RESEARCH REPORT

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A deep dive into phonemic proficiency

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Introduction

In recent years, there has been a spike in the popularity of literacy programs that claim to train young students in attaining phonemic proficiency. This has led to (sometimes heated) discussions within both academic and educational circles, which have focused on the efficacy of these programs and the strength of research on which the programs' rationales are founded. (For published examples of the perspectives involved in these debates, see Brady, 2021; Clemens et al., 2021; Kilpatrick et al., 2022; Parker, 2022; Shanahan, 2021.) Unquestionably, all parties involved in the discussions want only to promote the practices that will lead to the very best literacy outcomes for students. Nevertheless, there remains confusion about how certain instructional strategies related to phonemic proficiency fit into the 'science of reading'. The aim of the present article is to address some of this confusion by investigating in depth one popular program that promotes such strategies: *Equipped for Reading Success* (Kilpatrick, 2018).

Dykstra's target metaphor

Before delving into the topic itself, it is worth first thinking about how best to frame interpretations of research findings. In other words, what exactly is meant by the 'science of reading'?

A useful way of thinking about reading research is that the strength of evidence in support of any idea falls somewhere into the sections of a target. This is how Dr Steven Dykstra has described it in his 'target' metaphor (Dykstra, 2021).

Ideas in the 'bullseye' of the target are supported by multiple robust, empirical studies. Here is where we get as close as possible to the absolute truth, while also acknowledging that humans are humans, and we are, of course, talking about the relatively messy field of social science.

Completely outside of the target are those ideas that are actively *un*supported by scientific evidence. Despite having been tried and tested, they lack empirical support, or they have actually been *dis*credited by research. According to Dykstra, advocates for the 'science of reading' should actively reject – and not just avoid – these ideas.

Between the bullseye and the outside is the most interesting part of the target, and it is here that most scientific evidence from reading research actually sits. Findings here are not rock solid, but they may have some empirical backing. Perhaps, for example, there is bullseye evidence that supports a certain teaching practice, but the student population in that research context looks different from what you're dealing with. As such, you may need to have a little more uncertainty about whether you would see the same effects. You may even need to adapt that practice somewhat to fit your specific contextual constraints. Still, you have a foot in the science – you're just drawing a conclusion that is reasonable, given the current state of incomplete research.

A key point that Dykstra has emphasised when describing his target metaphor is that it is not possible to base instruction only on the concepts in the bullseye, because there simply isn't enough there to get the job done. One example he uses relates to phonics instruction. We know that high-quality phonics instruction positively influences students' early word-level reading development; that's a finding that sits squarely in the bullseye. However, there are choices about how to teach phonics that fall somewhere along the gradients.

Not every synthetic phonics program is the same, for instance. They differ in how detailed and extensive the rules are, the sequence of taught grapheme-phoneme correspondences, the presence or absence of letter name instruction, when and how morphology and other aspects

of literacy instruction are incorporated, and so forth. Decisions around these program elements are not clear-cut, and must be made using reason, knowledge of a classroom's practical constraints, and reference to whatever research does exist on the topic. And the point is – that's okay! Convergent evidence is hard to come by. The best we can do is keep the bullseye evidence as directly linked to practice as possible, while also acknowledging the uncertainty and remaining open to the possibility of being wrong. Scientific understanding is something that evolves over time, after all.

Dykstra has also referred to three mistakes that consumers of research make when judging the strength of a research finding.

1. One of the mistakes is to attribute a researched treatment's success (or failure) to just one of the treatment's multiple components. This is quite tricky to negotiate, because most treatments or programs are multi-componential and differ to a control condition in a variety of ways. It's difficult to conduct research in any other way, because each little element is likely to contribute only somewhat to the overall outcomes, meaning you need to have a lot of statistical power (i.e., large sample sizes and more resources) to detect it. Therefore, it's something that consumers of research need to bear in mind.

2. The second mistake is to miscategorise a lack of research as off-the-target. An absence of evidence on a certain topic does not mean that it is disproven.

3. The third mistake is to make the bullseye too big. That is, some people overreach and assume something is supported by rock-solid evidence when it is really only tangentially related to an idea that lives in the bullseye. This is a bad trap to fall into, because it makes it difficult to change your mind on the basis of new or contrary evidence.

Dykstra's target metaphor is useful to bear in mind when evaluating the research evidence in support of a certain idea or theory. In this article, it will be used to frame the evidence on what effects result from attempting to train students to become phonemically proficient.

What does it mean to be 'phonemically proficient'?

According to Kilpatrick (2020), phonemic proficiency refers to having automatic and unconscious access to the phonemic (i.e., speech sound) structure of words. This is in contrast with phonemic *awareness*, which involves *conscious* access to such information. To be proficient is a step beyond simply being *aware*.

Phonemic proficiency is said to develop via *orthographic mapping*. 'Orthographic mapping' is a term coined by Professor Linnea Ehri (Ehri, 2017). It is used by Ehri to describe the process by which readers store familiar words for automatic word recognition. Acquiring a decent-sized sight word vocabulary is very important for any reader, because it means their cognitive resources can be allocated to the comprehension of text, rather than identifying words. And getting to that point necessitates orthographic mapping – the bonding of each soon-to-be sight word's pronunciation, spelling and meaning in long-term memory.

This central theory is sound. Unskilled readers who have not yet banked a lot of familiar sight words read slowly and effortfully, while skilled readers recognise familiar words immediately, so that information about the presented word's phonological representation (i.e., pronunciation) and semantic representation (i.e., meaning) is immediately activated. Therefore, there must be a process taking place as an unskilled reader becomes skilled, during which the orthographic representation (i.e., spelling), phonological representation and semantic representation are bonded for each word that becomes familiar.

