Structured Word Inquiry (SWI):

Literacy instruction that makes sense of English spelling for students of all ages and abilities

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Special Circumstances:

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Abstract

In this paper I show that literacy instruction widely considered to be "best practice" includes key misrepresentations of how English orthography works in ways that should be of concern to researchers and educators. Most researchers would describe phonics instruction targeting grapheme-phoneme correspondences as essential research-based best practice, and that additional instruction in morphology, vocabulary and other aspects of literacy is important. Instruction which meets all these criteria presents many words as having "irregular spellings" which don't follow the grapheme-phoneme correspondences taught in phonics. I show that "structured word inquiry" (SWI) (Bowers & Kirby, 2010) provides an alternative approach to teaching grapheme-phoneme correspondences which reflects well-established facts about how English orthography works to represent the interrelation of morphology, etymology and phonology. Teaching how grapheme-phoneme correspondences are constrained and explained by morphology and etymology makes sense of spellings phonics treats as "irregular." The morphological matrix and word sum help explain how English orthography has evolved to favour consistent spelling of the meaning elements (morphemes) over consistent spelling of phonemes in our morphophonemic language. Drawing attention to spelling-meaning connections of related words facilitates memory for the spelling, pronunciation and meanings of high frequency words, and provides leverage for vocabulary learning. The research basis for SWI is also discussed.

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Does your current understanding and instruction of English spelling treat words like *does, rough, one, because,* or *business* as having "irregular" spellings children have to memorize? If so, you know how frustrating such "exceptions" are for students in general, but especially for those who struggle in literacy as a result of dyslexia or other challenges. Of course such experiences can be devastating in terms of motivation.The exasperated plea, "I just wish English spelling made sense!" is familiar to countless students, parents and educators.

Surprisingly, we already have a spelling system that makes sense - as long as we are willing to reconsider long-held assumptions about how it actually works.

If we agree with Rayner, Foorman, Perfetti, Pesetsky, and Seidenberg (2001), that "The child learning how to read needs to learn how his or her writing system works" (p. 34), it makes sense to step back and test how well typical research-based instruction reflects the conventions of English spelling.

The fact that the words cited above (and countless others) do not follow the spelling conventions we teach suggests two possibilities.

1) English spelling is in fact a flawed and unreliable system with many exceptions to the basic conventions that explain most spellings.

2) The inability of typical instruction to explain these spellings is evidence of flaws in the understanding of English orthography that drives that instruction.

If the evidence supports option one, we can conclude that current instructional research is on the right track. We are then left to refine how we teach the same understanding of English spelling, hoping to increase the number of students who succeed in literacy.

If the evidence supports option two, however, it is very good news for researchers and educators seeking novel, more effective literacy instruction.

What do we know about English orthography?

To get a sense of why typical instruction leads many to conclude that English spelling is full of exceptions, consider the following observations from Richard Venezky.

>   …[T]he simple fact is that the present orthography system is not merely a letter-to-sound system riddled with imperfections, but, instead, a more complex and more regular relationship wherein phoneme and morpheme share leading roles (Venezky, 1967, p. 77).

>   English orthography is not a failed phonetic transcription system, invented out of madness or perversity. Instead, it is a more complex system that preserves bits of history (i.e., etymology), facilitates understanding, and also translates into sound (Venezky, 1999, p. 4).

Venezky posits that people think English spelling is filled with "imperfections" because they misunderstand it as "merely a letter-to sound system." Let's see if a wider view of

orthography from Venezky and others (e.g. N. Chomsky & Halle, 1968; C. Chomsky, 1970) can explain spellings treated as "irregular" in typical research-based instruction.

Consider some common misspellings in contrast to their actual spellings below.

*< duz > for < does >

*< acshun > for < action >

*< evry > for < every >

< sine > for < sign >

Note that < sine > is not actually a misspelling, but the spelling of a mathematical word that is homophonic with < sign >. An elementary student making this mistake is applying the grapheme-phoneme correspondences they have been taught. Those correspondences do reflect one word with this pronunciation, but not the word they mean for "a stop sign."

