

## Special issue editorial

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DOI:

[10.1111/1467-9817.12346](https://doi.org/10.1111/1467-9817.12346)

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Peer reviewed version

*Citation for published version (Harvard):*

Breadmore, HL, Levesque, K & Deacon, SH 2021, 'Special issue editorial: advances in understanding the role of morphemes in literacy development', *Journal of Research in Reading*, vol. 44, no. 1, pp. 1-9.  
<https://doi.org/10.1111/1467-9817.12346>

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**Special Issue Editorial: Advances in understanding the role of morphemes in literacy development**

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Cite as: Breadmore, H. L., Levesque, K., and Deacon, S. H. (2021) Special issue editorial: Advances in understanding the role of morphemes in literacy development. *Journal of Research in Reading*, 44. 1– 9.

<https://doi.org/10.1111/1467-9817.12346>

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**Abstract**

This special issue, *Advances in Understanding the Role of Morphemes in Literacy Development*, is comprised of one narrative review and 11 empirical papers that contribute new theoretical and empirical evidence to our understanding of how morphemes influence reading and spelling development. Here, we summarise key findings from these papers in terms of what they tell us about the multidimensional nature of morphological knowledge, and how morphological information is processed at different levels, including across developmental changes and languages. Throughout this discussion we draw out the implications for education, and highlight targeted areas for further research.

**Special Issue Editorial: Advances in Understanding the Role of Morphemes in Literacy Development**

We were inspired to launch this special issue in part by the abundant evidence demonstrating the importance of morphology in literacy development. Decades of empirical research have established that the morpheme is the fundamental unit of organisation in the adult lexicon (see Rastle, 2019 for a review). We know that awareness of morphemes also plays an important role in the development of word reading, spelling, and reading comprehension (e.g., Angelelli et al., 2014; Deacon & Kirby, 2004). Several papers in this special issue add to this body of evidence. For instance, the relationship between morphological awareness and reading ability is demonstrated cross-sectionally in French by Rassel et al. (2021), in Chinese-English bilinguals by Qiao et al. (2021) and longitudinally over a span of 9 years by Lyster et al. (2021).

Yet, there is great need for theoretical and empirical specificity to explain how morphemes influence literacy development (Carlisle, 2010; Kuo & Anderson, 2006; Nagy et al., 2014). For the most part, current models of skilled reading and reading development do not mention morphology, or do not distinguish morphemes from other non-morpheme letter patterns. For example, several models suggest that suffixes are processed similarly to rime units (e.g., *-able* and *-ight*; Ehri, 2015; Grainger & Ziegler, 2011). Likewise, the role of morphology is often mentioned, but remains greatly underspecified in models of reading comprehension (Perfetti & Stafura, 2014) and writing composition (Berninger et al., 2002). Here, we highlight how the papers within the special issue further this conversation.

**Levels of Processing**

This special issue begins with a narrative review by the editorial team—Levesque, Breadmore, and Deacon (2021)—in which we describe the extensive empirical evidence illustrating the importance of knowledge about morphemes and morphological awareness for the development of word reading, spelling, and reading comprehension. We confront the gap in the theoretical description of the role of morphology in literacy development by presenting the Morphological Pathways Framework. Scaffolded

on the Reading Systems Framework (Perfetti et al., 2005; Perfetti & Stafura, 2014), the Morphological Pathways Framework is the first testable model to explore specifically how the morphological structure of words impacts literacy at multiple levels of processing. Illustrating the unusual degree of applicability of this model, Levesque et al. (2021) describe how this model generalises to both reading and writing, at both single word (reading and spelling) and text levels of processing (reading comprehension and writing composition).

The Morphological Pathways Framework supposes that knowledge about morphology is multidimensional and is therefore distributed between the linguistic system, orthographic system, and lexical representations. Morphological awareness is the explicit ability to manipulate morphemes in speech, which resides within the linguistic system. Generalised knowledge about the orthographic structure of morphemes resides within the orthographic system. Finally, knowledge about the morphological structure of individual words is included in lexical representations. Levesque et al. (2021) argue that this results in three pathways through which morphological awareness influences literacy. There is a direct pathway from morphological awareness to text comprehension and generation, and two indirect pathways via word identification processes: morphological analysis and morphological decoding. Morphological analysis links morphological awareness to lexical representations. Morphological decoding links generalised representations of morphemes in the orthographic system to lexical representations. Hence, the Morphological Pathways Framework highlights the importance of considering morphology not as a unitary concept, but as influencing literacy at different levels of processing. This means that strengths and weaknesses in each of these different sources of morphological knowledge could impact on literacy attainment. As Levesque et al. (2021) conclude, it is not enough to ask teachers to just teach “morphology”. Further research is needed to understand exactly what should be taught, when, and to whom.

