Spreading jam with a butter knight: Near-homophones and phonological pre-activation

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Lexical pre-activation in predictive contexts is a well-established effect, but additional evidence is required to determine the level of detail in comprehenders' predictions. The current ERP study uses near-homophones to ask whether comprehenders pre-activate phonological representations in their predictions. Preliminary results (N=14) do not support the hypothesis that phonological information can be pre-activated, even in highly predictive contexts.

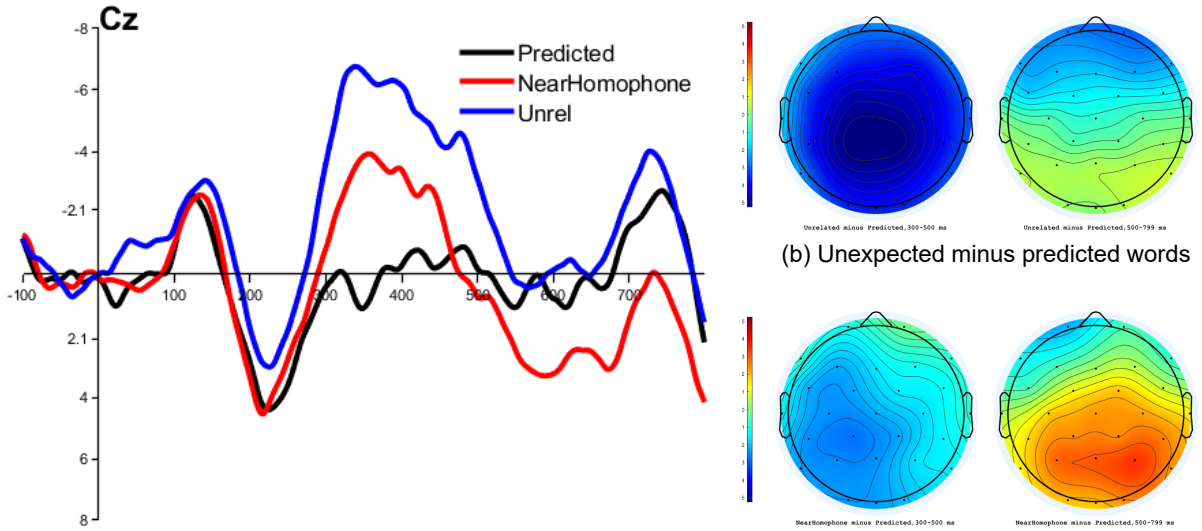
In previous studies, phonological pre-activation has been approached using the allomorphy of the English indefinite article *a*/*an*, since the correct form of the article is determined by the phonology of the following word. Most notably, [1] found an N400 effect when predictive contexts were followed by an unexpected determiner. Under the view that the N400 reflects lexical activation processes [4], the increased N400 amplitude on unanticipated articles was interpreted as an indicator that phonological features may be preactivated in sentence processing. However, a recent large-scale study [5] failed to replicate these findings. Our ERP experiment investigates the role of phonological prediction in sentence processing by comparing the amplitude of the N400 response to semantically implausible near-homophones of predicted sentence completions versus predicted and unrelated completions. A sample item set is given in Table 1. Materials were normed for predictability and for semantic similarity between target words in an item set in separate online tasks (N=30 each). In order to reduce potential shallow processing of the near-homophones, participants were asked after one-third of items whether a specific phrase was seen in the previous sentence (e.g. "Did the sentence you just read include 'along the sandy beach'?").

We hypothesized that if comprehender predictions include phonological detail, spreading activation to phonological neighbors of an anticipated continuation would attenuate the amplitude of the N400 effect in the near-homophone condition relative to the unrelated condition. At first glance, preliminary results appear to support this prediction. Both the the near-homophone and unrelated conditions show a significantly larger N400 than the predicted condition ($p<0.01$), and the N400 is significantly reduced for the near-homophones relative to unrelated words ($p<0.01$). This is illustrated in Figure 1. The near-homophone condition also showed greater positivity in the 500–800ms time window relative to the other two conditions ($p<0.01$). One possible explanation for these results is that the predicted word was pre-activated sufficiently to allow spreading activation to the phonologically-related near-homophone, causing the reduced N400 seen. The P600 effect may reflect participants noticing that the word they saw is very similar to the highly predicted word, which may have triggered a reanalysis or monitoring process [2, 3]. This would suggest that at least in very highly constraining contexts, prediction of a word may include pre-activation of its phonological features, inducing spreading activation to phonologically similar words. However, an alternative explanation is that the reduced N400 was simply caused by component overlap with the P600. This would mean that there was no real facilitation in accessing the near-homophone relative to the unrelated item, and that the P600 reflecting reanalysis or monitoring began early enough to reduce the amplitude of the N400 in the near-homophone condition. This possibility is supported by a high correlation between the difference in size of the N400 and P600 effects in the unrelated and near-homophone conditions ($R=0.81$, $p<0.001$). A reduced N400 was only seen in the near-homophone condition for participants who also had a relatively large P600 effect.

Our results do not, therefore, provide convincing evidence for phonological pre-activation in lexical prediction, and instead demonstrate that when participants read an unexpected word that is related phonologically to a highly predicted word, they may reanalyze or monitor their interpretation of the sentence, leading to a post-N400 P600 effect. However, more data is needed in order to draw firm conclusions about the source of the reduced N400 seen.

Table 1: Sample item set

Pre-critical region	
Sandra looked out at the ocean as she walked along the sandy…	
Condition	**Critical word and end of sentence**
Predicted:	…**beach** that day.
Near-homophone	…**beef** that day.
Unrelated:	…**lime** that day.



(a) Predicted = black, Near-homophonic = red, Unrelated = blue

(b) Unexpected minus predicted words

(c) Near-homophone minus predicted words

Figure 1: Experiment results, N=14. (a) gives the ERP at the Cz electrode for the critical word. (b) and (c) are scalp maps showing the effect of the unexpected (b) and near-homophone (c) conditions relative to the predicted condition in the N400 and P600 time windows (300–500ms and 500–800ms).

References

[1] DeLong, K. A., Urbach, T. P., & Kutas, M. (2005). *Nature Neuroscience*. **[2]** Kaan, E., & Swaab, T. Y. (2003). *Journal of Cognitive Neuroscience*. **[3]** Kolk, H., & Chwilla, D. (2007). *Brain and Language*. **[4]** Lau, E. F., Namyst, A., … Delgado, T. (2016). *Collabra*. **[5]** Nieuwland, M. S., Politzer-Ahles, S., … Huettig, F. (2018). *eLife*.