

Accessing the mental lexicon by visual speech cues: A priming study of children's speech production

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Introduction

Adults:

- Use auditory and visual speech information for speech processing (Calvert et al., 1997; Buchwald et al., 2009; Fort et al., 2012).
- Can access mental lexicon from visual speech information (Fort et al., 2010).

Children:

- Less influenced by visual speech (Massaro, 1984)
- Are sensitive to visual information and articulatory gestures during language processing (Kuhl & Meltzoff, 1984)
- Less is known about visual speech contributions to mental lexicon
 - Visual speech contributes to phonemic processing (Fort et al., 2012)
 - 4, 10 to 14-year-olds demonstrated stronger phonological priming effects when primes were given in audio-visual mode compared to an audio only mode (PPNT); 5-year-olds did not demonstrate a difference between modes (Jerger et al., 2009).

The Current Study

Does visual speech contribute to the mental lexicon?

- Are children faster to name a picture after they see it being spoken (without hearing it)?

Hypothesis

Children will be faster to name pictures when see it spoken compared to see an unrelated word spoken.

- References:
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- Buchwald, A. B., Winters, S. J., & Pisoni, D. B. (2009). Visual speech primes open-set recognition of spoken words. *Language and Cognitive Processes*, 24(4), 580-610.
- Fort, M., Kandel, S., Chipot, J., Savariaux, C., Granjon, L., & Spinelli, E. (2012). Seeing the initial articulatory gestures of a word triggers lexical access. *Language and Cognitive Processes*, 28(8), 1207-1223.
- Fort, M., Spinelli, E., Savariaux, C., & Kandel, S. (2010). The word superiority effect in audiovisual speech perception. *Speech Communication*, 52, 525-532.
- Massaro, D. W. (1984). Children's perception of visual and auditory speech. *Child Development*, 55(5), 1777-1788.
- Kuhl, P. K., & Meltzoff, A. N. (1984). The intermodal representation of speech in infants. *Infant Behavior and Development*, 7, 361-381.
- Jerger, S., Damian, M. F., Tye-Murray, N., & Abdi, H. (2009). Developmental shifts in children's sensitivity to visual speech: A new multimodal picture-word task. *Journal of Experimental Child Psychology*, 102, 40-59.
- Zamuner, T. S., Kilbertus, L., & Boyce, K. (2019). *Phonological priming in children's speech production: Developmental and methodological influences*. Unpublished manuscript.

Method

Experiment:

- Primed picture naming task (adapted from Zamuner, Kilbertus, & Weinhold, 2017)

Participants:

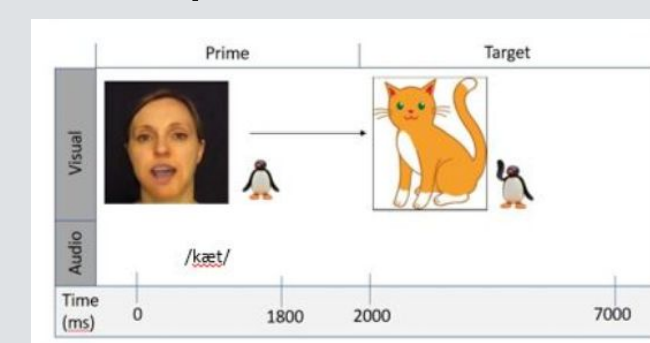
- 20 participants (13 males, 7 females)
- English dominant (<30% exposure to another language)
- Ages 4 to 6 years-old (M=5;6, range 4;3 to 6;9)

Stimuli:

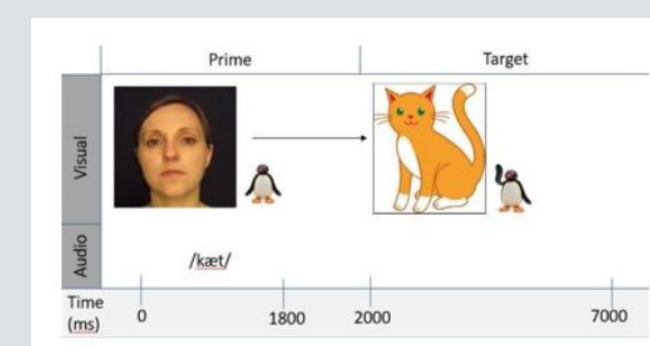
- 8 familiar, early-acquired words
- 4 /k/ onset (coat, cow, car, cat); 4 /b/ onset (ball, bird, bed, bear)