Ehri has also described *how* orthographic mapping takes place. With several prerequisite skills, readers can activate orthographic mapping through a self-teaching mechanism. In other words, through repeatedly encountering words in written text and learning their pronunciations and meanings, readers activate orthographic mapping to retain and solidify those written words in long-term memory. The prerequisites Ehri lists are:

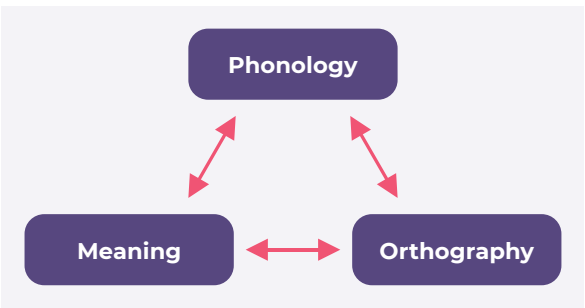
— Phonemic awareness (particularly segmentation and blending)

— Knowledge of the major grapheme-phoneme correspondences of the writing system (and, eventually, knowledge of the grapho-syllabic spelling-sound patterns)
— The ability to read unfamiliar words independently by applying a decoding, analogy or prediction strategy

Again, we are on quite solid ground here, research-wise. Share's self-teaching hypothesis (1995) is well-supported, and Ehri herself has published many studies on the phases of reading development and the word reading strategies employed by readers. The listed prerequisites for sight word learning are also reasonable, given the underlying theory and the research that shows these factors significantly predict reading success.

Moreover, Ehri has conducted experimental research that speaks to an interactivity between how phonological, orthographic and semantic representations develop. This research aligns with her theory of orthographic mapping in which such representations are assumed to become bonded together. Briefly, results from her research have provided evidence for:

— Using articulatory gestures to teach grapheme-phoneme correspondences (Boyer & Ehri, 2011; Castiglioni-Spalten & Ehri, 2009)
— Using embedded picture mnemonics to teach grapheme-phoneme correspondences (Ehri et al., 1984; Shmidman & Ehri, 2010)
— Exposing students to word spellings to teach vocabulary (Ehri, 2005; Rosenthal & Ehri, 2008)
— Exposing students to word pronunciations to teach vocabulary (Rosenthal & Ehri, 2011)
— Word spellings influencing how skilled readers perform phonological awareness tasks (Ehri, 1987; Ehri & Wilce, 1980)



One conclusion to draw from the orthographic mapping theory is that the quality of a word's phonological representation is extremely important for reading, because this is the foundation that dictates how stable and readily accessible the orthographic representation is. Indeed, this appears to be the rationale for training phonological awareness and word study skills to the point of phonemic proficiency.

However, note that this conclusion focuses on just one arrow in the diagram (below left), and that Ehri's work is entirely consistent with an account of reading development in which a word's pronunciation, spelling and meaning all influence one another during the sight word learning process. (This is also consistent with other statistical models of word recognition, such as that posited by Seidenberg and colleagues; Seidenberg, 2001.)

General principles promoted in programs that target phonemic proficiency

One of the most popular programs in the phonemic proficiency space comes from Professor David Kilpatrick's book, *Equipped for Reading Success* (Kilpatrick, 2018), and it is this resource that will be the focus of the present report.

There are several general recommendations that Kilpatrick outlines in his book, before introducing specific strategies and activities. The first two of these recommendations are:

> 1. "Train the prerequisite skills for orthographic mapping: letter-sound skills, phoneme awareness to the level of phonemic proficiency, and word study.
> 2. Teach reading in a developmental sequence that 1) is consistent with the sequence of phonological awareness development, and 2) is consistent with what we know about the development of how children efficiently build a sight word vocabulary." (p. 45)

The specifics and consequences of these recommendations are worth teasing out in a little more detail.

Train the prerequisite skills

Firstly, the training referred to does not include instruction in the application of such prerequisite skills (even 'letter-sound skills') to real words, as would typically be the protocol in a systematic synthetic phonics program. In fact, readers are warned against teaching students to decode print until the foundational skills have been mastered, which is estimated to be around the middle of Year 1 for most (non-at-risk) students (p. 19).

> "Teaching reading before students are ready inadvertently promotes bad compensating habits for those with weak readiness skills." (p. 48)
>
> "[P]honics is *not* the developmentally most appropriate introduction to reading." (p. 49)
>
> "Phonics works best when students are at the *full alphabetic phase* of reading development [i.e., able to attend to individual phonemes in words]." (p. 49)
>
> "Once children start developing phoneme-level skills, they can move to phonic materials." (p. 50)
>
> "[At-risk students with limited phonological awareness] will likely struggle with phonics instruction and may benefit from continuing with linguistic materials until the basic phoneme-level skills emerge. Otherwise, we force students to come up with ways of remembering words that are not consistent with efficient sight word development." (p. 51)

As the quotes above make clear, letter-sound knowledge, phonemic awareness (to the level of proficiency) and word study skills are framed as foundational to the development of decoding. It is only once such 'prerequisites' are mastered that students should progress to applying those skills to actual text.

The problem with this advice is that it does not account for the reciprocity that exists between reading and foundational skill development. Of course, there is research to show that instruction in phonemic awareness results in improved reading outcomes. However, there is also research to show that instruction in *reading* results in improved *phonemic awareness* outcomes (e.g., Perfetti et al., 1987; see also Castles & Coltheart, 2004). Linnea Ehri herself recommends instruction wherein the fundamentals for orthographic mapping are applied to word decoding contexts.

> "[Foundational knowledge] includes grapheme-phoneme [GP] knowledge, phonemic awareness, and decoding skill. These skills are most effectively taught in systematic phonics programs where students learn and apply the major GP relations to decode words and to store them in memory." (Ehri, 2022, p. 8)

Kilpatrick also acknowledges in multiple places that reading and phonemic awareness have a reciprocal relationship (e.g., Kilpatrick et al., 2022). Nevertheless, this reciprocity is not reflected in this first general recommendation that underlies his program.

Beyond suggesting that phonics instruction is postponed until students acquire the listed prerequisites, Kilpatrick also comments in his book on the fruitlessness of repeatedly exposing struggling readers to print. This is done by rationalising such a practice on the basis of an outdated 'visual memory' theory. In other words, repeated text reading is said to be based on the assumption that readers retrieve a visual image of every word they read, and because that assumption is incorrect, the practice itself is unjustified.

