Learning to be a good orthographic reader

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Recent years have brought about rapid advances in our understanding of reading and how it develops, particularly in relation to the importance of alphabetic coding skills. However, much less has been known about the transition from alphabetic decoding to the rapid and automatic orthographic recognition of words, which is the hallmark of skilled reading. The purpose of this special issue is to focus specifically on orthographic processes in reading and how they are acquired. The present paper provides an overview of the special issue, drawing attention to key themes that run through the various contributions.

Huge advances have been made in recent years in our understanding of reading and how it develops. In particular, the centrality of alphabetic decoding skills is now accepted and is enshrined in reading education policy in several countries, including the United Kingdom (Department for Education and Skills, 2006) and the United States (National Institute of Child Health and Human Development, 2000). However, as teachers, practitioners and reading researchers are well aware, accurate and efficient reading, at least of English, involves considerably more than the assembly of pronunciations on the basis of spelling–sound correspondences: it involves the deployment of a rapid and flexible word recognition system that allows the reader to efficiently gain access to the pronunciations and meanings of all known words.

A clear picture has also emerged of what the nature of this skilled orthographic word recognition system might be. According to Perfetti (1992), it involves having fully specified internal representations. That is, the input code is sufficient to uniquely identify the word to be read without the necessity for discrimination between several competing partially activated candidates. Also according to Perfetti, there is autonomy in the orthographic word recognition process, such that it is effectively modular, and only very minimally influenced by factors other than the input code itself. Ehri (2005) argues that the orthographic word recognition process is also automatic and unconscious: it cannot be turned on and off, and is not subject to strategic control. The benefit of all of these characteristics of skilled orthographic word recognition, according to these authors, is that they allow conscious attentional resources to be directed fully, and without interruption, to the primary task of deriving meaning from text.
While, as is evident from the above, we have a reasonably clear depiction of what the outcome of successful orthographic learning looks like, much less has been known about how orthographic learning takes place, and what modulates the transition from the slow, effortful alphabetic decoding of words to their rapid and automatic orthographic recognition. In a recent review (Castles & Nation, 2006), we called for more research into these questions and emphasised the need for carefully designed experimental studies, both of the orthographic learning process and of skilled orthographic processing itself.

This special issue of the *Journal of Research in Reading* goes a long way towards filling the gap we identified at that time. It consists of nine articles that address a wide range of issues in orthographic processing and orthographic learning, and which do so using an even wider range of methodologies, many of which are extremely innovative. The research reported within these articles contributes an enormous amount to the body of knowledge on the orthographic reading process, in ways that cannot be fully canvassed here. Nevertheless, we can point to three broad themes that, together, run through all of the articles, and that we feel capture the essence of what will undoubtedly be an important volume. Let us expand on each of these themes in turn.

**Developing novel ways of measuring orthographic learning**

One of the factors that has arguably had a limiting effect on research into the orthographic learning process has been the difficulty of developing valid and reliable measures of this learning. How do we decide when a word is being read orthographically, as opposed to via alphabetic decoding skills? How do we document the process of change? The most widely used measures to date have been versions of the orthographic choice task, such as that used by Share in his influential self-teaching experiments (Share, 1995, 1999, 2004). Here, a target newly learned word, such as *yait*, is presented alongside a homophone foil, such as *yate*. As sounding out both items alphabetically will produce the same phonological output, and so not be of assistance, it is assumed that the child will need to have acquired an orthographic representation of the new word in order to respond correctly. Another approach has been to ask the child to spell the new word, on the basis that a correct spelling can only be produced if an accurate, fully specified orthographic representation has been formed.

Although both of these measures have been extremely useful, they are also limited in several ways. They do not capture the rapid and automatic aspects of processing thought to be characteristic of skilled orthographic reading and, particularly in relation to the orthographic choice task, may be open to a wide range of strategic influences. Indeed, the orthographic choice task involves presenting the reader with two alternative words with the same phonology at the same time, which is potentially confusing and which may actually disrupt the normal process of word recognition. And while spelling does require access to fully specified representations, there has been considerable debate within the field as to the degree to which this access process, and the associated representations, can be assumed to be the same as those used for reading (Funnell, 1992; Holmes & Barbauta, 2005).

Several papers in this issue offer promising alternatives to these more standard tasks. Martens and de Jong (2008) introduce the possibility of indexing the orthographic word recognition process in terms of a reduction in the word length effect. The length effect refers to the observation of increased response times as a function of the number of letters
in a word or nonword, and has been interpreted as an index of sequential alphabetic decoding. Accordingly, the absence of a length effect in a set of words can be seen as an indication that orthographic knowledge for these words has been established. Although Martens and de Jong (2008) do not find evidence for a modulation of the length effect over repeated readings in their study, this approach certainly warrants further investigation.

