Consolidation-enhanced semantic influence on word learning

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Background

- A critical feature of learning a new spoken word is establishing a well-specified phonological representation (e.g. Papagno & Vallar, 1992)
- Whilst models of *known* word recognition posit an interaction between phonology and meaning (Gaskell & Marslen-Wilson, 2002), it is unclear whether meaning also interacts with the *learning* of new phonological representations (cf. Dumay, Gaskell, & Feng, 2004; Leach & Samuel, 2007).
- Consolidation plays an important role in the lexical integration of new words (Davis & Gaskell, 2009, for review). Interestingly, the integration of novel word meanings is also strengthened by consolidation (Tamminen & Gaskell, 2013).
- Given this, a surprisingly overlooked possibility is how semantic information modulates the consolidation effect on newly-learnt phonological forms.

Research Questions:

1) Whether the meaning of a novel word enhances learning of the low- level phonological form of that word;

2) Whether a period of offline consolidation impacts upon the emergence of that semantic influence.

Method

Participants

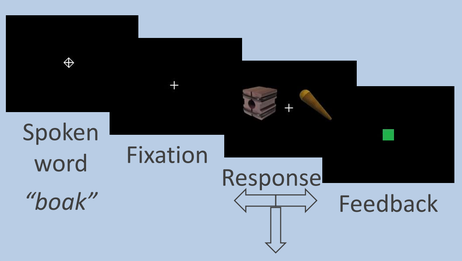
Twenty-four right-handed native English speakers (mean age = 21.5 years, S.D. = 2.6; 15 females) completed the study.

Design

Day 1

Learning Task

Six ***correlated*** items with a high percentage of referent picture-word pairings, and six ***uncorrelated*** items with no consistent picture-word pairing. Forty exposures to each pseudoword.



Test of Phonological Form Learning

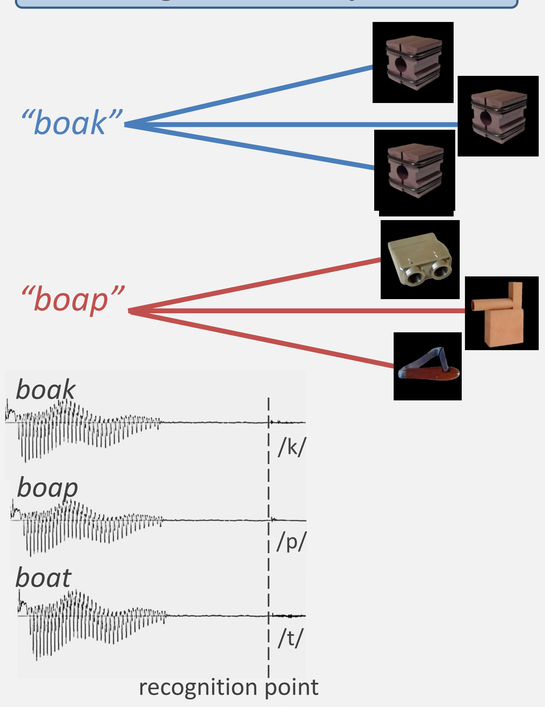
Mismatch negativity (MMN) potential measured discrimination of newly-learnt pseudowords from known words.

Day 2

Test of Phonological Form Learning

Mismatch negativity (MMN) potential measured discrimination of pseudowords from known words after 24h of consolidation.

Recognition memory task



Learning Task

- All items were part of an unvoiced place-contrast minimal set (i.e. *boat-boap-boak*), and cross-spliced to be identical until the recognition point
- Each word was followed by two pictures; participants' task was to respond based on whether one of the two pictures was the referent for that word
- Veridical feedback was presented in the correlated condition, and chance-level 'correct' feedback in the uncorrelated condition.

Test of phonological form learning: Mismatch Negativity (MMN)

- The MMN is an ERP measure evoked to rare 'deviant' stimuli in a continuous stream of 'standard' filler stimuli (Näätänen et al., 1997).
- The deviant stimulus must be discriminated from the standard to elicit an MMN (e.g. Shtyrov, Nikulin, & Pulvermüller, 2010)
- We used a multi-feature oddball paradigm to present both a newly learnt *correlated* and *uncorrelated* pseudoword (1/6 probability each) against a background of known filler words (4/6 probability).

