

Lexical bias and the phonemic similarity effect in inner speech

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Inner speech (or verbal thought) is possible without any intention to articulate the words overtly. It is, however, unclear to what extent the speech production network is activated on such occasions. Speedwise, it would be advantageous if plans for such speech remained unspecified at featural (phonetic) and articulatory levels.

Dell's (1986) interactive model of language production predicts that if a speech-plan is not specified at the featural level, the phonemic similarity effect will be absent. Exploiting this prediction, Oppenheim and Dell (2008) asked participants to recite (real-word) tongue-twisters in inner and overt speech and report their errors. A phonemic similarity effect was only found in self reports of overt speech, prompting the conclusion that inner speech is underspecified at the featural level.

The current study

It is possible that participants under-reported their single-feature errors in inner speech, perhaps because such errors are difficult to perceive internally. In Exp.1, we therefore used the same (Oppenheim & Dell 2008) paradigm but added an auditorily masked condition, to test: (a) whether the phonemic similarity effect is also absent during overt auditorily masked recitations; and (b) whether the numbers of overt errors reported by participants is significantly less than the numbers perceived by an independent rater.

In Exp.2, to make participants focus on the *phonology* of the tongue-twisters in inner-speech (rather than their *lexicity*), we repeated the Exp.1 procedure using tongue-twisters with a random mix of real and non-words.

Lexical bias is the tendency, all other things being equal, for phoneme substitution errors to result in the production of real words (rather than non words).

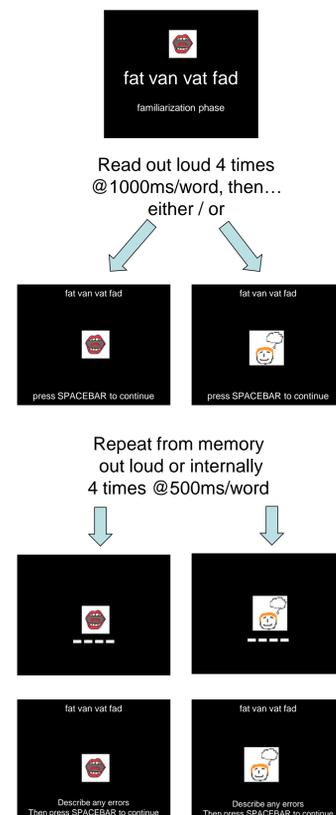
- darn bore → barn door ✓✓✓
- dart board → bart doart ✓

The **Phonemic similarity effect** is the tendency for phoneme substitution errors to occur most readily between phonemes that are "similar" insofar as they differ by only a single feature.

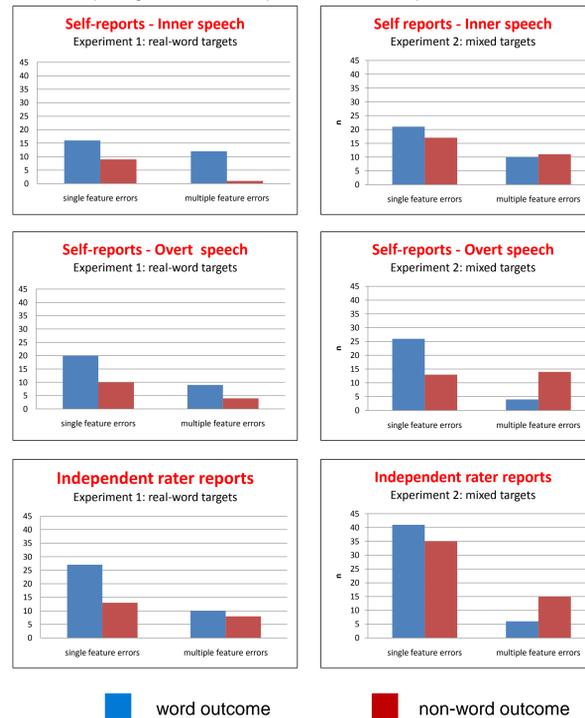
- cope poke → pope coke ✓✓✓
- soap poke → pope soak ✓

Method

- 32 participants each read aloud (four times), and then repeated from memory (four times), 48, 4-word tongue twisters.
- Half the tongue twisters comprised of words with similar onsets; half dissimilar onsets.
- Word-3 codas were manipulated so that half of the (primed-for) onset-substitution errors would result in real words and half in non words. (see table).
- Following the familiarisation phase, half of the tongue twisters were (randomly) marked to be repeated overtly and half in inner speech.
- Participants were instructed to report all errors made during these repetitions.
- 50% of the tongue twisters were accompanied by pink-noise to prevent speakers from auditorily monitoring the sound of their voice.



Comparing numbers of reported errors in Experiments 1 and 2



Example of a set of tongue-twisters from Exp.1: all word context

Similar Onsets	Dissimilar Onsets	Primed-for outcome
fan van vat fad	man van vat mad	mat (real word)
fan van valve fad	man van valve mad	malve (non-word)

Numbers of reported errors with and without auditory masking, in Experiments 1 and 2



Results - Best fit logistic mixed effects models

Self reports, -Experiment 1: inner & overt speech

- Likelihood of primed-for errors being reported increases with ...
- Lexicality of primed-for outcomes $p=.0004$ ***
 - Similarity of onset phonemes $p=.0015$ **
- (adding a similarity*overtiness interaction term did not improve the model)

Self reports, -Experiment 2 inner & overt speech

- Likelihood of primed-for errors being reported increases with ...
- Similarity of onset phonemes $p=.0005$ ***
 - Masking $p=.096$
- (adding a similarity*overtiness interaction term did not improve the model)

Overt speech, -Experiment 1: self & independent ratings

- Likelihood of primed-for errors being reported increases with ...
- Lexicality of primed-for outcomes $p=.0015$ **
 - Similarity of onset phonemes $p<.0001$ ***
 - Independent rater $p=.079$
- (adding a similarity*rater interaction term did not improve the model)

Overt speech, -Experiment 2: self & independent ratings

- Likelihood of primed-for errors being reported increases with ...
- Similarity of onset phonemes $p<.0001$ ***
 - Independent rater $p=.0004$ ***
 - Masking $p=.0029$ **
- (adding a similarity*rater interaction term did not improve the model: $p=.128$)

Conclusions

In both Experiments 1 and 2, Contrary to Oppenheim & Dell (2008), our participants' self-reported errors revealed phonemic similarity effects of similar magnitudes in both inner and overt speech. This suggests that, at least within this experimental paradigm, plans for inner speech were fully specified at the featural level, even in the absence of any intention on the part of the speaker to utter the words overtly.

With respect to the hypothesised under-reporting of single-feature errors, in Experiment 1, the failure of *masking*similarity* or *masking*similarity*rater* interaction terms to improve the goodness of fit of the model suggests that, when reciting entirely real-word tongue-twisters, our participants were equally efficient at reporting both single and multiple-feature errors - both with and without auditory feedback. In Experiment 2, although there was a reduction in the proportion of overt single-feature errors self-reported when auditory feedback was masked, this was not statistically significant and was too small to nullify the phonemic similarity effect.

It is noteworthy that in Experiment 2, more overt single-feature errors were *made* in the auditorily masked condition. This is because, in the masked condition, participants often repeated the same error more than once, whereas they almost never repeated errors more than once when auditory feedback was not masked.

References

- Dell, G.S. (1986). A spreading activation theory of retrieval in sentence production. *Psychological Review*, 93, 283-321.
- Oppenheim, G. M., & Dell, G. S. (2008). Inner speech slips exhibit lexical bias, but not the phonemic similarity effect. *Cognition*, 106, 528-537.