



Are acronyms really irregular? Preserved acronym reading in a case of semantic dementia

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ABSTRACT

This paper describes the progressive performance of JD, a patient with semantic dementia, on acronym categorisation, recognition and reading aloud over a period of 18 months. Most acronyms have orthographic and phonological configurations that are different from English words (BBC, DVD, HIV). While some acronyms, the majority, are regularly pronounced letter by letter, others are pronounced in a more holistic, and irregular, way (NASA, AWOL). Semantic dementia at its moderate stage shows deficits in irregular word reading while reading accuracy for regular words and novel words is preserved. Nothing is known about acronym comprehension and reading ability in semantic dementia. Thus, in this study we explore for the first time the impact that semantic decline has on acronym recognition and reading processes. The decline in JD's semantic system led to increasingly impaired semantic categorisation and lexical decision for acronyms relative to healthy controls. However, her accuracy for reading aloud regular acronyms (i.e. those pronounced letter by letter such as BBC) remained near ceiling while reading irregular acronyms (i.e. those pronounced as mainstream words such as NASA) demonstrated impairment. It is therefore argued that consequences of semantic impairment vary across acronym types, a finding that informs our understanding of any reading account of this growing class of words.

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1. Introduction

The processes involved in single word reading have been the subject of extensive study in psychology, and investigations have identified a number of factors that can affect the ease with which words are read aloud such as frequency, age of acquisition, imageability and orthographic neighbourhood (Andrews, 1989, 1992; Brysbaert & Ghyselinck, 2006; Connine, Mullinex, Shernoff, & Yelen, 1990; Ghyselinck, Lewis, & Brysbaert, 2004; Izura et al., 2011; Mathey, 2001; Sears, Hino, & Lupker, 1995; Strain, Patterson, & Seidenberg, 1995). The present study is concerned with reading for a class of word which has not been considered in any great detail to date, and never in the context of neuropsychological presentation; acronyms (e.g. BBC, HIV, NASA). A small number of studies have shown that acronyms and other abbreviations are integrated alongside mainstream words in mental lexicon (Besner, Davellaar, Alcott, & Parry, 1984; Brysbaert, Speybroeck, & Vanderelst, 2009; Ganushchak, Krott, & Meyer, 2012; Prinzmetal & Millis-Wright, 1984) and that there are considerable similarities between acronyms and words with regard to semantic processing (Ganushchak, Krott, & Meyer, 2010;

Laszlo & Federmeier, 2007a, 2007b, 2008; Playfoot & Izura, 2013). Assuming this is the case and that acronyms fit in the same mental space as common words, it is likely that they are both processed by the same system, although the exact details of the processes underpinning acronym reading are still open to debate. The current study seeks to further contribute to this discussion.

An important characteristic of English words is that their pronunciation is not always predictable from their spelling. For some words the conversion from print to pronunciation is relatively straightforward (MINT, TINT, HINT, etc.) and can be inferred with sufficient knowledge of the spelling and sound conventions of the language. The rules governing spelling to sound conversion discussed in a great part of the psycholinguistics literature draw on the work by Venezky (1970). He grouped the written representation of sounds into 'graphemes' (a letter or combination of letters equivalent to one sound) and established two types of grapheme-to-phoneme correspondences; 'major' for those occurring with higher frequency and 'minor' for those occurring with lower frequency. As an illustrative example of Venezky's taxonomy, the pronunciation of 'ea' as in 'seal' was described as a major correspondence, while the pronunciations for 'ea' in 'steak' or 'bread' were minor correspondences. In most cases words can be pronounced accurately by assigning the major grapheme-to-phoneme correspondences. When a word can be read accurately by applying this rule it is described as being regular.

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However, a proportion of English words have pronunciations which deviate from the major grapheme-to-phoneme correspondences. Words (e.g. PINT) which cannot be read correctly following the set of rules for spelling to sound conversion are referred to as irregular.

A common finding in the literature is that words with irregular spelling to sound correspondences are named at longer latencies than regular words (e.g. Hino & Lupker, 2000; Jared, 2002). It has been argued that this reflects a difference in the way that regular and irregular words are processed. The dual route cascaded (DRC) model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) proposes two different methods (i.e. routes) to arrive at a pronunciation for a written word. Using the *lexical* route, the reader accesses the stored orthographic and phonological representations of the stimulus which guide them towards the correct pronunciation. Using the *non-lexical* route, the pronunciation of the stimulus is computed by the application of the major correspondences described by Venezky (1970). For irregular words the pronunciation outcome from the two methods is different and only the lexical route option would lead to the correct pronunciation. For non-words and unknown words there will be no stored representations available, hence the lexical route will not be able to offer any pronunciation and the non-lexical route must be used. An alternative view is offered by parallel distributed processing models (PDP, e.g. Harm & Seidenberg, 2004; Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989). In PDP theories, the conversion from orthography to phonology in all words is achieved by a single system based on patterns of pronunciation for word bodies. In irregular words pronunciation does not follow the general pattern, and input from the semantic system constrains the orthography to phonology pathway such that a less common pronunciation is generated.