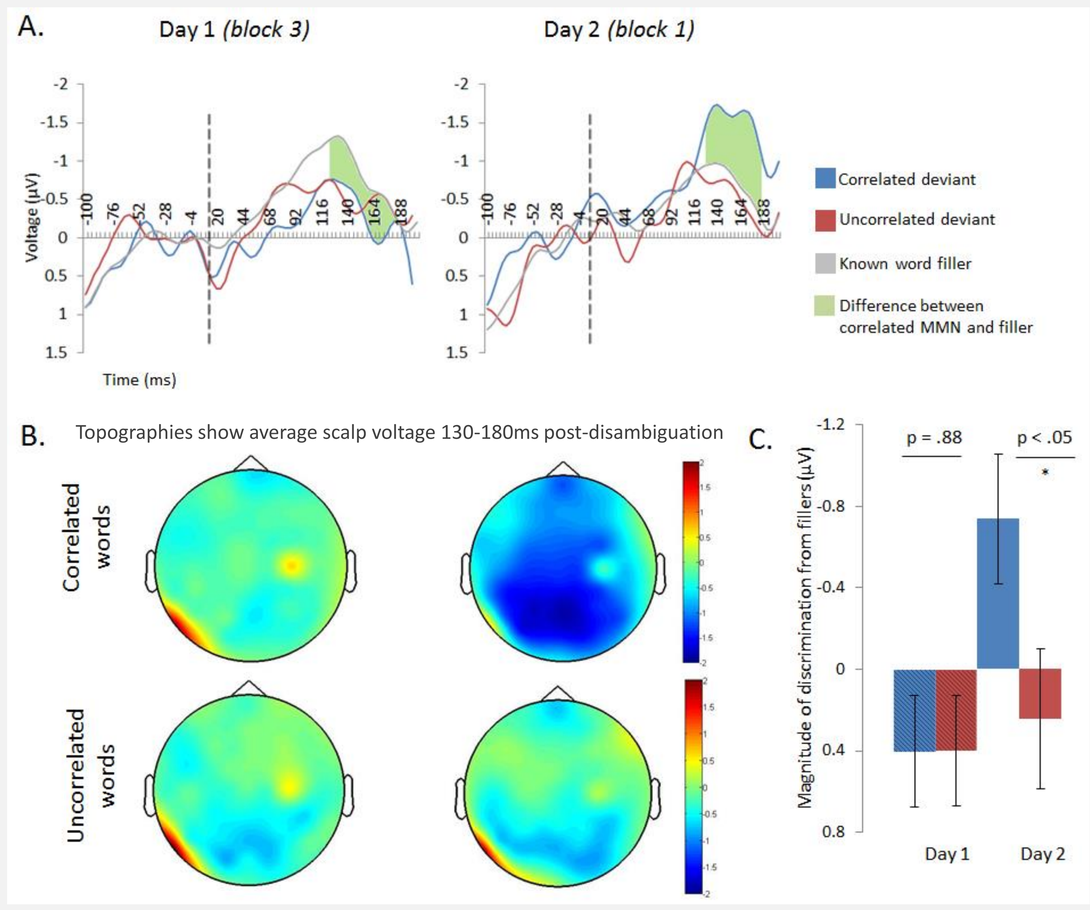
Results

Behavioural data

- Learning task performance showed good knowledge of correlated word associations at the end of the task, with group-level accuracy at 74.38% (SD = 19.69)
- Recognition memory accuracy on Day 2 was higher for correlated (91.67%, SD = 9.04) than uncorrelated (71.30%, SD = 14.07) words.

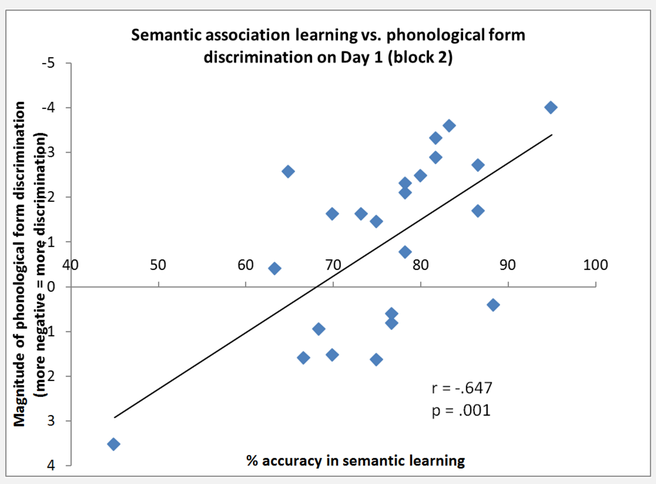
The role of consolidation

- ERP difference waves (pseudoword MMN minus filler) analysed at Cz, CPz, Pz, POz and Oz (pooled), 130-180ms post-recognition. Divided each oddball task into first, middle and last third of trials for analysis
- At the end of Day 1, correlated and uncorrelated discrimination did not differ; at the start of Day 2, correlated word discrimination was significantly greater than uncorrelated word discrimination.



Semantic effects on phonological form discrimination

- Tested more nuanced differences between the conditions over the course of oddball task on each day; on Day 1 correlated word discrimination was present in block 2 only
- Episodic knowledge about semantic associations from the learning task only contributed to correlated word discrimination on Day 1 (block 2). Correlated word discrimination on Day 2 was not dependent on episodic knowledge from the learning task (Meng's Z for change in correlations between days, p = .0018).



Conclusions

- Semantic knowledge can facilitate the learning of phonological representations
- This demonstrates that semantic exposure can impact directly upon phonological form learning itself, rather than word-level recall or identification of new items
- Consolidation is not *essential* for semantic information to influence the acquisition of phonological representations, but it nonetheless confers a *selective benefit* for forms for which semantic information is available
- Correlated-word discrimination on Day 1 was improved for participants with greater episodic knowledge of the semantic associations; however, episodic semantic knowledge was irrelevant for performance on Day 2
- Suggests consolidation period also decreased correlated words' reliance on the episodic semantic knowledge which had benefited these forms in the first place.

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