



Orthography-phonology consistency in English: Theory- and data-driven measures and their impact on auditory vs. visual word recognition

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Abstract

Research on orthographic consistency in English words has selectively identified different sub-syllabic units in isolation (grapheme, onset, vowel, coda, rime), yet there is no comprehensive assessment of how these measures affect word identification when taken together. To study which aspects of consistency are more psychologically relevant, we investigated their independent and composite effects on human reading behavior using large-scale databases. Study 1 found effects on adults' naming responses of both feedforward consistency (orthography to phonology) and feedback consistency (phonology to orthography). Study 2 found feedback but no feedforward consistency effects on visual and auditory lexical decision tasks, with the best predictor being a composite measure of consistency across grapheme, rime, OVC, and word-initial letter-phoneme. In Study 3, we explicitly modeled the reading process with forward and backward flow in a bidirectionally connected neural network. The model captured latent dimensions of quasi-regular mapping that explain additional variance in human reading and spelling behavior, compared to the established measures. Together, the results suggest interactive activation between phonological and orthographic word representations. They also validate the role of computational analyses of language to better understand how print maps to sound, and what properties of natural language affect reading complexity.

Keywords Spelling-sound consistency · Sound-spelling consistency · Word naming · Lexical decision · Word recognition · Computational modelling

Introduction

The ability to recognize written representations of words is considered foundational for fluent reading acquisition

and comprehension. As a pivotal process in literacy word reading has been the focus of an extensive body of psycholinguistic research. For skilled adult readers, this research points to the well-specified representations of words' phonology, orthography, and meaning within the mental lexicon (Perfetti, 2007). While there is agreement that in order to acquire and master such decoding abilities readers must learn to map between orthography (print) and phonology (speech) (Verhoeven & Perfetti, 2017), the specific properties of writing systems that are most cognitively relevant to the reading brain have not been entirely spelled out.

Skilled readers of alphabetic languages are able to 'cipher' or decode known and unfamiliar words using acquired orthographic-phonological mappings (Ehri & Wilce, 1987), otherwise referred to as grapheme-phoneme correspondences (GPCs), where 'graphemes' refer to single letters or letter clusters that correspond to a single 'phoneme' or speech sound. Readers are also adept spellers, and so they have also acquired phoneme-grapheme correspondences (PGCs). To establish these mapping systems

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