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Improving the reading skills of typically developing children and children with an intellectual disability

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**Improving the reading skills of typically developing children and
children with an intellectual disability**

Emily J Tyler

Thesis submitted to the School of Psychology, Bangor University, in partial fulfilment
for the degree of Doctor of Philosophy

December 2013

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Summary

The purpose of this thesis was to address three broad questions: to investigate the effects of a computer-based reading programme – Headsprout® *Early Reading* (HER) – with typically developing children in a UK setting; to investigate current practices in reading instruction with children in special schools, and in particular, children with an intellectual disability (ID); and to explore some important feasibility questions regarding the potential use and effects of HER with children with ID.

Chapter 1 begins with an introduction to the literature on literacy and effective approaches for reading instruction for typically developing children and children with ID. A review of the current evidence-base for HER is then presented.

Chapter 2 focuses on the use of HER as supplementary reading instruction during beginning reading instruction with typically developing children in Y2 (aged 6-7years). In this randomised study, the intervention group enrolled in HER for the duration of the school year, whilst the control group continued with their typical classroom instruction. Children in the intervention group made significantly greater improvements than the control group across reading measures.

Chapter 3 reports on the results of a survey of teachers in special schools in the UK to further elucidate the current practices and challenges related to reading instruction for children with ID in these settings. The aims of the survey were to collate information on current practices related to reading instruction provided for children with ID in special schools across the United Kingdom (UK); investigate the putative effects of age and severity of ID on teachers' choice of instructional approaches; and examine teachers' perception of barriers to improving reading skills in this population. It was found that age and severity of ID influenced responses on some items relating to choice of approaches and expectations, and that access to training and suitable curricula were seen as greater barriers to improving reading skills than factors relating to time or staffing.

The remaining two research chapters investigate the use of HER with children with ID. Chapter 4 presents case studies investigating initial feasibility questions related to using the programme with children with ID. This chapter reports on the progress of six children with mild to moderate ID enrolled in HER. All children accessed and completed the programme with minimal additional input and demonstrated improved reading skills.

Chapter 5 investigates further feasibility questions relating to conducting a full-scale RCT evaluation of HER with children with ID. Employing a randomised pre-test post-test group design, this study aimed to explore and trial important aspects of an RCT evaluation to inform a full-scale RCT with children with ID in special schools in the UK. In addition to informing the design of a future study, we also found that HER had a significant effect on reading skills when compared with 'treatment as usual', with large effect sizes on the main outcome measure.

This thesis evaluated the use of HER with typically developing children and children with ID, and demonstrated that it can have a significant positive impact for many children. Additionally, it has further elucidated current practices and challenges related to reading instruction in special schools and suggested further research across these areas.

Chapter 1 – An introduction to the literature and the current evidence-base for
Headsprout® *Early Reading*

This introductory chapter will be in two parts. Part one will provide an overview of the current literacy rates, effective approaches and current policies for both typically developing children and children with an intellectual disability; part two will provide an overview of a specific online reading programme (Headsprout *Early Reading*) and a review of the published literature evaluating the programme in different populations.

Literacy rates in the UK

Reading is an essential skill required for many aspects of life, from basic academic progress to the ability to live independently and participate in modern society (Marchand-Martella, Slocum, & Martella, 2004). However, many children struggle to acquire this complex skill (Fletcher & Lyon, 1998). In England, 15% of 7 year olds are not reaching the required National Curriculum level 2 (Department for Education, 2010; See Appendix 5), 13% of children entering secondary school are reading below the expected level, 5% of adults are below the expected reading age for 11 year olds (Department for Education, 2008), and a further 16% of adults are said to be functionally illiterate, suggesting they will struggle with tasks such as reading simple information or filling out basic forms (Jama & Dugdale, 2012). Furthermore, it has recently been reported that 40% of pupils in Wales enter secondary schools with a reading age of more than 6 months below their chronological age (Estyn, 2012). As well as reading being an essential skill for basic academic success and independent living, the high correlation between illiteracy and both unemployment and crime suggest a broader societal impact of poor literacy skills (Roman, 2004; Malicky & Norman, 1994; National Literacy Trust, 2008).

Children with an intellectual disability (ID) particularly struggle to acquire reading skills. It is estimated that 67% of those with ID in the USA have considerable difficulty learning basic reading skills (National Assessment of Educational Progress; Institute of Education Sciences, 2007). In the UK, only 2.2% of children attending special schools (many

of whom have mild-severe ID) achieved national curriculum target levels for literacy (level 2) at age 7 in 2009 (National Pupil Database, Department of Education, 2009). Furthermore, only 20% of children in special schools had attained level 2 or above for literacy at age 11 in Wales in 2013, with no children achieving the national curriculum target level (level 4) at this age (School Statistics Database, Welsh Government, 2013).

Reading difficulties

The simple view of reading suggests that two fundamental skills are essential to becoming a functional reader: decoding (the ability to segment and blend phonemes fluently, and recognise printed words); and linguistic comprehension (the ability to understand and process semantically what is decoded from written or oral language; Gough & Tunmer, 1986; Gough, Hoover & Peterson, 1996). Within this view, reading comprehension is not possible without proficiency in both decoding and linguistic comprehension skills; therefore deficits in either skill will negatively impact reading comprehension (Nation, 2005).

Struggling readers present with different profiles of reading behaviors. However, there are some specific patterns of difficulties encountered (Nation, 2005). For example, children with autism and those with language disorders are commonly found to have very poor comprehension skills despite average or above average decoding skills (Huemer & Mann, 2010). Furthermore, it has been found that those with weak reading comprehension demonstrate considerably weaker oral language skills (e.g., picture naming and semantic tasks) than competent comprehenders when matched on decoding skills and nonverbal ability (Nation & Snowling, 1998; Nation, Marshall & Snowling, 2001). Research therefore suggests that children with autism may benefit from reading instruction that emphasises comprehension skills early on (Whalon, Otaiba, & Delano, 2009). Conversely, for many children, poor comprehension is related to weak decoding skills. For example, from a cognitive perspective it has been suggested that both inaccurate and inefficient decoding

skills lead to a high level of resources being devoted to phonological rather than semantic processes, resulting in weak comprehension (Perfetti, 1985; 1994; Perfetti, Marron & Foltz, 1996). This can also be explained behaviourally in terms of component skill deficits and cumulative dysfluency – if component reading skills (such as segmenting and blending sounds to decode a word) are not fluent, learners will struggle with more complex, composite reading skills (Binder, 1996; Johnson & Street, 2013). As such, Oral Reading Fluency is generally a strong predictor of reading comprehension skills (Kubina & Starlin, 2003). Much research therefore suggests interventions that increase decoding skills enable readers with this profile to focus on comprehending written language (National Reading Panel, 2000; Whalon, Otaiba & Delano, 2009).

What is effective reading instruction?

There is a considerable evidence base indicating effective approaches for teaching reading to typically developing children that has been extensively reviewed both in the USA and the UK. In the USA, the National Reading Panel (NRP, 2000) systematically reviewed the evidence-base and proposed five component skills as necessary to become a functional reader: phonemic awareness (recognising words are formed with separate sounds); reading phonics fluently (linking these sounds to specific letter combinations); extending spoken vocabulary to become reading vocabulary (understanding written words mean something); fluency (reading orally with speed, accuracy and appropriate prosody); and comprehension (understanding what is read). The NRP also reported that instruction in phonemic awareness and phonic skills had the greatest effect in kindergarten (equivalent to Year 1 in the UK system) and first grade (Year 2 in the UK). Systematic phonics instruction (in which phonic elements and the letters that represent them are taught in a specific sequence – as opposed to some phonics approaches in which elements are taught on an ad hoc basis) was found to have considerable positive effects: it was significantly more effective than instruction including

little or no phonics element; it had a significant and positive effect on readers identified as having specific reading difficulties ('disabled readers'); and significant benefits were seen for children from the equivalent of Year 1 (5-6years) through to the equivalent of Year 7 (11-12years).

Despite the statistics previously outlined relating to reading attainment in individuals with ID, there is generally insufficient information regarding effective approaches for teaching reading or other academic skills for children with ID (Marks, 2000; Wehmeyer, 2006; Fletcher-Campbell, 2000). Typically, reading research and instruction for individuals with ID has focused on sight-word reading approaches (Katims, 2000; Browder & Xin, 1998). However, increasing evidence suggests individuals with ID might also benefit from instruction incorporating components of reading found to be effective for TD children (Allor, Mathes, Roberts, Jones & Champlin, 2010; Browder, Ahlgrim-DeLzell, Flowers, & Baker, 2012; Browder, Wakeman, Spooner, Ahlgrim-DeLzell & Aldozzine, 2006). Specifically, it has been reported that phonics-based instruction directly focused on the teaching of decoding skills may lead to positive outcomes (Joseph & Seery, 2004; Whalon, Otaiba & Delano, 2009). Despite these findings, research into reading instruction for children with ID has not typically incorporated the five components outlined in the extensive NRP review, and has rarely included phonics instruction (Browder et al., 2006; Joseph & Seery, 2004).

Literacy policy

The core components identified by the NRP are widely used by educators in the US to guide reading instruction and evaluate reading programmes (Armbruster, Lehr & Osborn, 2001, Simmons & Kame'enui, 2003, Begeny, Schulte & Johnson, 2012). In the UK, recommendations following the NRP review (2000) and subsequent independent reviews commissioned by the Department for Education (Rose, 2006; Rose 2009) outlined the importance of high quality systematic phonics as the main approach to teaching early reading

and spelling, and that phonics work should begin for most children at the age of 5 (Parliamentary office of Science and Technology, 2009). Following these findings, the use of systematic phonics in early reading instruction has been strongly advised within the National Curriculum since 2007.

In England in 1998, the National Literacy Strategy (NLS) was introduced, which prescribed both content and pedagogy for primary schools with a view to raising literacy standards across the board (Saunders, 2007). The NLS was implemented in most schools, including special schools (Wall, 2003; OFSTED, 2000). Although some reading improvements were noted in special schools, concerns were also reported (OFSTED, 2000): the standard of phonics instruction was found to be weak or lacking; sufficient suitable materials were not provided within existing programmes for children with various disabilities; and provision of guidelines and training specific to reading instruction for teachers in special schools was highlighted as an area in need of improvement (OFSTED, 2000).

Overall, outcome data since the introduction of the NLS indicates considerable improvement; reportedly 98,000 more children have attained expected National Curriculum levels in English since 1997 (Department for Education, 2011). However, despite being considered the ‘gold standard’ for informing evidence-based practice in medicine and healthcare, the use of RCTs to inform practice in education has not been as prevalent (Milton, 2007; Torgersen & Torgesen, 2001; Oakley, 2006). As such, educational policies are often introduced and implemented without sufficient evidence of their efficacy (e.g., UK National literacy and numeracy strategies; Torgersen & Torgersen, 2001). Furthermore, the literacy figures previously outlined indicate there are still many children struggling to learn to read, and it has been acknowledged that there is a need for further robust evaluations of educational interventions (Department for Education, 2013) as well as a need for evaluations

of reading programmes and approaches that might be used with children with ID (Fletcher-Campbell, 2000).

Computer-assisted instruction

Computer-assisted reading programmes are increasingly used to supplement reading instruction (Andrews, 2004) which are often designed to target specific skills, including phonological awareness, word identification, and reading fluency (Wise & Olson, 1995; Soe, Koki & Chang, 2000; Blok, Oostdam, Oter & Overmaat, 2002). In a meta-analysis of 42 studies evaluating such programmes, Blok et al. (2002) found some evidence of effectiveness when computer-based instruction is used alongside beginning reading instruction. Similarly, Macaruso, Hook and McCabe (2006) found that computer-based supplementary reading instruction can have a significant effect on the reading skills of ‘at-risk’ first graders (Y2). Increasing evidence also suggests such programmes can help improve reading skills in children with autism (Grindle, Hughes, Saville, Huxley, & Hastings, 2013) and children with ID (Coleman-Martin, Heller, Cihak & Irvine, 2005; Jones, Torgesen & Saxton, 1987; Torgesen, Waters, Cohen & Torgesen, 1988).

Furthermore, it has been suggested that computer-assisted instruction (CAI) could potentially provide expert instruction in remedial reading, especially when the time and resources available to train teaching staff are limited (Chambers, Abrami, McWhaw & Therrien, 2001).

Headsprout[®] Early Reading

Programme overview

Headsprout[®] *Early Reading*¹ (referred to throughout as HER) is an Internet-based programme designed to teach the skills and strategies necessary for efficient, fluent reading,

¹ NB. Although initially released as Headsprout[®] *Early Reading*, this programme was temporarily called ‘MimioSprout’ *Early Reading* during 2012/2013. It has now returned to Headsprout[®] *Early Reading*.

taking beginning readers to a mid Y3 reading age in around 24 hours of instruction. Children enrolled in the programme have an individual license that can be accessed anywhere with Internet access and a computer with Adobe® Flash® player, allowing access to the 80 online lessons (episodes). The account also includes *Sprout Stories*™ to be read after specified episodes, sheets to track story reading scores, a teachers' Guide, and other resources to help implementation (e.g., reward charts and progress maps). Progress data is available at a child level (e.g., episode accuracy and phonetic elements learned) and at class-wide, school-wide and district-wide levels (e.g., how often episodes are completed, average progress through the programme and benchmark assessment scores; see HER *Teacher's Guide* for further details on the implementation of the programme).

Considerable evidence indicates that systematic phonics instruction including explicitly and systematically teaching letter-sound correspondences enables children to make better progress in reading accuracy than no instruction in phonics, or unsystematic phonics instruction (NRP, 2000; Torgesen, Brooks & Hall, 2006). As well as providing such systematic phonics instruction, HER explicitly incorporates the five components of reading instruction evidence suggests are essential for reading success (as previously outlined; NRP, 2000), including: phonemic awareness; reading phonics fluently; extending spoken vocabulary to become reading vocabulary; fluency; and comprehension.

A distinguishing feature of HER as compared to most educational programmes is the Non-linear approach to instructional design (Twyman, Layng, Stikeleather & Hobbins, 2004). Using the instructional programming process of Markle and Tiemann (1967), HER was developed through a rigorous scientific approach. This process begins with a content analysis, in which the content and concepts necessary to teach the desired repertoire effectively and efficiently are thoroughly investigated. Clear instructional objectives are then outlined to define the outcomes to be achieved. Criterion tests are then developed to

appropriately test within the programme whether these objectives are met. Specific entry repertoires are then established. The instruction to meet the objectives is then designed, and performance data is used to assess whether the criterion tests and instructional objectives have been met. Maintaining consequences are also built in for programme extrinsic and intrinsic motivation (Goldiamond, 1974). Within HER, this is achieved in part through the carefully sequenced introduction of phonetic elements. Unlike many phonics-based programmes in which children are taught the sounds of the alphabet in isolation, HER begins by teaching highly stable phonetic elements (such as ‘v’, ‘ee’, ‘s’ and ‘an’): the 33 elements introduced in the first 40 episodes are regular in over 85% of the words in which they appear (*HER Teacher’s Guide*, 2010). This allows for essential decoding strategies to be mastered before less stable elements are introduced, and children are able to read the Sprout Stories™ made up from these elements from as early as episode 5.

The culmination of these programming steps for HER is outlined in Table 1. Learners move through the programme in a very different way to how it has been developed, and each learner moves through the programme differently depending on their pattern of responding. It is a recursive process, ensuring learners meet objectives as they progress through the programme.

Formative evaluation

In the development of HER, performance data was used to allow for extensive formative evaluation at three levels: *Developmental testing* (focusing on developing a workable instruction programme, during which learners visited the testing lab so instructional designers could observe their interaction with the programme, collect performance and affective measures, and test new sequences based on these data); *Validation testing* (focusing on replicating performance across different learners, and investigating the specific parameters of programme effectiveness in order to accurately describe the programme and further refine

elements as necessary); and *Field testing* (in which use of the programme in the field is closely monitored, with performance and outcome data collected and further investigation of parameters of effectiveness and further refinements made; Twyman, Layng, Stikeleather & Hobbins, 2004).

In addition to the overall programme design, a non-linear approach is also taken for individual learners. Based on individual performance within tasks and across lessons, learners will be exposed to different instructional sequences in order to meet the objectives of the criterion tests built into the programme. These patterns of responding also provide continuous evaluation of the programme and inform further adaptations to the programme that might be required.

Typically, 'evidence-based' reading programmes are informed by research to some degree (e.g., including some components of reading instruction found to be effective), and evaluated summatively (i.e., comparing reading outcomes to those of another specific programme or 'treatment as usual'; Layng, Stikeleather & Twyman, 2006). However, for many programmes, the first stage of formal testing of the programme would be either some field-testing prior to commercial release, or measurement of outcomes after commercial release. Layng, Stikeleather and Twyman (2006) suggest that employing *scientific formative evaluation* of programme components during development (including iterative cycles of instructional sequences with individual learners), as well as the more common *summative evaluation* (in which a programme is compared to another specific programme or 'treatment as usual') provides a scientifically developed *and* scientifically evaluated programme, which acknowledges and responds to individual learner progression and outcomes in addition to group outcomes, is more likely to result in an instructional programme that ensures learner success.

Table 1.

A Description of the Nine Teaching Routines Incorporated into HER

Establishing routines	Teach sound–letter correspondence and sight words through explicit instruction
Adduction routines	Teach skills through a discovery learning method
Vocal potentiation routines	Teach speaking out loud and become one’s own listener
Blending and segmenting routines	Teach blending sounds together into words and segmenting words into their individual sounds
Sentence and story routines	Teach skills such as reading from left to right and reading for meaning
Fluency routines	Involve guided, timed reading practice
Motivation routines	Involve both extrinsic and intrinsic reward components
Application routines	Involve applying skills and strategies to new words, stories, and contexts
Overall sequencing	Designed to develop an interlocking set of skills and strategies and to allow to begin reading quickly

(Table from Twyman, Layng & Layng, 2011)

Field-testing during the formative evaluation of HER indicated considerable benefits across a range of reading measures with a range of children (*Headsprout, Results count, 2013*). A mainstream, state-funded primary school (in which over 90% of children were receiving free school meals – indicating low Socio-economic status) introduced HER for

children in kindergarten (Year 1) and with children with English as an additional language across grade levels (equivalent of Y1 through to Y6). After four months of implementing the first 40 lessons of the programme (initially released as *Headsprout Reading Basics*) 1-2 times per week, there was an average gain of over 1.15 grade levels.

