Non-native speech perception and the role of phonological memory: A re-examination

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BACKGROUND

- In a rapidly changing and increasingly socially distant world, previously laboratory-based research is moving to online settings

Main Research Question
Can findings from a laboratory-based speech perception study be replicated in an online data collection environment?

- The present study aims to bolster findings from a previous study (Inceoglu, 2019) that investigated the role of phonological short-term memory (PSTM) in second language (L2) speech perception by repeating the study's laboratory-based research online

ORIGINAL STUDY

The Modern Language Journal

Individual Differences in L2 Speech Perception: The Role of Phonological Memory and Lipreading Ability

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Research Question

- How is the perception of L2 French nasal vowels related to individual differences in phonological memory?

Participants

- 32 native speakers of English (5 male, 27 female; mean age 30 years old) enrolled in undergraduate French courses at a large Australian university
- Intermediate proficiency in French; mean age of onset of French learning: 14.42 years (range 10-19 years)

Materials

L2 French vowel identification task
- Stimuli recorded by a native speaker of French (female; mid-30s)
- 108 CVC items with one of three French nasal vowels: /ɔ̃/, /ɑ̃/, or /ɛ̃/
- Initial and final consonants were distributed between manner and place of articulation (six items per manner/place, 108 stimuli total)
  - e.g. *pompe* [pɔ̃p] and *singe* [sɛ̃ʒ]
- Participants heard a stimulus and were asked to identify which French nasal vowel it contained (represented orthographically as "on," "an," and "un")

Non-word repetition task stimuli (PSTM)
- Participants heard 16 pairs of English non-words that varied in syllable length from three to eight syllables (e.g. *pondomicious/najistery*)
- After each pair was presented aurally, there was a two-second tone-filled delay and participants repeated each pair

Analysis and Results

- Simple linear regression
- **Dependent variable:** Vowel identification task score (% correct)
- **Independent variable:** Non-word repetition task score (one point awarded per pair with no more than one incorrect syllable)
- **Participants with higher PSTM had significantly higher scores in the identification task** [$F(1,30) – 9.23, p = .004$]
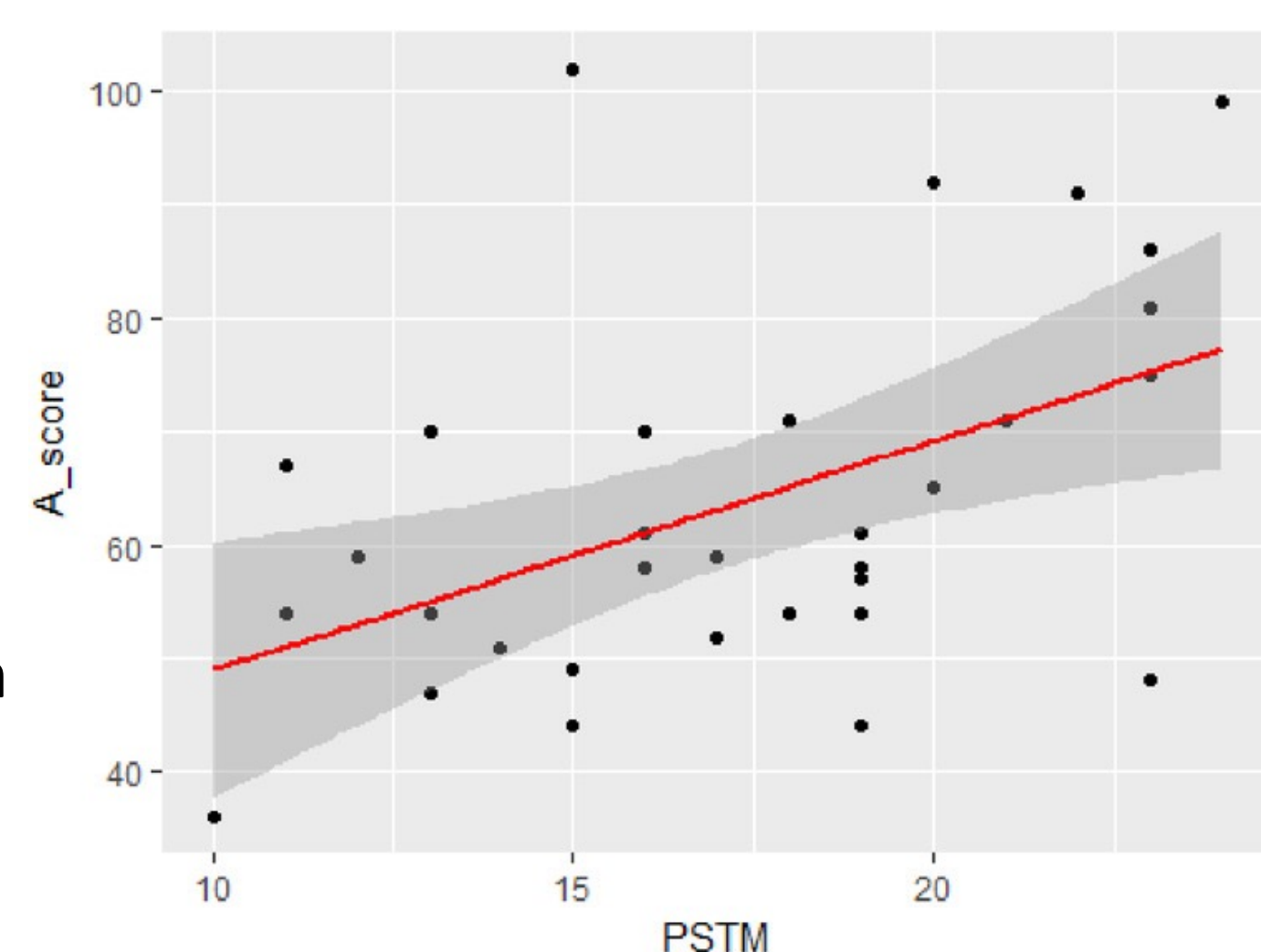
Figure 1. Relationship between vowel identification scores and PSTM (from Inceoglu, 2019)