> "We assume that if students see the words enough, they will learn them. This is not true. Children with reading problems often cannot remember new words, even after many exposures. When they finally learn new words, they may forget them over school breaks or even long weekends. We mistakenly blame their visual memories." (p. 29)
>
> "I believe this assumption that we store words based on visual memory is a major reason why we have widespread reading difficulties in our country. *Until we properly understand how to promote permanent word storage, we will continue to have many weak readers.*" (p. 29)

Kilpatrick's assertion that we do not acquire word reading automaticity by using information about words' visual qualities is absolutely true. However, setting aside the research evidence that supports the efficacy of repeated reading (summarised by Shanahan, 2017), a 'visual memory' theory is not what underlies the practice. Instead, the rationale is entirely in line with Ehri's orthographic mapping theory. That is, assuming students have the decoding skills (and/or external support) to accurately retrieve the phonological representations for printed words in the given text, repeated exposure to such words in context should help to bond representations and solidify sight words in memory.

In Ehri's own words:

> "An important function of reading words in text is to activate meanings and syntactic information about the words' roles in sentences so that this information becomes bonded to spellings and pronunciations stored in memory. Giving children lots of practice reading and comprehending text at their level serves this purpose. It establishes fully formed sight words with all their identities – spellings, pronunciations, meanings, roles in sentences – bonded together as one unit in memory." (Ehri, 2022, p. 5)

It is certainly a valid observation that some children *do* seem to struggle particularly with storing words in their sight word vocabularies, even despite multiple exposures to a given target word. Nevertheless, it does not inevitably follow that (a) repeated reading is based on outdated theory, (b) providing multiple exposures to a text does not align with orthographic mapping, and (c) the solution is to implement *Equipped for Reading Success*. Points (a) and (b) are misleading, and (c) may well be true but is – as yet – an untested hypothesis.

Phonemic awareness to the level of phonemic proficiency

Another part worth highlighting in Kilpatrick's earlier-referenced recommendations is the idea that phonemic awareness instruction should continue to the 'level of phonemic proficiency'. The essential nature of training phonological awareness to this point is emphasised in the quotes below.

> "Until phonemic proficiency is developed, a student will not have an efficient way to make letter strings familiar." (p. 35)
>
> "The oral form of the word is already stored in memory. When we map, the letters of the printed form of the word piggyback onto the phonemes in our existing rapid oral filing system, which we use to understand spoken language. *If a student is not attuned to the sounds within oral words, there is no efficient way for printed words to become familiar letter strings.*" (p. 37)
>
> "[I]f students cannot do phoneme-level processing automatically, they are not likely to make substantial reading gains. Because automatic phoneme awareness is necessary for efficiently building a large sight vocabulary (i.e., orthographic mapping), poor or non-automatic phonemic awareness will limit a student's progress." (p. 84)
>
> "Remember that phonological awareness is 1) a critical mental skill needed to acquire a large sight vocabulary; 2) the most common source of word reading difficulties; and 3) not meaningfully related to intelligence, so we cannot assume who will struggle in this skill. Thus, phonological awareness should be trained and monitored with *all* students. Regardless of grade level (1st to 12th) *continue using the progress chart in Appendix A* [see what this comprises in the section below] *until a student has mastered all the skills to the point of automaticity.*" (p. 84)
>
> "Children with weak phoneme awareness will not develop adequate reading abilities if that weakness is not corrected." (p. 88)

What exactly are the implications of training phonological awareness *to the level of phonemic proficiency*?

According to the program sequence (p. 12), typically developing students should receive phonological awareness instruction from the start of Kindergarten until the end of Year 2[1]. The same starting point applies to 'struggling students', although the end point is not time-scaled; instead, it is recommended until the students reach mastery.

With respect to the other 'prerequisite' skills, letter-sound instruction follows the same recommended schedule as phonological awareness, and word study strategy instruction is suggested from the end of Kindergarten until the middle of Year 3 (or until the student is a skilled reader, if they are 'struggling').

Critically, it is not clear when instruction in applying acquired knowledge to *actual decoding contexts* should begin for struggling students, given the explicit emphasis on the importance of phonemic proficiency, as well as the recommendation that the three prerequisites must be acquired before a student should learn to decode. Additionally, a student's status as 'struggling' appears to be dependent on their performance on phonological awareness tasks, rather than reading.

Thus, it would be easy for a teacher to interpret the program's guidance in such a way that, in a remedial setting with a student at risk of reading difficulties (but who is not yet even given the opportunity to demonstrate these difficulties), attaining phonemic proficiency is the goal of instruction, rather than the means to a very important end – that is, becoming literate. To withhold decoding instruction and text exposure from already-struggling readers (and those assumed to become struggling readers) is to keep them, for an indefinite period of time, from learning to read at the same pace as their peers. Advising such a course of action should be based on a strong and compelling rationale, which, based on the current state of research evidence, does not exist.

Teach reading in a developmental sequence

According to the schedule (p. 19) referenced above, instruction in "developmental reading" is suggested from the middle of Kindergarten. This extends to the middle of Year 1 for typically developing readers, and until the student is "ready" for struggling students. "Developmental reading" or a "linguistic approach" (p. 49) refers to the teaching of spelling patterns for rime units or word families (e.g., m<u>at</u>, c<u>at</u>, s<u>at</u>, b<u>at</u>, h<u>at</u>). This is different to a systematic synthetic phonics approach, in which students are taught to synthesise or blend together *phoneme*-level word parts.

> "The linguistic approach is like 'training wheels' for learning to read. This approach often allows at-risk readers to start reading in early first grade without requiring them to struggle or compensate. They can thus practise basic reading while their phonological awareness abilities are developing to the phoneme level, at which point they are ready for phonic materials. It is my opinion that the linguistic approach is a developmentally more appropriate starting point than phonics. If you use this 'linguistics first, phonics second' approach, while systematically training phonological awareness, you will reduce the number of struggling readers to a fraction of what any traditional method (including phonics alone) would produce." (p. 50)

The idea that literacy instruction needs to follow a developmental sequence, whereby students are taught how to read progressively smaller word parts, is – according to the author – based on an understanding of how phonological awareness develops. Children are first sensitive to syllables, then to rimes, and then eventually to phonemes. It is this sequence that guides the progression of phonological awareness tasks that the program prescribes.