Further field testing was conducted with 13 children aged between four and six in their home environment over the Summer break (*Headsprout, Results count, 2013*). Eleven of the thirteen had scored below grade level prior to Summer; on returning to school, all demonstrated scores above grade level, with 12 scoring well beyond expected grade level.

There have also been a number of unpublished evaluations of HER following its commercial release (See *Headsprout, Results count, 2013*). These studies also demonstrate considerable positive effects of the programme. For example, one primary school in New York implemented the programme with children in Y1 and Y2, randomising participants so that half of each year group enrolled in HER, and half continued with current provision. Initial outcome data indicated that those who completed over 70 of the 80 lessons made significant and substantial gains across measures of letter and word recognition, word analysis, reading words and reading comprehension.

HER is scientifically designed, and results from thorough formative evaluation indicate many children demonstrate significantly improved reading skills upon completing the programme. However, what is the evidence-base for the efficacy of HER beyond this formative evaluation? The next section of this chapter will comprise a review of peer-reviewed research evaluating HER.

A review of peer-reviewed research evaluating HER

For this review, only articles published in peer-reviewed journals and specifically evaluating the use of HER are included. Using the search terms 'Headsprout Early Reading' across numerous databases, five evaluation studies were identified; two were group design

evaluations of the programme with typically developing children, and three were single-case experimental or pre-post designs with children with additional needs.

Evaluations with typically developing children

Huffstetter, King, Onwuegbuzie, Schneider and Powell-Smith (2010) investigated the effects of using HER with at-risk preschool children, averaging 5 years of age. Sixty-two children were randomly assigned to either receive HER as supplemental reading instruction, or to enroll in a computer-based maths programme (Millie's math house) for the same period. All children also received their typical classroom reading instruction. During an 8-week intervention period, children engaged in either programme for 30-minutes each day. Gains at post-test on measures of reading (Test of Early Reading Ability-3) were significant for the group enrolled in HER, with a large effect size ($d = 1.39$) and were not significant for the control group. Gains in oral language skills (Test of Language Development-Primary 3) were significant for both groups, however were significantly higher in the group enrolled in HER, with a medium effect size ($d = .78$).

In addition to measures of reading and oral language skills, Huffstetter et al., (2010) also conducted an open-ended interview following the intervention to investigate perceptions of the programme. In these interviews, most respondents (both teachers and assistants) stated that HER helped improve reading and oral language skills, was suitable for children at this age, and was positively received by both children and parents. The results of this study indicate that receiving HER as supplemental reading instruction can have a significant impact on reading and language skills, even over a short intervention period.

Twyman, Layng & Layng (2011) investigated the effects of HER with kindergarten (year 1) and first-grade children (year 2). As previously outlined, the programme is designed to teach and build reading repertoires throughout the 80 lessons, indicating the programme must be completed to have the maximum effect on reading ability. However, the purpose of

this study was to determine whether there is an '*instructionally beneficial*' effect if the programme is not completed through investigating improvements after completing at least half of the HER lessons.

Twyman, Layng and Layng (2011) suggest that, despite the conventional use of statistical significance to determine the efficacy of educational programmes, whether differences in performance are instructionally beneficial is of greater importance to educators than whether they are statistically significant. (For further information on this analysis see Batterham & Hopkins, 2006, and Hopkins 2002 and 2007.)

In a cluster-randomised design, an equal number of kindergarten and first-grade classes were randomly assigned (through the flip of a coin) to either the experimental or control group. Three kindergarten classes and two first grade classes were assigned to each, with 65 children enrolled in HER, and 60 in the control group.

Prior to beginning the programme, participants were assessed on the Woodcock-Johnson III-R (WJ-LW; Schrank, Maher & Woodcock, 2006) letter-word identification subtest, and the appropriate grade level subtests of the Iowa Test of Basic Skills (ITBS; Hoover et al., 2001), including: word analysis, reading words and reading comprehension. After the 7-month research period, these assessments were repeated.

During the research period, children in the experimental group had daily HER sessions of around 40 minutes in a computer lab, while the control groups received alternative supplementary reading instruction. Over the school year, children enrolled in HER completed an average of 67 lessons.

The level decided as demonstrating an instructionally beneficial effect was 2 months grade level reading improvement above improvements seen with the typical curriculum after 7-months. Therefore, if more than 2 months improvement over the control group was found, this would demonstrate a *beneficial effect*. When compared to the control group, all

participants demonstrated instructionally beneficial effects on all reading tests, suggesting that instructional benefit is likely even if children have not completed all 80 lessons.

Dynarski, Agodini and Campuzano (2010) investigated the effects of reading software products on reading outcomes. Nine software applications focused on reading were chosen based on previous research suggesting effectiveness (either by the company or independent research), the feasibility of implementing the programme at sufficient scale for a national study, and the capacity of the company to train staff in the use of the programme. These programmes included 5 first grade (Year 2) reading products (*Destination reading, HER, Waterford Early reading program, Plato focus and the Academy of reading*). Four reading products for fourth grade (Y5) were also investigated.

Forty-six schools, 169 teachers and 2619 students participated in the first grade product evaluations, in which teachers were randomly assigned to one of the five products (treatment group), or a control group in which these specific products were not used. At the beginning of the school year, all children were assessed on various reading measures that were repeated in the spring of the same school year. There was found to be no significant difference in reading test scores on any measures between the treatment and control groups. However, because the remit of this study was to investigate the general effects of reading software products, the effectiveness of HER was not specifically reported.

Evaluations with children with additional needs

Clarfield and Stoner (2005) investigated the effects of using HER with children with ADHD on oral reading fluency and on-task behaviour. A multiple-baseline design across three children was conducted, with weekly measures of oral reading fluency and twice weekly observations of task engagement during reading instruction (reduced to fortnightly after 3-weeks of intervention). During baseline, participants engaged in their usual teacher-led reading instruction. Throughout the intervention phase, participants had three 20-30

minute sessions per week in addition to their teacher-led reading instruction. Participants completed between 21-27 of the 80 lessons over the intervention period (8-9 weeks). All participants demonstrated an increase in oral reading fluency throughout the intervention, with each child's estimated weekly growth of words read correct increasing, indicating educationally significant gains as a result of the programme (according to expected growth rates reported in Deno, Fuchs, Marston & Shin, 2001). Off-task behaviour was also found to decrease during the intervention, suggesting HER may help increase task engagement in children with attention difficulties.

Whitcomb, Bass and Luiselli (2011) investigated the use of HER with a 9-year-old boy with autism. In a multiple-baseline across behaviours, two repeated-measures of reading accuracy were conducted throughout baseline and intervention. Intervention included the first 23 episodes of the programme. The first percentage accuracy measure comprised four word sets of phonetically regular words taken from HER, ranging from 10 to 26 words per set. The child was repeatedly measured on all four word sets throughout baseline and intervention. However, word sets were sequenced in the order they are taught in the programme, therefore 'intervention' for each specific word set was staggered, beginning with the introduction of word set 1 (with sets 2-4 remaining in baseline).

HER readers (stories from HER including words from the word sets) were used as the second percentage accuracy measure. Similarly to the word sets, intervention across these readers was staggered, and baseline data taken for each story one session prior to the episode that specified this story to be read. Accuracy across word sets and HER readers increased following intervention, demonstrating improved word reading and reading of connected text. This indicates that the programme can be used with children with autism and that they do master the criterion tests within the programme. However, due to the complexities of measuring the growth of early reading skills as required for a multiple-baseline design, there

are limitations of these findings. Given that only programme materials were used to measure and demonstrate reading progress, it is difficult to generalise these findings beyond mastery of the specific curriculum.

Grindle, Hughes, Saville, Huxley & Hastings (2013) enrolled 4 children with a diagnosis of autism (aged between 5 and 7) in HER. With some additional procedures to enable access (e.g., additional Discrete Trial Teaching for areas of difficulty, dividing episodes over 2-3 sittings, and delivery of additional reinforcers to increase motivation), all four children completed the programme over a period of 14 weeks. Notable improvements in early literacy skills and word recognition were seen across participants after the intervention, with improvements in word recognition skills measuring between 14 months and over 3 years. This study further demonstrates that HER can be successfully implemented with children with autism, and indicates that it could have considerable statistically and educationally significant effects on early reading skills for these children.

These published studies indicate HER can help improve reading skills of children with various difficulties. However, to further investigate the effects of HER in different populations and settings, we arguably need a more coordinated research effort. Whilst there are some robust findings across the field testing data and published studies for the effects of HER when used with typically developing children (e.g., Huffstetter et al., 2010), it is important to note that this research has been conducted in the USA and that evaluations of effective practices in education ideally need to be conducted in a UK context to determine whether these potential outcomes translate – both to British English in terms of reading measures, and to the UK education system in terms of feasibility and social validity of the intervention (Slavin, 2008). Furthermore, whilst the findings that HER can be used successfully with children with ADHD and children with autism are encouraging, further and more robust investigation of this and evaluations of the use of HER in other populations with

additional needs are required in order to determine the efficacy of the programme for diverse learners and guide effective implementation of the programme.

Overview of this thesis

At the time of writing, there are few published evaluations investigating the effects of HER with typically developing children, and no UK-based evaluations. Therefore, the first aim of this thesis is to investigate the effects of HER with typically developing children in a UK setting.

Statistics relating to literacy skills in special schools indicate very low rates of basic literacy. However, there is very little information available regarding typical instruction in these settings, and therefore no clear picture of the potential barriers precluding the improvement of reading skills in special schools. The second aim of this thesis is therefore to investigate current practices in reading instruction with children in special schools, and in particular, children with an intellectual disability (ID).

There is some encouraging evidence that HER could be effective for children who are not typically developing. However, considering there are only three published studies and no RCT evaluations, this requires considerable further investigation. Models for complex interventions recommend that feasibility research be conducted prior to conducting randomised studies to assess efficacy of interventions (Thabane et al., 2010). Feasibility studies can serve various purposes, including investigating the process of conducting RCTs for a specific intervention with a specific population, the resources required to enable such a study, management issues, and the investigation of potential outcomes of the intervention (Van Tiejlingen, Rennie, Hundley & Graham, 2001; Van Tiejlingen & Hundley, 2001; Thabane et al., 2010). The third aim of this thesis is therefore to explore some important feasibility questions regarding the potential use and effects of HER with children with ID.

The remaining five chapters in this thesis comprise four research chapters and a general discussion chapter. Each of the research chapters have been prepared as manuscripts for publication in peer-reviewed academic journals, and, at the time of completing this thesis, two are under review and two are awaiting submission for review.

Chapter 2 focuses on the use of HER as supplementary reading instruction during beginning reading instruction with typically developing children in Y2 (aged 6-7years). In this randomised study, the intervention group enrolled in HER for the duration of the school year, whilst the control group continued with their typical classroom instruction. Children in the intervention group made significantly greater improvements than the control group across reading measures.

Chapter 3 reports on the results of a survey of teachers in special schools in the UK to further elucidate the current practices and challenges related to reading instruction for children with ID in these settings. The aims of the survey were to collate information on current practices related to reading instruction provided for children with ID in special schools across the United Kingdom (UK); investigate the putative effects of age and severity of ID on teachers' choice of instructional approaches; and examine teachers' perception of barriers to improving reading skills in this population. It was found that age and severity of ID influenced responses on some items relating to choice of approaches and expectations, and that access to training and suitable curricula were seen as greater barriers to improving reading skills than factors relating to time or staffing.

The remaining two research chapters investigate the use of HER with children with ID. Chapter 4 presents case studies investigating initial feasibility questions related to using the programme with children with ID. This chapter reports on the progress of six children with mild to moderate ID, including their individual progress through the programme and a comparison of reading scores before and after completing the programme. All children

accessed and completed the programme with minimal additional input and demonstrated improved reading skills.

Chapter 5 investigates further feasibility questions relating to conducting a full-scale RCT evaluation of HER with children with ID. Employing a randomised pre-test post-test group design, this study aimed to explore and trial important aspects of an RCT evaluation to inform a full-scale RCT with children with ID in special schools in the UK. In addition to informing the design of a future study, we also found that HER had a significant effect on reading skills when compared with ‘treatment as usual’, with large effect sizes on the main outcome measure. This indicates that further more robust evaluations using HER with children with ID are a worthwhile pursuit.

The final chapter provides a general discussion of the research included in this thesis, including discussion of how these findings contribute to the current literature in this area, methodological challenges and limitations, and the real-world impact of investigating and implementing HER in schools in North Wales.

Chapter 2 - Improving early reading skills for beginning readers using an online programme as supplementary instruction²

² This chapter is under review as: Tyler, E. J., Hughes, J. C., Beverley, M., & Hastings, R. P. Improving early reading skills for beginning readers using an online programme as supplementary instruction.

Abstract

Many children fail to acquire basic reading skills. The current evidence base for supplementary reading instruction indicates that explicit, systematic, and intensive instruction in the early years for children considered to be ‘at-risk’ of reading difficulties can have significant and preventative effects on reading skills. However, little research has investigated the effects of supplementary instruction for beginning readers as they first encounter formal reading instruction, regardless of whether they are considered ‘at-risk’. The current study investigated whether using an online reading programme (Headsprout *Early Reading*; HER) as supplementary instruction for readers in Year 2 regardless of initial reading problems leads to improvements in reading skills as compared to children not receiving this additional instruction. Fifty-one children in Y2 (6-7 years) from two mainstream schools in North Wales participated in the study. Participants were randomly allocated to either the HER group or a waiting list control group. Following pretest reading assessments, the HER group enrolled in the programme as supplementary instruction for up to 45 minutes daily for 8-months. There were significant and marginally significant differences in favour of the HER group across measures of reading accuracy and word recognition skills, with medium and large effect sizes on most measures. The results indicate that using HER as supplementary reading instruction for beginning readers in Year 2 can have a significant effect on reading skills. Further research is required to investigate the potential benefits of class-wide implementation as standard provision for beginning readers.

Reading is an essential skill, and being unable to read affects many aspects of life, from basic academic progress to the ability to live independently and participate in modern society (Marchand-Martella, Slocum, & Martella, 2004). However, reading is a complex skill that many children struggle to acquire (Fletcher & Lyon, 1998). In England, 15% of 7 year olds are not reaching the required National Curriculum level 2 (Department for Education, 2010), 13% of children entering secondary school are reading below the expected level, 5% of adults are below the expected reading age for 11 year olds (Department for Education, 2008), and a further 16% of adults are said to be functionally illiterate, suggesting they will struggle with tasks such as reading simple information or filling out basic forms (Jama & Dugdale, 2012). Furthermore, it has recently been reported that 40% of pupils in Wales enter secondary schools with a reading age of more than 6 months below their chronological age (Estyn, 2012).

There is a considerable evidence base indicating effective approaches for teaching reading to typically developing children that has been extensively reviewed both in the USA and the UK. In the USA, the National Reading Panel (NRP, 2000) systematically reviewed the evidence-base and proposed five component skills as necessary to become a functional reader: phonemic awareness (recognising words are formed with separate sounds); reading phonics fluently (linking these sounds to specific letter combinations); extending spoken vocabulary to become reading vocabulary (understanding written words mean something); fluency (reading orally with speed, accuracy and appropriate prosody); and comprehension (understanding what is read). The NRP also reported that instruction in phonemic awareness and phonic skills had the greatest effect in kindergarten (Equivalent to Year 1 in the UK system) and first grade (Year 2 in the UK). These core components are widely used by educators in the US to guide reading instruction and evaluate reading programmes

(Armbruster, Lehr & Osborn, 2001, Simmons & Kame'enui, 2003, Begeny, Schulte & Johnson, 2012).

In the UK, recommendations following the NRP review (2000) and subsequent independent reviews commissioned by the Department for Education (Rose, 2006; Rose 2009) outlined the importance of high quality systematic phonics as the main approach to teaching early reading and spelling, and that phonics work should begin for most children at the age of 5 (Parliamentary office of Science and Technology, 2009). Following these findings, the use of systematic phonics in early reading instruction has been strongly advised within the National Curriculum since 2007. However, the literacy data previously outlined suggest that in many cases some additional instruction may be necessary for children to develop fluent reading skills.

Several researchers have evaluated the use of supplementary reading instruction to improve reading outcomes for beginning readers considered to be 'at-risk' of reading failure (e.g., Cooke, Kretlow, & Helf, 2009; Coyne, Kame'enui, Simmons, & Harn, 2004; Harn, Linan-Thompson, & Roberts, 2008; Vadasy, Sanders, & Peyton, 2006; Vellutino, Scanlon, Small, & Fanuele, 2006), children learning English as an additional language (Calhoon, Al Otaiba, Greenberg, King, & Avalos, 2006; Gunn, Smolkowski, Biglan, Black, & Blair, 2005; Linan-Thompson, Sharon, Hickman-Davis, & Kouzekanani, 2003), and remedial supplementary reading instruction to support struggling readers (Berninger et al., 2003; Denton, Fletcher, Anthony, & Francis, 2006; Jitendra et al., 2004; McIntyre et al., 2005).

Coyne et al. (2004) investigated whether delivering intensive beginning reading instruction to children at-risk of reading difficulties in kindergarten (Year 1) might have a preventative effect on reading difficulties a year later. Children identified as at-risk (based on phonological deficits entering kindergarten) were enrolled in a 7-month reading intervention focused on phonological awareness and the alphabetic principle. Strong responders to this

intervention were followed up in first grade (Year 2), and it was found that most participants continued to make progress comparable to their peers, even if they had not received further supplementary instruction. Coyne et al. (2004), therefore, suggested that targeting children at-risk prior to Year 2 can provide an ‘inoculation’ effect well into Year 2 for some children.

Harn et al. (2008) investigated whether more instructional time for first grade children at-risk had an effect on reading outcomes. All children in the study had been identified as requiring additional reading instruction in small groups, and were allocated to groups implementing similar instruction delivered by individuals with the same specific training. However, half of the students received 30 minutes of instruction 5 days per week, whilst the other half received 60 minutes 5 days per week. It was found that children who received the more intense intervention scored significantly higher on measures of word reading skills (including identification, nonsense words, and oral reading) than those who received 30 minute intervention sessions. These findings suggest that increased instructional time can have a positive effect on reading outcomes for children receiving supplementary instruction.