In order to answer the question about what should be taught and when, we need to know more about when and how morphological information comes online. For example, neuroimaging data provides precise information about when and where morphological processing happens during word recognition (Cavalli et al., 2016). Analyses of spatiotemporal dynamics of handwriting can now provide insight into when morphemes are activated during spelling (Breadmore & Deacon, 2019)—offering a parallel tool to well-established reaction time approaches in word recognition. At the text level, eye-tracking studies have begun to explore the interaction between sublexical, lexical, and syntactic information during text reading (Breadmore & Carroll, 2018). Meanwhile, new statistical techniques enable researchers to combine exploratory and hypothesis-driven models to understand how and when morphemes are activated in the steps of developing a text representation (Colé et al., 2018).

Several papers in this special issue examine how the morphological structure of words influences literacy processes. Fleischhauer et al. (2021) present experimental evidence of developmental changes in use of morpho-orthographic and morpho-semantic processes during word recognition. Others illustrate multiple morphological processes involved in orthographic word learning (in adolescents, Dawson et al., 2021; in adults, Ginestet et al., 2021). For example, Dawson et al. (2021) utilized an experimental nonword learning paradigm with English-speaking adolescents. Their findings demonstrate how the suffix plays an important role in mapping form and meaning in support of word learning. Ginestet et al. (2021) illustrated the influence of morphological information at several different levels during adult word learning, supplementing an orthographic learning paradigm with eye movement recording. Eye movements during reading in the learning phase suggested that not only did morphological structure facilitate initial visual processing, it also seemed to result in more learning – accuracy on both spelling and orthographic choice tasks was higher for morphologically complex pseudowords than for matched monomorphemic pseudowords. This finding is particularly striking given that less time was spent reading these pseudowords.

More data are needed to understand how morphological processes are used during spelling and writing. Reliable tools that capture the multidimensionality of morphological knowledge will be key to this endeavor, and to date research has been held back by limited availability of validated tasks. In this Special Issue, Goodwin, Petscher and Tock (2021) present and validate a new gamified computer adaptive multidimensional measure of morphological skills, Monster, PI. This application was developed with 3214 fifth to eighth grade children in the US and then validated in its final form with 1140 children. This is an invaluable tool to enable both researchers and practitioners to distinguish between children's strengths and weaknesses in different morphological skills. During development of the application, Goodwin et al. (2021) distinguished four morphological skills which are measured in Monster, PI, and which align to the multiple pathways described by Levesque et al. (2021).

### **Developmental Changes and Interventions**

Increased empirical and theoretical specificity will help guide the development of new intervention approaches. To date, systematic reviews have revealed small effects of morphological interventions in comparison to standard treatments (e.g., see Bowers et al., 2010; Carlisle, 2010; Goodwin & Ahn, 2013). These reviews have all called for greater clarity in how to design instruction. Understanding how and when morphemes influence literacy development is essential to optimise the potential of morphological instruction and intervention practices.

Several studies in this special issue highlight the importance of morphology throughout development, but also begin to illustrate developmental changes. For example, Fleischhauer et al. (2021) demonstrated developmental progression in the nature of morphological processing during word recognition in a masked primed lexical decision task. Both adults and fourth graders (11 to 12 years old) showed morpho-semantic and morpho-orthographic priming effects, suggesting that they automatically decomposed written words into morphemes using morpho-orthography and morpho-semantics. Third graders (9 to 10 years old), however, only showed morpho-semantic priming effects, suggesting that

they detected stems but did not rely on morpho-orthography. The youngest children, first and second Graders (6 to 8 years old), did not show any priming effects, suggesting that neither process was activated automatically during word recognition.

James et al. (2021) measured awareness of inflections, derivations, and compounds in judgement and production tasks provided in written format. Principle Components Analysis revealed a single morphological awareness factor, with performance increasing with age. After controlling for age, nonverbal reasoning, vocabulary, phonological awareness and word reading, morphological awareness uniquely predicted reading comprehension in 6- and 8-year-olds and 12- and 13-year-olds, but the contribution was smaller and not significant in 9- to 11-year-olds. Furthermore, quantile regressions indicated that the role of morphology was of equal importance across the ability range, suggesting that all children benefit from increased knowledge about morphology. However, further research is needed to understand whether the specific nature of the relationship between morphological knowledge and reading comprehension changes through development. In James et al.'s study, the measure of morphological awareness not only tapped into the ability to reflect on and manipulate morphemes in speech – the definition applied by Levesque et al. (2021 as defined by Carlisle, 2000; Nagy et al., 2014). Instead, morphological awareness was measured using a combined oral and written format for the two younger groups and with a written format only for the older group. Results across age groups might be confounded with these differences in how morphological awareness was measured. In Morphological Pathways Framework terms (Levesque et al., 2021), this measure taps knowledge from the linguistic and writing system, as well as lexical representations.