However, the underlying premise that such a sequence needs to guide instructional decision-making, in either a phonological awareness or literacy context, is not supported by the research. Dr Susan Brady has published specifically in this area, and has stated:

> "[R]esearch indicates that phonological sensitivity instruction (with larger units such as rhyme, syllables, and onset-rime) is neither a prerequisite nor a causal factor in the development of phonemic awareness." (Brady, n.d.)

Linnea Ehri, the aforementioned scholar who first published on the theory of orthographic mapping, has also been involved in research related to this question:

> "[Some] programs start out by teaching beginning readers to read larger multi-letter units such as onsets and rimes or syllabic units that consist of blended GP [grapheme-phoneme] units … However, results from our study [Sargiani et al., 2021] showed that this approach was not nearly as effective as teaching children to decode by sounding out and blending GP units … Students who were taught with GPs learned to decode CVs [consonant-vowel units; e.g., 'ba', 'da'] much faster than the syllable group … These findings suggest that when the basic units of a writing system are GP units [as in English], children should begin instruction by learning to decode words using these basic units rather than larger units such as syllables or onset-rime units." (Ehri, 2022, p. 5)

As such, based on the existing research, it should not be concluded that instruction in either phonological awareness or word-level reading must progress from syllables and rimes to phonemes.

General principles: A summary

To summarise the points made about phonemic proficiency training thus far, the general principles and recommendations from *Equipped for Reading Success* are that:

1. Instruction in letter-sound knowledge, phonological awareness and word study should precede instruction that focuses on teaching decoding using knowledge of grapheme-phoneme correspondences.
2. For struggling readers, repeated exposure to print is unhelpful and based on a flawed underlying theory.
3. Phonological awareness instruction should continue until the level of phonemic proficiency. This may be until the end of Year 2 for typically developing students, or until mastery for struggling students. (It is unclear when struggling students are suggested to begin learning to decode, based on Points 1, 2 and 4.)
4. Phonological awareness instruction should follow a sequence wherein students first become aware of larger word parts (i.e., syllables and rimes) before phonemes.
5. On the basis of Point 4, word-level reading instruction should also follow a sequence wherein students first learn to negotiate the larger word parts in written words before learning to negotiate grapheme-phoneme correspondences in written words.

In the above sections of this article, arguments have been made to counter the rationales that underpin these five points. In the next section, the nature of the specific phonological awareness tasks recommended in Kilpatrick's book will be discussed. In particular, the focus will be on two aspects of the program that have not yet been mentioned: the emphasis on phonological awareness instruction *without* letters, and the emphasis on tasks involving phonemic *manipulation*.

Specific phonological awareness tasks in the program

Table 1 lists all the phonological awareness tasks that students are expected to progress through to complete the program. These tasks are outlined in the book's 'Phonological Awareness Development Chart' (p. 235 or Appendix A), and they correspond with levels in the 'Phonological Awareness Screening Test' (pp. 237–245 or Appendix C) and the program's 'One Minute Activities' (pp. 129–226).

Table 1. Tasks from the *Equipped for Reading Success* 'Phonological Awareness Development Chart'.

Level	Task	Example
D	Syllable deletion (two-syllable words)	cowboy → boy under → der
E	Syllable deletion (three-syllable words)	pineapple → apple elephant → ele
F	Onset/rime deletion	cat → at man → m
G	Onset/rime substitution	not → hot tan → toy
H	Start-of-word deletion/substitution (first phoneme in consonant cluster)	plane → lane class → glass
I	End-of-word phoneme deletion	cart → car sheep → she
J	Medial phoneme (vowel) substitution	bag → big ran → run
K	Start-of-word phoneme deletion/substitution (second phoneme in consonant cluster)	club → cub grow → glow
L	End-of-word phoneme substitution	pet → pen sent → send
M	End-of-word phoneme deletion/substitution (first phoneme in consonant cluster)	best → bet lift → list

Within each level, students may progress from the Multisensory Stage (where they can only do the task with external prompts), to the Knowledge Stage (where they can do the task independently but not quickly), to the Automatic Stage (where they can do the task independently and within two seconds). The 'external prompts' employed at the Multisensory Stage refer to letter stimuli, tokens, clapping or any form of teacher support. Hence, it is only at this point that phonological awareness activities can involve letters, and to progress through the program, students must demonstrate that they can do the tasks in oral-only contexts.

Phonological awareness without letters

Kilpatrick makes it clear from the outset of the book that he sees phonological awareness as an oral language skill, and that the introduction of letters into a phonological or phonemic awareness activity fundamentally redefines it as a phonics activity.

> "Phoneme awareness is an oral language skill." (p. 15)
>
> "A way to remember the difference between phonemic awareness and phonics is that *you can do phoneme awareness with your eyes closed but you cannot do the phonic skill of sounding out with your eyes closed.*" (p. 15)
>
> "*It must be kept in mind that this activity* [i.e., using letters/spelling to illustrate phonemic awareness concepts] *is not phoneme awareness.* Rather, it is phonics … Do not assume if students can do this successfully that they are demonstrating phoneme awareness." (p. 79)

Contrary to this perspective, instruction that effectively targets phonemic awareness, whether delivered in a classroom or remedial context, often incorporates letter stimuli (e.g., in this video by Clarke, 2022). Indeed, such an approach aligns with research evidence that demonstrates the efficacy of *combining* instruction in letter knowledge and phonemic awareness (see Chapter 3 of National Institute of Child Health and Development, 2010).

There is also a logical reason for using letter stimuli in phonemic awareness activities. Written graphemes provide a visual anchor for tasks that are otherwise abstract, complex and highly dependent on working memory. There is no empirically supported reason why they should be used only as an external support, rather than as an integral element of instruction. Phonemes are, after all, a "convenient fiction" (Seidenberg, 2021). The nature of coarticulation is such that spoken words are not truly separable into 44(-ish) individual speech sounds, each one categorically sounding and feeling a certain way. Nevertheless, we can approximate these sounds and feelings, and to do so is useful because knowing what sounds the squiggles on the page roughly represent is an excellent starting point in the journey towards learning to read.