REPLICATION STUDY METHODS

Participants

- 32 native speakers of American English (12 male, 20 female; mean age 33.93 years old) recruited on Prolific
- Prior to participating in the main study, participants who indicated via Prolific that they had knowledge of French **and** were native speakers of American English were invited to complete a short language background questionnaire and the LexTALE-FR (Brysbaert, 2013)
  - Participants who scored in the 49th percentile or higher on the LexTALE-FR were invited to complete the main study
    - High intermediate/advanced proficiency; mean age of onset of French learning: 12.54 years (range 5-23 years)

Materials and Procedures

- All materials were designed using Gorilla Experiment Builder

Headphone screener
- Participants completed a short headphone screener based on dichotic pitch to ensure the use of headphones (Woods et al., 2017)
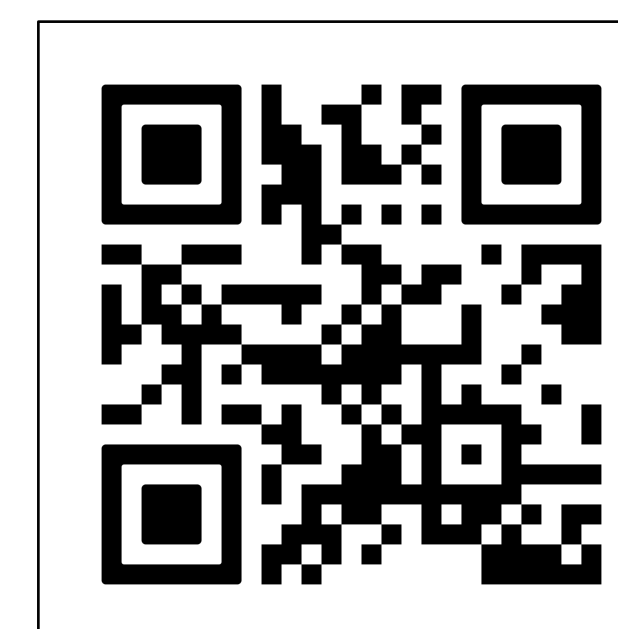
L2 French vowel identification task
- Stimuli recorded by a native speaker of French (female; 31 years old)
- All materials and procedures were identical to the original study
- Prior to completing the experimental task, participants completed a short practice task

Non-word repetition task stimuli (PSTM)
- All materials and procedures were identical to the original study
- Prior to completing the experimental task, participants completed a short practice task

Try out a shortened version of our experiment by scanning this QR code and selecting the "Preview" button next to "Try it out!"

Analysis

- Linear mixed effects model (*lme4* function in R)
- **Dependent variable:** Vowel identification task score (% correct)
- **Fixed effects:** Non-word repetition task score (one point awarded per pair with no more than one incorrect syllable)
- **Random effects:** Subject and Item (random intercepts)

Difference	Justification
Data was collected online using Prolific	Main goal of study was to investigate if previously laboratory speech perception research could be replicated online
Variety of English spoken by participants was different	Current study collected data from native speakers of American English (rather than Australian English) due to restrictions in Prolific's participant pool (~25 active participants on Prolific who were native speakers of Australian English and spoke French as an L2)
L2 proficiency level was higher	The threshold of L2 proficiency levels in the present study had to be wider and higher due to availability of participants on Prolific
No lip-reading data collected	Replicating lip-reading portion would have significantly lengthened experiment time, likely leading to a larger drop-out rate and lower quality data in an online setting (Finley & Penningroth, 2015)