Two papers in this special issue present preliminary evidence about the potential effectiveness of targeted interventions to increase knowledge about morphology. Georgiou et al. (2021) found a researcher-delivered morphology intervention (Structured Word Inquiry) to be at least as effective as a phonics intervention (Simplicity Intervention) for poor readers in grade 3. The interventions were



delivered as a Tier 2 intervention in Canada to children who had not previously responded to phonics teaching. Although neither intervention significantly improved literacy outcomes, neither decreased literacy outcomes compared to a business-as-usual control either. Both interventions improved performance on a morphological relatedness task. The lack of significant gains in literacy might have been due to the small sample size (17 children per condition) or low dosage (30 minutes, 3 times per week for 10 weeks). Nonetheless, this study is encouraging and suggests that further investigation into the effectiveness of morphological interventions is warranted.

Crosson et al. (2021) examined whether English Learners' Robust Academic Vocabulary Encounters (EL RAVE), was effective in raising academic vocabulary knowledge for seventh and eighth Grade (11 to 13 years old) English language learners in the US. EL RAVE focuses on teaching and analysis of Latin roots – using constituent morphemes to problem solve word meaning. Compared to business-as-usual controls, children who received the intervention showed improvements in morphological analysis and academic vocabulary, and promising preliminary evidence of improvements in reading comprehension. Although the effect via morphological analysis was only marginal, there was an indirect effect via improvement in academic vocabulary. Further research should include a delayed post-test to explore whether improvements in reading comprehension are observed downstream, after improvements in word level skills such as vocabulary.

The two intervention studies presented in this special issue examined the effectiveness of morphological interventions amongst poor readers and English language learners. We need to know more about whether certain groups of children particularly benefit from morphological interventions, or whether all children do. Such research should not only consider whether morphological interventions are effective, but also why – which levels of morphological processes are most effectively taught? Which have the most impact on literacy outcomes?

We also need to know more about when over the course of development these interventions should be delivered in order to have the most impact. Lyster et al. (2021) describe the long-term value of morphological awareness assessed at preschool (age 6) — with direct and indirect impacts on reading comprehension measured 9 years later. Like others (e.g., Foorman et al., 2015), they show a single latent factor for language at preschool. This does not mean that teaching needs to be undifferentiated. Indeed, the authors note that instruction can encourage children to detect the phonological and morphological structures of words, as well as developing semantic knowledge.

### **Cross language considerations**

Our understanding of morphological processing and the role of morphology in literacy development has been dominated by studies of the English language. English has a morpho-phonemic writing system but is not a morphologically rich language. Further cross-linguistic research is needed to explore whether all levels of morphological processing are of equal importance across languages, or whether the linguistic features influence the relative importance of different morphological pathways. One of the goals of this special issue was to bring together empirical evidence from different languages and contexts to inform these questions. To this end, this special issue includes studies in Chinese (Cantonese; Qiao et al., 2021), French (Rassel et al., 2021), German (Fleischhauer et al., 2021; Görgen, De Simone, Schulte-Körne, & Moll, 2021), Norwegian (Lyster et al., 2021), and studies in English that draw upon the varied educational contexts of the UK (Dawson et al., 2021; James et al., 2021), US (Goodwin et al., 2021) and Canada (Georgiou et al., 2021; Ginestet et al., 2021).

Qiao et al. (2021) explored the relationship between morphological awareness and reading comprehension in both Chinese and English with Chinese-English bilingual children in Hong Kong (8 to 10 years old). In both languages, morphological awareness contributed indirectly to reading comprehension through two paths; via word reading and via vocabulary to word reading. In English there was also a direct effect of morphological awareness on reading comprehension. These results for English are

consistent with the three pathways described in the Morphological Pathways Framework (Levesque et al., 2021). However, in Chinese the direct effect on reading comprehension was not observed. This highlights the need for models to account for differences between languages. Further empirical research is also needed to understand whether the differences between English and Chinese that were observed in this study are indeed due to differences between languages, or due to differences in bilingual children's relative proficiency or point in reading or language development in each language.

