Is Four Better than Two? The Influence of Bilingual and Multilingual Metrics in an Implicit Bilingual Statistical Learning Task

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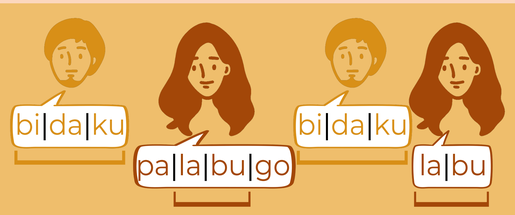
Introduction

Bilingual statistical learning

- **goal**: understand structure of world
- **dual-language** learning stream - need to track regularities in two languages simultaneously
- **explicit** cue to language membership: distinct speakers
- **bilinguals** can track more complex patterns with fewer explicit cues[1]

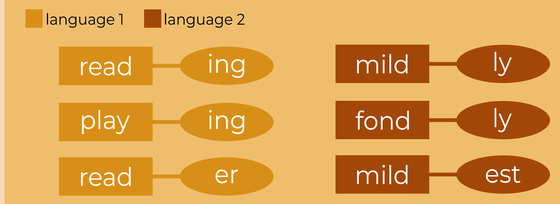


Bilingual statistical learning task: a constant flow of speech is played, in two distinct voices (red for female, yellow for male) for each language. Each language is composed of individual chunks (morphemes, represented by vertical lines), with some morphemes always appearing together (represented by brackets).

Which multilingual metrics help learning in an implicit bilingual statistical learning task?

Methods

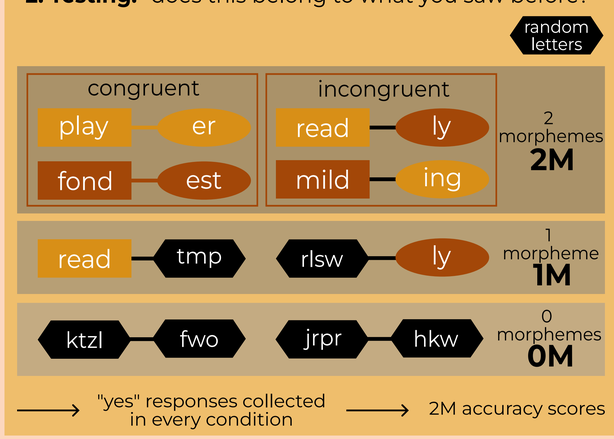
1. Training: "pay attention to the words on the screen"



All words presented in BACS-1 font[2]:

Participants need to
1. Segment words into parts
2. Track co-occurence of parts

2. Testing: "does this belong to what you saw before?"



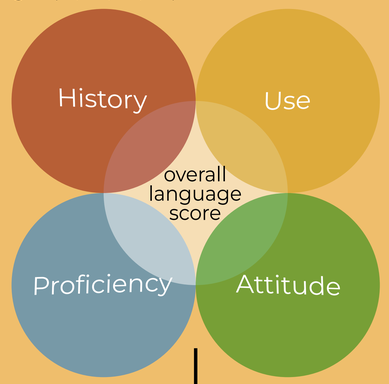
"yes" responses collected in every condition → 2M accuracy scores

3. Familiarity: "which item have you seen before?"

read or fwlk gp or ly

4. Multilingual Language Profile
adapted from the Bilingual Language Profile[3], for up to 4 languages (L1, L2, L3, L4)

goal: **continuous** measures of multilingualism



bilingual balance
"entropy" of L1 & L2 score

multilingual experience
sum of all scores

multilingual balance
"entropy" of all scores

example of a high degree of multilingual balance

example of a low degree of multilingual balance

Results

n= 193

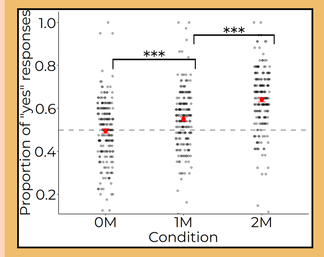


Figure 1: Proportion of "yes" responses in the no morphemes (0M), one morpheme (1M), and two morphemes (2M) testing conditions.