This last example raises another issue. How do we help children know which spelling to use for homophones they are familiar with, like those listed below?

< to >, < too > and < two >

< one > and < won >

< hear > and < here >

< which > and < witch >

< there > and < their >

< where > and < wear >

Instruction of grapheme-phoneme correspondences in isolation from morphology and etymology cannot help you *understand* grapheme choice in many words

These spelling errors and confusions about homophones show that students have successfully learned possible grapheme-phoneme correspondences taught in phonics. What they do not understand is how to know which grapheme to use when more than one is possible.

Knowing the available grapheme-phoneme correspondences is necessary, but not sufficient, for understanding spelling. Both morphology and etymology need to be considered when choosing between possible graphemes. Consider this issue in light of the orthography of "does" shown in Figure 1.

The misspelling *<duz> follows grapheme-phoneme correspondences taught in phonics. It has what are often called the "d sound" and the "z sound." The <u> is a common way to spell the "short u." So how can we explain the actual spelling <does>?
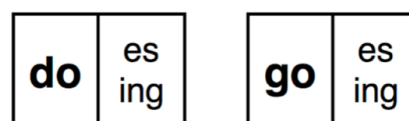

Figure 1: Word sums from the <do> and <go> matrices

do + es —> does
do + ing —> doing

go + es —> going
go + ing —> going

Instruction can draw attention to the meaningful morphological relationship between "does" and its base spelled <do> by saying "I **do** my work and she **do**es her work." We can use word sums and matrices to look at the structure of these and related words as in Figure 1.

Comparing the structure of the words "do" "does" and "doing" draws attention to the fact that the pronunciation of the base spelled <do> is the same when used as a word on its own and in the word "doing." However, in "does" the pronunciation of that base changes. The matrix and the word sum help us to study the phonology of these words in the context of their morphological structure. We can also study the family of words including "goes" and "going" which have exactly the same structure, but in which the pronunciation of the base does not shift.

Studying grapheme-phoneme correspondences in the context of morphological structure allows us to *understand* the spelling of "does." More importantly, we can use these common early words to introduce a foundational principle of English orthography: English spelling has evolved to favour consistent spelling of the meaning elements of words (morphemes) over consistent spelling of the units of pronunciation (phonemes). This key driver of English orthography is not reflected in literacy instruction that teaches grapheme-phoneme correspondences in isolation from morphology.

Watch a video at this link (https://youtu.be/ghhJfUbIp70?t=1) to see such an SWI lesson in a classroom.

Study the morphological families reflected in the matrices and word sums in Figure 2 (next page). Consider the associations between the spellings, meanings and pronunciations of these words, building on what we learned from studying "does." Notice how framing attention to grapheme-phoneme correspondences within the context of morphological families brings clarity for grapheme choice, and anchors that instruction to a meaningful context.

*<acshun> vs. <action>

The family of the base <act> can be used to explain why the word "action" cannot use the <sh> digraph, nor can it be spelled with a final <un>. Saying "Die Hard is the **act**ion movie with my favourite **act**ors" draws attention to the meaning/structure connection between these words. The grapheme-phoneme diagram shows that the default job of the <t> is to spell the phoneme /t/, but it can also spell the /ʃ/ if it is followed by the <u> or <i>.

*<evry> vs. <every>

When saying "every," we can't use phonology to explain the second <e>, whereas, when we pronounce its base <ever> on its own, we can understand the presence of that <e>.

<sine> vs. <sign>

The pronunciation of "sign" gives no signal of the need for the <g>, but adding the <-al> suffix helps see why this base needs that <g> as do other words constructed by this base. We see "mark, token" in the banner of this matrix which marks the meaning of this