Design:

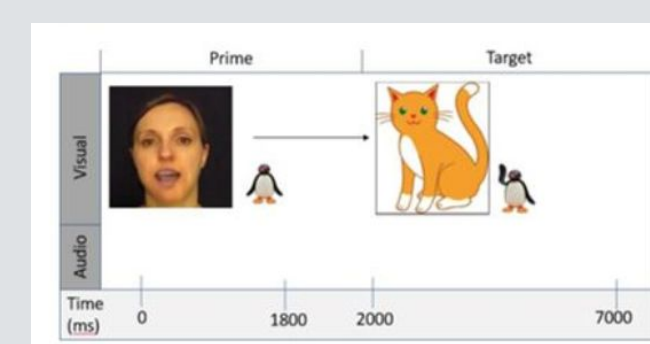
- Early stimuli-onset-asynchrony (SOA)
- Prime Modes (blocked):
 - **Auditory-Visual (AV):** hear (A) and see (V) production of word



- **Auditory-only (A):** hear (A) production of the prime; see static image of a face



- **Visual-only (V):** see (V) production of word; no audio



- Prime Conditions (blocked):
 - *Repetition* (e.g. BALL-ball)
 - *Unrelated* (e.g. COAT-ball)
- Mixed design:

AV-A	AV-V*	
AV Repetition	AV Repetition	Block 1
AV Unrelated	AV Unrelated	
A Repetition	V Repetition	Block 2
A Unrelated	V Unrelated	

*Participants were randomly assigned to either the AV-A or AV-V group

Results

Speech Reaction Time (SRT):

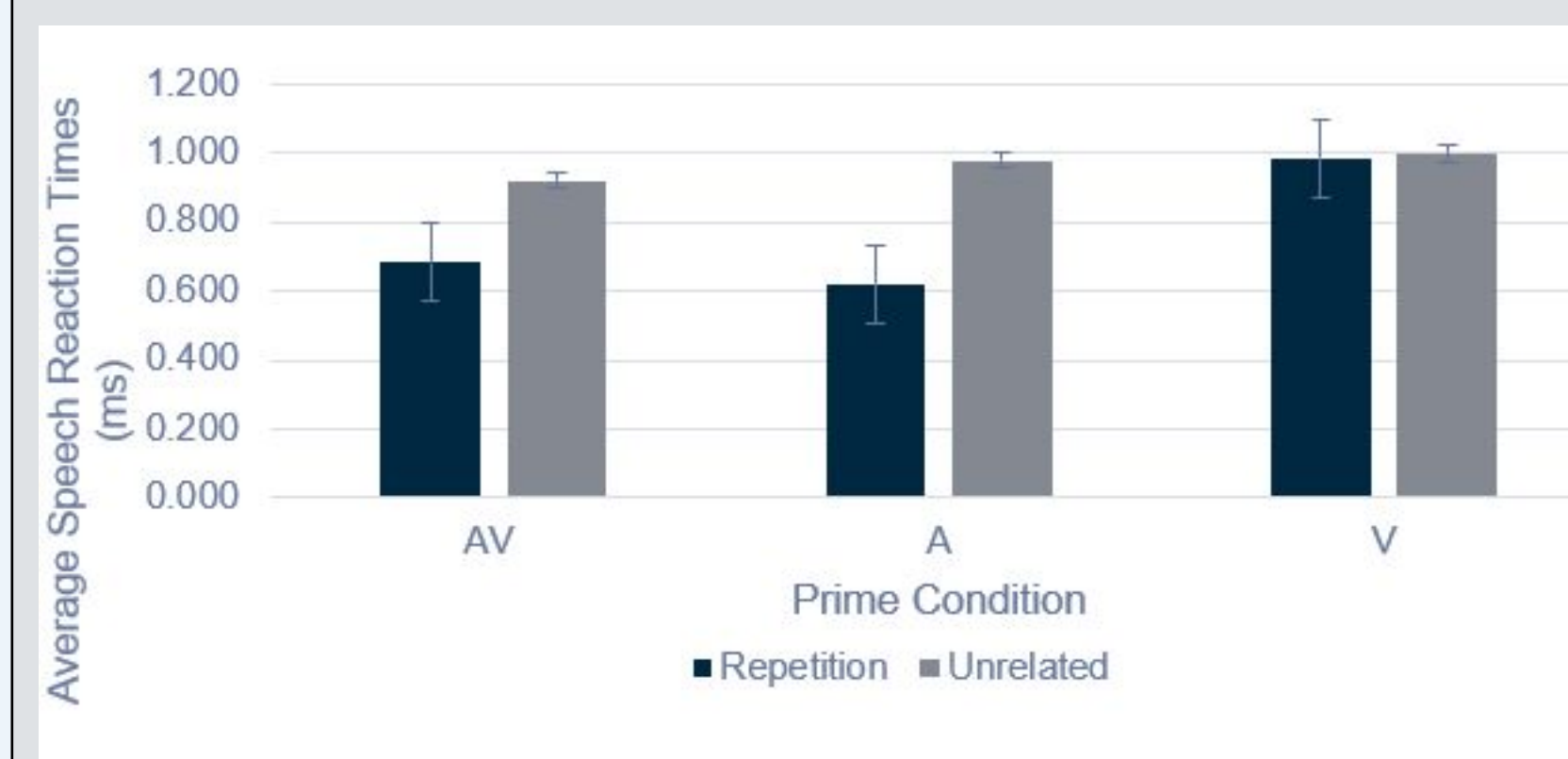
- SRTs calculated from correct trials
- SRTs under 200ms not included

