An alternative approach to defining cross-linguistic phonological similarity using a model of monolingual speech recognition

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Cross-linguistic word pairs that overlap both in meaning and in phonology are known as cognates. Bilinguals have been found to recognise, produce and translate cognates faster than non-cognates. One method to define cognateness is to present unfamiliar foreign words to monolingual participants and ask them to guess the equivalent translation in their native language. Under this method, words that are correctly translated by a high number of participants (*e.g.* more than 50%) are classified as cognates. This method for defining cognates is informative but time-consuming as it requires behavioural data to be collected for each word. Another common method is by computing Levenshtein distance (Levenshtein, 1966), which takes the minimal edit distance between two strings. Levenshtein distance and other computed measures are simple to apply across many word pairs. However, these measures only rely on surface similarity and do not take into account additional factors of spoken word recognition such as lexical frequency, neighbourhood density and position of phoneme matches that are captured by behavioural measures.

The aim of our study is to explore the use of a computational model to predict participants' behavioural response on such tasks, integrating the key advantages of behavioural and computed approaches to defining cognateness. The TRACE model (McClelland & Elman, 1986) is a model of monolingual spoken word recognition trained using an English lexicon. Transcriptions of Spanish and Catalan words will be applied to the TRACE model using its Java re-implementation jTRACE (Strauss, Harris, & Magnuson, 2007). We will test the model's success at predicting English monolinguals' phonology-based translation of foreign words by comparing the generated output against behavioural data. Data was collected from monolingual English speakers who heard Spanish or Catalan words in isolation, and were asked to guess the English translation. 31 participants translated Spanish words (each participant saw 103 trials), and 33 participants translated Catalan words (86 trials). We will utilise two continuous measures in our analysis - the activation values of a given output word in jTRACE and the percentage of human participants who produce the output word as their response to a given cue word. The correlation between these measures will be used to judge the effectiveness of jTRACE in modelling human data.

Given no prior knowledge of the test language, participants are expected to rely on phonological similarity between the presented word and words in their native language as the primary answering strategy. We make the prediction that the higher the phonological similarity between a presented word and a given word in English, the more likely it is that participants will produce that English word as their response. However, if multiple words share strong phonological similarity with the presented word, participant answers are expected to be spread across these words. Therefore, given the same degree of phonological similarity, a word in a dense neighbourhood should be less likely to be produced as a response than one in a sparse neighbourhood. These interacting parameters of phonological similarity and competition from neighbours are implemented in the TRACE model. Studying these parameters in the context of monolingual recognition of foreign words will allow us to better understand how unfamiliar words are processed in relation to the existing lexicon. By building on the TRACE model, we aim to develop a computed definition of cognateness that is: (1) relatively easy and inexpensive to compute, (2) easily extended to new word pairs, and (3) takes into account the mix of phonology and neighbourhood density that influence the recognition of auditorily-presented cognates.

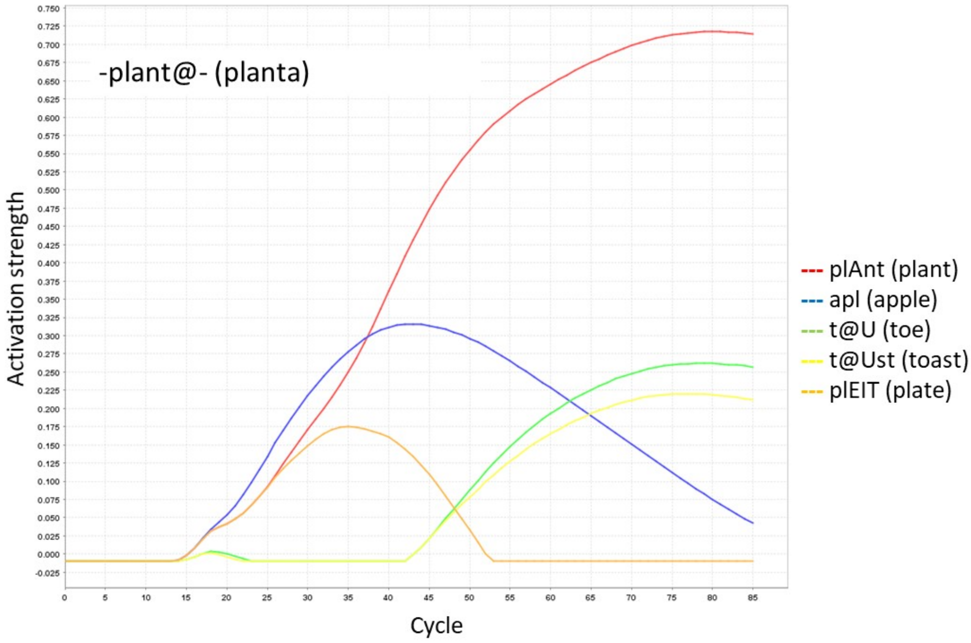

Figure 1: jTRACE graph output for the Catalan word “planta" (plant@) with the dominant activated word English “plant" (plAnt).

References

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