The mode of delivery of supplementary reading instruction is also important to consider. There are several computer-assisted supplementary reading programmes targeting specific skills including phonological awareness, word identification, and reading fluency (Wise & Olson, 1995; Soe, Koki & Chang, 2000; Blok, Oostdam, Oter & Overmaat, 2002). In a meta-analysis of 42 studies evaluating various computer-assisted reading programmes, Blok et al. (2002) found some evidence of effectiveness when computer-based instruction is used alongside beginning reading instruction. Furthermore, it has been suggested that computer-assisted instruction (CAI) could potentially provide expert instruction in remedial reading especially when the time and resources available to train teaching staff are limited (Chambers, Abrami, McWhaw & Therrien, 2001).

Macaruso, Hook and McCabe (2006) investigated the effects of a computer-based supplementary reading programme designed by Lexia (LLS Inc., 2001), which incorporated phonological awareness and phonics-based decoding strategies. Ten first grade classes were assigned to either receive Lexia as supplementary instruction, or to receive only typical in-class instruction. Of the 83 students in the Lexia group and 84 in the control group, 15 in each group were identified as ‘at-risk’. Frequency of Lexia sessions varied across schools; an average of 64 sessions were completed over a 6-month period. After 6 months, it was found that, although the Lexia group gains were higher than for the control group, there was no significant difference in these gains. However, further analysis indicated that children considered ‘at-risk’ in the Lexia group scored significantly higher than the ‘at-risk’ children in the control group on a measure of letter-sound correspondence, and that the Lexia ‘at-risk’ group scored similarly to their peers on this measure at post-test. These findings suggest that computer-based supplementary reading instruction can have a significant effect on the reading skills of ‘at-risk’ first graders.

Huffstetter, King, Onwuegbuzie, Schneider and Powell-Smith (2010) investigated the effects of an online programme – Headsprout™ *Early Reading*– which is Internet-based systematic, synthetic phonics programme designed to teach the skills and strategies necessary for efficient, fluent reading (Layng, Twyman, & Stikeleather, 2003). Sixty-two ‘at-risk’ preschool children (averaging 5 years of age) were randomly assigned to either receive Headsprout *Early Reading* (HER) as supplementary reading instruction, or to enroll in a computer-based maths programme (Millie’s math house) for the same period. All children also received their typical classroom reading instruction. During an 8-week intervention period, children engaged with their assigned programme for 30-minutes each day. Gains at post-test on measures of reading (Test of Early Reading Ability-3) were significant for the group enrolled in HER, with a large effect size and were not significant for the control group.

Gains in oral language skills (Test of Language Development-Primary 3) were significant for both groups. However, these language gains were significantly higher in the group enrolled in HER, with a medium effect size.

In addition to measures of reading and oral language skills, Huffstetter et al., (2010) conducted an open-ended interview following the intervention to investigate perceptions of the programme. Most respondents (both teachers and assistants) stated that HER helped improve reading and oral language skills, was suitable for children at this age, and was positively received by both children and parents. The results of this study indicate that receiving HER as supplementary reading instruction can have a significant impact on reading and language skills, even over a short intervention period.

The current evidence base for supplementary reading instruction indicates that explicit, systematic, and intensive instruction in the early years for children considered to be ‘at-risk’ of reading difficulties can have significant and preventative effects on reading skills (Cooke et al., 2009; Coyne, Kame'enui, & Simmons, 2004), and that response to such intervention can serve to identify children who will likely require continuing additional support (Vellutino et al., 2006). However, there is little research investigating the effects of supplementary phonics-based instruction for beginning readers as they first encounter formal reading instruction, regardless of whether they are considered ‘at-risk’ of reading failure at that time. Even with class-wide implementation of early reading intervention, there will most likely be children who will require further support to acquire more advanced reading skills and some children may still require remedial reading instruction in the future (Coyne, Kame'enui, Simmons, et al., 2004) Shanahan & Barr, 1995; National Research Council, 1998). However, by providing additional instruction for all beginning readers at the point of initial reading instruction arguably fewer children might struggle in the first instance (Coyne et al., 2004).

The current randomised study investigated whether the use of HER as a supplementary reading programme for all beginning readers in Year 2 regardless of initial reading problems leads to improvements in reading skills as compared to children not receiving this additional instruction.

Method

Participants and setting

Pupils in Year 2 (aged 6-7 years) from two mainstream primary schools in North Wales participated in the study. In the first part of the school year, 51 children were randomly allocated to either the Headsprout *Early Reading* (HER) group, or a waiting list control group (C). Twenty five were allocated to the HER group (Female = 12, Male = 13) and 26 to the control group (Female = 5, Male = 21). In the pre-test reading assessments, a number of participants demonstrated reading ages beyond a beginning reading level for which the HER programme is designed, and were therefore excluded from the study. Thus, at the beginning of the intervention period, there were 24 children in the HER group (Female = 11, Male = 13) and 17 children in the control group (Female = 3, Male = 14). Eight participants were learning English as an additional language (HER = 5, C = 3).

Materials

Headsprout[®] *Early Reading* (HER) is an Internet-based programme designed to teach the skills and strategies necessary for efficient, fluent reading. Comprising 80, 20-minute lessons (episodes), HER is a systematic, synthetic phonics programme that includes instruction in phonemic awareness, print awareness, phonics, sounding out, segmenting and blending, and explicitly incorporates the five components of reading proposed by the NRP (Layng, Twyman, & Stikeleather, 2003). HER utilises similar principles of instructional design employed in Direct Instruction curricula (Engelmann & Carnine, 1982), including: teaching consistent elements before exceptions, teaching basic strategies to mastery before exceptions

are introduced, and introducing easy skills prior to more difficult skills. For example, unlike many phonics-based programmes in which children are taught the sounds of the alphabet in isolation, HER begins by teaching highly stable phonetic elements (such as ‘v’, ‘ee’, ‘s’ and ‘an’): the 33 elements introduced in the first 40 episodes are regular in over 85% of the words in which they appear (*HER Teacher’s Guide*, 2010). This allows for essential decoding strategies to be mastered before less stable elements are introduced, and children are able to read the Sprout Stories™ made up from these elements from as early as episode 5. Similarly, rather than being organised in discrete units of content, content within HER is organised into ‘tracks’, meaning that skills are taught across multiple lessons, with each lesson containing activities from various instructional tracks. This enables reading skills to be further practiced and developed throughout the programme (See appendix 1 for tables of the Scope and Sequence of the HER curriculum). Furthermore, HER is an adaptive learning technology—every mouse-click forms data on individual learners’ progress that is used to provide additional instruction or to ensure repeated practice of components not yet fluent. In this way the instruction is individually adapted to each child’s responses, and provides high levels of response and feedback opportunities. See Procedure or Layng et al. (2003) for more detail.

HER episodes were delivered on computers that were available within the schools, either in designated computer labs or on computers located outside the classrooms.

HER also includes 80 stories comprising material covered in the programme. These were printed out for participants to read after specified episodes. Licenses for all participants allowed access to progress reports and further information on the implementation protocol (*HER Teacher’s Guide*, 2010). Teachers also downloaded and printed a progress map from the HER website for each child to display in the classroom as a visual representation of their progress.

Measures

We conducted three reading assessments with all participants:

The *Diagnostic Reading Analysis* (Crumpler & McCarthy, 2007) and the *Oral Reading Fluency (ORF) subtest* of the *Dynamic Indicator of Basic Early Literacy* (Good & Kaminski, 2007) were used to assess progress in oral reading. The DRA comprises of passages of increasing difficulty, and provides an accuracy score, standardised score, and reading age for each participant. The *ORF* subtest consisted of three passages at Year 2 equivalent level. The child reads as many words from each passage as they can in one minute, and the median score is taken.

The *Word Recognition and Phonic Skills assessment* (Carver & Mosely, 1994) was used to assess progress in word recognition skills. In this assessment, the child is read a word and asked to choose the correct word from a choice of four or five. The assessment places children within a word recognition stage, from one (almost no word recognition knowledge) to ten (moving towards mastery of clusters and digraphs necessary for word recognition).

Procedure

Pre programme. We assessed all participants on all measures before beginning the programme. Additionally, prior to episode one, *Mousing Around* was completed. This is a short introductory online episode that familiarises the child with the instructional language of the programme and provides practice of appropriate responding prior to introducing the reading episodes.

In each school, one training session was conducted so that a teaching assistant and undergraduate students could implement the programme. Researchers were present for the initial session, after which we monitored online episode data to ensure fidelity of implementation. An implementation checklist to guide the running of the sessions was

adapted from Huffstetter et al., (2010) for use during the training session and thereafter in all sessions conducted in both schools. This included items such as: ‘Have you checked every child is responding audibly to the speak-out-loud activities?’, ‘Have you responded to any requests for help by redirecting the child back to the programme?’, ‘Have you read the HER stories and scored performance on the appropriate sheets?’ and ‘Have you checked each child has achieved 90% accuracy immediately after episode completion?’.

Online episodes. Episodes were conducted according to implementation guidelines provided by Headsprout. Daily sessions of approximately 45 minutes were conducted, in which the children in the HER group participated in the programme whilst the control group remained in the classroom for other activities. The sessions took place during a ‘free choice’ session in the class, therefore the control group activities did not directly involve any literacy work or other work on academic skills. Participants engaged in episodes at a computer set up ready to access their individual profile. Two student researchers or school staff members were present in each class session. However, they did not interact with the child other than to offer encouragement to stay on task. This was to ensure there was no interference with the sophisticated correction procedure built into the program, and that the responses made provided accurate feedback of the child’s current ability and progress. When each child finished an episode, online data were examined to ensure they had attained the required accuracy level 90% in each episode. Following episode completion, each child chose a sticker to place on their progress map that indicated which episode they had completed.

Stories. In accordance with implementation guidelines, children were also required to read stories provided by the programme after specified episodes. If the child struggled, the instructors reminded them to sound out the word, and implemented a Model-Lead-Test error correction procedure. If a child misread or omitted a word, they were first asked to try again.

If the word was then read correctly, they were praised and then asked to read the whole sentence. If they misread the word again, the staff member/researcher would model sounding out the word and saying it fast (*Model*), then do this with the student (*Lead*) and then ask the student to do this on their own (*Test*). They would then be asked to read the whole sentence.

Additional support. In addition to the online episodes, frequency-building exercises accompany the HER programme. There are two tiers of this additional support—*Targeted Practice* and *Intensive Practice*— both comprising frequency-building activities to help develop fluency in the elements and strategies introduced in the episodes. In accordance with implementation protocol, all children began the programme with only the online episodes and Sprout Stories.

Benchmark Reading Assessments. Twelve of the 80 stories are considered *Benchmark Reading Assessments*, to be conducted after specified episodes. For the Benchmark readers, data on reading accuracy was taken (i.e., number of words read correctly), and a rating of reading proficiency of either *Independent* (read with few errors), *Satisfactory* (read with some errors and slight hesitation), or *Needs Practice* (read with frequent errors). Those involved in implementing the programme were instructed to record these data either electronically through the HER site, or on printed sheets available to download. These data were then used, alongside the programme data, to guide decisions on whether additional frequency-building activities were required.

At the end of the school year (after 8-months of HER intervention), we repeated assessments with all children, regardless of whether they finished the programme earlier and regardless of whether they had finished all episodes of the programme.

Results

Formative evaluations of the HER and reading outcomes were based on children completing all 80 episodes of the programme (Layng et al., 2003). Therefore, 7 children in the HER group were excluded from the statistical analysis on the basis that they had not completed all 80 episodes by the end of the school year. A further 2 children left the school during the research period. The final HER group available for analysis numbered 15 (Female = 6, Male = 9). The final Control group remained at 17 (Female = 3, Male = 13). Given that this was an initial evaluation of the approach, it was important to examine the results associated with implementation as intended (i.e., all episodes), rather than on an intention to treat/educate basis.

Table 1 shows the mean scores, results of ANCOVA and t-test analysis, and effect sizes for all measures for the HER and Control group. To control for potential pre-test differences between the groups despite initial random assignment, a one-way analysis of covariance model was used. Because no participants attained a standardised score or reading age on the DRA at pre-test, independent samples t-tests were conducted to compare post-test scores only for this outcome measure. Effect sizes based on Cohen's *d* were calculated using the mean change scores for the HER and Control group and the pooled pre-test Standard Deviation (Rosnow & Rosenthal, 1996). For the DRA Standardised Scores and reading age, effect sizes based on Cohen's *d* were calculated using the means at post-test for each condition and the pooled post-test Standard Deviation.

Table 1.

Mean Assessment Scores and Standard Deviations at pre and post-test for Intervention and Control groups and Results of T-test and ANCOVA Analysis and Effect Sizes.

		Headsprout Early Reading (HER)		Control group (C)		ANCOVA		
		Pre-test	Post-test	Pre-test	Post-test			
		<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>F (1,29)</i>	<i>p</i>	<i>d</i>
Diagnostic Reading Analysis	Standardised Score ¹	0 (0)	77.60 (41.39)	0 (0)	46.53 (52.40)	t (30) = 1.87	.04	0.61
	Accuracy Score	16.07 (12.52)	90.40 (38.17)	20.59 (15.34)	70.29 (50.04)	6.87	.014	1.67
	Reading age (months) ¹	0 (0)	67.87 (36.27)	0 (0)	45.65 (47.03)	t (30) = 1.51	.07	0.49
Word Recognition and Phonic Skills Assessment	Word recognition Raw Score	20.27 (8.68)	38.27 (9.81)	24.06 (8.24)	33.53 (8.43)	9.95	.004	1.02
	Word recognition Stage	3.60 (2.03)	8.07 (2.34)	4.41 (2.09)	6.71 (1.99)	10.12	.003	0.99
	Word recognition Age (months)	54.80 (29.35)	81.27 (23.29)	71.35 (7.44)	81.24 (7.93)	1.40	.246	1.03
DIBELS	Oral Reading Fluency	13.60 (23.85)	35.67 (18.81)	12.47 (22.17)	26.94 (27.86)	1.27	.270	.34

¹Independent samples T-Tests were conducted on post-test scores for this output due to no participants attaining scores at pre-test

The results indicate that for the DRA Accuracy Scores and Standardised scores there was a significant difference in the HER group at post-test compared to the Control group, and a marginally significant difference in DRA reading age (after controlling for pre-test scores). Effect sizes were large for DRA Accuracy scores and medium for standardised scores and reading age. For the WRaPS assessment Raw Score and Word Recognition Stage, there was a significant difference in the HER group at post-test, with large effect sizes for both. For the

WRaPS Word Recognition Age and the DIBELS *ORF*, there was no significant difference at post-test, however effect sizes were large for Recognition Age and small for *ORF*. All differences between the groups were in favour of the HER group.

Individual change

Individual improvement scores on each measure were also calculated to enable analysis at an individual level. These scores were obtained by subtracting pre-test scores from post-test scores for each participant. Using the *Reliable Change Index* (RCI), individual improvement scores were then used to determine how many participants had demonstrated reliable change at post-test. The RCI is a measure of statistical significance, enabling analysis of the effect of an intervention on individuals (Jacobson & Truax, 1991; Zahra & Hedge, 2010). Because change between pre-test and post-test is required to calculate reliable change and no pre-test scores were available for DRA standardised scores and reading age, the RCI was not calculated for this output.

Figure 1 indicates individual improvement and reliable change level for DRA Accuracy scores, WRAPS Raw Scores, WRAPS Stage and DIBELS *ORF*, indicating that more children in the HER group made gains above the reliable change threshold for each output than children in the Control group. For DRA Accuracy Scores, 11 out of 15 children in the HER group made gains above the reliable change threshold of 51.77, compared with 8 out of 17 in the Control group. For WRAPS Raw Scores, 12 out of 15 children in the HER group made gains above the reliable change threshold of 11.67 compared with 4 out of 17 in the Control group. For WRAPS Stage, 13 out of 15 children in the HER group made gains above the reliable change threshold of 3.0, compared with 6 out of 17 in the Control group. For DIBELS *ORF*, 6 out of 15 children in the HER group made gains above the reliable change threshold of 31.84, compared with 3 out of 17 in the Control group.

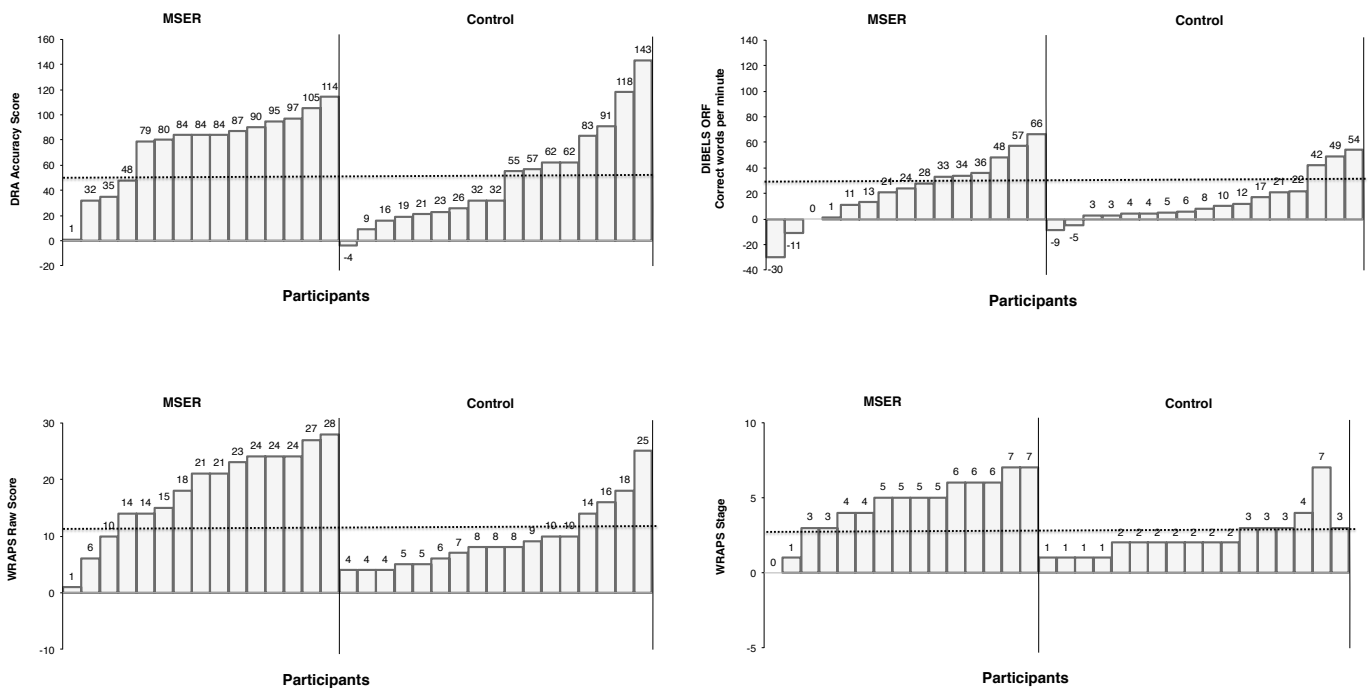


Figure 1. Individual improvement and reliable change in Reading Accuracy, Oral Reading Fluency, and Word Recognition raw score and stage.