As mentioned earlier, it is difficult to reconcile the reciprocal and interactive nature of reading development with the principles and strategies promoted in this program – in this case, with respect to having such a strong emphasis on oral-only phonemic awareness.

Phonological manipulation tasks

Another point regarding the tasks listed in Table 1, which form the basis of Kilpatrick's program and assessment, is that they all involve the deletion or substitution (i.e., manipulation) of word parts. The following quotes reflect Kilpatrick's emphasis on training phonological awareness in general, and phonological manipulation in particular.

> "Students with good phonological awareness are in a great position to become good readers, while students with poor phonological awareness almost always struggle in reading. Poor phonological awareness is the most common cause of poor reading. Reading problems can be *prevented* if all students are trained in letter-sound skills and phonological awareness, starting in kindergarten." (p. 13)
>
> "[P]honological manipulation represents the best way to address phonological awareness assessment and intervention. It has a stronger correlation with reading than any of the other tasks [e.g., segmentation or blending], it has the other tasks built into it, and it produces the best results in reading intervention studies." (pp. 75-76)
>
> "[W]hen students respond instantly to a phoneme manipulation task, they are not even aware that the first step they performed involved efficient, unconscious segmentation of the target word. As a result, teachers can be assured that segmentation is automatic and unconscious. This represents phonemic proficiency and is the foundation of efficient orthographic mapping. It is for this reason that the *Equipped for Reading Success* program is based upon phonological manipulation activities. This training provides the assurance of the development of phonemic proficiency." (p. 76)
>
> "One Minute Activities use phonological manipulation. Thus, they incorporate the other phonological tasks: segmentation, isolation, and blending. For this reason, they are the most efficient way to train phonological awareness." (p. 87)

There appear to be four main arguments that, within *Equipped for Reading Success*, are used as justifications for teaching phonological manipulation tasks.

Firstly, the author's ideas are based on an interpretation of Ehri's orthographic mapping theory, and it is this that provides the theoretical foundation for promoting phonological manipulation. However, in her formulation of

the theory, Ehri mentions only the phonological awareness tasks of segmentation and blending, which are the key skills required when applying grapheme-phoneme correspondence knowledge to decoding and spelling. This does *not* mean that teaching phonological manipulation is incompatible with the theory of orthographic mapping. It *does* mean that that the theory provides no direct support for such teaching at the expense of instruction related to segmentation and blending.

Secondly, Kilpatrick argues that reading is more strongly correlated with the 'advanced' phonological awareness task of deletion than with the 'basic' phonological awareness task of segmentation. Indeed, in comparison with segmentation tasks, both blending and deletion tasks do appear more strongly correlated with reading measures – at least in the studies cited (i.e., Kilpatrick, 2012; Swank & Catts, 1994; for wider review, see Clemens et al., 2021). Blending, though, is a 'basic' phonological awareness task just like segmentation. So why is it not targeted in the training program or assessment?

The main reason appears to be related to Kilpatrick's third point: that phonological manipulation tasks incorporate an element of blending anyway (as well as the other basic skills of segmentation and isolation). For example, to replace the /r/ in 'grow' with /l/ (Level K), the student must:

1. **Segment** the word into phonemes
2. **Isolate** the /r/
3. **Substitute** the /r/ with a /l/
4. **Blend** together the phonemes to produce the resulting word.

By itself, the fact that manipulation tasks necessitate segmentation, isolation and blending does not mean such tasks are most effective in producing positive reading outcomes. It may instead be the case that phonological manipulation activities are unnecessary, and that better results would be seen if the basic skills most directly related to literacy development were targeted without imposing that additional working memory load.

This leads to a point that has not yet been factored into discussions at all: to perform the above steps *without* external prompts and in the space of two seconds requires a great deal from a student's working memory. From a statistical perspective, this means that working memory is likely to account for at least some of the shared variance between phonological manipulation and reading proficiency, and it is why we need to draw conclusions about instruction from studies that have *implemented* that instruction – not just those that have focused on correlations between skills.

From a practical perspective, the working memory factor inherent in phonological manipulation tasks also means that students with difficulties in this area can be expected to struggle a great deal. Could practising phonological manipulation *improve* these students' working memory and, by extension, their reading skills? Possibly, but working memory deficits have proven very resistant to training programs in the past (Hempenstall, 2019). Again, we need to turn to the results from studies wherein phonological manipulation skills have been trained.

This is Kilpatrick's fourth argument, and it has the potential to be a very strong one. If there are even a handful of studies that indicate phonological manipulation training has been efficacious, we can have a good deal of confidence in the certainty of Kilpatrick's conclusions. The 13[2] studies cited by Kilpatrick (2015) and Kilpatrick and O'Brien (2019) in support of this argument are listed in Table 2.

There are several points to consider when evaluating the quality and implications of these listed studies. Two of them (Alexander et al., 1991; Simos et al., 2002) included 10 or fewer participants. Although studies with such small sample sizes may be useful for preliminary explorations, they are not useful as concrete sources of evidence in support of instructional efficacy.

Setting the Alexander et al. (1991) and Simos et al. (2002) studies aside then, many of the other studies involved only one experimental group and no control or comparison group (Bhat et al., 2003;

McGuinness et al., 1996; Truch, 1994, 2003, 2004). The programs examined in each of these studies appear to have effected word reading improvements relative to age-related expectations, based on increases in standard scores. However, there are many variables that could have accounted for this, such as intervention intensiveness, fidelity or duration. Critically, all of the programs also targeted a number of other skills, and incorporated elements such as phonics instruction or text reading. Any one of these factors (or, more likely, a combination of them) may have led to the observed improvements.

Similarly, two of the remaining studies evaluated multi-componential interventions against control groups that received regular classroom support (Lennon & Slesinski, 1999; Vellutino et al., 1996). While the students in these control conditions presumably received more similar instruction to the experimental group than that received by a sample of students randomly selected for norm-referenced tests, it is nevertheless unclear what element of the experimental program led to improved word reading outcomes. Moreover, phonological *manipulation* tasks are not explicitly mentioned as part of the programs examined in these two studies. Only phonological *awareness* (alongside phonics and text reading activities) is targeted.