Table 1. Mean SRT (ms) across priming conditions

Prime Condition	Repetition	Unrelated	Total
AV	682	920	809
A	622	979	809
V	986	999	993

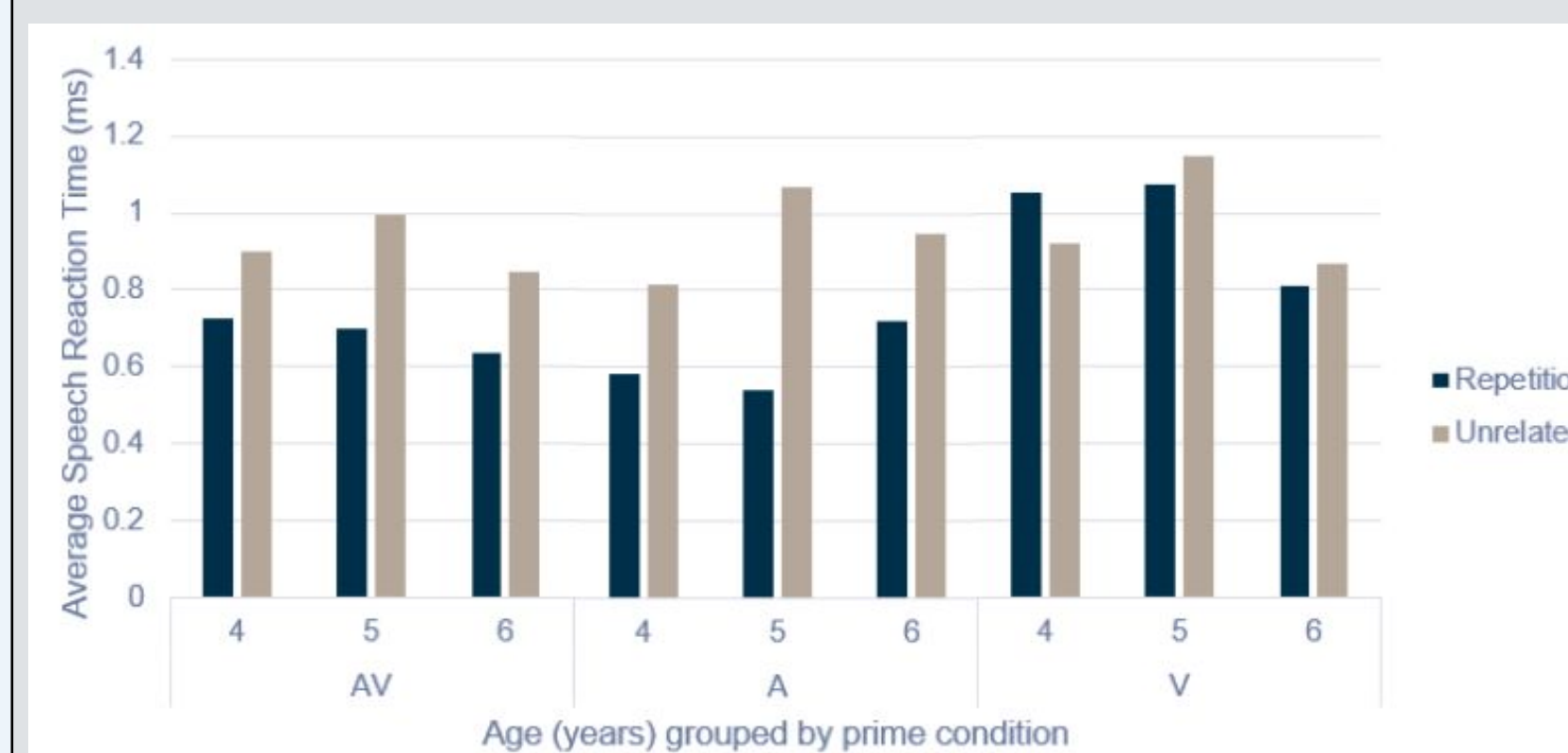
- A condition contains the shortest mean SRT in the *Repetition* condition and the longest SRT in the *Unrelated* condition, compared to all SRTs
- V *Repetition* condition yielded the longest SRTs compared to AV and A *Repetition* conditions

Table 2. Mean SRT (S) across priming conditions (bars show standard deviation)



- SRTs shorter in *Repetition* condition compared to *Unrelated* condition in AV and A prime condition, and no difference in the V prime condition.
- Difference between *Repetition* and *Unrelated* is created in the A condition than the AV condition

Table 3. Mean SRT (S) across priming conditions



- 4-year olds had longer SRTs in V *Repetition* condition compared to unrelated

Results Continued

Accuracy:

- Participants had an average of 99.6% of correct trials (range 98% to 100%)

Table 1. Mean accuracy (%) across all priming modes

Prime Condition	Prime Mode		
	AV	A	V
Repetition	88	92	95
Unrelated	99	99	100

- A total of 17 mistrials and errors: 9 from the first block (AV) and 10 from the second block (A and V)

Table 2. Types of Errors made by Participants by Block and Prime Conditions

Error Type	Block 1 & 2 (AV)		Block 3 & 4 (A)		Block 3 & 4 (V)	
	Repetition	Unrelated	Repetition	Unrelated	Repetition	Unrelated
<200ms	13	1	4	0	4	0
Alternative	1	2	0	0	1	3
Determiner	1	0	0	0	0	0
Incorrect	1	2	0	0	1	0
No Data	1	1	0	0	1	0
Prompted	3	0	0	0	1	0
Stuttered	0	2	3	0	1	1
Talking	3	4	3	1	4	6

Discussion

- All participants had shorter SRTs in the *Repetition* condition in AV and A mode compared to *Unrelated* condition in the AV and A mode.
 - Shorter SRTs were expected as a result of the activation in the mental lexicon.
- SRTs in V repetition were not shorter than in unrelated condition.
 - Visual repetition <200ms errors

Limitations and Considerations

- Individual differences
- Development of speech-reading, not all or nothing
- Speech-reading more taxing (SOA)