Discussion

This study investigated the effects of HER as supplementary reading instruction for beginning readers in Year 2 regardless of whether they were identified as “at risk” but excluding children already reading beyond the level of skills taught by HER. The results indicate that there was a significant difference in favour of the HER group at post-test for all but the WRAPS word recognition age and the DIBELS *ORF*, with medium and large effect sizes across all measures (with the exception of DIBELS *ORF* where only a small effect size was found). The mean reading age on the DRA at post-test was 22 months higher in the MER group than the control group, despite similar scores at pre-test. Furthermore, when examining individual participants’ RCI scores, more children in the HER group reached a level of reliable change than in the control group across all measures. This indicates that

improvements at the group level were reflected at the level of individual children's response to the intervention. These findings suggest that using HER as supplementary reading instruction was more effective than typical classroom instruction alone for beginning readers.

Seven children in the HER group were excluded from the analysis because they did not complete the full 80 episode programme within the school year. Progress through the episodes and reasons for these children not completing the programme varied. Four children reached the second half of the programme (ranging from episode 41-71). Three of these children did not complete due to many school absences (either long periods of absence, or absence during the HER sessions). Two children completed a significant proportion of the programme (39 and 47 episodes), but required additional input in later episodes which slowed progress. This additional input was in the form of the *Targeted Practice* tier of support, and was to be delivered during the usual HER sessions for those children. As such, they did not have as many opportunities to complete the online episodes.

One participant who did complete all episodes demonstrated very little improvement across reading measures, most notably the DRA in which he read only one word correctly. With this participant, it was noted during the second half of the programme that he was having difficulties with the stories and benchmark assessments. Therefore, it was advised that he should complete the Targeted Practice activities. However, due to difficulties trying to incorporate these additional activities within the usual HER sessions, these activities were not implemented with the rigour required, and this participant had been allowed to continue on through the online episodes despite obvious difficulty applying these skills to reading text away from the programme. Therefore, although this child had completed the programme, he had not completed it in accordance with the implementation protocol.

These experiences highlight some important considerations for future implementation of the programme. Firstly, if children are identified as requiring additional tiers of support,

additional time outside of the class-wide sessions would be beneficial to allow for this to be implemented effectively, and without unnecessary delay in these children also progressing through the online lessons. Secondly, additional time for the benchmark reading assessments outside of these sessions would also allow for these to be conducted with more rigour and for decisions regarding progress and the introduction of additional support to be made in a more timely manner.

The preceding points also raise some questions regarding implementation fidelity in this study. The lessons themselves were delivered with high fidelity – with the online programme delivering the instruction and progress data closely monitored to ensure they did not progress through the lessons unless they reached the accuracy criteria. However, the fact that some children progressed through the lessons despite demonstrating difficulties in the benchmark assessments indicates that further observation and coaching on this element of the programme is necessary for future implementation and evaluation. It is a crucial aspect of implementation that the data from the benchmark assessments is used in conjunction with the episode data to make instructional decisions. However, despite this aspect not being implemented rigorously for all children, statistically reliable change was seen in more children who received HER than for the control group.

In addition to exclusions based on completion, a number of participants were excluded from both the HER and Control groups prior to beginning the programme. It is current policy in Wales that formal reading instruction does not begin until Year 2. It was therefore assumed that all children in this year could potentially benefit from HER. However, after pre-test assessments were administered, it was clear some children had reading skills beyond the level at which the programme would be beneficial. In future studies, these exclusion criteria should be applied prior to randomisation into intervention or control groups.

A number of children in the study were learning English as an additional language (EAL). Within the schools involved, there was a strong EAL provision, and all EAL children made notable improvements. However, those in the HER group made considerable improvements, and it was anecdotally reported by the EAL coordinator that children enrolled in the programme had made unexpected gains. Further research investigating the use of the programme specifically with this population would be greatly beneficial.

Given children in the HER group received up to 3 hours additional reading instruction each week, our results may not be surprising. However, considering these findings in the context of current literacy data, the feasibility of providing such additional instruction at a class-wide level is important to explore. HER is computer-delivered instruction that required minimal training to be implemented well enough to have the significant effects reported in this study. Therefore, providing this instruction for all beginning readers to improve early reading skills prior to difficulties arising is perhaps feasible, and could provide a cost effective way to increase intensity of phonics-based instruction during beginning reading instruction.

In the context of previous research using computer-based supplementary programmes (e.g., Huffstetter et al., 2010; Macaruso et al., 2006), these findings contribute to the evidence-base indicating the potential benefits of such programmes to provide additional support for beginning readers. However, because there are many computer-based programmes commercially available to schools, further research comparing the effects of different computer-based programmes to help inform implementation decisions is essential to ensure appropriate and effective use of such technologies.

Although this is a small study, the results indicate that using HER as supplementary reading instruction for beginning readers in Year 2 can have a significant effect on reading skills. Further research is required to investigate the potential benefits of: class-wide

implementation as standard provision for beginning readers (including potential preventative effects); using the programme with children deemed “at-risk” (both as early and remedial intervention); the use of the programme specifically for EAL children; and, the use of HER compared to other computer-based reading programmes.

Chapter 3 – Reading instruction in special schools in the UK: A survey of current practices and perceived barriers

Abstract

Statistics relating to literacy skills in special schools indicate very low rates of basic literacy. However, there is very little information available regarding typical instruction in these settings, and therefore no clear picture of the potential barriers precluding the improvement of reading skills in special schools. The aim of the current paper was therefore to investigate current practices in reading instruction with children in special schools, and in particular, children with an intellectual disability (ID). A survey of teachers in special schools in the UK was devised and conducted to further elucidate the current practices and challenges related to reading instruction for children with ID in these settings. The aims of the survey were to collate information on current practices related to reading instruction provided for children with ID in special schools across the United Kingdom (UK); investigate the putative effects of age and severity of ID on teachers' choice of instructional approaches; and examine teachers' perception of barriers to improving reading skills in this population. It was found that age and severity of ID influenced responses on some items relating to choice of approaches and expectations, and that access to training and suitable curricula were seen as greater barriers to improving reading skills than factors relating to time or staffing.

Many children with Intellectual Disabilities (ID) struggle to learn to read (NAEP, 2007). With the movement towards inclusive education, many children with ID attend mainstream schools (Department for Education, 2013). However, 41% of children with statements of special educational needs (SEN) attended special schools in England in 2012 (Department for Education, 2012), indicating that a considerable number of children with ID are still educated in special schools. Only 2.2% of children in special schools in England (many of whom have mild-severe ID) achieved the national curriculum target levels for literacy (level 2) at age 7 in 2009 (National Pupil Database, Department of Education, 2009). Furthermore, only 20% of children in special schools had attained level 2 or above for literacy at age 11 in Wales in 2013, with no children achieving the national curriculum target level (level 4) at this age (School Statistics Database, Welsh Government, 2013). Although it is expected that many children in special schools, especially those with more severe ID, will likely not attain National Curriculum levels, it has been suggested that such expectations may be influenced by historic attainment data rather than the potential for developing literacy skills with children with ID (Fletcher-Campbell, 2000; Kliever & Biklen, 2001).

Teaching early reading skills to children with ID

Reading instruction for children with ID has typically focused on developing a vocabulary of sight words (Katims, 2000). Whilst this is clearly important to enable individuals with more severe ID to make choices and to enable greater participation in the community (Browder, Wakeman, Spooner, Ahlgrim-Delzell & Algozzine, 2006), it has been found that sight words learned are often not generalized to become functionally useful in either academic or daily living contexts (Browder & Xin, 1998). Furthermore, a sight word approach in isolation does not teach the skills necessary to decode unfamiliar words, thus limiting reading skills to words directly taught (Browder et al., 2006). More recent research indicates that children with ID might benefit from phonics-based reading instruction to

develop such decoding skills, as has been found for typically developing children (NRP, 2000; Joseph & Seery, 2004; Whalon, Otaiba & Delano, 2009).

There is little evidence concerning the extent to which individuals with ID can acquire reading skills (Houston, Al Otaiba & Torgesen, 2006). This presents challenges for both educators and policy makers, in that the level of achievement and rates of progress that might be expected in early reading skills for children with ID are unclear. Similarly, little is known about predictors of reading outcomes for these children (Browder, Wakeman, Spooner, Ahlgrim-Delzell & Aldozzine, 2006). However, the current evidence-base does indicate that children with ID will require more explicit and intensive instruction in reading to support acquisition of reading skills (Browder et al., 2006; Vaughn & Linan-Thompson, 2003).

Literacy policy in special schools

In an effort to raise literacy standards, the National Literacy Strategy (NLS) introduced in England in 1998 prescribed both content and pedagogy for primary schools (Saunders, 2007). Despite concerns that preliminary data indicated children with SEN were making significantly less progress than their peers (Sainsbury, Schagen, Whetton, Hagues & Minnis, 1998), the NLS was implemented in most schools, including special schools (Wall, 2003; OFSTED, 2000).

Following inspections of a number of special schools in England, OFSTED (2000) reported that many special schools had successfully implemented the NLS in some form, and that some improvements in pupil progress had been made since the introduction of the NLS. However, various concerns were also noted. For example, many teachers reported concern with the use of phonics instruction introduced in the NLS, which OFSTED reported to be due to teachers' lack of experience or knowledge of this aspect. The report also found phonics instruction to be the weakest area of teaching performance in observed lessons, and found it was not included in many lessons when the opportunity was available. This is arguably due to

the historic prevalence of sight word instruction in these settings. A further common difficulty was the lack of appropriate materials, including materials with appropriate content for older students, and appropriate text size for pupils with visual impairments. OFSTED (2000) noted that teachers often had to modify materials considerably for use with the children they teach. The report also indicated that some literacy consultants employed to support schools in effective literacy provision often had little SEN experience. Various recommendations were therefore outlined in the report, including the need to encourage publishers to produce suitable materials, and the need for Local Education Authorities (LEAs) to assist in the provision of additional guidelines and further training relating to literacy instruction for teachers in special schools (OFSTED, 2000).

In a review on literacy in special education, Fletcher-Campbell (2000) found evidence indicating schools were increasingly using more ‘mainstream’ approaches (such as alphabetic knowledge and phonemic awareness) when teaching reading to children with severe ID. Fletcher-Campbell also found that a mixture of approaches was being used, which was often determined by the background and training influences of individual teachers. Based on this review, Fletcher-Campbell stated that “practitioners have been experimenting with an eclectic range of approaches in the absence of any authoritative, research-driven guidance” (p. 35), and that ‘craft knowledge’ (“hard-won wisdom of teachers with years of experience”, Barth, 2001) appears to have more influence on choice of teaching strategies than research findings. Acknowledging the limited understanding of effective literacy approaches for children with ID that leads to such reliance on ‘craft knowledge’, Fletcher-Campbell called for a shift in culture to support teachers in actively and systematically seeking evidence of effective practices. Additionally, Fletcher-Campbell suggested that further research on current classroom practice and evaluations of different approaches should be encouraged.

Teacher training

Prior to the movement towards inclusive education, dual systems of teacher training in which there were separate programmes for SEN and mainstream teaching were commonplace (Carroll, Forlin & Jobling, 2003). However, separate programmes for special education teaching ended in 1992, and currently one programme of Initial Teacher Training (ITT) is delivered for all trainees (Lawson, Norwich & Nash, 2013). In one year, trainees receive generic teacher training at either primary or secondary level, including some subject and Key Stage³ specific training, and some ‘SEN’ training. The inadequacy of SEN training within ITT has been the subject of concern, with trainees and newly qualified teachers expressing their dissatisfaction with the provision (Golder, Jones & Quinn, 2009). In a survey conducted by OFSTED (2008), it was reported that an over-reliance on school placements for the ITT SEN provision led to variable quality of provision, with some trainees receiving poor quality training in comparison to those placed in schools implementing good practice for children with SEN. Additionally, even for those trainees placed in ‘good’ schools, it was noted that their learning might focus predominantly on issues currently important to the particular school, rather than gaining a breadth of experience and knowledge required to teach children with a wide range of difficulties. Furthermore, despite trainees’ positive reports of placements in special schools during their ITT year, placements were often reported as being based on convenience rather than quality, and that in some cases trainees were discouraged from pursuing placements in challenging settings (OFSTED, 2008). Despite having received potentially inadequate training specific to teaching children with

³ In England, Wales and Northern Ireland, Key Stages denote age groups in which certain curriculum areas are taught and at the end of which outcomes are measured Nationally: Key Stage 1 spans ages 4-7; Key Stage 2 spans ages 7-11, Key Stage 3 spans ages 11-14, and Key Stage 4 spans ages 14-16. Scotland categorise age groups only as ‘Primary’ (ages 5-11) and ‘Secondary’ (ages 11-16).

SEN, following completion of ITT and one year teaching to gain Qualified Teacher Status, teachers are eligible to teach in both mainstream and special school classrooms.

Teachers training to teach children in primary years receive training in reading instruction. Whilst teacher satisfaction with reading instruction training has recently increased, many still do not rate it highly. In 2012, 32% of newly qualified teachers rated their training in reading instruction (including both phonics and comprehension) as satisfactory or poor (Teaching Agency, 2012). Furthermore, given the educational level of the vast majority of children in secondary education, reading instruction is not an aspect of training for teachers at this level. Individuals teaching in special schools in secondary years can therefore be faced with the challenge of teaching reading skills to children with complex needs, with no training in teaching specific to the nature of their difficulties *or* the skill to be taught.

Although Fletcher-Campbell's (2000) review and call for further research into classroom practices for reading in special schools was over a decade ago, there is still little information available regarding current practice in these contexts. Furthermore, little is known regarding what teachers in special schools might perceive as specific barriers to improving reading skills in their setting. Through further understanding such barriers, policy makers might be better informed as to factors influencing feasibility and outcomes.

Teacher expectations can affect student outcomes, either negatively through low expectations, or positively through high expectations (Jussim, 1989; Weinstein, 2002). Academic expectations of children with ID have been found to be lower than expectations of typically developing children (Aloia, Maxwell & Aiola, 1981). However, there is little research investigating the effects of severity of ID on expectations, and no research we are aware of to date specifically investigating the effects of severity of ID on expectations relating to literacy and teachers' choice of instructional approach.

The aims of the current study were to: (a) collate information on current practices related to reading instruction provided for children with ID in special schools across the United Kingdom (UK), (b) investigate the putative effects of age and severity of ID on teachers' choice of instructional approaches, and (c) examine teachers' perception of barriers to improving reading skills in this population.

Method

Participants

Participants were 190 teachers currently teaching in special schools in the UK. Of these participants, 15.8% were male, and 84.2% were female; 75.4% were teaching in England, 12.8% in Wales, 4.1% in Northern Ireland, and 3.6% in Scotland. The majority (77.9%) were teaching in Maintained schools, 5.6% in Non-maintained schools, 8.7% in Independent schools, and 2.6% in other schools.⁴ In terms of the ages of children taught, 14.4% of respondents were teaching in schools for primary aged children, 24.1% in schools for secondary aged children, and 57.4% in schools for both primary and secondary aged children.

The mean number of years teaching was 18.89 ($SD=11.44$), and 12.90 ($SD=9.51$) years for teaching in a SEN setting.

Information obtained from respondents indicated that teachers had between 1 and more than 12 students in their class, with the majority (60%) reporting between 3 and 5 children. Specific Key Stages taught by respondents varied, with 17% teaching Key Stage 1, 21.1% teaching Key Stage 2, 26.8% teaching Key Stage 3, 13.4% teaching post-16 age groups, and 9.3% teaching mixed secondary year groups. Over 90% of respondents also

⁴ Maintained schools are funded by local authorities and do not charge tuition fees; Non-maintained schools are usually funded by charitable organisations and are non-profit making; and Independent schools are private schools, often charging tuition fees.

reported having at least one additional staff member in class, with 57.4% reporting 1-2 and 27.4% reporting 3-4 additional staff.

Questionnaire

A web-based survey was devised for this study, comprising four sections:

1. Demographic and setting information. This section included questions regarding training and experience, and information specific to the setting of each respondent (e.g., the nature of the educational difficulties of children in the school, class size, and additional staff provision).

2. Choice of approaches and expectations. The purpose of this section was to investigate any effects of age and severity of ID on choices of instructional approach and expectations of students. This section included one of six vignettes including a description of a specific child. The vignettes were determined based on the outcome of an Initial Focus Group conducted prior to the study (see *Procedure*). The age or severity of ID of the child varied across the vignettes, with three ages (6, 12, and 17 years) and two levels of ID (mild or severe) investigated. Each respondent was randomly allocated (through a randomised web-link) to respond to one vignette. One of the vignettes read: *‘Jack is a 6-year-old with a mild intellectual disability/mild learning difficulty, attending a special needs school. He is able to speak, but has no reading skills and recognises barely any sounds or sight words. He has no physical disability and does not currently have one-to-one support in the classroom.’* The questions in this section related to choice of instructional approaches (i.e., *‘To what extent do you agree that the following would be good reading interventions to use with Jack?’*) and expectations (i.e., rating agreement on statements such as *‘Children like Jack are unable to learn to read text’*). Responses were given on a five-point likert scale (*1 – strongly disagree to 5 – strongly agree*).

3. *Perceived barriers*. To investigate the perceived barriers to improving reading skills of children with ID in SEN schools, this section included 10 items relating to common barriers. These items were also determined based on the outcome of the Initial Focus Group conducted prior to the study (see *Procedure*). In the Perceived barriers section, respondents were asked to rate the extent of their agreement (on a five-point likert scale) that the presented statements are barriers to improving reading skills of the children they work with. Presented statements included those relating to time and resources (e.g., ‘*There is insufficient time to prepare reading instruction*’), curricula and materials (e.g., ‘*Reading curricula that are available provide insufficient guidance in effective delivery for children with ID*’), and training (e.g., ‘*There is no training in reading instruction readily available to me*’).