We are now left with four studies, three of which were conducted by Torgesen and colleagues (1999, 2001, 2010). In these cases, it is still not possible to categorically attribute the results to just one element of instruction, because, as with the aforementioned studies, the programs under investigation (in both experimental and comparison conditions) were multi-componential. Nevertheless, there is more detail given by the study authors about what the examined programs entail, and so we can draw inferences about the effects of focusing *more* so on a specific component in one program versus another.

To this end, it may be said that the studies by Torgesen et al. (1999, 2001, 2010) allow for a comparison between approaches that have a strong emphasis on teaching articulatory awareness and word-level reading skills (i.e., PASP, Lindamood ADD, LiPS) with those that have a strong emphasis on teaching text-level reading and writing skills (i.e., EP, RWT). What do the results of these comparisons tell us? In general, the word reading improvements associated with word-level interventions were slightly better than for text-level interventions (see Table 2). However, this was not to a statistically significant degree, and both kinds of approaches appeared effective.

The final study from Table 2 was conducted by Wise and colleagues (1999). This is the only investigation from the list in which the provision of phonemic manipulation instruction was experimentally controlled between conditions, with other elements of instruction being reasonably consistent. Results from this study therefore arguably represent the best source of evidence concerning the efficacy of phonemic manipulation intervention. So, what did these results indicate? Students who received training in phonemic manipulation showed improved word reading outcomes over the course of their intervention; however, so did students whose intervention did not involve phonemic manipulation. The gains made by these groups were statistically equivalent to one another and to another group of students who received a combination of phonemic manipulation and articulatory awareness training.

In summary, although most of the studies listed in Table 2 provide valuable information on what combination of instructional components may be targeted to effect word reading improvements, they should not be referenced as evidence in support of teaching one specific component by itself (see Dykstra's first mistake, referred to at the beginning of this article). This is an especially important point because Kilpatrick's program does not integrate phonemic manipulation instruction with other components that were included in the studied programs, such as phonological blending and segmentation, synthetic phonics, and connected text reading. More evidence is needed in this area, in the form of well-controlled phonemic manipulation studies (e.g., Wise et al., 1999) or meta-analytic comparisons *between* studies that do and do not incorporate phonemic manipulation training.

Table 2. Studies cited by Kilpatrick (2015) and Kilpatrick and O'Brien (2019) on the effect on phonological manipulation practice on word reading

#	Study authors	Experimental group (all at-risk or struggling readers)		Comparison group(s)		Summary of word reading results in favour of experimental condition
		No. participants	Intervention received	No. participants	Intervention received	
1	Alexander et al. (1991)	10	Lindamood Auditory Discrimination in Depth (ADD) program, which includes phonemic manipulation (among other phonological awareness tasks), letter-sound and reading activities (av. = 65.2hrs)	N/A	N/A	+12.5 standard score (SS) points at post-test
2	Truch (1994)	281	Lindamood ADD program (duration not specified)	N/A	N/A	+17 SS points at post-test
3	McGuinness (1996)	87	Phono-Graphix, which includes phonemic manipulation (among other phonological awareness tasks) and phonics activities (av. = 12hrs)	N/A	N/A	+13.7 SS points at post-test
4	Vellutino et al. (1996)	76	Individual literacy tutoring, including phonological awareness, letter-sound, reading and writing activities (estimated av. = 37.5hrs)	**Group 1:** 42 **Group 2:** 65	**Group 1:** Below-average readers receiving regular small-group classroom support (n=26) or idiosyncratic tutoring (n=16) **Group 2:** Average readers	Results difficult to summarise but indicative of intervention efficacy. Study focused on growth curve analyses for various profiles within experimental group. On word reading measure, gain scores for all profiles within experimental group were better than, or similar to, those of average readers.
5	Lennon & Slesinski (1999)	40	1:2 tutoring, including phonological awareness (blending and segmentation only), letter-sound knowledge and reading (estimated av. = 22.5hrs)	40	Waitlist-control (i.e., did not receive tutoring until experimental group had finished). (Note: 96 other students who performed at or above average on the screening task were also involved in the study but not included in this summary.)	Standard scores not reported. Significant main effect of group (tutored vs. waitlist-control), indicating intervention efficacy.

Table 2. Studies cited by Kilpatrick (2015) and Kilpatrick and O'Brien (2019) on the effect on phonological manipulation practice on word reading (cont.)

#	Study authors	Experimental group (all at-risk or struggling readers)		Comparison group(s)		Summary of word reading results in favour of experimental condition
		No. participants	Intervention received	No. participants	Intervention received	
6	Wise et al. (1999)	37	Combination of articulatory awareness and phonological manipulation activities (involving print), plus phonics and reading activities (av. = 40hrs)	**Group 1:** 42 **Group 2:** 43 **Group 3:** 31	**Group 1:** Same as experimental but without articulatory awareness (av. = 40hrs) **Group 2:** Same as experimental but without phonological manipulation (av. = 40hrs) **Group 3:** Regular classroom support	+8-10 SS points for experimental group and Groups 1 and 2 (i.e., all treatment groups combined) vs. +3-4 SS points for Group 3 (i.e., no treatment group). No difference among treatment conditions (i.e., experimental group, Group 1 and Group 2) on word reading measures. Similar pattern of results after 1 year.
7	Torgesen et al. (1999)	45	Phonemic awareness and synthetic phonics (PASP), which included phonemic manipulation (among other phonological awareness tasks), letter-sound and reading activities (av. = 48.1hrs)	**Group 1:** 45 **Group 2:** 45 **Group 3:** 45	**Group 1:** No treatment control (NTC) **Group 2:** Regular classroom support (RCS) **Group 3:** Embedded phonics (EP), which includes phonemic manipulation, phonics and a greater amount of text reading than PASP	Standard scores at pre-test not reported. PASP condition slightly better than EP, but statistically similar. PASP condition significantly better than RCS/NTC. EP condition slightly better than RCS/NTC, but statistically similar.
8	Torgesen et al. (2001)	26	Lindamood ADD program (av. = 67.5hrs)	24	Embedded phonics (EP) (av. = 67.5hrs)	+13.5 SS points (ADD) at post-test +14.1 SS points (EP) at post-test +13.8 SS points (ADD) after 1 year +11.8 SS points (EP) after 1 year +18.1 SS points (ADD) after 2 years +17.5 SS points (EP) after 2 years
9	Simos et al. (2002)	8	Phono-Graphix or Lindamood Phonemic Sequencing (LiPS) program, which includes phonemic manipulation (among other phonological awareness tasks), phonics and reading activities (duration not specified)	N/A	N/A	+ 25 SS points at post-test

Table 2. Studies cited by Kilpatrick (2015) and Kilpatrick and O'Brien (2019) on the effect on phonological manipulation practice on word reading (cont.)