Group means are shown by a red circle with error bars.

Chance level (0.5) is shown as a dotted line.

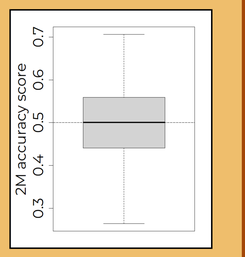


Figure 2: Boxplot of the accuracy scores in the 2M condition.

Chance level (0.5) shown as a dotted line.

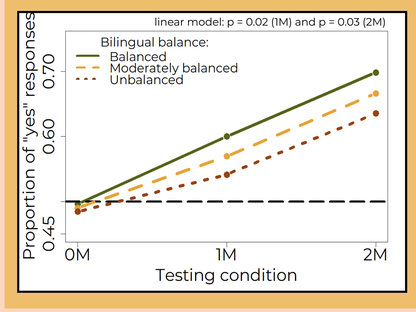


Figure 3: model fit for the interaction of the amount of "yes" responses in each condition and different amounts of imbalance of participants' scores for their first two languages.

Chance level (0.5) shown as a dotted line.

EXPERIMENT 2

IDENTICAL METHODS TO EXPERIMENT 1, WITH THE ADDITION OF:

0.5. Pre training: "spell these word parts"

read mild
est ing

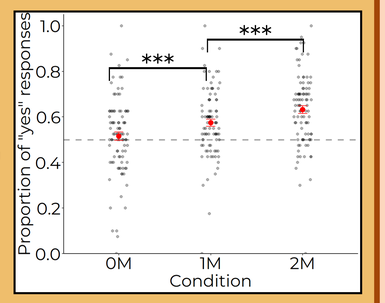
Participants need to
Only track co-occurence of parts

n= 91

Figure 4: Proportion of "yes" responses in the 0M, 1M, and 2M testing conditions.

Group means are shown by a red circle with error bars.

Chance level (0.5) is shown as a dotted line.



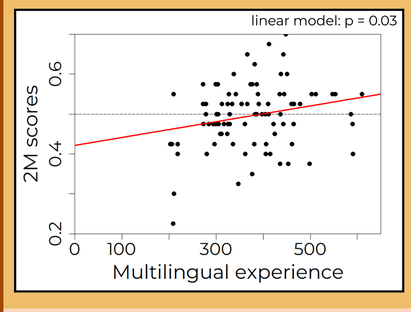


Figure 5: model fit for the interaction of scores in the 2M condition and the amount of multilingual experience.

Chance level (0.5) shown as a dotted line.

Discussion

Greater number of familiar morphemes - higher chance of responding "yes"
- expansion of Lelonkiewicz et al. (2020)[4]

Group 2M performance at chance level
- task too difficult OR no multilingual metrics with significant effect

More balanced bilinguals say "yes" more when there are more familiar morphemes
- no significant interaction with multilingual balance - strictly **bi**lingual phenomenon?

Greater number of familiar morphemes - higher chance of responding "yes"
- same as in experiment 1

Group 2M performance still at chance level
- task still too difficult to see group-level effect

More experienced multilinguals have higher 2M accuracy
- more **multi**lingual experience - more experience tracking mutliple statistical systems - better able to track co-occurences in a novel dual-language environment

Does balance or experience matter more? Does it depend on task difficulty?

References

1. Antovich & Graf Estes (*Developmental Science*, 2018)
2. Vidal et al. (*Behavior Research Methods*, 2017)
3. Gertken et al. (Measuring L2 Proficiency, p.208-225, 2014)
4. Lelonkiewicz et al. (*Journal of Memory and Language*, 2020)

Woman & Man icons by kenneth bryan chung from Noun Project