Respondents were also given the opportunity to write any general comments related to reading instruction or the research on the last page of the survey.

Procedure

Initial focus group. To develop meaningful items for sections two and four of the survey, a focus group was held with six teachers from SEN schools in the UK. A schedule of questions was prepared by the first author to encourage discussion of perceptions of current practice and barriers to reading instruction in their settings (e.g., ‘*What kind of reading approaches do you typically use in your school?*’, ‘*What are your views on staffing levels and time to deliver reading instruction in your setting?*’, and ‘*What do you think are the biggest and most common barriers to improving reading skills of children in your setting?*’). Items in section 2 relating to teacher expectations, and all items in section 4 (*perceived barriers*) were developed from common themes that emerged during the focus group.

Survey distribution and data collection. A database of special schools in the UK was compiled using information from government and local authority websites. Email addresses were obtained for 1588 schools: 1434 in England, 122 in Scotland, and 32 in

Wales. An email containing information and a link to the web-based survey (see *Measures*) was then sent to the Headteachers of each of the schools for them to distribute to all teaching staff at their school. By clicking on the link, individuals were randomly allocated to one of six versions of the survey, in which only the age or severity of ID in the vignette differed.

After two months of the survey going live, a second call for respondents was sent out to each of the schools. The survey was live for a total of 8 months, after which responses were collated. Responses were predominantly automatically coded by the online survey programme (e.g., for all the likert scales), with the remaining data coded manually (e.g., categories of school and setting information). Although it is not known how many teachers received the invitation to participate in the survey, respondents represented over 70 different local authorities across the UK.

Results

Instructional context

Table 1 outlines the frequency of measurement of reading skills reported by respondents. Over 40% of respondents reported measuring reading skills more than once school term, 40% reported measuring either termly or twice during each school year, whilst 10% reported only measuring reading skills once during each school year.

The majority of respondents also reported using a specific reading programme, with 66.5% reporting using a specific programme that includes a phonics element. However, 21.5% of respondents reportedly used no specific reading programme in their school.

Training

Table 2 outlines the percentage of respondents with various levels of training, and what type of training had been received. Only 50.8% of respondents had received training specific to SEN teaching. Relating specifically to reading instruction, 60% of respondents

had received some form of training in reading instruction, but only 42.1% had received training specific to reading instruction with children with SEN.

Table 1.

Frequency of measurement of reading progress reported by respondents

	% of respondents	Number of participants
Daily	10	19
Weekly	17.4	33
Every Half-term	16.8	32
Every Term	30	37
Twice annually	10	19
Once annually	10	19
Informally often, formally once annually	2.1	4
Individual basis for poor readers	1.1	2
Not specified	2.6	5

Perceived barriers

Table 3 outlines the percentage of respondents agreeing or strongly agreeing on each individual item of the barriers scale. Responses indicated that respondents demonstrated stronger agreement with statements related to inadequacies in *training* provision and *curricula and materials* compared to statements related to inadequate time and staffing. Overall, respondents perceived access to training, curricula and materials as greater barriers to improving the reading skills of children with ID than instructional time or staffing.

Expectations

Table 4 outlines the percentage of respondents agreeing or strongly agreeing on statements relating to educational priorities and literacy capabilities for children with challenging behavior, physical disabilities or non-verbal children. A one-way repeated

Table 2.

Percentage of respondents with training specific to SEN teaching, training specific to reading instruction, and training specific to reading instruction with children with SEN.

Area of training	Percentage of respondents with training	Type of training				Condition specific training	Symbol reading training
		Graduate	Post-graduate	Other	Not specified		
Training specific to SEN teaching	50.8	9.7	22.1	18.5	3.1		
		Teacher training	Graduate training	In-service/LEA training	For a specific reading programme		
Training specific to reading instruction	60	11.3	8.7	12.8	21.5		
		Teacher training	Graduate/post-graduate training	In-service/LEA training	For a specific reading programme		
Training specific to reading instruction with children with SEN	42.1	4.6	5.6	7.7	8.7	9.2	0.5

measures ANOVA indicated there was a significant difference among the three child needs regarding educational priorities, $F(2,183) = 7.23, p = .001$. Paired-samples t-tests then indicated there was significantly stronger agreement ($p < .05$) that reading was less of an educational priority for non-verbal children compared to children with challenging behaviour and those with physical disabilities. Respondents also demonstrated strong agreement with the notion that literacy capabilities are often underestimated for children with ID.

Table 3.

Means and Standard Deviations for Individual Agreement Scores and the Mean and Standard Deviations for Each Cluster on the Perceived Barriers Scale.

	Statement	% of respondents agreeing or strongly agreeing
Training	“There is insufficient training about effective reading instruction provided for special needs teachers”	41.7
	“There is no training in reading instruction readily available to me”	23.8
	“Training in reading instruction that is available does not seem applicable to my class”	19.2
	“There is a lack of consistency in approaches to reading instruction among staff”	34.3
Curricula and materials	“There are no age-appropriate resources for older children with ID who have minimal reading skills”	41.5
	“Reading curricula that are available provide insufficient guidance in effective delivery for children with ID”	35.8
	“There is no suitable reading curriculum available to support students with ID in my class”	21.9
Time and staffing	“There is insufficient time to prepare reading instruction”	26.9
	“There is insufficient time to deliver reading instruction”	27.7
	“There is insufficient staffing to focus on developing reading skills”	18.1

Table 4.

Means and Standard Deviations for Agreement Scores on Statements Regarding Educational Priorities

Statement	% of respondents agreeing or strongly agreeing
“Reading is less likely to be an educational priority for children with challenging behaviour.”	3.5
“Reading is less likely to be an educational priority for children with a physical disability.”	4.2
“Reading is less likely to be an educational priority for children who are non-verbal”	5.0
“Literacy capabilities of children with ID are often underestimated”	59.3

Table 5 outlines the mean agreements scores on statements relating to literacy expectations for each experimental condition. A two-way MANOVA revealed a significant multivariate main effect for severity, $F(1,189) = 7.59, p < .001$, and age, $F(2,189) = 2.49, p = .012$ but no significant interaction. A series of 2x3 ANOVAs were then conducted to examine these main effects of age and severity for each statement. These analyses indicated a significant effect of severity for statement one (*“A basic sight word vocabulary is all we can probably expect children like Jack to acquire.”*), $F(1,189) = 5.90, p = .006$, statement two (*“Jack should be able to develop fluent reading skills with appropriate instruction and support.”*), $F(1,189) = 17.38, p < .001$, and statement four (*“Reading is not an educational priority for children like Jack.”*), $F(1,189) = 13.68, p < .001$, indicating significantly stronger agreement with these statements one and four when relating to children with more severe ID, and stronger agreement with item two when relating to children with milder ID.

The two-way ANOVAs indicated significant effects of age for statements one, two, and three. These effects were explored using post-hoc analysis employing Fisher’s LSD. For statement one (*“A basic sight word vocabulary is all we can probably expect children like Jack to acquire.”*), respondents demonstrated significantly stronger agreement with the statement when relating to 17-year-olds compared to 6-year-olds or 12-year-olds. For statement two (*“Jack should be able to develop fluent reading skills with appropriate instruction and support.”*), there was significantly stronger agreement with the statement when relating to 12-year-olds compared to 17-year-olds. For statement three (*“Children like Jack are unable to learn to read text.”*), there was significantly stronger agreement with the statement when relating to 17-year-olds compared to 6-year-olds or 12-year-olds.

Table 5.

Mean Scores and Standard Deviations for Each Condition and Statements Relating to Expectations.

Severity		Mild			Severe		
Age		6years (n=29)	12years (n=35)	17years (n=22)	6years (n=34)	12years (n=32)	17years (n=30)
Statement	1. "A basic sight word vocabulary is all we can probably expect children like Jack to acquire."	1.79 (0.68)	1.75 (0.84)	2.35 (0.98)	2.29 (0.78)	2.06 (0.88)	2.65 (1.05)
	2. "Jack should be able to develop fluent reading skills with appropriate instruction and support."	3.62 (0.87)	3.81 (1.09)	3.09 (1.28)	2.71 (0.97)	3.06 (1.01)	2.78 (1.18)
	3. "Children like Jack are unable to learn to read text."	1.28 (0.59)	1.47 (0.56)	1.83 (0.72)	1.61 (0.70)	1.59 (0.76)	1.84 (0.88)
	4. "Reading is not an educational priority for children like Jack."	1.43 (0.63)	1.39 (0.65)	1.55 (0.96)	1.97 (1.06)	1.88 (0.91)	2.28 (1.02)

Choice of instructional approaches

Table 6.

Mean Scores and Standard Deviations for Each Condition and Instructional Approach.

Severity		Mild			Severe		
Age		6years (n=29)	12years (n=35)	17years (n=22)	6years (n=34)	12years (n=32)	17years (n=30)
Reading Teaching Approach	Phonemic awareness	4.36 (0.87)	3.89 (1.12)	3.55 (1.47)	3.43 (1.04)	3.66 (1.18)	3.43 (1.10)
	Phonics	4.03 (1.05)	3.94 (1.21)	3.91 (1.19)	3.82 (0.90)	3.72 (1.30)	3.57 (1.07)
	Sight words	3.72 (1.03)	3.91 (0.89)	4.09 (0.87)	3.71 (1.02)	3.47 (0.95)	3.86 (0.83)
	Whole language	3.28 (1.25)	3.50 (1.28)	3.55 (1.10)	3.57 (1.15)	3.34 (1.38)	3.87 (1.06)

Tables 6 outlines the mean agreement scores for each condition for items relating to choice of instructional approach. A two-way MANOVA revealed a significant multivariate main effect for severity, $F(1,189) = 2.77, p = .029$, but no significant effect for age, F

(2,189) = 1.08, $p = .379$, and no significant interaction, $F(2,189) = 1.15, p = .327$. A series of 2x3 ANOVAs were then used to explore this effect. These analyses indicated a significant effect of severity relating to the choice to teach phonemic awareness, in that respondents were significantly more likely to use this as an approach when teaching children with mild ID ($M = 3.98, SD = 1.18$) than when teaching children with severe ID, ($M = 3.48, SD = 1.10$) $F(1,189) = 7.45, p = .007$. A marginally significant effect of severity was also found relating to choice to teach phonics, with respondents more likely to use this as an approach with children with mild ID ($M = 4.00, SD = 1.11$) than children with severe ID ($M = 3.70, SD = 1.09$), $F(1,189) = 3.31, p = .07$. No other effects of severity were found.

Discussion

The current study investigated current practices in reading instruction in special schools in the UK, including the putative effects of child age and severity of ID on teachers' choice of instructional approaches and their expectations about the reading skills of children with ID.

Choice of instructional approaches and expectations

The current study indicated teachers are using a range of approaches for teaching reading. There were no significant effects of child age on teachers' choice of instructional approaches, and sight word instruction was no more likely to be chosen for children with severe ID than for children with mild ID. However, there were significant effects of severity for phonemic awareness and phonics instruction, with both approaches less likely to be used with children with severe ID than children with mild ID. Teachers report that they would expect to use sight word and whole language approaches with children with severe ID, whereas they would expect to use other approaches as well with children with mild ID. Regarding literacy expectations, the results suggest that severity of ID may influence expectations relating to literacy, with expectations lower for children with severe ID. Literacy

expectations were also found to be lower for an older child (age 17) compared to younger age groups.

A strong theme throughout the initial focus group in the current study was that for children who were still struggling with reading at older ages, vocational skill areas often began to take priority. Further investigation of what reading approaches are used with older children, with what frequency, and with what outcomes, would help elucidate the extent to which priorities shift and what might be gained from continued instructional efforts.

Perceived barriers to improving reading skills

Responses on the barriers statements indicated that respondents perceived access to training, curricula and materials as greater barriers to improving the reading skills of children with ID than instructional time or staffing. Given that the training of respondents for SEN (50.8%) and SEN specific training in reading instruction (42.1%), were by no means universal, this is perhaps to be expected. Some pertinent comments were also made by respondents on this issue, including reference to a “stunning lack of training in special schools” in reading instruction, and more general concern relating to inadequacies in SEN training. One respondent, in senior management, commented:

“...the majority of teachers entering special schools have had no specific training for these settings (which) has meant a gradual reduction in skills. The consequence is a wide variety of skills and training among teaching staff, (making it) difficult for schools to provide adequate training (and) to pitch to the variety of training needs. Adequate induction puts huge pressure on special schools. This influences every area of learning, including reading”.

Such concerns regarding the current state of SEN training have long since been voiced (Golder, 2009), and this was another strong theme in the initial focus group.

Implications for practice

Literacy consultants, coordinators, and specialist literacy teachers may be relied upon for assisting with reading instruction in special schools. Therefore, it could be argued that it is not necessary for all teachers in special schools to be formally trained in reading instruction. However, many comments from respondents indicated their direct involvement in preparing and delivering instruction. Furthermore, some respondents indicated that, although literacy coordinators did take the lead, training of other staff (both teachers and assistants) was still very much needed. Lack of training was reported by others to lead to very poor consistency in dealing with reading difficulties within the school.

The current study was devised to investigate the practice and perceived barriers of teachers. However, the crucial role of teaching assistants in delivering literacy support should not be overlooked. Given the majority of teachers in this study reported having at least one additional staff member in their class, further research investigating the perceptions, self-efficacy, and level of training of teaching assistants, literacy coordinators and specialist teachers would provide additional insight into the instructional context and current challenges in special schools.

Access to appropriate curricula and materials was also identified as a common barrier to improving reading skills for children in special schools. Although items referring to time to deliver and prepare instruction were rated significantly lower than items referring to curricula and training many respondents commented that time taken to create age appropriate resources for older children with ID is also a common barrier. Despite OFSTED (2000) suggesting that there was a need to encourage publishers to address this issue, it clearly still presents a challenge for teachers in special schools.

Although not included within the questionnaire, grouping of students within special schools was reported by a number of respondents to be a barrier to improving reading skills.

In particular, one respondent cited the need to deliver the English curriculum for the appropriate Key Stages as prohibitive to teaching reading to lower ability students.

Instructional grouping has been found to play a critical role in effective implementation for children requiring additional support (Vaughn, Hughes, Moody & Elbaum, 2001). Therefore, this aspect of the instructional context in special schools requires special consideration to ensure instructional grouping supports the acquisition of reading skills for children with ID.

The current study supports the notion that practices in reading instruction for children with ID largely involves “experimenting with an eclectic range of approaches” (Fletcher-Campbell, 2000, p. 35). However, for this ‘experimentation’ to inform practice beyond individual classrooms and schools, teachers must be encouraged and supported to enable them to systematically collect evidence of their practices. Fletcher-Campbell (2000) suggests that, “Practitioners should be made aware that... all rigorously collected data can contribute to a larger corpus of evidence about practice and performance” (p. 84). We found that only 40% of respondents measured reading progress more than once per school term, with only 10% measuring progress daily, and 10% measuring progress weekly. This suggests that teachers are not adequately informed and/or supported to collect such evidence. Frequent progress monitoring would inform both immediate instructional decision-making (informing teachers whether their instructional approach is working), and our collective understanding of what approaches are effective. Furthermore, the potential rate of progress, levels of attainment, and predictors of both of these outcomes might be better understood with more systematic and frequent measurement of component reading skills as well as more advanced reading skills.

In addition to encouraging practitioners to seek evidence, Fletcher-Campbell (2000) recommended the evaluation of approaches and programmes for specific cohorts of children with special needs. Whilst it is encouraging that many respondents in this study reported

using programmes that included some phonics element, further investigation of this is required to understand the real impact of this for children with ID. First, we do not know the quality of delivery of the instruction. OFSTED (2000) reported that, although the intention of introducing phonics instruction was present for many schools when initially rolling out the NLS, in reality, delivery of this was weak. Second, we do not know whether the specific programmes being used in special schools are effective for children with ID. Robust evaluations of potentially effective programmes are required to ascertain their effects specifically for children with ID.

Chapter 4 - Teaching early reading skills to children with Intellectual Disabilities
using computer-delivered instruction: A pilot study⁵

⁵ This chapter is under review as: Tyler, E. J., Hughes, J. C., Williams, B. M., Wilson, M. M., Beverley, M., & Hastings, R. P. Teaching early reading skills to children with Intellectual Disabilities using computer-delivered instruction: A pilot study

Abstract

Many children with Intellectual Disability (ID) have considerable difficulty learning basic reading skills. Increasing evidence suggests individuals with ID may similarly benefit from instruction incorporating components of reading found to be effective for typically developing children. However, little research into reading instruction for children with ID has incorporated these components. There is evidence for the efficacy of Headsprout *Early Reading* programme for typically developing children, and emerging evidence suggesting that children with autism can benefit from the programme. The current study investigated the accessibility of Headsprout *Early Reading* for children with Intellectual Disabilities, and whether there were any measurable effects of the programme on key early reading and language skills. Six children aged between 7 and 15 years with mild to moderate ID completed the programme, and all made measurable improvements across reading measures, demonstrating children with mild to moderate ID can access the programme.

Reading is an essential skill, and being unable to read affects many aspects of life, from basic academic progress to the ability to live independently and participate in modern society (Marchand-Martella, Slocum & Martella, 2004). However, reading is a complex skill that many children struggle to acquire (Lyon, 1998), and children with Intellectual and Developmental Disabilities (IDD) particularly so. The National Assessment of Educational Progress (NAEP; Institute of Education Sciences, 2007) found that around two thirds of children with IDD have considerable difficulty learning basic reading skills.

The increased focus on curriculum inclusion and academic content within education, in addition to greater accountability for individual progress in recent years (e.g., *Every Child Matters*, 2004, UK; *No Child Left Behind*, 2001, US), presents a compelling argument to establish and develop accessible methods for teaching reading in this population. It has been suggested that an ‘accessible’ curriculum should not only enable participation, but also enable academic progress, and that this should be done through making the necessary curriculum adaptations and providing additional support (Wehmeyer, 2006; Wehmeyer, Lattin, Lapp-Rincker, & Agran, 2003). However, there is a dearth of information and guidelines regarding effective approaches for teaching reading or other academic skills for children with Intellectual Disabilities (ID; Marks, 2000; Wehmeyer, 2006).

