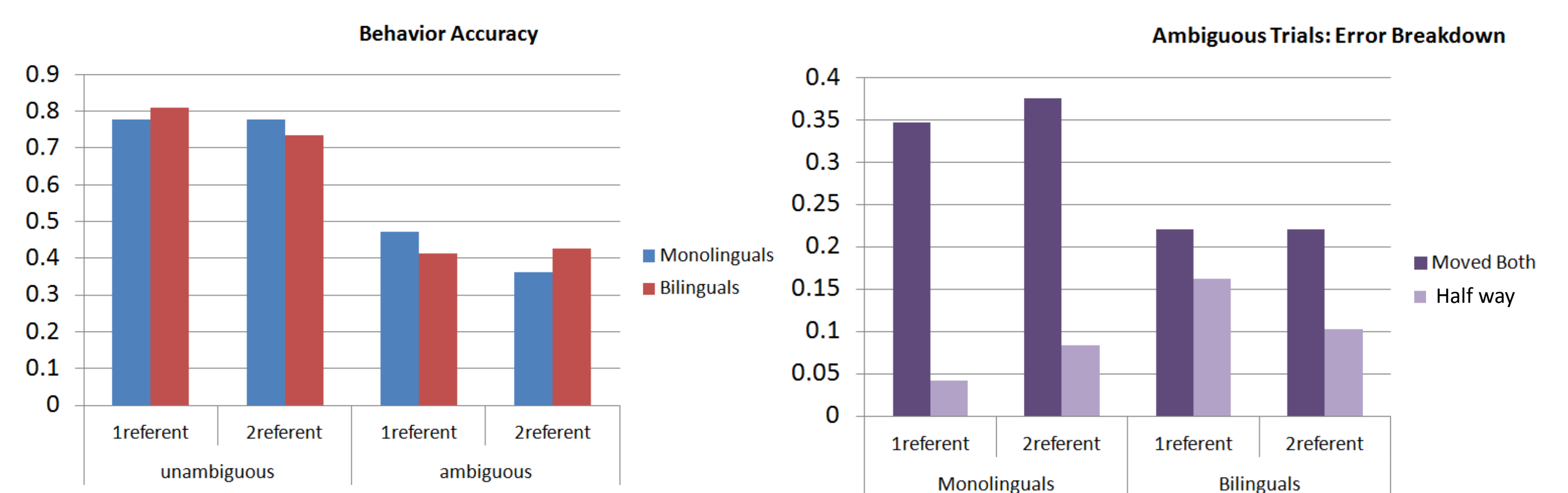


- Although bilingual children show better use of contextual information, both monolingual and bilingual children show similar looking patterns to the Distracter Destination, consistent with a garden-path error.

#### Behavioral Data

Action errors were grouped into 2 types:

- 1) **Moving Both:** both the Animal and the Distracter Object moved to the Correct Goal
- 2) **Half Way:** Animal moved to the Distracter Object, but not further



- Monolingual and bilingual participants do not differ in their behavior, showing similar rates and types of garden-path errors.

## Discussion

- Contrary to the Language Experience Hypothesis, bilingual children show better use of top-down contextual information, despite having less experience with English.
- Unable to test Executive Functioning Hypothesis, as there are no reliable EF differences between monolinguals and bilinguals.
- New Pragmatic Hypothesis: If bilingual children need to rely on context more often over the course of English language acquisition, they may be more aware of how language is influenced by context.

#### References:

1. Trueswell, J. C., Sekerina, I., Hill, N. M., & Logrip, M. L. (1999). The kindergarten-path effect: Studying on-line sentence processing in young children. *Cognition*, 73(2), 89-134.
2. Kidd, E., Stewart, A. J., & Serratrice, L. (2011). Children do not overcome lexical biases where adults do: the role of the referential scene in garden-path recovery. *Journal of Child Language*, 38(01), 222-234.
3. Choi, Y., & Trueswell, J. C. (2010). Children’s (in)ability to recover from garden-paths in a verb-final language: Evidence for developing control in sentence processing. *Journal of Experimental Child Psychology*, 106(1), 41-61.
4. Borovsky, A., Elman, J., & Fernald, A. (2012). Knowing a lot for one’s age: Vocabulary skill and not age is associated with anticipatory incremental sentence interpretation in children and adults. *Journal of Experimental Child Psychology*, 112(4), 417-436.
5. Bialystok, E. (2007). Cognitive effects of bilingualism: How linguistic experience leads to cognitive change. *International Journal of Bilingual Education and Bilingualism*, 10(3), 210-223.
6. Bialystok, E., Luk, G., Peets, K. F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition*, 13(04), 525-531.