A few recent studies have assumed that the unusual orthography and phonology of acronyms means that they are processed in a similar way to irregular words (Laszlo & Federmeier, 2007b, 2008). However, acronyms exhibit a pattern of regularity different to that observed by Venezky (1970) for mainstream words. Here we discuss “regularity” not as adherence to the major grapheme–phoneme correspondences (as is traditionally the case in word reading research) but as shorthand for “obeying a particular spelling to sound rule.” The rules relevant to acronym reading are not the same as those discussed above relating to words. Regular acronyms obey one rule: being pronounced by naming each letter aloud. Irregular acronyms are the rest (e.g. BAFTA, FIFA, etc). An additional consideration when establishing the pronunciation of acronyms is their orthographic structure. Those acronyms consisting of a combination of vowels and consonants introduce ambiguity at the time of pronunciation. A person unfamiliar with an acronym such as REM will not know whether the correct pronunciation is /rɛm/ or /ar i ɛm/. The evidence reported by Izura and Playfoot (2012) seems to indicate that people have little difficulty in reverting to letter by letter reading, especially when the characteristics of the stimulus preclude alternative pronunciation. If these newly defined criteria are implemented, then acronyms, too, can be described as either regular (as in BBC or HIV) or irregular (as in NATO) according to whether the letter by letter rule is followed. An extra factor to keep in mind is the ambiguity that the presence of vowels introduces in acronyms. Thus, regular acronyms can be unambiguous (e.g. DVD) or ambiguous (e.g. AOL) while irregular acronyms will always be ambiguous (e.g. UEFA).

In this paper, the issue of the regularity of acronyms is explored in the context of surface dyslexia as associated with semantic dementia, a progressive degenerative disorder of the semantic system characterized by a semantic impairment while other aspects of cognitive performance are preserved (Hodges, Patterson, Oxbury, & Funnell, 1992; Snowden, Goulding, & Neary,

1989). In semantic dementia, accessing the information that has previously been stored about words becomes increasingly difficult and categorisation and picture naming performance is adversely affected (e.g. Bonner et al. 2009; Hodges et al., 1992). Semantic dementia is also characterised by an increase in errors when reading aloud irregular words (particularly low frequency irregular words such as *suave*), while reading words with regular spelling to sound correspondences is preserved; a condition known as surface dyslexia. (e.g. Coltheart, Saunders, & Tree, 2010; Graham, Patterson, & Hodges, 2000; Mendez, 2002; Patterson et al., 2006; Rogers, Lambon Ralph, Hodges, & Patterson, 2004; Woollams, Lambon Ralph, Plaut, & Patterson, 2007). Surface dyslexic reading is accounted for in the DRC model by a failure in the lexical route and an over-reliance on the non-lexical route. The asymmetric performance of surface dyslexic patients, that is, good reading of regular words and poor reading of irregular words has been studied profusely and it is one of the key symptoms that discriminate surface dyslexia from other types of reading difficulties.

In contrast to the wealth of research on how dyslexics read regular and irregular words, no one study to date has examined the naming performance of dyslexic patients when reading acronyms. This is striking since a comprehensive view of a reading disorder such as dyslexia, should offer an account of reading performance for all types of words, including acronyms. Acronyms have an added interest since they exhibit a combination of regular and irregular features. Thus, different predictions can be generated depending on whether the attention is focused on the *irregular* orthographic structure of acronyms (compared to English words) or on their *regular* spelling and pronunciation patterns (based on letter naming rules). The examination of reading performance in semantic dementia is therefore essential.

Here we present the first longitudinal investigation of acronym processing in a case of semantic dementia. It is a meticulous examination of acronym reading where all types of acronyms described to date have been considered (Izura & Playfoot, 2012). These are: *regular*¹ ambiguous (e.g. HIV), regular unambiguous (e.g. PDF), and irregular, by definition always ambiguous (e.g. UEFA).

The adherence to a letter naming rule confers unambiguous acronyms (e.g. BBC) with a form of regularity that should facilitate reading in surface dyslexia. In contrast, ambiguous acronyms would be prone to error once the lexical route has degenerated such that it could not be used to determine the appropriate pronunciation. The decline in naming accuracy for ambiguous yet regularly pronounced acronyms (i.e. HIV) would be attenuated by their adherence to the letter naming rule system in the same way as regular word reading is preserved relative to irregular word reading. If, on the other hand, the irregular orthographic structure of acronyms determines the need for lexico-semantic input, then reading accuracy would be expected to decrease for all types of acronyms as the dementia progresses.

Using the performance of a semantic dementia patient as a means to assess acronym reading makes the assumption that recognition and comprehension processes are affected in the same way for both acronyms and mainstream words. Therefore JD was assessed on tasks relating to the semantic and lexical properties of acronyms.

The intention of the semantic categorisation task was to determine whether the semantic representations for acronyms had been damaged by the semantic dementia. The semantic categorisation task used in this study required that JD classified acronyms according to whether or not their meaning related to science and technology. In order to achieve this categorisation

¹ Izura and Playfoot (2012) actually refer to “typical” versus “atypical” pronunciations for acronyms. Here we have adopted regularity according to the rules describe earlier in order to keep the comparisons between word and acronym reading processes clear.

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