Reading research and instruction for individuals with ID has typically focused on sight-word reading approaches (Katims, 2000). In a meta-analysis of 32 single-subject studies into sight word reading approaches with individuals with moderate and severe disabilities, Browder and Xin (1998) found such approaches were highly effective in teaching sight word vocabulary in this population. However, there was a lack of evidence for acquired sight words being used in functional academic or daily living contexts. Furthermore, acquiring reading skills through sight word reading instruction alone does not necessarily enable the

learning of more generative decoding skills, thus limiting the potential for fluent reading skills (NRP, 2000).

Increasing evidence suggests individuals with ID may similarly benefit from instruction incorporating components of reading found to be effective for typically developing (TD) children (Allor, Mathes, Roberts, Jones & Champlin, 2010; Browder, Ahlgrim-Delzell, Flowers, & Baker, 2012; Browder, Wakeman, Spooner, Ahlgrim-Delzell & Aldozzine, 2006). Specifically, phonics-based instruction directly focused on the teaching of decoding skills may lead to positive outcomes (Joseph & Seery, 2004; Whalon, Otaiba & Delano, 2009). There is an evidence base indicating effective approaches for teaching reading to TD children that was systematically reviewed by the National Reading Panel (NRP, 2000). In this review, the NRP proposed five component skills as necessary to become a functional reader: phonemic awareness (recognizing words are formed with separate sounds); reading phonics fluently (linking these sounds to specific letter combinations); extending spoken vocabulary to become reading vocabulary (understanding written words mean something); fluency (reading orally with speed, accuracy and appropriate prosody); and comprehension (understanding what is read). These core components are widely used by educators in the US to guide reading instruction and evaluate reading programs (Armbruster, Lehr & Osborn, 2001, Simmons & Kame'enui, 2003, Begeny, Schulte & Johnson, 2012).

Despite these recommendations, research into reading instruction for children with ID has not typically incorporated these evidence-based components, and has rarely included phonics instruction (Browder et al., 2006; Joseph & Seery, 2004). In a review of over 100 studies investigating literacy in ID between 1975 and 2003, Browder et al. (2006) found only 36 had any measure of reading fluency, only five focused on phonemic awareness, and only 13 focused on phonics. Further research is required to establish what approaches and programmes incorporating evidence-based components are accessible, or may be made

accessible, for children with ID (Browder, Gibbs, Ahlgrim-Dezell, Courtade, Mraz, & Flowers, 2009; Whalon, Otaiba & Delano, 2009). Additionally, for a curriculum to promote inclusion, there is a need to investigate programmes that may be used with both TD children and children with ID (Wehmeyer, 2006).

Headsprout® *Early Reading* (HER) is an Internet-based programme designed to teach the skills and strategies necessary for efficient, fluent reading. Comprising 80, 20-minute lessons (episodes), HER includes instruction in phonemic awareness, print awareness, phonics, sounding out, segmenting and blending, and explicitly incorporates the five components of reading proposed by the NRP (Layng, Twyman, & Stikeleather, 2003). HER is an adaptive learning technology—every mouse-click forms data on individual learners' progress that is used to provide additional instruction or to ensure repeated practice of components not yet fluent. In this way the instruction is individually adapted to each child's responses. In addition to an empirically informed development process (Layng, Twyman, & Stikeleather, 2003), there is increasing evidence suggesting that HER can help improve reading skills for many children, including TD children (Huffstetter, King, Onwuegbuzie, Schneider, & Powell-Smith, 2010; Twyman, Layng, & Layng, 2011) and children with ADHD (Clarfield & Stoner, 2005).

Although HER is not designed for children with ID, preliminary findings suggest the programme can be implemented with children with autism to improve reading and language skills (Grindle, Hughes, Saville, Huxley & Hastings, 2013; Whitcomb, Bass, & Luiselli, 2011). Grindle et al., (2013) enrolled 4 children with a diagnosis of autism (aged between 5 and 7) in HER. With some additional procedures to enable access (e.g., additional Discrete Trial Teaching for areas of difficulty, dividing episodes over 2-3 sittings, and delivery of additional reinforcers to increase motivation), all four children completed the programme.

Notable improvements in early literacy skills and word recognition were seen across participants after the intervention.

The current pilot study investigated two questions: 1. Can children with ID access (i.e., progress through) HER and what adaptations may be necessary to achieve this access? 2. Are there measurable effects of the programme on key early reading and language skills of children with ID?

Method

Participants

We chose six children (2 female, 4 male) aged between 7 and 14 to participate based on their documented difficulties with literacy. As can be seen in Table 1, participants had a range of developmental delay, and attended special needs schools in the same county in North Wales. Demographic and other information about each of the children is summarised in Table 1.

Materials and setting

HER comprises 80 online episodes, averaging around 20 minutes, during which the programme directly delivers instruction to each learner. The episodes include explicit instruction in synthetic phonics, incorporating fluency-based activities to ensure concepts are mastered in each lesson (see Procedure or Layng, Twyman, & Stikeleather, 2003, for more detail). Episodes were delivered on computers that were available within the schools, either on standard computer monitors or interactive whiteboards. When the latter were used, we placed a table and chair in front of the whiteboard, and provided a mouse for participants to interact with the programme.

In addition to the online episodes, frequency-building exercises accompany the HER programme. There are two tiers of this additional support—*Targeted Practice* and *Intensive Practice*. Because the participants in this study had significant learning difficulties,

Table 1

Age and Diagnoses of Participants at Baseline and Completion of HER, and Estimate of Verbal Ability as Measured by BPVS-II Score at Baseline.

Participant	Gender	Chronological Age		BPVS-II	Diagnoses/statements of Special Educational Needs ¹
		(yrs,mnths)		Age	
		Baseline	Post-test	equivalent	
				at	
				baseline	
Rose	Female	7,9	9,1	3,9	General developmental delay. Difficulty with development of motor skills, speech and language skills and social skills
Catrin	Female	14,4	15,8	8,10	Global developmental delay. Significant delays in language and social development
Medwyn	Male	11,1	12,10	7,10	William's syndrome. Strong verbal skills but language delay. Delayed in development of basic educational skills.
Ben	Male	12,11	14,6	5,1	Severe communication disorder
James	Male	13,8	14,9	7,7	Global Developmental Delay
Dewi	Male	11,11	13,0	7,5	Global Developmental Delay

¹*Statements of SEN describe difficulties and stipulate the educational support to which a child is entitled based on statutory assessment*

we used the *Intensive Practice* programme to provide increased practice of material covered in the online episodes. We made some adaptations to materials for this additional support.

Previous use of the programme indicated some children had difficulty with the layout and

print size of the *Intensive Practice* material. Therefore, we used a flashcards protocol (Graf & Lindsley, 2002), in which cards with the *Intensive Practice* stimuli were presented, thus altering the medium of delivery but not the content or fluency aims of this tier of support. A timer was required for this part of the programme. We also designed alternative data recording sheets to allow for multiple attempts to be recorded.

HER also includes 80 stories comprising material covered in the programme. These were printed out for participants to read after specified episodes. Licenses for all participants allowed access to progress reports and further information on implementation protocol (*HER Teacher's Guide*, 2010). Teachers also downloaded and printed a progress map from the HER website for each child to display in the classroom as a visual representation of their progress.

Measures

Reading and early literacy skills.

We conducted the following reading tests:

The *Dynamic Indicators of Basic Early Literacy Skills 6th edition, First Grade Scoring Booklet Benchmark Assessment* (DIBELS; Good & Kaminski, 2007), including measures of: *initial sound identification, phoneme segmentation fluency, letter naming fluency, nonsense words fluency, and word use fluency*. The DIBELS assesses fluency in core component skills predictive of reading success, providing correct responses per minute across these skills. DIBELS scores are typically interpreted in terms of indicators of risk, with different benchmarks for children depending on their grade indicating whether they are at risk of later reading difficulties (Good, Gruba & Kaminski, 2002). Due to the participants in this study having minimal reading skills, the subtests used were devised for children in kindergarten and first grade, despite children being aged between 7 and 14 years. Therefore these risk categories do not provide the same information as they would for children in those

grades. However, they do give some indication of the educational meaning of the improvements in fluency scores.

The *Word Recognition and Phonic Skills assessment* (WRaPS; Carver & Mosely, 1994) to assess progress in word recognition skills. In this assessment, the child is read a word and asked to choose the correct word from a choice of four or five. The assessment places children within a word recognition stage, from one (almost no word recognition knowledge) to ten (moving towards mastery of clusters and digraphs necessary for word recognition).

The Welsh language version of the *All Wales Reading Test* as an additional measure with three participants because they were predominantly Welsh speaking. Because the specific test used (*Ein Stori Ni*) was designed for typically developing children of a younger age, standardized scores were not available. Therefore, we used raw scores and age equivalent scores to illustrate performance. The San Diego Quick Assessment (La Pray & Ross, 1969) was also included for James and Dewi as an additional measure of word reading to investigate potential effects on word reading fluency. Children are asked to read blocks of words that increase in difficulty. The assessment provides an indication of instructional level and allows for the calculation of word reading fluency.

Secondary measures: Language skills.

We conducted the *British Picture Vocabulary Scale 2nd edition* (BPVS-II; Dunn, Dunn, Whetton, & Burley, 1997) at baseline to provide an estimate of verbal ability. We also conducted the *Test for the Reception of Grammar 2nd edition* (TROG-2; Bishop, 2003) to measure potential collateral effects on linguistic comprehension. These are widely used standardised tests by Speech and Language Therapists in the UK. The TROG-2 involves presenting the child with four pictures and reading a sentence that relates to one of the pictures. The child is asked to choose the correct picture, with items increasing in difficulty. A direct measure of reading comprehension was not conducted due to some participants

beginning with very limited decoding skills. Therefore, we included this assessment to measure linguistic comprehension before and after the programme.

Interobserver agreement

All assessments (other than the WRaPS and Ein Stori Ni in which responses were marked on the page by the child) were double-scored, either while the assessment was conducted or from an audio recording of the assessment. We calculated Interobserver agreement (IOA) by dividing the number of agreements by the number of judgements and multiplying by 100. The IOA for each measure was as follows: DIBELS (pre-test, 93.72%; post-test, 94.25%); BPVS (pre-test, 99.42%; post-test, 100%); TROG-2 (pre-test, 99.75%; post-test, 100%).

Procedure

Pre programme. We assessed all participants on all measures before beginning the programme. Additionally, prior to episode one, *Mousing Around* was completed: this is a short introductory online episode that familiarizes the child with the instructional language of the programme and provides practice of appropriate responding prior to introducing the reading episodes.

The first 10-weeks of the intervention was a training phase in which the researchers were involved and staff were trained to implement the programme. This was in part due to researcher availability to provide this support, rather than to any predetermined idea of what might constitute adequate training for the education staff. Participants were enrolled during this training phase. For the remainder of the programme, staff at each school took the lead in conducting the intervention with monthly support from researchers. In each school, we trained the child's class teacher and a teaching assistant to implement the programme, and monitored online episode data and frequency-building data to ensure fidelity of implementation. Following the first 10-weeks of the intervention, school staff (namely

teaching assistants) conducted all procedures for all children. For two participants (James and Dewi) school staff conducted the entire programme, after initial training, with minimal researcher support.

HER online episodes. Episodes were conducted according to implementation guidelines provided by HER. Participants engaged in episodes at a computer set up ready to access their individual profile. A researcher or staff member remained with the child while they were interacting with the programme. However, they did not interact with the child other than to offer encouragement to stay on task. This was to ensure there was no interference with the sophisticated correction procedure built into the programme, and that the responses made provided accurate feedback of the child's current ability and progress. When each child finished an episode, online data were checked to ensure they had attained the required level of accuracy, set at 80% in each episode. They were accompanied back to the classroom and chose a sticker to place on their progress map that indicated which lesson they had completed.

HER Stories. In accordance with implementation guidelines, children were also required to read stories provided by the programme after specified episodes. If the child struggled, we reminded them to sound out the word, and implemented the Model-Lead-Test error correction procedure as described below in the *Intensive Practice* exercises.

HER Intensive Practice flashcards. The *Intensive Practice* tier of the HER programme was conducted after the episodes specified in the HER protocol. This comprises 100 frequency-building exercises consisting of individual sounds and words and 17 oral reading fluency exercises designed to ensure children were fluent on the materials taught in specific episodes before they progress to the next episode. As previously outlined, in this study we used a modified flashcards procedure rather than the sheets provided with the *Intensive Practice* materials. A researcher or classroom assistant worked with the child at the

table and conducted practice sessions using a Model-Lead-Test format (Engelmann & Carnine, 1982). This involved demonstrating the procedure by responding to four cards (model), then repeating this along with the child (lead), and then the child responding alone (test). This ensured participants understood the procedure, and also served as a warm-up activity prior to timing. We then told the child they would be timed for one-minute, and to answer as quickly and accurately as possible. Because HER was not designed specifically for children with ID, we reduced the number of correct responses required for reaching criterion to that recommended for children aged between five and six years, which varied between 25 and 50 correct responses per minute. Correct and incorrect responses were recorded on each child's data sheet. To demonstrate mastery, participants had to obtain the target for the specific activity over three timings before the child could move onto the next episode of the programme. We employed a correction procedure after each timing, again using the Model-Lead-Test format outlined previously. This was repeated until the participant responded correctly to all errors made during the timing.

HER Intensive Practice Oral Reading Fluency. We also conducted oral reading fluency measures as part of the *Intensive Practice* programme. Participants were required to read a short passage, and the number of words read correctly per minute was recorded. As with the flashcards, oral reading fluency targets had to be met in three timings before progressing, and we used the same error correction procedure.

We repeated assessments once each child had completed the programme (i.e., after they had completed all 80 episodes/lessons). The time taken to complete 80 lessons varied for each child.

Additional procedures

An amendment to the procedures outlined above was only required for one participant. As was found for a number of the children in the Grindle et al. (2013) study, Ben experienced

difficulty responding appropriately to a task involving negation (*‘If it does not say (chosen word), click on the arrow’*) introduced in Episode four of HER. As a result, his percentage accuracy scores for this episode remained below 60% despite numerous repetitions. Using a similar procedure to that outlined in Grindle et al., (2013), this component was broken down and taught away from the programme to enable progression through the episodes. These teaching trials were conducted over seven sessions until Ben had mastered the instruction and generalized this to the episode. Having identified a reinforcer (logos from cartoon channels), a token economy system was used whereby tokens were earned for correct responses that could be exchanged for a logo. Logos were initially earned for five correct responses (FR5), and then for every 10 responses (FR10). Ben subsequently completed episode 4 with 96% accuracy.

Results

HER Online Data

Table 2 summarises overall progress of all participants through the 80 HER episodes.

Episode Data. Time to completion varied considerably between participants, with those children with stronger reading skills prior to beginning the programme (Catrin, James, and Dewi) taking the least time (see Table 2). All participants enrolled in the training phase completed more episodes on average per week during the initial 10 weeks during which the researcher was supporting and training the teachers, than the subsequent teacher-led intervention. Over all episodes, Rose and Medwyn required four episode repetitions, Ben required three episode repetitions (all for episode 4, in which negation was introduced), and Catrin, James, and Dewi required no episode repetitions.

Data collected by Headsprout from 1000 typically developing children indicates that average accuracy is 94%, average number of interactions per episode is 190, and average

Table 2

Individual Progress and Episode Data Showing Average Episode Accuracy, Number of Interactions, and Time to Completion for Each Participant.

Participant	Average % accuracy in episodes	Total time engaged in episodes (hrs:mins)	No. of interactions across episodes	No. of school weeks to complete	Average no. of episodes per week of school term
Rose	95	28:17	21,750	59	1.36
Catrin	99	18:00	20,324	24	3.33
Medwyn	93	23:53	22,603	74	1.08
Ben	95	22:23	25,934	79	1.01
James	99	18:10	19,536	50	1.6
Dewi	98	17:59	19,853	50	1.6

episode duration is 17 minutes (Layng, Twyman & Stikeleather, 2004). Percentage accuracy scores indicate how much instruction was required to meet the criteria for completing an episode, with a lower percentage indicating more instruction was required to master the learning objectives. The data in Table 2 show that all participants demonstrated similar average duration and correct responding in completed episodes as the data from TD learners. Participants with ID also demonstrated above average interactions within episodes, which could indicate increased errors leading to additional instruction and practice. However, the average episode duration and accuracy suggest these increased interactions were more likely due to quicker than average responding within fluency activities in episodes where participants were familiar with presented stimuli (as was the case in early episodes for all participants). This indicates that the participants in this study did not require more instruction within the episodes than typically developing children.

Table 3.

Individual Scores on DIBELS Subtests at Baseline and Post-test, and Individual Improvement Scores for All Participants.

Participant	DIBELS fluency subtest	Baseline	Post-test	Change
Rose	Initial sounds (/16)	8	13	+5
	Phoneme segmentation	(0)	18	+18
	Letter naming	(16)	34	+18
	Nonsense words	(2)	(11)	+9
	Nonsense word sounds	7	41	+34
	Word use	8	30	+22
Catrin	Initial sounds (/16)	15	15	0
	Phoneme segmentation	18	24	+6
	Letter naming	93	102	+9
	Nonsense words	(8)	41	+34
	Nonsense word sounds	33	119	+86
	Word use	52	62	+10
Medwyn	Initial sounds (/16)	15	16	+1
	Phoneme segmentation	13	27	+14
	Letter naming	(21)	50	+29
	Nonsense words	(2)	(10)	+8
	Nonsense word sounds	23	48	+25
	Word use	26	26	0
Ben	Initial sounds (/16)	5	9	+4
	Phoneme segmentation	(0)	17	+17
	Letter naming	78	73	-5
	Nonsense words	(4)	(20)	+16
	Nonsense word sounds	25	79	+54
	Word use	0	24	+24
James	Initial sounds (/16)	16	16	0
	Phoneme segmentation	(4)	25	+21
	Letter naming	(7)	72	+65
	Nonsense words	(17)	(23)	+6
	Nonsense word sounds	58	63	+5
	Word use	25	31	+6
Dewi	Initial sounds	14	16	+2
	Phoneme segmentation	33	40	+7
	Letter naming	68	81	+13
	Nonsense words	(17)	32	+15
	Nonsense word sounds	67	100	+33
	Word use	32	64	+32

Parentheses indicate scores that suggest children are 'at-risk' of later reading difficulties

Reading and language assessments

DIBELS. Scores between baseline and post-test increased for all participants, most notably in *phoneme segmentation fluency* (gains ranging from 6 to 21 per minute), *nonsense words* (gains ranging from 6 to 34 per minute), and *nonsense word sounds* (gains ranging

from 5 to 86 per minute). Table 3 indicates that on some subtests, children who were scoring in the ‘at-risk’ category at pre-test demonstrated reduced risk at post-test. Of particular interest is Nonsense word fluency scores for Rose, Catrin and Dewi, indicating meaningful improvement in an important decoding skill.