base that derives from the Latin root *signum* for "mark, token." We discuss the meanings of all words represented by this matrix guided by the underlying sense and meaning that will be present to some extent for any word with the base <sign>. A "design" is about marks that stand for something else. An architectural design is not the building, but the marks on the page standing in place of the building. A "signature" is a special mark that stands in the place of the person who made it. This matrix was used in our vocabulary intervention (Bowers & Kirby, 2010) that introduced the phrase "structured word inquiry." We found the experimental group were not only better at defining words they were exposed to in such a matrix, they were also better at defining words they never saw but which have the same base (e.g. "insignificance").
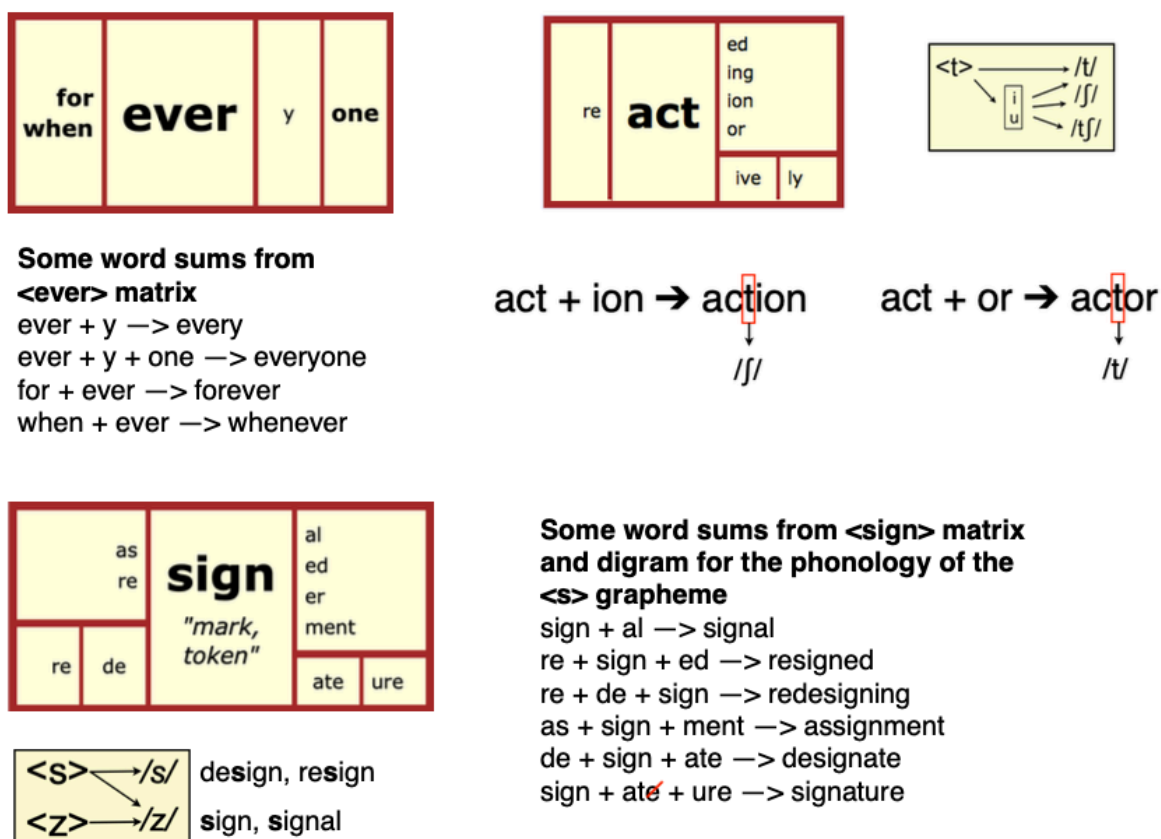
Some word sums from <ever> matrix
ever + y —> every
ever + y + one —> everyone
for + ever —> forever
when + ever —> whenever

act + ion ➔ action   act + or ➔ actor
/ʃ/   /t/

Some word sums from <sign> matrix and digram for the phonology of the <s> grapheme
sign + al —> signal
re + sign + ed —> resigned
re + de + sign —> redesigning
as + sign + ment —> assignment
de + sign + ate —> designate
sign + ate + ure —> signature

<s>—/s/ design, resign
<z>—/z/ sign, signal

Figure 2: Morphological matrices, words sums and grapheme-phoneme correspondences for a variety of morphological word families

Other etymological influences on grapheme choice: Distinguishing words with different meanings and linking words of related meaning.

