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1980–2026: Evidence of Awareness of Orthographic Issues

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A chronological review of the research base on orthographic knowledge, orthographic processing, and spelling difficulty

Given the difficulties in orthographic processing that have been evidenced in spelling difficulties over the last 46 years, why has teaching been limited to phoneme to grapheme correspondence only, and why have children been told to take each sound in turn all through a word, which trains them to identify single phonemes only, thus entrenching their difficulties identifying patterns in print and words as a whole?

1980

Frith, U. (1980) (Ed) *Cognitive Processes in Spelling.* New York: Academic Press

Frith noted that spelling difficulties remain long after reading difficulties are remediated.

1985

Treiman, R. (1985) Onsets and rimes as units of spoken syllables: Evidence from children. *Journal of Experimental Child Psychology*, 39, 161–181

1986

Goswami, U. (1986). Children's Use of Analogy in Learning to Read: A Developmental Study. *Journal of Experimental Child Psychology*, 42, pp 73–83.

In the 1980s Treiman and Goswami established the importance of the intra-syllabic unit (onset and rime) and reasoning by analogy. In the 1990s when the whole language approach to teaching reading and spelling was prevalent, the approach to teaching phoneme-to-grapheme correspondence was incidental. Similarly, at this time the development of awareness of onset and rime patterns and reasoning by analogy was also taught incidentally through reading, and was not systematic, structured and sequential. With the move to systematic phonics in the 2000s the importance of teaching phoneme-to-grapheme correspondences systematically was recognised, but there was failure to recognise that systematic teaching of onset and rime patterns was also required.

It has been a weakness in the interpretation of the phonological deficit (what we can hear) that it was not recognised that establishing letter-to-sound correspondences requires the development of orthographic knowledge (what we can see). In a complex orthography with multiple mappings from sound to spelling, teaching must include links to orthographic onset and rime patterns, syllables and whole words as well as establishing phoneme-to-grapheme correspondences.

Children who can use reasoning by analogy effectively without structured teaching of onset and rime patterns, are children who have good orthographic processing skills. They can acquire this knowledge from implicit learning when reading. Children with poor orthographic processing skills cannot acquire this knowledge implicitly and require explicit teaching. The systematic teaching of onset and rime patterns cannot be achieved through learning to read but can be effectively and systematically taught though learning to spell as demonstrated by McMurray (2004). *Learning to Spell*. Development and Evaluation of a Spelling Programme for Key Stage 1. Ph.D thesis, School of Education: Queens University, Belfast. $p<0.0001$, effect size 1.19

1990

Adams, M.J (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Adams (1990) in her seminal review of beginning reading, made the case for teaching phonics at orthographic levels as well as the alphabetic level, stressing the benefits of onset and rime for learning vowel sounds which she described as notoriously difficult when learned in isolation. She advised that vowel sounds are more stable within rime patterns.

1993 **Bowers, P.G and Wolf, M. (1993). Theoretical links among naming speed, precise timing mechanisms and orthographic skill in dyslexia. *Reading and Writing: An Interdisciplinary Journal* 5:69–85, 1993. The Netherlands: Kluwer Academic**

Bowers and Wolf noted difficulties in orthographic skills.

1993 **Willows, D. M., & Terepocki, M. (1993). The relation of reversal errors to reading disabilities. In D. M. Willows, R. S. Kruk, & E. Corcos (Eds.), *Visual processes in reading and reading disabilities* (pp. 31–56). Lawrence Erlbaum.**

'*In describing the spelling of visual dyslexics it is common for clinicians to observe that "it doesn't look like English." This observation reflects the fact that visual dyslexics have greater difficulty learning the orthographic patterns of the language*'. Page 38

1993 **Treiman, R. (1993) *Beginning to Spell: A Study of First Grade Children.* Oxford University Press**

1994 **Treiman, R (1994) 'Sources of Information used by beginning spellers', in Brown, G.D.A. and Elllis N.C. (Eds) *Handbook of Spelling: Theory, Process and Intervention*. Chichester: John Wiley & Sons Ltd.**

In analysing the errors made by beginning spellers, Treiman (1993) noted that children use a variety of sources of information drawing on their pre-existing and developing knowledge. This developing knowledge includes information about phonological forms of spoken words, the names of letters and the sequences of letters that make up printed words. From this evidence Treiman (1994) argued that it is unlikely that spelling development progresses through a series of qualitatively distinct stages in which different sources of knowledge are used. According to Treiman (1994), it is more likely that development is continuous, reflecting gradual improvements in children's phonological and orthographic knowledge.

1994 **Lennox, C. and Siegel, L.S (1994) 'The Role of Phonological and Orthographic Processes in Learning to Spell', in G.D.A. Brown and N.C. Ellis. (Eds) *Handbook of Spelling: Theory, Process and Intervention*. Chichester: John Wiley & Sons Ltd.**

Lennox and Siegel (1994) identified three groups of young readers: 'good readers/good spellers', 'good readers/poor spellers', 'poor readers/poor spellers'. The group of children who are 'good readers/poor spellers' do not benefit from implicit learning when reading and fail to develop the orthographic knowledge needed to spell correctly. Lennox and Siegel (1994) found that children with normal spelling abilities (i.e., 'good readers and good spellers') develop visual skills and the use of analogy implicitly from exposure to print 'in tandem' with phonological skills. However, Lennox and Siegel found that those children who were 'poor spellers but good readers', were able to use phonological skills in their spelling but had difficulty choosing the correct orthographic representation of a word from the phonologically accurate alternatives. This difficulty was due, they asserted, to deficits in visual memory and lack of awareness of orthographic patterns.