#	Study authors	Experimental group (all at-risk or struggling readers)		Comparison group(s)		Summary of word reading results in favour of experimental condition
		No. participants	Intervention received	No. participants	Intervention received	
10	Bhat et al. (2003)	40	Great Leaps Reading program, which includes phonological blending, segmentation and manipulation activities (duration not specified)	N/A	N/A	Standard scores not reported. Significant differences in raw scores from pre- to post-test, but no change in how these scores related to students' grade level (i.e., achieved at 3rd grade level at both pre- and post-test).
11	Truch (2003)	203	Phono-Graphix (av. = 78hrs)	N/A	N/A	+7.4 SS points after 12hrs instruction +8.2 SS points after 24hrs instruction +15.3 SS points after full program
12	Truch (2004)	146	Discover Reading Program, which includes phonemic manipulation (among other phonological awareness tasks), letter-sound, reading, spelling and comprehension activities (av. = 80hrs)	N/A	N/A	+6.5 SS points after 12hrs of instruction +6.9 SS points after 24hrs of instruction +14.4 SS points after full program
13	Torgesen et al. (2010)	35	LiPS program (av. = 84.3hrs)	**Group 1:** 34 **Group 2:** 39	**Group 1:** Read, Write and Type (RWT) program, which includes phonemic manipulation (among other phonological awareness tasks), letter-sound, reading, writing and typing activities (av. = 80.4hrs) **Group 2:** Regular classroom support	+23.4 SS points (LiPS) at post-test +21.4 SS points (RWT) at post-test +19.6 SS points (LiPS) after 1 year +18.2 SS points (RWT) after 1 year No statistical differences between LiPS and Group 1 (i.e., RWT). Gain scores on decoding/RAN/spelling measures were significantly better for LiPS and RWT groups vs. Group 2 (i.e., no treatment).

Specific word study strategies in the program

The final part of the *Equipped for Reading Success* program to be discussed here involves its word study strategies. 'Word study' is defined by the author as "the unconscious or conscious mental habit of connecting what is heard in the mind (phoneme awareness) with what is seen on the page (letter-sound skills)" (p. 45). The specific strategies that are described in the main text of the book are listed in Table 3 (from p. 246 or Appendix D).

Table 3. Word study strategies, *Equipped for Reading Success* program

#	Word study activities
1	Teach students the vocabulary of mapping (e.g., 'schwa', 'voiced consonants', 'orthographic mapping', 'diphthong', 'stressed syllable')
2	Phoneme-to-grapheme mapping (using flash cards)
3	Teaching students to map rime units (using a word wall for reinforcement)
4	Introduce words orally first (and analyse them – all before they are seen in print)
5	Use look-a-like words (in flash card or word search activities)
6	Mapping irregular words
7	Direct mapping technique (e.g., "what letter in 'brush' makes the /u/ sound?")
8	Backward decoding technique
9	Highlight rime units in words (using underlining and slashes)
10	Use oral spelling to reinforce mapping
11	Oral decoding (identifying orally spelled words)
12	Invented spelling (with feedback)
13	Reading nonsense words
14	Spelling nonsense words
15	Spelling irregular words (using mnemonics where appropriate)
16	Word structure analysis (e.g., "how many syllables are in 'carpenter'?"; "what is the onset and rime in 'key'?")
17	Making/breaking words (e.g., "how many words can you make out of 'independent'?")
18	Words Their Way
19	Reversed sentence reading technique
20	Use all capitals and other forms of presenting words
21	Reading sideways and upside-down
22	Multiple font and mixed case reading
23	Spaced out letters technique
24	Linked words technique

At a broad level, it is worth thinking about where on Dykstra's target these strategies might each sit. Based on my own incomplete reading of the research literature, strategies #2, #6, #7 and #10–15 seem like reasonable ways of having students develop word decoding and encoding habits or knowledge. Strategy #4 is supported by research, insofar as familiarity with a word appears to facilitate recognition of that word (McKague et al., 2001; Wegener et al., 2016). Strategies #9 and #16, where implemented alongside phoneme-level activities, also seem reasonable. Thus, these would appear to be best represented fairly close to the target bullseye.

The remaining strategies are less convincing, either because there are reasons *against* doing them that may be stronger (e.g., strategy #1), or because the research (to my knowledge) does not favour them (e.g., strategy #18), or because there are likely to be much better ways of using valuable classroom time (e.g., strategies #3, #5, #8, #17 and #19–24). These I would place much closer to the outside of Dykstra's target.

Beyond these very broad impressions, it is difficult to comment further on the listed word study strategies, because there are no references to research in which the implementation of any listed strategy has led to improved student learning. This is the key point to be emphasised here: the effects associated with any one or combination of these strategies are uncertain. Some level of caution is therefore advisable, especially in cases where there are good reasons *not* to employ the strategy, such as those mentioned in the previous paragraph.

Conclusions: How does the program fit within the 'science of reading'?

It is hoped that, by piecing apart the various elements of *Equipped for Reading Success*, the arguments made here can be generalised to other programs that target phonemic proficiency in similar ways. Dissecting the program into its parts was also considered important because of the first mistake that Dykstra alludes to when consumers of research interpret findings. Each individual principle and strategy in *Equipped for Reading Success* may contribute to – or take away from – its overall efficacy. The 'parts' discussed in this article include the duration and intensity of instruction focused on training prerequisite skills, the developmental sequence of phonological awareness and word reading instruction, the emphasis on teaching phonemic awareness without letter stimuli, the phonological awareness activities focusing on manipulation only, and the numerous word study strategies that are offered. Some of these elements are more justified by research and reason than others.