Figure 3 (next page) provides a context for understanding the spelling of homophones. Venezky (1999) describes a homophone principle that, where possible, words that can be pronounced the same evolved to use different spellings to signal that difference in meaning. To distinguish homophones with different spellings, we *need* a spelling system

with multiple graphemes for the same phoneme. Etymological influences also mark words that have connected meanings with connected spellings as shown with the letters in red. Many know the <w> in "two" is there to mark its connection to the idea of "twoness" with other words where the <w> is pronounced. This effect of etymology on grapheme choice is not restricted to this example. Study the other examples to see how we can draw spelling-meaning connections between words to help understand why these words are spelled as they are.
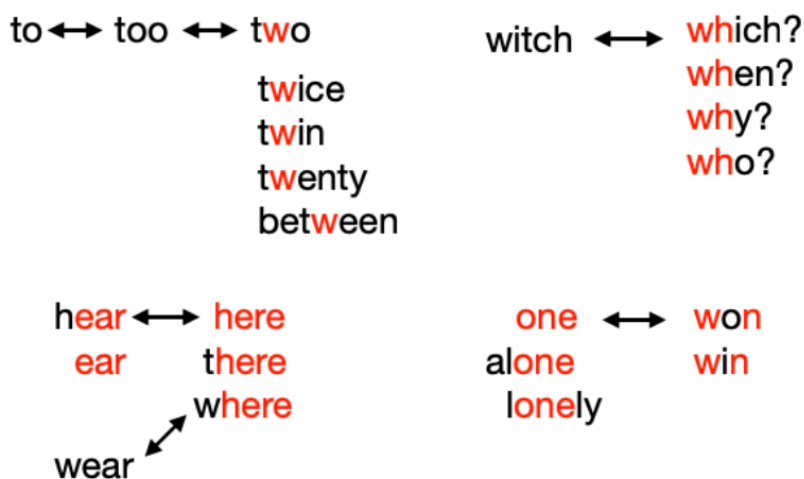

Figure 3: Etymological influence on grapheme choice.

The double arrows mark homophonic words distinguished by different spellings. The letters in red mark words with related meaning providing cues to grapheme choice.

Implications for literacy research and instruction

Above I have presented some common spelling errors that cannot be explained by considering grapheme-phoneme correspondences in isolation from morphology and etymology. The conventions used to describe these spellings are not recent discoveries; they are long-established conventions described by major figures in linguistics that are regularly cited in the literacy research (e.g. C. Chomsky, 1970; N. Chomsky & Halle, 1968; Venezky, 1967, 1999).

Most would agree the following is a characteristic definition of systematic phonics:

> The term 'systematic phonics' describes practices for teaching decoding and word reading. It teaches students the correspondences between graphemes (letters and letter clusters) in written words and phonemes (speech sounds) in spoken words, and how to use these grapheme-phoneme correspondences to read and spell. Phonics instruction is systematic when it teaches the major grapheme-phoneme correspondences in a planned sequence. (Buckingham, 2020, p. 2)

Noticeably absent from this definition is any reference to morphology or etymology. So far I have yet to find any published definition of phonics that makes any reference to the role of morphology or etymology on grapheme choice.

Both SWI and systematic phonics provide explicit instruction about what the available grapheme-phoneme correspondences are. SWI *also* teaches how those correspondences are constrained by other factors of English orthography. I use the phrase "orthographic phonology" in SWI in contrast to "isolated phonics" to capture the difference in how these approaches teach grapheme-phoneme correspondences. See a video explaining this distinction (https://youtu.be/bNBSCw7Fp0Y) and Bowers (2021) for more on this topic. See this video (https://youtu.be/EhNv7AGtkAM) modeling teaching teaching of grapheme-phoneme correspondences in SWI from the beginning of instruction in SWI.

It is important to note that proponents of phonics rightly point out that they do not recommend phonics as the only important aspect of literacy instruction. They present phonics as an essential aspect of literacy instruction which should be taught along with other aspects of reading instruction including morphological instruction, reading comprehension strategies and more.