McKague, Davis, Pratt and Johnston (2008) draw on a widely used method in adult psycholinguistic research in indexing orthographic learning in terms of masked priming. In this procedure, a prime is presented briefly before the presentation of a target word. The brevity of the prime means that participants are rarely able to report it, and it is not open to slow decoding or strategic influences. Thus, any facilitation produced by the prime is assumed to reflect the fact that the prime has rapidly and automatically activated the orthographic representation for the target word (see Forster, Mohan & Hector, 2003). In their study, McKague et al. (2008) teach adults new words, in either oral or written form, and examine the nature and extent of their orthographic learning by examining facilitation in responding to these newly learned items from different types of prime. This is an innovative approach, which could potentially be extended to research with developing readers, because children as young as 7 years have been shown to display robust masked priming effects (Castles, Davis, Cavalot & Forster, 2007; Castles, Davis & Letcher, 1999).

Finally, Pitchford, Ledgeway and Masterson (2008) take a different approach again, by examining the effect that orthographic learning appears to have on a much lower-level process – the coding of visual letter position. Using a visual letter search task, they show that search latencies are affected by a left-to-right scanning process and also by positional letter frequency. This opens up the possibility that, with further extension of their work, we may ultimately be able to index the extent of individual orthographic learning by looking at the degree to which the effects of this learning are evident in more low-level tasks.

**Specifying the mechanisms that play a role in orthographic learning**

In Castles and Nation (2006), we emphasised the need for researchers to further dissect the process of orthographic learning itself, uncovering the role played by different factors as individuals progress from alphabetic decoding to the skilled recognition of new words, rather than examining their influence after such a transition has occurred. Share’s self-teaching experiments represent an excellent example of such an enterprise, demonstrating the centrality of alphabetic decoding in orthographic learning (Share, 1999, 2004). However, Share’s experiments themselves show that there is considerable variance in orthographic learning not explained by decoding ability, and there would therefore seem to be a need to look to other influences.

Several researchers whose work is reported in this issue have taken up this challenge. Shahar-Yames and Share (2008) examine the possibility that spelling may play an important role in the acquisition of orthographic knowledge based on the idea that, like decoding, it requires close attention to letter order and identity as well as word-specific spelling–sound mappings. In support of this hypothesis, they show that third grade Hebrew readers show superior orthographic learning for novel letter strings that they have been required to spell compared with those they have been required to read. The paper by Holmes, Malone and Redenbach (2008) also demonstrates the close reciprocity between spelling and orthographic processing.
Ricketts, Bishop and Nation (2008), Burt and Blackwell (2008) and McKague et al. (2008) all explore aspects of the effects of consistency on the orthographic learning process. Burt and Blackwell exposed adults to novel words containing either consistent or inconsistent mappings between orthography and phonology. Consistent novel words were easier to learn than inconsistent novel words, and were better spelled at post-test. Ricketts et al. (2008) observed exactly the same effect in children: those items trained with consistent pronunciations (e.g. TROM to rhyme with ‘prom’) were easier to learn than the same items trained with inconsistent pronunciations (e.g. TROM to rhyme with ‘home’). At post-test, consistent items were easier to spell, and were more likely to be recognised correctly in an orthographic choice task. While Burt and Blackwell and Ricketts et al. manipulated feedforward consistency – the consistency of orthography → phonology mappings, McKague et al. explored the hypothesis that feedback consistency from phonology → orthography plays a role in orthographic learning. They argue that during learning, feedback from phonology provides the necessary glue to bind associations between orthographic input and phonological form, refining the perception of the orthographic code and helping to build an autonomous orthographic representation.

Burt and Blackwell raise the possibility that semantic information may serve to scaffold the process of orthographic learning. In their experiment, novel words were always presented alongside their definitions, leaving open the possibility that learners may draw on this information when learning new orthographic forms. Ricketts et al. addressed this issue by comparing orthographic learning in helpful compared with unhelpful contexts. They reasoned that the semantic cue provided by helpful context may be most useful when children are learning novel orthographic forms that have inconsistent pronunciations. In fact, orthographic learning was equivalent for words learned in helpful compared with unhelpful contexts, and this was equally true for consistent and inconsistent forms. Ricketts et al. also included a post-test that assessed semantic learning – whether children had learned the meaning of the novel words. Not surprisingly, semantic learning was enhanced for those words learned in helpful rather than unhelpful contexts.

Finally Byrne et al. (2008) introduce the idea of a general learning mechanism that might underlie not only the acquisition of orthographic representations but also the ability to acquire spelling and decoding skills. In a genetically informative twin-study design, Grade 2 children were measured on their performance on an orthographic learning task (modelled on the Share procedure), as well as on spelling and decoding. Multivariate analyses revealed very high genetic correlations among the three variables, indicating that the same genes are involved in their aetiology. Intriguingly, a further analysis revealed that the genetic covariation between decoding and orthographic learning was best explained by common genes rather than by a direct causal path from decoding to orthographic learning. As the authors conclude, this pattern is consistent with the proposal of a basic, genetically determined learning parameter affecting performance on all tasks. As well as providing valuable data on the question of self-teaching, this paper nicely illustrates the power of behaviour-genetic data in exploring the complex causal relations between processes involved in orthographic learning.