WRaPS. With the exception of Catrin, who scored almost at ceiling at all times of testing, all participants demonstrated improvements in word recognition at post-test, most notably Rose and Medwyn who gained 12 and 16 months word recognition age respectively (see Table 4).

Table 4.

Individual Scores on the WRaPS assessment at Baseline and Post-test, and Individual Improvement Scores for All Participants.

Participant	WRAPS scores	Baseline	Post-test	Change
Rose	Stage (/10)	6	9	+3
	Age equivalent (yrs,mnths)	6,7	7,7	+1yr
Catrin	Stage (/10)	10	10	0
	Age equivalent (yrs,mnths)	8 ¹	8 ¹	0
Medwyn	Stage (/10)	2	7	+5
	Age equivalent (yrs,mnths)	5,5	6,9	+1yr, 4m
Ben	Stage (/10)	6	8	+2
	Age equivalent (yrs,mnths)	6,8	7,3	+7m
James	Stage (/10)	9	10	+1
	Age equivalent (yrs,mnths)	7,6	8	+6m
Dewi	Stage (/10)	9	10	+1
	Age equivalent (yrs,mnths)	7,9	8 ¹	+3

¹*This assessment only provides age equivalents up to 8years of age.*

San Diego Quick Assessment. Both James and Dewi demonstrated increased word reading accuracy and fluency (See Table 5). James read 13 additional words accurately, increasing his reading rate from 16 to 24 words per minute and moving up one instructional level, and Dewi reading 8 additional words accurately and doubling his reading rate to 40 words per minute.

Table 5. *Individual Scores on the San Diego at Baseline and Post-test*

Participant	San Diego scores	Baseline	Post-test	Change
James	Corrects	32	45	+13
	Corrects per min	16	24	+8
	Instructional level	1 st Grade	2 nd Grade	+1yr equivalent
Dewi	Corrects	37	45	+8
	Corrects per min	20	40	+20
	Instructional level	2 nd Grade	2 nd Grade	0 equivalent

Table 6. *Individual Scores on the All Wales Reading Test at Baseline and Post-test*

Participant	Scores	Baseline	Post-test	Change
Ben	Raw score	0	17	+17
	Age Equivalent	--	--	--
James	Raw score	27	40	13
	Age Equivalent	6,5	8,2	+1yr 9m
Dewi	Raw score	28	42	+14
	Age Equivalent	6,5	8,11	+2yr 6m

All Wales Reading Test. James and Dewi made considerable gains in Welsh reading ability of 1 year 9 months and 2 years 6 months word reading age respectively over a 16-month period (See Table 6). Ben increased his raw score from 0 to 13, however made no measurable improvement on age equivalent score.

TROG-2. With the exception of Rose, all participants made gains in age equivalent scores. Catrin gained 1 year, Dewi gained 6 months, and Ben increased from <4 years to 4 years. The most notable gains were seen for Medwyn, who gained 2 years 6 months, and James who gained 3 years 10 months.

Discussion

The first question addressed in the present pilot study was whether children with ID can access (i.e., progress through) a mainstream online reading programme, HER, and what adaptations may be necessary to achieve this. All six participants completed the programme, (with five out the six requiring no additional input), indicating children with ID can access the programme, and that not all children require adaptations to enable this progress.

All participants enrolled in the training phase completed a greater number of episodes per week during the training phase than the subsequent teacher-led intervention period, suggesting the intensity of the intervention decreased over time. Crucially, only one participant completed the episodes at a rate that is recommended by the programme developers (i.e., at least 3 per week). The formative data on outcomes of the programme for typically developing children were based on the progress of children who completed at least three lessons each week, therefore this is the minimum suggested to achieve the reported outcomes of the programme for typically developing children (M. Leon, personal communication, 28th June, 2012). It is possible that the significantly reduced rate of episode completion demonstrated by the participants in this study reduced the impact of the programme on their reading skills.

Children with ID might not be expected to complete episodes with the same frequency as TD children (accounting for potentially slower responding due to episode repetition or splitting episodes over sessions). However, participants in this study demonstrated similar progress in terms of accuracy and duration of episodes, suggesting they were able to access the programme in a similar way and at a similar pace to TD children. Furthermore, unlike previous research with children with autism and other disabilities, only one participant required additional input beyond the episodes and *Intensive Practice* exercises, requiring a small adaptation to enable progression through the programme. This suggests time to completion could also be similar to that found with TD children for some children with ID, highlighting the suggestion that others' low expectations for these children may be a variable preventing them becoming successful readers (Kliewer & Biklen, 2001; Kliewer, Biklen, & Kasa-Hendrickson, 2006).

The second question we wanted to address in this study was whether there are measurable effects of the programme on key early reading and language skills of children with ID. All participants had typically made no measurable gains in reading skills from year to year during their schooling. Although no historical data on the reading scores of these children were available, the fact that all children were well beyond beginning reading age and had very minimal reading skills at pre-test indicates that they had made little recent progress in reading. This suggests that any improvements seen were likely to be related to the use of HER, even for those children who took considerable time to complete the programme.

With this context in mind, after completing HER, all six participants demonstrated improvements in reading skills, most notably in phonemic awareness, nonsense word decoding, and word recognition skills. The extent to which these reading skills generalized to improved oral reading fluency and overall reading age was not captured in any of the measures used with Rose, Catrin, Medwyn, or Ben. However, James and Dewi demonstrated

increased fluency in word reading. Assessments of oral reading fluency and broader phonological abilities are needed to further elucidate the potential effects of HER for children with ID. In addition, it is important to be cautious about the findings since no control comparisons were available in this pilot study.

Improvements in language assessments were variable across participants and time of testing. However, some notable improvements were made on the *TROG-2* and the *word use fluency* subtest that indicate there may be collateral effects on other language skills that merit further investigation. Improvements in Welsh reading ability also indicate the collateral effects on an additional language is also worthy of further investigation.

The data from this pilot study demonstrate that children with ID can access and may benefit from HER, suggesting children with ID can benefit from phonics-based reading instruction incorporating the five essential components of reading instruction (NRP, 2000). The increasing evidence that many children with additional needs can access HER (e.g., Clarfield & Stoner, 2006; Grindle et al., 2013), and the indication from the current study that some children with ID can progress through the programme at a similar pace to TD children, also has significant implications for the potential use of the programme as part of an inclusive curriculum. Furthermore, with expert instruction provided directly through the online programme, high quality access to this core curriculum area can be provided with minimal training. However, as the current study indicated it was more difficult to maintain the intensity of the intervention when it was teacher-led, an appropriate training and support model for high fidelity use of the programme requires further investigation.

There are a number of considerations for future research. In addition to the general issues of training, time and staff resources in SEN settings, an important consideration in the timescale of programme completion is the input required through implementing the *Intensive Practice* additional support, which includes over 100 frequency-building exercises. In the

present study, we decided that all participants would complete these additional exercises because of their language and learning difficulties. However, because all participants started at Episode one of the programme (which begins with reading basics suitable for TD children from the age of four) and their episode data were comparable to that of TD children, it may be that this additional tier of support is not necessary for all children with ID to complete the programme and obtain significant outcomes. Further research using either the *Targeted Practice* tier (including only 25 additional exercises) or the standard intervention (episodes and stories alone), may increase the feasibility of conducting the programme with the recommended intensity, also reducing time to completion and thus enabling the evaluation of the effects of the programme as a whole for children with ID.

Although all participants were receiving educational services for children with ID and BPVS scores indicate each had an ID, no specific measure of adaptive skills or IQ was conducted. To investigate the parameters for beneficial use of HER with children with ID, clearer information is required to define the population in future research. Such information could also enable investigation of predicting factors in the level of support children may require in order to benefit from the programme.

This is the first study that we are aware of investigating the use of an online reading programme designed for TD children with children with ID. Given that children with ID have historically underachieved in this crucial academic area, and the challenge of teaching complex functional reading skills to many children with ID, this study represents the beginning of an exciting area for future research that could have significant impact on children with ID and their academic achievement.

Chapter 5 - Evaluating an online reading programme with children with
Intellectual Disabilities: Feasibility and pilot research.

Abstract

There is some encouraging evidence that HER could be effective for children who are not typically developing. However, considering there are only three published studies and no RCT evaluations, this requires considerable further investigation. Models for complex interventions recommend that feasibility research be conducted prior to conducting randomised studies to assess efficacy of interventions (Thabane et al., 2010). The aim of the current paper is therefore to investigate further feasibility questions relating to conducting a full-scale RCT evaluation of HER with children with ID. Employing a randomised pre-test post-test group design, this study aimed to explore and trial important aspects of an RCT evaluation to inform a full-scale RCT with children with ID in special schools in the UK. In addition to informing the design of a future study, we also found that HER had a significant effect on reading skills when compared with ‘treatment as usual’, with large effect sizes on the main outcome measure. This indicates that further more robust evaluations using HER with children with ID are a worthwhile pursuit.

Reading instruction in ID

Many children with Intellectual Disabilities (ID) struggle to learn to read. In the USA, 67% of children with ID have considerable difficulty learning basic reading skills (NAEP; US Department of Education, 2007). Within the UK, in 2009, only 2.2% of children in special needs schools in England (many of whom have mild-severe ID) achieved the national curriculum target levels for literacy (level 2) at aged 7 (National Pupil Database, Department of Education, 2009). This suggests that many children with ID in the UK are also having considerable difficulty learning to read. Despite these difficulties internationally, information and guidelines regarding teaching reading or other academic skills for children with ID are scarce, and often inadequate (Marks, 2000; Wehmeyer, 2006).

As has been found for typically developing (TD) children, increasing evidence indicates individuals with ID might benefit from phonics-based instruction (NRP, 2000; Joseph & Seery, 2004; Whalon, Otaiba, & Delano, 2009). However, research and instruction in the ID field has predominantly focused on sight word reading (Katims, 2000) and has less frequently investigated phonics instruction (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Aldozzine, 2006; Joseph & Seery, 2004). Therefore, further research is required to investigate the effects of phonics-based programmes, and programmes incorporating evidence-based instructional components, on the reading skills of children with ID (Browder, Gibbs, Ahlgrim-Delzell, Courtade, Mraz, & Flowers, 2009; Whalon, Otaiba & Delano, 2009).

Research indicates that children with ID may have less access than their typically developing peers to literacy activities at home (Fitzgerald, Roberts, Pierce & Schuele, 1995), and to reading instruction in school (Kliewer & Landis, 1999). Well-designed computer-assisted instruction has the potential to provide many more practice and response opportunities than teacher-delivered instruction, as well as providing opportunities for

independent practice. This efficient use of instructional time may be especially significant for children with ID who will likely require more input to develop reading skills (Browder & Spooner, 2006). Computer-assisted reading programmes are increasingly used to supplement reading instruction (Andrews, 2004). Although the quality of, and supporting evidence for, such programmes is somewhat variable, they have generally been found to have a positive effect on reading skills (Blok, Oostdam, Otter & Overmaat, 2002; NRP, 2000). There is also a growing evidence base to suggest computer-assisted reading programmes can help improve reading skills in children with autism (Grindle, Hughes, Saville, Huxley, & Hastings, 2013) and children with ID (Coleman-Martin, Heller, Cihak & Irvine, 2005; Jones, Torgesen & Saxton, 1987; Torgesen, Waters, Cohen & Torgesen, 1988).

Headsprout[®] *Early Reading* (HER) is an Internet-based programme designed to teach the skills and strategies necessary for efficient, fluent reading. Comprising 80, 20-minute lessons (episodes), HER is a computer-delivered systematic, synthetic phonics programme that includes instruction in phonemic awareness, print awareness, phonics, sounding out, segmenting and blending, and explicitly incorporates the five components of reading proposed by the NRP (Layng, Twyman, & Stikeleather, 2003). HER is an adaptive learning technology—every mouse-click forms data on individual learners' progress that is used to provide additional instruction or to ensure repeated practice of components not yet fluent. In this way, the instruction is individually adapted to each child's responses. In addition to the online episodes, frequency-building exercises accompany HER. There are two tiers of this additional support—*Targeted Practice* and *Intensive Practice* (see Procedure below, or Layng et al. 2003, for more detail).

Although HER is designed for typically developing children, there is some evidence it can be beneficial for children with ADHD (Clarfield & Stoner, 2005) and autism (Grindle, Hughes, Saville, Huxley, & Hastings, 2013; Whitcomb, Bass, & Luiselli, 2011). Grindle et

al., (2013) enrolled 4 children with a diagnosis of autism (aged between 5 and 7 years) in HER. With additional input (e.g., additional Discrete Trial Teaching for areas of difficulty, dividing episodes over 2-3 sittings, and delivery of additional reinforcers to increase motivation), all four children were able to access the programme. On completing the programme, notable improvements were seen in early literacy skills and word recognition across participants. Through a similar series of case studies conducted as previous pilot work, we have demonstrated that children with ID can also access and benefit from HER with minimal or no adaptations (Tyler et al, under review; Chapter 4).

Educational research

Randomised Control Trials (RCTs) have long been considered the ‘gold standard’ for informing evidence-based practice in medicine and healthcare (Milton, 2007). However, despite educational researchers also advocating the use of RCTs in evaluation research (Oakley, 1998, 2000), the use of RCTs in educational research has lagged behind healthcare in more recent decades (Torgersen & Torgersen, 2001; Oakley, 2006). As such, educational policies are often introduced and implemented without sufficient evidence of their efficacy (e.g., National literacy and numeracy strategies; Torgersen & Torgersen, 2001). Although the detrimental effects of administering ineffective interventions in education may not be as pronounced as for life and death outcomes in medicine, it has been suggested that: “the exposure of children to educational harm when initiatives are not properly tested is a very real risk” (Hutchinson & Styles, 2010, p.7). Furthermore, the Department for Education in the UK has recently stated their intention to conduct more large scale RCTs of educational interventions and make greater use of quantitative evidence to inform policy (Department for Education, 2013).

To design and conduct well-controlled RCTs, it is often necessary to conduct feasibility research to help inform and trial aspects of design and methodology for a larger

scale study. Models for complex interventions (Medical Research Council, 2007, 2008; Thornicroft, Lempp & Tansella, 2011) recommend that feasibility research be conducted prior to conducting randomised studies to assess efficacy of interventions (also known as Phase III trials; Thabane et al., 2010). The purpose of feasibility studies can be grouped into four general categories: Process (investigating feasibility of necessary steps of a main study, including determining recruitment, retention and adherence/compliance rates), resources (investigating potential time and budget requirements, including time taken to administer assessments and resources related to intervention implementation), management (investigating relevant management issues in participating settings), and scientific (investigating various aspects of the intervention, including estimation of treatment effect) (Van Tiejlingen, Rennie, Hundley & Graham, 2001; Van Tiejlingen & Hundley, 2001; Thabane et al., 2010). Through investigating these important parameters, the feasibility of conducting a full-scale evaluation can be better understood, and the chances of a subsequent full-scale evaluation being successful is greatly increased (Arain, Campbell, Cooper & Lancaster, 2010; Thabane et al., 2010).

Despite the obvious importance of feasibility and pilot studies, it is an aspect of the research process often neglected in research training (Thabane et al., 2010). Similarly, although feasibility work has the potential to inform other researchers of important parameters in a given context, such work is seldom published (Van Teijlingen & Hundley, 2001). The increased dissemination of such studies could serve to reduce unnecessarily duplicating the efforts of researchers in similar fields (Thabane et al., 2010).

Evaluating HER with children with ID

Our initial pilot work implementing HER with children with ID (Tyler et al, under review Chapter 4) has served to elucidate some important feasibility questions related to conducting a larger evaluation of the programme. Because HER is designed for typically developing children, our initial objectives were to investigate whether the programme is accessible or can be made accessible for children with ID. We also explored the use of the additional tiers of support within HER. Table one outlines these initial feasibility objectives.

Regarding the accessibility of HER, we determined that HER can be used with children with ID. Some children required additional input, although predominantly only if they did not understand the concept of negation (e.g., “Which of these is not a fish?”), which is crucial to progression beyond HER Episode 4). Furthermore, reading skills did appear to improve following completion of HER.

Table 1.

Initial feasibility objectives for investigating the use of HER with children with ID.

Initial feasibility objectives
<p>Accessibility:</p> <ul style="list-style-type: none"> • Can HER be accessed by children with ID? • Is additional input required to enable access? • Do children with ID appear to benefit from HER?
<p>Implementation feasibility (episodes + <i>Intensive Practice</i> activities):</p> <ul style="list-style-type: none"> • How does episode performance of children with ID compare to TD children? • How feasible is the use of the <i>Intensive Practice</i> tier of support as standard provision for children with ID using HER?

Regarding the implementation of HER with children with ID, we found that the episode data (collected online by the programme) of most children with mild-moderate ID who were enrolled in the programme demonstrated similar performance (in terms of

percentage scores and time taken per episode) to TD children (Tyler et al., under review; Chapter 4). This suggests they did not necessarily require the level of additional support provided through completing the *Intensive Practice* activities. Furthermore, based on observations of the rate of progress through the programme, we concluded that conducting the *Intensive Practice* tier of support as standard provision greatly increases the amount of 1:1 input required. In a number of cases, this was prohibitive to episode progress, and in fact appeared to reduce overall intensity of the programme for these children.

The main objective of a full-scale RCT to evaluate the use of HER with children with ID in the UK would be to determine the efficacy of the programme to improve the reading skills of children with ID when compared with children with ID receiving either ‘treatment as usual’ or another specified reading programme. However, further feasibility work is required to effectively design and conduct such an evaluation. In the present research, we conducted a pilot RCT to investigate the feasibility of a RCT design evaluating an online reading programme with children with ID attending special needs schools. The feasibility objectives span the four categories previously outlined. Table 2 was devised for the purpose of this study, and is based on the general guidelines for conducting feasibility research provided by Thabane et al., (2010). The table outlines the feasibility objectives and the specific questions under investigation, along with how these objectives were assessed within the current study.

