Connectionist modelling of Chinese character pronunciation

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Introduction

Psychologists and cognitive scientists aim to understand the universals involved when the brain deals with written language. Seidenberg and McClelland's "triangle model" of the reading of monosyllabic English words has been substantially developed (e.g. Harm & Seidenberg, 1999), but with little application to languages other than English. Here we report our initial application of this approach to the reading of Chinese, a radically different orthography from English, illuminating processing universals in reading.

The granularity of Chinese orthography is a fundamental issue in modelling its pronunciation. The character is the unit of pronunciation. Several formats exist, but a central paradigm exists in which a *phonetic radical*, on the right, specifies pronunciation information, and a *semantic radical*, on the left, specifies information about meaning (Figure 1). Chen et al. (1996) argue that these radicals (plus any remaining sub-character material) are the functional processing units of Chinese reading. Therefore, the typical granularity is substantially coarser than that found in English orthography. Is there thus a principled architecture for modelling Chinese pronunciation that uses distributed representations in a non-trivial way? We resolve the issue by referring to the anatomy of the visual pathways.

Figure 1: A Chinese character.

The split fovea

In recent years it has become clearer that the human fovea – across which a fixated word is projected on the retina – is precisely vertically split: the left of a fixated word initially projects to the right hemisphere and the right to the left hemisphere (Shillcock et al., 2000). Our model reflects this observation (Figure 2). It is trained with a "fixation point" to the left, to the right, and in the middle of each character, so that each character is represented in three different positions. Thus, superpositional storage occurs within each half of the model, in a psychologically realistic way.

The split-fovea model of Chinese reading

Input units are localist representations of radicals. A model with 252 radicals on the right and 857 radicals on the left can represent 2163 different left-right structured characters. The input is mapped onto a feature-level phonological output. The necessary recurrence is implemented as "callosal" connections between the two sets of hidden units – a further reflection of anatomical reality.

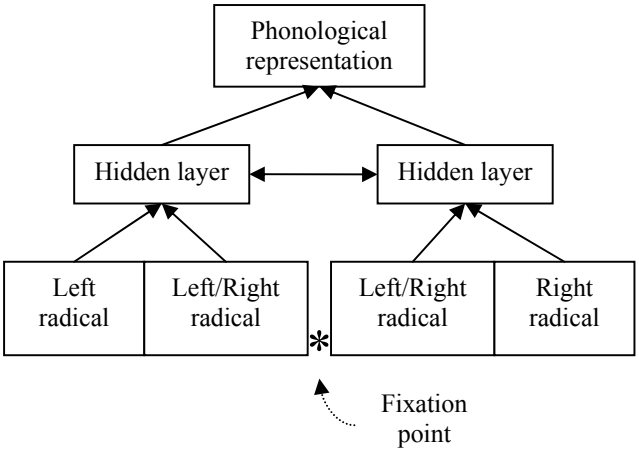

Figure 2: The split-fovea model of Chinese reading.

Discussion

The model allows principled superpositional storage of the relations between sub-character orthographic units in the pronunciation of the entire character. It enables us to model the core data from experiments with characters presented centrally and in a single hemifield.

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