First Letter Dominance in Word Recognition

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Introduction

Current neural network models of word recognition claim that all letters in a word are used in parallel to build up activation. This disagrees with the dictionary model of word recognition, which claims that people use letters serially from left to right.

This study uses a letter deletion technique to examine the importance of each serial position in a word. Neural network models would predict that each letter deletion will impact the naming time similarly, while the dictionary model predicts that the letters are ordered in importance, with a monotonic decrease over serial positions.

Methods & Results

Eight expert readers (7 graduate students and a professor) were placed in front of a CRT and shown 120 different seven-letter words. Each of the 120 words appears eight times; once intact and with each of the letters serially removed and replaced with an underscore. The 960 words were printed in capitals in a width-constant font (courier), and were presented in random order. An example is shown in Figure 1.

_NTROPY	ENTR_PY
E_TROPY	ENTRO_Y
EN_ROPY	ENTROP_
ENT_OPY	ENTROPY

Figure 1: The eight conditions of a stimulus

Subjects were told that many of the words would have a missing letter and that their task was to name the word in its completed form. The subject's naming latency was recorded with the timer beginning at the onset of the stimulus presentation and ended at onset of vocalization. The stimulus stayed on screen until the word was named. All words were hermits and could only be completed one way.

For each subject we found a median naming latency for each of the deletion conditions. Figure 1 shows the average reaction time for all subjects at each segment deletion condition and the intact condition. When the initial letter is deleted, subjects are slowest to name the words, but when other positions are deleted there are only the slightest of differences.

Subjects take longer to name a word when a letter is deleted (Mean = 590ms) than when a word is intact (Mean = 542ms). This difference is statistically reliable, $t(7) = 6.34$, $p < .001$. Fisher's post-hoc test comparing all pairs showed a reliable difference, $p < .05$, between the first position deletion and each of the second through seventh positions. There were no reliable differences found between any of the second through seventh positions.

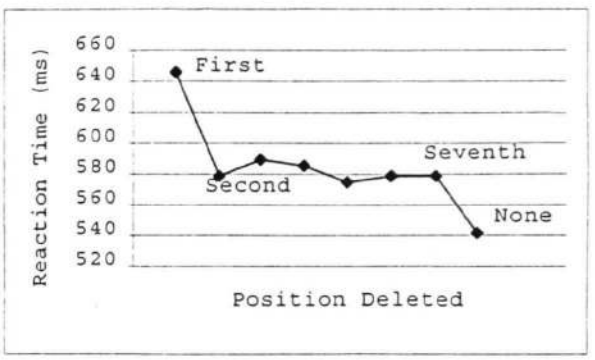

Figure 2: Naming latencies of words with a letter deleted

Discussion

The experiment revealed a large, consistent difference between the first and second position, and almost no difference between the second through seventh positions. Words are about 10% slower to recognize if their first letter is missing than if any other letter is missing. This finding is not predicted by either neural network models or by the dictionary model. It suggests that words are indexed by the first letter in the mental lexicon.

Spoonerisms are further evidence of first letter indexing. The most common form of Spoonerism is swapping the first letter of two words. No other single letter is ever moved in a Spoonerism, suggesting something unique about the first letter.

While neural network models do not predict first letter indexing, a model with the correct input representation should be able to simulate this data. If the representation of the first letter in the input layer of a neural network contains greater statistical regularity than any other letter position, than the first letter would take on an indexing function. Future input representations should be designed with this data in mind.

Reference

Larson, K. (1997). *The Effect of Segment Deletion on Word Recognition* (Unpublished Masters Thesis). Austin, TX: University of Texas at Austin.