As Lennox and Siegel identified that there is a group of good readers who are unexpectedly poor spellers, this research provides evidence that orthographic processing difficulties are not 'downstream' as a result of poor reading as suggested by Holden et al (2024: p25),

'*further research is required to differentiate the most likely risk factors for dyslexia from secondary factors affecting prognosis, some of which may be downstream effects of poor reading, such as difficulties in orthographic processing.*' *Holden, C., Kirby, P., Snowling, M.J., Carroll, J., & Thompson, P.A. (2024) forthcoming. Towards a consensus for dyslexia practice: Findings of a Delphi study on assessment and identification. osf.io/preprints/edarxiv/g7m8n*

1994 **Brown G.D.A & Elllis N.C. (1994) Issues in Spelling Research: An Overview in Brown G.D.A, Elllis N.C, (Eds) *Handbook of Spelling: Theory, Process and Intervention.* John Wiley and Sons Ltd**

Brown and Ellis (1994) pointed out that children can have awareness of rhyme patterns in spoken language but have insufficient experience of them in written form. They stressed the importance of ensuring that the written form of the sounds which we can identify in spoken language are developed at compatible levels with print.

1996 **Stothard, S. E., Snowling, M. J., Hulme, C. (1996) Deficits in phonology but not dyslexic? *Cognitive Neuropsychology*. Vol. 13, No. 5. pp. 641–672.**

Stothard, Snowling and Hulme (1996) reported the case of LF. LF was unable to establish phoneme-to-grapheme correspondences and could not read non-words, yet she learned to read and spell at a normal rate. LF learned to read by developing mappings between orthography and coarse-grained phonological representations. She recognised groups of letters that represented groups of sounds without being able to identify the individual phonemes within these groups.

2006 **Breznitz, Z. (2006). *Fluency in Reading. Synchronization of Processes*. New Jersey: Lawrence Erlbaum Associates**

Children with dyslexia have difficulty with automatic word recognition due to difficulties establishing unitised orthographic patterns.

2011 **Fernandez, G., Vaquero, Jimenez, L. and Defior, S. (2011) Dyslexic children show deficits in implicit sequence learning, but not in explicit sequence learning or contextual cues. *Annals of Dyslexia*, 61, pp. 85–110.**

Children with dyslexia require explicit teaching because they cannot learn implicitly.

2019 **Treiman, R., Kessler, B., & Caravolas, M. (2019). What methods of scoring young children's spelling best predict later spelling performance? *Journal of research in reading*, 42(1), 80–96.**

'*Overall, our results show that the scoring of children's spellings for correctness allows for good prediction of their future spelling success and this is true from a surprisingly early point in development*' page 94.

'*As early as the end of Reception Year, time 2, correctness was a significantly better predictor than the phoneme-based binary measure, phonological plausibility.*'

For clarity, in the quote above 'time 2' was the second testing point which was at the end of the reception year.

2020 **McMurray, S. (2020) "Learning to spell for children 5–8 years of age: the importance of an integrated approach to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels". *Dyslexia*, 26:4, 442–458**

The paper's central position is that alphabetic knowledge: knowing letters and the single phonemes they represent is what phoneme-grapheme correspondence (SSP) teaches, consequently, the ability to recognise and recall letter patterns that represent larger units of sound is left to implicit learning from reading. Children who have difficulty identifying onset and rime patterns and syllables from reading experience develop entrenched spelling difficulties if orthographic patterns are not systematically taught within the optimum period for development.

The paper proposes that 5–8 years of age may be the optimum period for connecting phonemic, orthographic and morphemic knowledge.

2021 **Georgiou, G.K., Martinez, D., Vieira, A.P.A. & Guo, K. (2021) Is orthographic knowledge a strength or a weakness in individuals with dyslexia? Evidence from a meta-analysis. *Annals of Dyslexia*, 71:5–27. https://doi.org/10.1007/s11881-021-00220-6**

According to Georgiou et al. (2021) children with dyslexia have an orthographic knowledge deficit that is as large as that of the phonological processing and rapid automatised naming (RAN) deficits.

2021 **Mather, N., & Jaffe, L. (2021). Orthographic knowledge is essential for reading and spelling. *Reading League Journal*, 2(3), 15–25.**

'*Readers with a weakness in the ability to process orthographic information are less likely to perceive the orthographic pattern initially; thus, no stable memory for the letter sequence is established. Subsequently, when they see a word, even if they have seen it multiple times before, that word does not register as familiar or activate its pronunciation. Consequently, they depend on sounding out words for identification, acquire sight words more slowly, read less fluently, and spell words phonetically.*' Page 16

2021

Zarić, J., Hasselhorn, M., & Nagler, T. (2021). Orthographic knowledge predicts reading and spelling skills over and above general intelligence and phonological awareness. *European Journal of Psychology of Education*, 36(1), 21–43. https://doi.org/10.1007/s10212-020-00464-7

Zarić et al's (2021) research, which was conducted in German, a regular orthography which like English has long syllables, provides evidence that longer syllables make spelling harder, and that even when phoneme-to-grapheme correspondence is one-to-one, it is insufficient for the development of orthographic knowledge for reading fluency and spelling.

2026

McMurray, S., Morrow, M. & Bower. P (2026) An examination of the orthographic and phonological spelling knowledge observed in a sample of independent writing completed by 267 children with specific literacy difficulties. *Frontiers in Education.* Volume 10 – 2025 | https://doi.org/10.3389/feduc.2025.1641126

This paper provides evidence that for children who cannot acquire orthographic knowledge implicitly from reading experience, teaching phoneme to grapheme correspondence only, does not develop the orthographic knowledge needed for automatic sight word recognition, spelling accuracy and reading fluency.