However, teaching grapheme-phoneme correspondences in isolation from the influence of morphology and etymology and *also* teaching about morphology is not the same as teaching how morphology and etymology *constrain* and *explain* grapheme choice. Teaching phonics and separately teaching morphology does not explain the spellings addressed above.

Research evidence and theory for SWI

Currently there is only a little direct evidence testing the effectiveness of SWI because there have been so few instructional studies. But the evidence we have shows promise.

The vocabulary intervention by P. Bowers and Kirby (2010) introduced the phrase "structured word inquiry." We found that instruction targeting morphological families with matrices and word sums increased vocabulary for the experimental group over controls even for words that were not addressed in the study, so long as they shared a base with words that were taught. Devonshire, Morris and Fluck (2013) used an SWI type intervention with matrices and word sums to teach the interrelation of morphology, etymology and phonology to 5 to 7-year-olds compared to a phonics intervention. They found statistically significant benefits on standardized measures of reading and spelling for the SWI treatment. Rastle (2019) challenged this finding arguing that the phonics condition included a "whole word" approach. However, as Devonshire et al. (2013) made clear, all explicit instruction in this comparison condition is properly described as phonics. The only experience with a "whole word" approach was not taught, but independent work the school had students do at home. Crucially, this practice was the same for both SWI and Phonics conditions.

Georgiou, Savage, Dunn, P. Bowers, & Parrila, (2021) found SWI and phonics treatments were both significantly better than controls for poor Grade 3 readers, and that effects for SWI and phonics were similar. One difference was that effect sizes for measures of morphological relatedness and word reading in the SWI condition

increased from post-test to delayed post-test while those in the phonics condition decreased in this same time span. We posited this finding may reflect the theory of morphology as a binding agent (Kirby & Bowers, 2017) that creates higher quality lexical representations (Perfetti, 2007) of the spellings, pronunciations and meanings of words. Colenbrander, Parsons, J. Bowers, Davis (2021) looked at SWI compared to a vocabulary treatment for Gr. 3 and 5 poor readers and found both groups had similar gains.

The finding by Georgiou et al., that this new way of understanding and teaching literacy matched the effects of the well-established practice of phonics instruction can be seen as a sign of potential. We must be approaching ceiling in terms of refining phonics instruction while we are near the floor at learning how best to teach SWI in a research context. Another difference in these studies is that the SWI interventions in Bowers and Kirby (2010) and Devonshire et al. (2013) were conducted by experienced experts in this understanding and teaching of orthography. The other studies were conducted by teachers (teacher assistants in the case of Colenbrander et al.) who were brand new to this understanding.

The main justification for exploring SWI, besides the assumption that literacy instruction should reflect the orthographic structure studied, comes from related research and theory. It has long been assumed that morphological instruction should be held off for younger and less able students (e.g. Adams, 1990). After two decades of wide acceptance of this untested hypothesis, we finally had enough morphological interventions to test it. Table 1 shows all the meta-analyses and reviews on the effects of morphological instruction up to 2020. The findings from these studies point in the opposite direction of decades of assumptions in the literature: the youngest and less able gained the most from morphological instruction.

Table 1: [a]Meta-analyses and [b]reviews of morphological instruction

Authors	Findings	Journal
[b]Reed (2008) 7 studies	• Benefits overall • Especially less able (not statistical meta-analysis).	Learning Disabilities Research & Practice
[a]Bowers, Kirby & Deacon (2010) 22 studies	• Benefits overall • Largest effect for less able • Effects for Pre-School to Gr. 2 ≥ Gr. 3 -8	Review of Educational Research
[a]Goodwin & Ahn (2010) 17 studies	(Only studied children with learning disabilities) • Significant effects for less able	Annals of Dyslexia
[b]Carlisle (2010) 16 studies	• Benefits overall even with youngest students.	Reading Research Quarterly
[a]Goodwin & Ahn (2013) 30 studies	• Benefits overall • Significant differences in effects for English speaking students for MA, PA, Vocab, decoding, spelling (not RC) • Larger effect sizes with younger students	Scientific Studies of Reading
[a]Galuschka, Görgen, Kalmar, Haberstroh, Schmalz & Schulte-Körne (2020) 34 studies	(Only studied children with dyslexia and spelling deficits) • The greater children's spelling deficits study, the greater the effect of morphological instruction and the less effective was phonics instruction.	Educational Psycologist

Table 2 presents data from two of these meta-analyses (Goodwin & Ahn, 2010, 2013) that looked at effect sizes for various literacy outcomes. They found *phonological outcomes* showed the greatest benefits from *morphological* instruction. In all but one case phonological outcomes were greater than the morphological outcomes. Their interpretation of these results directly support the hypothesis of SWI.