The second mistake Dykstra warns against is classifying untested ideas as off-the-target. Again, this applies to many aspects of the program discussed here. Certainly, counterpoints have been presented that are intended to challenge the confidence with which Kilpatrick's recommendations for practice should be interpreted. Acknowledging that uncertainty exists around such recommendations is critical, because there is only a finite amount of time for literacy instruction in a classroom setting, and there are other approaches that sit closer to the centre of the target. Nevertheless, while there is a need for the practices promoted in this program to be empirically tested, there is no bullseye evidence to negate them, and so they do not fall outside of the target.

This leads to the third mistake that Dykstra lists, which has already been touched upon briefly. A key reason this program (and others like it) has become so popular is that the expectations around it have, in general, not been associated with a sufficient level of uncertainty. Instead, the program has been framed by members of the 'science of reading' community and, arguably, the author himself as bullseye material. As such, elements that are grounded in solid theory (e.g., orthographic mapping) or research (e.g., the important role of phonological awareness instruction in reading development) are used as justification for practices that are only tangentially related. This appears to be the main reason why there is such confusion about how scientific the program truly is.

As stated by Linnea Ehri herself:

> "David [Kilpatrick]'s hypotheses need to be tested directly with controlled studies that examine whether training improves phonemic proficiency, the involvement of grapho-phonemic proficiency, and whether this facilitates sight word learning in typically developing readers and struggling readers." (Ehri, cited in Shanahan, 2021, para. 30)

This quote by Ehri represents a reasonable conclusion about how *Equipped for Reading Success* should be seen as fitting into the 'science of reading'. The ideas underlying certain practices in the program are worthy of further empirical investigation, but there is no credible reason why – at this point in time – the program should supplant those that have been more rigorously tried and tested.

ENDNOTES

1 The grade levels referred to here (and by Kilpatrick) are based on the US educational system. There, the age of Kindergarten students is generally between four and six years. The US states vary in whether attendance at Kindergarten is mandatory and whether students can attend on a part-time or full-time basis.

2 One additional study by Torgesen et al. (2003) has also been referenced by Kilpatrick as supporting evidence. This study, which is published in a book chapter, could not be accessed, and so was excluded from mention in the present article.

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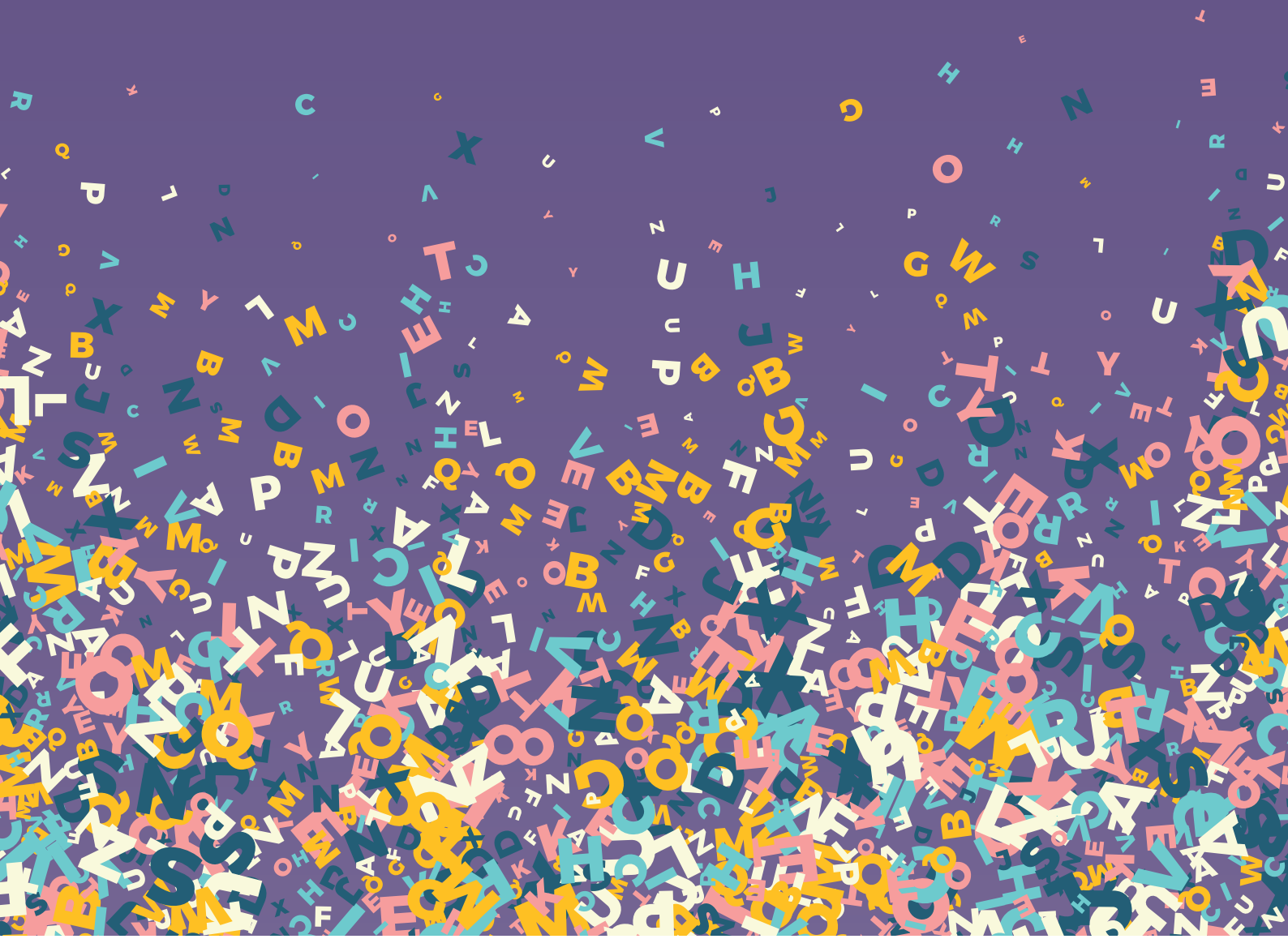

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