Exploring orthographic processing in special populations

Examining orthographic processing in skilled adult readers, or even young normally developing readers, is extremely challenging. As discussed, skilled readers recognise
words so quickly and automatically that obtaining a window on this process often involves recourse to procedures like masked priming or perceptual identification. And although developing readers are still in the process of acquiring orthographic representations, so there is more scope to observe their processes of learning, there is evidence that they acquire such representations extremely quickly, perhaps in some cases after only one exposure to a new word (Nation, Angell & Castles, 2007; Share, 2004). For this reason, some researchers have turned their attention to special populations, where certain aspects of literacy have not been acquired normally, with a view to understanding more about normal orthographic processing by examining in detail what happens when certain key processes are not functioning well.

Ricketts et al. (2008) take this approach in exploring orthographic and semantic learning processes in poor comprehenders – children who experience difficulties with reading comprehension despite age-appropriate reading accuracy. Interestingly, a group of 9–10-year-old poor comprehenders were no worse than age-matched control children in their ability to acquire new orthographic representations. However, while the poor comprehenders showed equivalent semantic learning to the controls immediately after exposure to the meanings of new words, this knowledge was not well retained over time. The authors conclude that poor comprehenders are able to make some links between new words and their orthographic and semantic properties, but that they have difficulty developing the rich and durable semantic representations that are required for skilled reading for meaning.

Holmes et al. (2008) focus on unexpectedly poor spellers in the adult population, who do not differ from controls on reading accuracy but who are poorer at producing correct spellings of words that they can read. A group such as this, selected from a university student population, illustrate that individual differences in aspects of orthographic processing skill can be identified right across the age and ability spectrum. Holmes et al. (2008) compare their two groups on visual memory tasks and find limited evidence for deficits in the poor speller group, suggesting that this skill does not have a significant role to play in the acquisition of precise orthographic representations used for spelling. However, they find that poor spellers do perform worse than controls on subtle measures of orthographic processing in reading: they are slower at categorising words and at detecting letter transpositions in long words. These results point to a close reciprocity between reading and spelling ability and suggest that researchers need to be looking at more subtle aspects of word reading when thinking about apparent dissociations between reading and spelling.

Kohnen, Nickels, Brunson and Coltheart (2008) take the issue of orthographic learning out of the laboratory and into the classroom. They present the case of K. M., an 8-year-old girl with very poor spelling. They systematically trained two different spelling rules and examined patterns of generalisation to novel and untrained words. As well as demonstrating the utility of specific and highly focused interventions, the approach adopted by Kohnen et al. provides a window on orthographic learning in a more naturalistic environment. One unexpected finding was that although trained spelling patterns generalised rapidly to nonwords containing those sounds, generalisation to untaught real words that shared the same spelling pattern was delayed. Kohnen et al. suggested that this may be a consequence of faulty feedback from the orthographic lexicon, that has existing but incorrect knowledge about a word’s spelling. This is an interesting observation that highlights the need for research to address how orthographic knowledge becomes reorganised as a function of training and experience.
Conclusions

The research reported in this special issue demonstrates that inroads are being made in solving the puzzle of orthographic learning. Particularly encouraging is the diversity of approaches that have been taken to the problem and the converging findings that have emerged across these different approaches. But clearly there is much more still to be done, and we expect that the next few years will produce some powerful new research in this domain.

There are several directions that we see as being particularly promising for future research. Firstly, we feel it is important that orthographic learning be viewed as a life-long process that continually develops and shapes over time. Even in adulthood, new words are regularly learned, and indeed the learning of new forms may have an effect on the processing of those that are already in existence (e.g. Bowers, Davis & Hanley, 2005). Therefore, future research might benefit from examining the orthographic learning process in a more gradual and continuous manner, rather than relying as it frequently does on data from designs involving a pre-test, limited exposure and then a post-test. Research with artificial orthographies may prove fruitful here, as they permit precise experimental control over factors like consistency and frequency, and allow close observation of the gradual acquisition of new representations over time. Findings from such studies could then be tested in research with children, to determine whether they apply to the orthographic learning of natural language.

A second fruitful area of inquiry may involve further exploration of orthographic learning in non-English orthographies. Most of the studies in this issue were concerned with English (with the exception of the Martens & de Jong and Shahar-Yames & Share papers). However, the findings from many would generate questions and predictions about orthographic learning in other orthographies. For example, one wonders about the extent to which the general learning mechanisms highlighted by Byrne et al. (2008) are implicated in languages where the relationship between orthography and phonology is more transparent. Similarly, the strong effects of consistency on orthographic learning reported in both Ricketts et al. (2008) and Burt and Blackwell (2008) would lead one to suggest that the acquisition of orthographic representations themselves, not just the ability to decode, should be easier and occur earlier for children learning to read more transparent languages than for those learning to read languages such as English.

Finally, we think that there will be great benefit in drawing closer connections between the developmental literature and the skilled word recognition literature when exploring orthographic processing and orthographic learning. Much of the developmental research to date has focused on identifying predictors of orthographic reading, typically in correlational designs, and has tended to place less emphasis on the mechanisms of orthographic learning. In contrast, the skilled word recognition research has tended to be more precise and explicit about mechanisms of orthographic reading, but has been less effectively applied in a developmental context. By drawing from each of these sources, we may soon have some answers to the question of how indeed we learn to become good orthographic readers.

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