Two studies in this special issue examine morphological processes in German and demonstrate that the structure of the language influences when morphological processes are observed (Fleischhauer et al., 2021; Görgen et al., 2021). German has a rich morpho-orthographic structure, but is asymmetrical in terms of transparency. In reading, grapheme-phoneme consistency is high. In spelling, phoneme-grapheme is less consistent and instead morphemes provide consistency. In line with this asymmetry, Görgen et al. (2021) found that morphological awareness was a particularly strong predictor of spelling ability. Using novel internet-based techniques for data collection enabled the authors to reach a large sample of 3122 children (9 to 10 years old). Morphological awareness predicted word reading and spelling after controlling for nonverbal cognitive abilities, age/grade, phoneme awareness and sublexical orthographic sensitivity, morphological awareness. As described previously, Fleischhauer et al. (2021) demonstrated a developmental progression in morpho-orthographic sensitivity which seemed to emerge earlier than has been shown in previous research in other languages (such as English). This suggests that the rich morpho-orthographic structure of German might contribute to earlier development of morpho-orthographic sensitivity during visual word recognition compared to more impoverished languages.

Lyster et al. (2021) demonstrated that morphological awareness has a long-lasting impact on reading comprehension in Norwegian. Norwegian is a relatively transparent language in terms of

phoneme-grapheme relationships, so this demonstrates that the impact of morphological awareness is not simply due to the utility of morphemes in resolving phonological opacity in the writing system.

As well as needing to know more about whether (and how) the role of morphology in literacy development varies dependent on the language system, international comparisons can also allow us to consider differences in other factors such as education systems and socio-cultural factors. In this issue, Rassel et al. (2021) found that socio-economic status does indeed influence morphological awareness, with French children of lower socio-economic status having weaknesses in morphological awareness compared to children of middle socio-economic status. However, after controlling for phonological awareness and vocabulary this relationship was no longer significant. There was emerging evidence that socio-economic status might mediate the relationship between morphological awareness and reading comprehension. However, this study used quite a blunt metric of socio-economic status, which was determined by the school the child attended and so was confounded with other factors such as the nature of the education received. Further research should explore the impact of socio-economic status at a more fine-grained level, within the same schools.

### **Implications for theory and recommendations for practice**

A key highlight throughout papers in this special issue is in furthering our understanding of the multidimensionality of knowledge about morphemes and the multiple ways in which this knowledge influences literacy. Understanding that morphology is not a unitary concept has important educational implications, and teachers should be encouraged to consider this when teaching about morphology and its links to literacy. This multidimensionality also has implications for future research, presenting a potential threat to construct validity if researchers do not carefully align their measurement tools to their research question. For example, care must be taken to ensure that the morphological knowledge that is trained in intervention studies is the same type of morphological knowledge that is measured at outcome. Researchers should also consider whether weaknesses in particular types of morphological

knowledge or underlying processes increase risk of literacy difficulties, and which of those respond well to intervention. Literacy interventions are most effective when they are targeted. Further research is needed to understand what to target, and in whom.

The abundant evidence of a relationship between morphological knowledge and literacy development implies two things; that children with deficits in morphological knowledge/processes are at risk of difficulty when it comes to learning to read and write, and that children with literacy difficulties are likely to have deficits in morphological knowledge/processes. Further research is needed to develop diagnostic batteries to distinguish between different types of deficits. Such batteries should apply some of the novel methods in this special issue, which suggest that digital applications (Goodwin et al., 2021) and internet-based remote testing (Görge et al., 2021) can be used effectively without the need to enter a classroom setting. These developments preceded the current COVID-19 pandemic, but have become essential to conduct ongoing research in this context. Beyond this context though, these methods extend the reach, scale and potentially also the inclusivity of research. They also suggest time- and cost-effective ways in which teachers may be supported to use diagnostic tools in future, without the need for specialist training to administer complex test batteries.

The differences between the studies within this special issue conducted across different languages highlight the need for cross-linguistic research that is more directly comparable. Guidelines for how such work can be conducted are provided in the classic work by McBride-Chang et al. (2005). That research also highlighted the need for measurement that captures features that are prominent (e.g., derivations in English and compounds in Chinese), or specific to each language (e.g., such as individual inflections in English; Lam et al., 2019). It may also be important to capture features that are common across languages (such as compounds in both English and Chinese). We describe here an ambitious agenda, one that is likely to be impactful in understanding development in both monolingual

and bilingual learners, including for those who struggle with reading (for a review see Deacon et al., 2019).

As a final note, the number of abstract submissions in response to the call for papers for this Special Issue revealed the huge amount of interest there is in understanding the role of morphology in literacy development. It also revealed a major gap in building this body of evidence. As is true in the broader literature, abstract submissions were dominated by studies of word reading and reading comprehension. Few studies examined morphological processes during spelling, and not one of the abstract submissions explored writing composition. Given the importance of writing composition in the measurement of educational attainment across disciplines, research is urgently needed to close this gap.

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