THE CONNECTIONIST APPROACH TO PHONOLOGICAL ENCODING: EVIDENCE FROM MANDARIN SPEECH AND APHASIC ERRORS

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The pioneering studies by Fromkin (1973) and Garrett (1988) suggest that the process of speech planning can be viewed as a series of stages, each devoted to a specific level of linguistic planning. This *serial* approach predicts that a speech error only occurs at a distinct level of speech production planning, with other levels unaffected. However, other researchers propose *parallel* models of production, where multiple levels of processing take place simultaneously (e.g., Dell 1988). This parallel approach thus predicts that a speech error occurring at one level may activate the processing at a different level.

The aim of this paper is to demonstrate that evidence from naturally-occurring speech errors as well as aphasic errors in Mandarin favors the connectionist approach advocated in Dell's interactive spreading activation models over the serial order mechanisms employed by Garrett. Analysis of a total of 1500 errors by Mandarin aphasic patients (2 Broca, 3 Wernicke, and 2 mixed) and 4500 speech errors by native speakers of Mandarin, all collected by the author's research team in naturalistic settings, support the following four findings.

First of all, phonological segments are the fundamental units that are manipulated during phonological encoding in processing since phonological errors involving single segments range from 71% in speech errors to 81% in aphasic errors. This finding is compatible with both Garrett's and Dell's models.

Secondly, the fact that substitution errors outnumber addition errors, which in turn outnumber omission errors, faithfully reflects the universal structure of language, as in both the serial order models and the connectionist models, substituting one segment for another causes less disruption in the phonological structure than the other two types.

Thirdly, phonological substitution errors show that the similarity of segments, as defined by the number of shared features, affects the frequency with which two segments are mutually involved, i.e., segments which are phonetically more similar are more likely to interact. 56% of speech errors and 54% of aphasic errors show that the target and error segment share all but one feature. In addition, similarity effects also occur in lexical substitution errors, out of which 89% in speech errors and 92% in aphasic errors show a semantic connection and 45% of all cases also show a phonological connection. However, malapropisms with a purely phonological relationship are rarely. Here Dell's parallel activation model provides a better account in terms of feedback from the phonological nodes to the semantic nodes, since the model allows separate representations of the intended message to work in parallel. A serial order model has difficulty in explaining for why phonological similarity effect occurs in lexical substitution errors.

Finally, in single substitution errors where one segment substitutes for another, 98% of

speech errors and 91% of aphasic speech observe syllable structures in that consonants replace consonants and vowel replaces vowels. Errors involving consonant-vowel substitution are rare. Furthermore, there is clear evidence of constituent structure in both error corpora, favoring the onset-rhyme division. Dell's model, which predicts more VC errors than CV in the structure, again affords a better account.

While Dell's parallel activation model fares much better as far as our data are concerned, it does have difficulty resolving the following conflicting findings. In naturally-occurring errors by Germanic adult speakers, anticipatory errors dominate perseverative errors (e.g., Stemberger 1989). Yet, the opposite is true in naturally-occurring errors by one-year-old children (e.g., Jaeger 2004) and by aphasic patients (Schwartz et al. 1994). This leads Schwartz et al. (1994) and Dell et al. (1997) to claim that a more mature or practiced speaker is more likely to plan ahead in longer chunks, thus causing previously activated items to be deactivated sooner. However, this preponderance of anticipatory errors is not found in non-Germanic languages. A possible explanation for this difference will be rendered in relation to the different syntagmatic organizing status in tone and stress languages.

In conclusion, Dell's parallel activation model correctly predicts the bidirectional interaction between semantic and phonological representations, evidenced by speech and aphasic errors that exhibit both phonological and semantic properties simultaneously. This connectionist approach is especially 'economical' for the representation of principles of parallel processing in the generation of speech. In general, Dell's model of phonological encoding has better explanatory power over Garnett's serial models for the range of Mandarin speech and aphasic errors considered.

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