> Similar to Bowers et al. (2010), results suggest that early morphological instruction may be particularly helpful perhaps because of the synergistic relationship between phonology and morphology and the larger repertoire of root [base] and affix meanings available for use. If a reciprocal relationship exists between morphological knowledge and literacy...it makes sense to jump start this knowledge from an early age" (Goodwin & Ahn, 2013, p. 23).

The most recent meta-analysis by Galuschka, Görgen, Kalmar, Haberstroh, Schmalz & Schulte-Körne (2020) looked at the effect of morphological interventions on spelling for dyslexics. Their findings are particularly striking. They wrote, "Against our hypotheses, the efficacy of phonics interventions decreased with increasing severity [of the children's spelling deficits], whereas the efficacy of orthographic and morphological interventions increased with increasing severity." (Galuschka et al., 2020, p. 12).

Table 2: Effect sizes by literacy outcome from meta-analyses of morphological instruction

Outcome	Effect size	
	Goodwin & Ahn, 2010 Literacy difficulties	Goodwin & Ahn, 2013 All students
Phonological awareness	0.49	0.48
Morphological knowledge	0.40	0.44
Phonological recoding	0.54	*
Decoding	0.23	0.59
Spelling	0.20	0.30
Vocabulary	0.40	0.34
Fluency	-0.28	-0.05
Reading comprehension	0.24	0.09

Outcomes with greatest effect sizes from morphological instruction are all *phonologically based:*

d = .49, .48, .54, .59

Outcomes with next greatest effect sizes from *morphological instruction* are almost all *morphologically based:*

d = .40, .44

* Not analyzed

All evidence about the effect of morphological instruction from meta-analyses suggests we should be teaching about morphology in general, and especially for younger and struggling students. However, we have almost no direct evidence telling us how best to teach morphology.

SWI is not morphological instruction; it is instruction about how our orthography system works. Accordingly, morphology is a central aspect of SWI, as is the instruction about grapheme-phoneme correspondences and how they work in that system (orthographic phonology). The meta-analytic evidence tells us we should be teaching about

morphology with younger and less able students. SWI offers a hypothesis that we should explicitly leverage morphological instruction to help children better understand grapheme-phoneme correspondences. Goodwin and Ahn's (2010, 2013) findings that phonological outcomes showed the greatest gains from morphological instruction provides support for this hypothesis. Their findings are particularly striking given that the vast majority of morphological interventions did not include any instruction about the relationship between morphology and phonology (Bowers, Kirby & Deacon, 2010).

For a more detailed account of the place of SWI in the research, see Bowers, P. (2021) and Bowers J. & Bowers P. (2017, 2018). Also, we have just published the first paper looking at different ways of presenting morphology for memory of words (Ng, Bowers P., Bowers J., 2022). Presenting university students with words organized around the base (as in a matrix) resulted in significantly better memory for words than when they were organized around affixes. Both types of morphological organization increased memory for words compared to no such organization,

There is no claim of strong empirical evidence for SWI instruction over other forms of instruction. There is, however, good evidence that research should be testing this instruction and component aspects of it. If we think about students struggling with the sense that English is full of irregularities and whatever they do they just can't make sense of it, we have even more reason to explore this instruction. If we have the choice of telling kids to memorize spellings like "does" and countless others, or explaining these spellings, the best choice seems straightforward.

Educators around the world have been working with SWI for years now. A common characteristic of anecdotal stories of their transformational experiences is how much more engaged and interested children become in reading and investigating words. Nothing motivates like understanding.

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