Parallel implicit and explicit processing mechanisms in statistical language learning

Nicolette Noonan & Lisa Archibald | *Department of Psychology, Western University*

nnoonan3@uwo.ca

Western

NSERC CRSNG

Introduction

- Statistical learning refers to the *discovery of patterns in the input*
- The learning of word boundaries can occur through an **implicit** computation of **transitional probabilities**, which are statistically predictive relationships between syllables (Saffran et al., 1996)
- Statistical learning is considered a **domain-general** resource (Kirkham et al., 2002), although **domain-specific interference effects** have not been investigated in detail
- Our previous research has demonstrated a domain-specific interference effect between verbal statistical learning and a concurrent, explicit non-auditory phonological task, when exposure to the artificial language is 28-minutes (Noonan & Archibald, in prep)
- However, the marginal effects observed in our previous study might reflect overlearning of the stimuli over our extended exposure time
- The present study examined how explicit domain-general and -specific working memory tasks with low or high demands impaired the statistical learning of word boundaries in a 7-minute artificial language

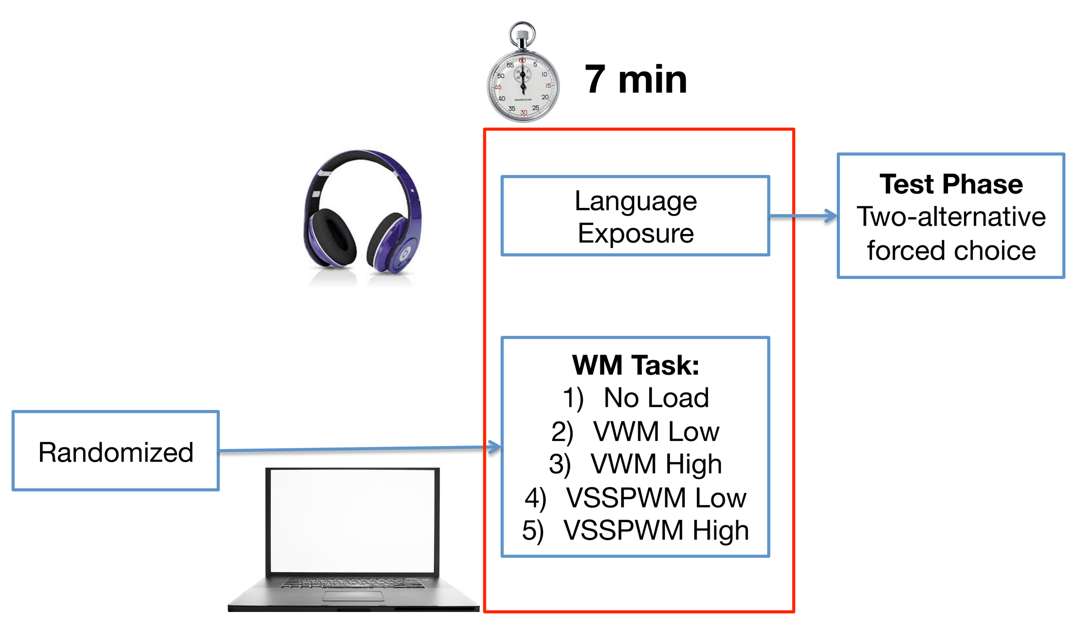
Method

Participants

105 young adults

English monolingual; normal hearing/vision

Procedure



Artificial Language Stimuli

- **Six trisyllabic "words"** generated from 12 CV syllables
- Unsegemented language stream: Only cue to word boundaries were the **transitional probabilities** between syllables

putibu bupada pidadi babupu dutaba tutibu

Within-word: frequency of /ba/./bu/ / frequency of /ba/ > **Between-word**: frequency of /ba/./tu/ / frequency of /ba/

Explicit Working Memory Task

- Participants completed a computer administered ***n*-back task**, or a control task
- Concurrent with language exposure
- **4 working memory task conditions** + **control** (no task):
  - → Verbal WM: Low Load (0-back) or High Load (2-back)
  - → Visuospatial WM: Low Load (0-back) or High Load (2-back)

Hypotheses

Implicit Learning Test Phase

- "Word"/nonword test pair: e.g.: "**putibu** or **pubati**"?
  - → Trisyllabic **nonwords** with transitional probabilities of zero

TABLE 1:

Predicted differences in word segmentation abilities, if constrained by domain-general capacities (purple) or verbal capacity (blue)

Task Load		Task Domain	
	No Domain	Verbal	Visuospatial
No Load			
M (SD)	XX		
Low Load			
M (SD)		XX	XX
d		xx	xx
High Load			
M (SD)		XX	XX
d		xx	xx

Results

TABLE 2:

Means and effect sizes of word identification scores (out of 36)

Task Load		Task Domain	
	No Domain	Verbal	Visuospatial
No Load			
M (SD)	22.06 (3.67)		
Low Load			
M (SD)		19.83 (3.21)	20.71 (3.35)
d		0.65	0.38
High Load			
M (SD)		**18.36 (3.68)**	**18.36 (3.94)**
d		**1.01**	**0.97**

Note: Experimental groups compared individually to controls using planned simple contrasts;
bolded values are $p < .05$

Conclusions

- **Control** condition
  - Successfully segmented words
- Concurrent **low load** working memory task
  - Successfully segmented words
  - No different from controls
  - Equivalent regardless of **task domain**
- Concurrent **high load** working memory task
  - Significantly **lower** word identification scores than controls
  - No different from chance
  - Lower score regardless of **task domain**
- Explicitly and implicitly coding of new information
  - May tap similar resources
  - Costs to implicit learning when under demanding processing conditions
  - Extended exposure time (Noonan & Archibald, in prep) might facilitate learning for cross- rather than same-domain interference

References

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