Table 1. Main differences between the original study (Inceoglu, 2019) and the present replication study
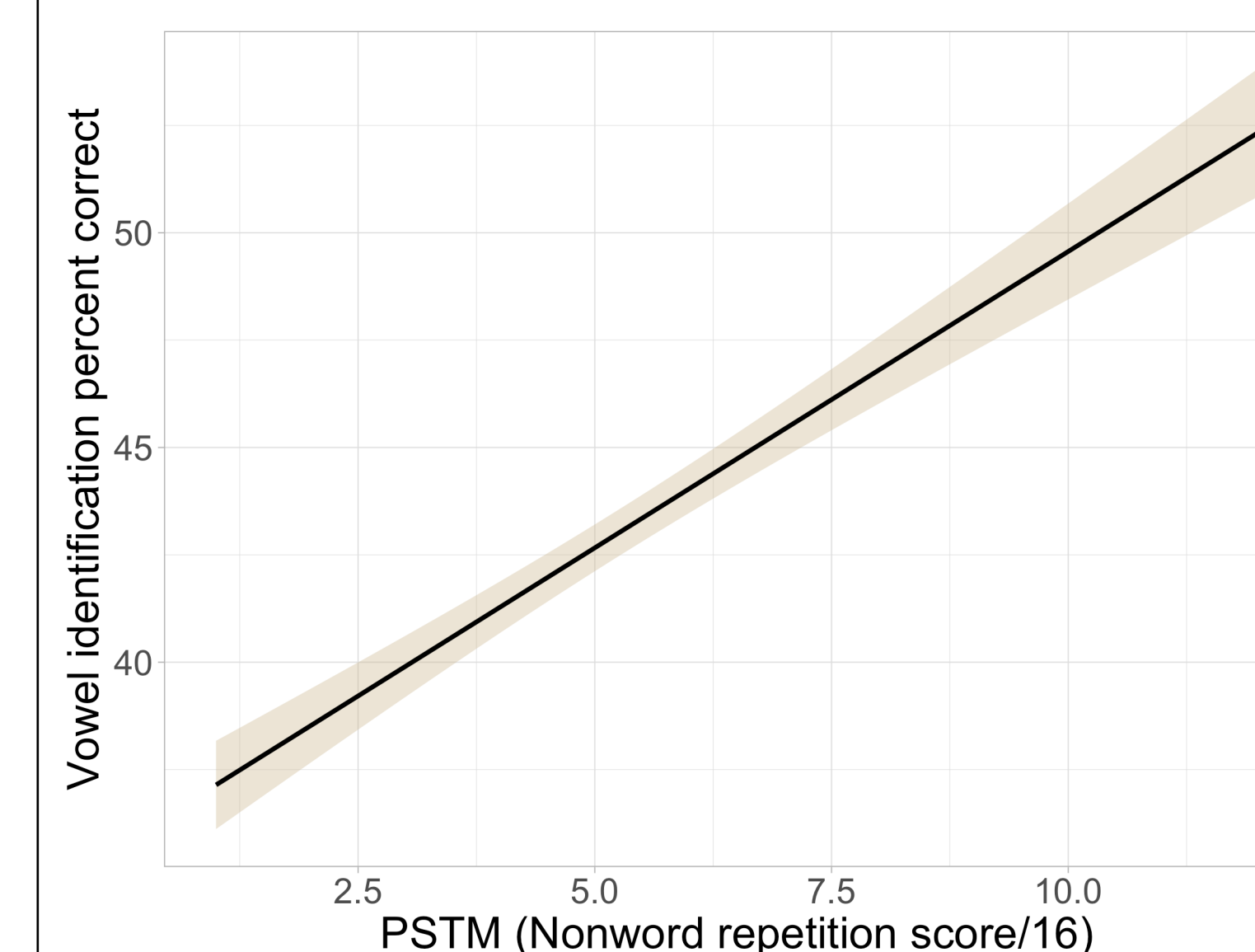
REPLICATION STUDY RESULTS

	Vowel identification %	Non-word repetition %
Mean	42.99	33.19
SD	16.73	16.59
Max	83.33	75.00
Min	10.19	6.25

Table 2. Descriptive statistics for the L2 French vowel identification task and the non-word repetition task

Figure 2. Relationship between vowel identification scores and PSTM

Predictors	Estimates	std. Error	CI	Statistic	p-value
(Intercept)	0.39	0.03	0.33- 0.44	13.06	<0.001
PSTM	0.13	0.02	0.09- 0.18	5.75	<0.001

Table 3. Table of fixed effects for the mixed effects model of L2 French vowel identification score and PSTM

Results

- Participants who scored higher on the non-word repetition task (indicative of higher phonological short-term memory) were significantly more likely to have higher scores on the vowel identification task than those with lower PSTM [$t= 5.75; p< 0.001$]

DISCUSSION

- As in Inceoglu (2019), **high PSTM significantly predicted success in L2 speech perception**- L2 learners with higher PSTM were significantly more target-like than those with low PSTM scores
  - PSTM capacity may encourage establishment of novel phonological material and phonetic features into stable, long-term mental representations (Inceoglu, 2019)
  - The phonological loop plays a direct role in the acquisition of L2 speech sounds (Baddeley, Gathercole, & Papagno, 1998)
- Results from Inceoglu (2019) were replicated, providing greater support for the role of PSTM in L2 speech perception

Major take-away:
Results from Inceoglu (2019) were replicated despite the switch from in-person to online data collection, ultimately providing support for the efficacy of online L2 speech research
- This finding is crucial as research begins to adjust to accommodate a more technologically advanced and socially distant world

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