Method

Design

This study employed a pre-test post-test randomised group design, in which participants were randomly allocated to the intervention (HER) group, or a waiting list control group. Those in the HER group received this intervention in place of other formal reading instruction they might otherwise have received, however they still participated in other literacy activities, including ‘group reading’ in class.

Table 2.

Feasibility objectives, specific questions of interest and method of measurement of objectives.

Feasibility objectives and specific questions of interest	Measurement of objective
Recruitment and retention rates (process):	
<ul style="list-style-type: none"> • Are schools and parents willing to consent to randomisation? • What is the rate of retention? • What eligibility criteria might be appropriate? Is the chosen eligibility criteria appropriate (i.e., not unduly exclusive or too inclusive)? • How long is the recruitment, consent and screening process? 	Collating recruitment and retention data
Assessing (process):	
<ul style="list-style-type: none"> • Can assessors be blind to condition? • How long is the assessment process? 	Collating assessment data
Equipment availability and resource preparation (resources & management):	
<ul style="list-style-type: none"> • Do schools have adequate computing facilities to implement the programme? • How feasible is preparation of additional resources? 	Informal staff interview
Rate of progress through the programme (process):	
<ul style="list-style-type: none"> • What is the average rate of progress through the episodes? 	Aggregated episode data from HER
Implementation fidelity/compliance rates (process):	
<ul style="list-style-type: none"> • Are implementation guidelines adhered to for the episodes (e.g., 3 per week), the <i>Targeted Practice</i> activities (completed prior to episode progress), and the benchmark reading assessments? • To what extent does this vary across settings? • What fidelity measures might be used, and are these sufficient? 	HER data and informal staff interview

Staffing and training requirements (resources &
management):

Informal staff

- What initial training and subsequent support might be provided, and is this sufficient? interview
 - What level of staffing for HER implementation might influence progress, fidelity and outcomes?
-

Appropriate outcome measures and potential effects of**HER in this population (scientific):**

Analysis of pre and

- Are the chosen outcome measures appropriate for this population? post-test reading assessment data
 - Do the chosen outcome measures detect change?
 - Are there any statistically significant effects of the intervention?
-

Defining ‘Treatment as usual’:

- What is ‘treatment as usual’ for reading instruction with children with ID in Special needs schools? Informal staff interview
 - To what degree is this consistent across settings?
-

Participants

Participants were 26 students (aged 5-19 years), who were all identified in their school records as having mild-moderate ID. All participants were recruited from three special schools in North Wales. Participants were selected by school staff in accordance with eligibility criteria established by the research team. These criteria were based on previous feasibility work, and were designed to ensure participants had an appropriately low reading level to potentially benefit from the programme, and the prerequisite skills to access the programme without requiring significant additional input. As such, participants had to be able to complete the *Mousing Around* episode independently (see intervention procedure), and have a word reading age below 7 years as measured by the Schonell Reading Test (1971).

Intervention

Materials

HER comprises 80 online episodes, averaging around 20 minutes, during which the programme directly delivers instruction to each learner. The episodes include explicit instruction in synthetic phonics, incorporating fluency-based activities to ensure concepts are mastered in each lesson (see Procedure or Layng, Twyman, & Stikeleather, 2003, for more detail). Episodes were delivered on computers that were available within the schools.

As previously outlined, HER also includes two tiers of additional support—*Targeted Practice* and *Intensive Practice*. In previous pilot work using HER with children with ID, we used the *Intensive Practice* programme (comprising over 100 additional activities). However, in the current study, the *Targeted Practice* programme (comprising only 25 activities) was used to remove a previously identified potential barrier to programme completion. As with previous pilot work, we made some adaptations to materials for this additional support. Due to some difficulty with the layout and print size of the *Intensive Practice* material, we used a flashcards protocol (Graf & Lindsley, 2002), in which cards with the *Targeted Practice* stimuli were presented, thus altering the medium of delivery but not the content or fluency aims of this tier of support. A timer was required for this part of the programme. We also designed alternative data recording sheets to allow for multiple attempts to be recorded.

HER also includes 80 stories comprising material covered in the programme. These were printed out for participants to read after specified episodes. Licenses for all participants allowed access to progress reports and further information on implementation protocol (*HER Teacher's Guide*, 2010). Teachers also downloaded and printed a progress map from the Headsprout website for each child to display in the classroom as a visual representation of their progress.

Three checklists were also used in this study. These included: an initial screening checklist for prerequisite skills during *Mousing Around*, an implementation checklist, and a school feedback checklist (see *Training and implementation fidelity*).

Outcome measures

Although evaluation of outcomes was not the focus of this feasibility study, reading assessments were conducted pre and post intervention for all participants (baseline and 6-months post-baseline), to investigate characteristics of outcome measures and to provide some information about the potential effects of HER in this population. The following assessments were investigated:

The *Diagnostic Reading Analysis* (Crumpler & McCarthy, 2007) and the *Oral Reading Fluency (ORF)* subtest of the *Dynamic Indicator of Basic Early Literacy* (Good & Kaminski, 2007) were used to assess progress in oral reading. The DRA comprises of passages of increasing difficulty, and provides an accuracy score, standardised score, and reading age for each participant. This was chosen in favour of the more commonly used *Neale's Analysis of Reading Ability* (NARA; Neale, 1999) due to the age range of participants involved in this programme of research. The DRA provides standardised scores for children up to the age of 16years 5months, as compared to only 12 years using the NARA. The *ORF* subtest consisted of three passages at Year 2 equivalent level. The child reads as many words from each passage as they can in one minute, and the median score is taken.

The *Word Recognition and Phonic Skills assessment* (Carver & Moseley, 1994) was used to assess progress in word recognition skills. In this assessment, the child is read a word and asked to choose the correct word from a choice of four or five. The assessment places children within a word recognition stage, from one (almost no word recognition knowledge) to ten (moving towards mastery of clusters and digraphs necessary for word recognition).

In our previous pilot work, component reading and early literacy skills were measured using various subtests of the *Dynamic Indicator of Basic Early Literacy Skills* (e.g., phonemic awareness, initial sounds, and nonsense word reading fluency; REF). In the current study, we wanted to ascertain if an assessment measuring the composite skill of decoding (i.e., passage reading accuracy) would be an appropriate primary outcome measure. The DIBELS *ORF* and the *WRaPS* assessment were included to provide potential alternatives to the DRA if it failed to detect changes in reading skills (i.e., if change was not measurable at the composite skill level at post-baseline assessment).

Procedure

Recruitment and screening. Three special needs schools in North Wales were approached and asked to participate in the study. One of these schools had used HER prior to this study, through previous involvement with the research team. Prior to participant recruitment and assessment, each school screened potential participants to ensure they met the eligibility criteria previously outlined. This included the Schonell reading test (1971), and the *Mousing Around* episode. *Mousing Around* is a short introductory online episode that familiarizes the child with the instructional language of the programme and provides practice of appropriate responding prior to introducing the reading episodes. To ensure each school was making similar decisions on performance on this episode, a checklist was devised to guide teachers on important prerequisite skills. This included items such as ‘*Responds appropriately to the speak out loud activities without continuous prompting*’, ‘*Can click at appropriate speed in the fluency activities*’.

Randomisation. Once consent was obtained, participants were randomly allocated to either the HER group or a waiting list control group prior to baseline assessment. Participants were randomised within each school using Microsoft Excel, ensuring that each school had half of their participants in each group. Due to the large range in the age of participants, t-

tests were conducted to ensure there was no significant difference in chronological age between the two groups. The HER group then began the programme.

HER online episodes. Episodes were conducted according to implementation guidelines provided by Headsprout. Participants engaged in episodes at a computer set up ready to access their individual profile. A staff member remained with the child while they were interacting with the programme, however, they did not interact with the child other than to offer encouragement to stay on task. This was to ensure there was no interference with the sophisticated correction procedure built into the programme, and that the responses made provided accurate feedback of the child's current ability and progress. When each child finished an episode, online data were checked to ensure they had attained the required level of accuracy, set at 90% in each episode. If this was attained, they chose a sticker to place on their progress map that indicated which lesson they had completed.

HER Stories. In accordance with implementation guidelines, children were also required to read stories provided by the programme after specified episodes. If the child struggled, staff were advised to remind them to sound out the word, and implemented the Model-Lead-Test error correction procedure as described below in the *Targeted Practice* exercises.

HER Targeted Practice flashcards. The *Targeted Practice* tier of HER was conducted after the episodes specified in the programme protocol. This comprises around 25 frequency-building exercises consisting of individual sounds and words and 10 oral reading fluency exercises designed to ensure children were fluent on the materials taught in specific episodes before they progress to the next episode. As previously outlined, in this study we used a modified flashcards procedure rather than the sheets provided with the *Targeted Practice* materials. A teacher or classroom assistant was advised to work with the child at the table and conduct practice sessions using a Model-Lead-Test format (Engelmann & Carnine,

1982). This involved demonstrating the procedure by responding to four cards (model), then repeating this along with the child (lead), and then the child responding alone (test). This ensured participants understood the procedure, and also served as a warm-up activity prior to timing. Staff then told the child they would be timed for one-minute, and to answer as quickly and accurately as possible. As in our previous pilot work, because HER was not designed specifically for children with ID, we reduced the number of correct responses required for reaching criterion to that recommended for children aged between five and six years, which varied between 25 and 50 correct responses per minute. Correct and incorrect responses were recorded on each child's data sheet. To demonstrate mastery, participants had to obtain the target for the specific activity over three timings before the child could move onto the next episode of the programme. Staff were advised to employ a correction procedure after each timing, again using the Model-Lead-Test format outlined previously. This was repeated until the participant responded correctly to all errors made during the timing.

HER Targeted Practice Oral Reading Fluency. Oral reading fluency measures also form part of the *Targeted Practice* programme. Participants were required to read a short passage, and the number of words read correctly per minute was recorded. As with the flashcards, oral reading fluency targets had to be met in three timings before progressing, and the same error correction procedure was employed.

Benchmark Reading Assessments. Twelve of the 80 stories are considered *Benchmark Reading Assessments*, to be conducted after specified episodes. For the Benchmark readers, data on reading accuracy was taken (i.e., number of words read correctly), and a rating of reading proficiency of *Independent* (read with few errors), *Satisfactory* (read with some errors and slight hesitation), or *Needs Practice* (read with frequent errors). Staff were instructed to record these data either electronically through the HER site, or on printed sheets available to download. These data were then used, alongside

the programme data, to guide decisions on whether additional frequency-building activities were required.

We repeated assessments with all participants at the end of the school (academic) year, regardless of which episode the child had reached. (See results for information on the flow of participants).

Training and implementation fidelity. In each school, one training session was conducted so that a teaching assistant or teacher could implement the programme with each participant. Researchers were present for either the initial session or a session early in the programme, after which we monitored online episode data to ensure fidelity of implementation. An implementation checklist to guide the running of the sessions was adapted from Huffstetter et al. (2010) for use during the training session and thereafter in all sessions conducted in each school. This included items such as: ‘Have you checked every child is responding audibly to the speak-out-loud activities?’, ‘Have you responded to any requests for help by redirecting the child back to the programme?’, ‘Have you read the HER stories and scored performance on the appropriate sheets?’ and ‘Have you checked each child has achieved 90% accuracy immediately after episode completion?’.

In response to teaching staff feedback and to encourage reporting of difficulties implementing the programme during the study, an additional checklist was introduced early on in the research period. This required one staff member at each school to ask other staff implementing the programme key fidelity questions regarding the child they were working with (e.g., ‘Have you completed three episodes this week?’, ‘Have you completed the *Targeted Practice* materials?’) and to ask whether they were experiencing any difficulty with the programme. This information served to check for implementation fidelity and as a request for assistance if required. This checklist was to be emailed to the lead researcher each week.

Assessments and teaching staff interviews. Assessments were conducted by the lead researcher and three undergraduate students trained in the administration of the assessments. Pre-test assessments were conducted after randomisation, but were blind to intervention condition. Thirty-six percent of post-test assessments were conducted blind to intervention condition (see Discussion).

Following the research period, a brief informal interview was conducted with each staff member involved in implementing the programme. The purpose of this was to ascertain any barriers to conducting the programme with fidelity (see below). It also provided an opportunity to clarify any aspects of the data collected on the *Benchmark stories* and the *Targeted Practice* activities. Teaching staff were asked to comment on their experience using the programme, including: whether they had any difficulties implementing the programme, any computer resource or technical difficulties, any difficulties preparing materials for the additional activities, how HER was implemented and staffed in their setting, and whether they thought the initial training and support was sufficient to implement the programme.

Implementation fidelity criteria

Episodes. According to the HER protocol, and the guidelines given to all staff involved in the study, at least three episodes should be completed each week. This can include episode repetitions, which should occur if the child scores below 90%. It is also essential children do not receive external prompts during the episodes, and that they speak out loud during specified points in the episode.

Benchmark stories. These should be read by the child, scored and rated (as previously outlined) by the teaching staff member following the relevant episode. If an ‘N’ (*Needs practice*) is recorded, the story must be repeated until it is rated an ‘S’ (*Satisfactory*), and the child should not progress onto the next episode until this is achieved.

Targeted Practice. These activities should be completed following the relevant episode. Correct and incorrect responses per minute should be recorded, and the target met or surpassed on three timings prior to moving onto the next episode.

Results

Recruitment and retention rates

Timeline for initial recruitment. Recruiting schools, selecting and screening participants, obtaining consent, staff training and pre-test assessments took up to 4 months. All schools began HER intervention in January of the school year, leaving approximately six months to the end of the academic year for delivery of the intervention.

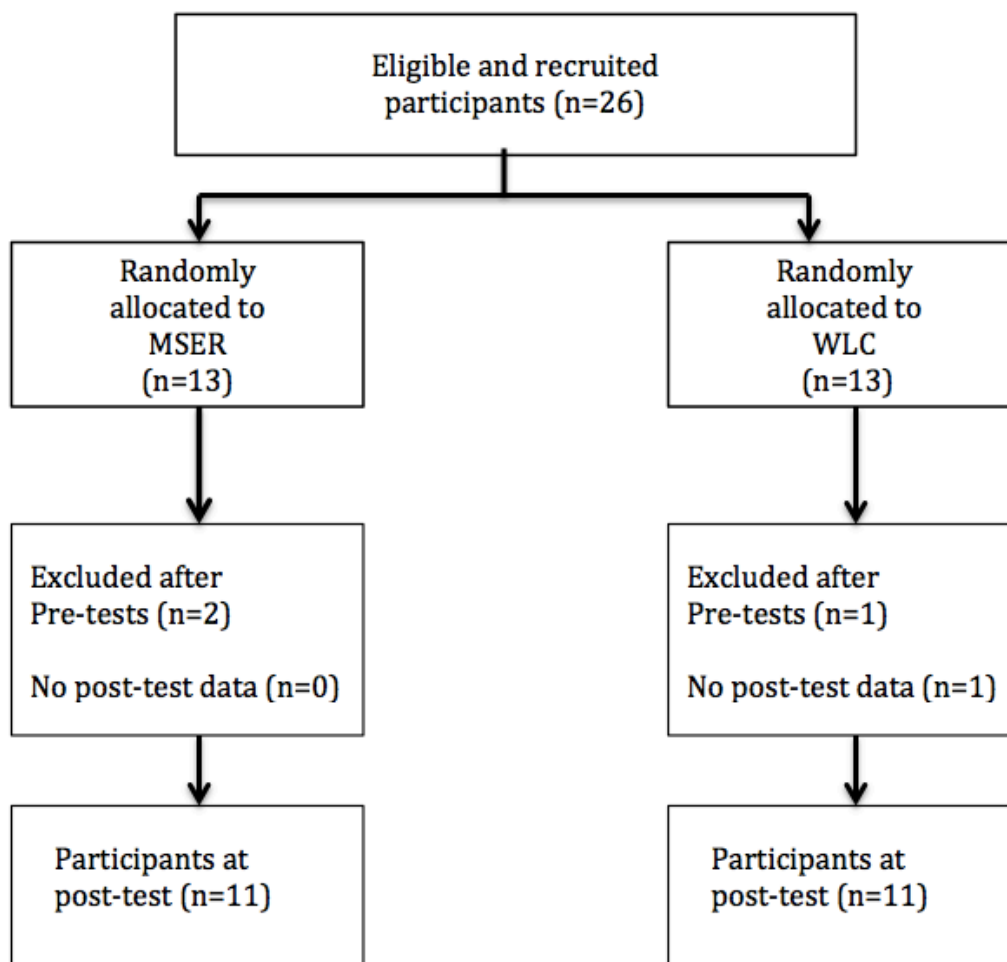


Figure 1. The flow of participants from initial screening to post-testing

Retention. Figure 1 outlines the flow of participants from screening to post-test data collection using a Consort-style presentation. Consent for participation in the study (including random allocation to intervention or waiting list control) was obtained for all twenty-six eligible children. However, following randomisation, two participants from the HER group and 1 from the control group were excluded due to non-compliance with baseline assessments. A further participant from the control group was not available for assessment 6 months post-baseline. All 11 children enrolled in HER remained in the study, demonstrating 85% retention overall in the intervention group.

Equipment availability and resource preparation

All schools had computers with Internet access available prior to the study. However, each school reported difficulties with teaching staff suggesting that existing facilities were inadequate for efficient delivery of HER. A number of staff members reported slow computer start up times and slow Internet access as barriers to completing more of the programme. No staff reported preparation of the additional materials as a barrier to using the additional materials.

Table 3.

Individual episode progress, including episode reached, number of repetitions, and average number of episodes completed each week.

School	Participant	Episode reached	Number of repetitions	Average completed per week
1	1	37	3	<3
	2	46	0	<3
	3	61	3	>3
	4	73	0	>3
2	5	21	0	<3
	6	40	0	<3
	7	59	0	>3
	8	61	0	>3
	9	73	0	>3
3	10	37	1	<3
	11	43	0	<3

Rates of progress

During the 6-month intervention period, none of the participants completed the programme. As reported in Table 3, episodes completed ranged from 21 to 73, with 8 participants reaching the second half of the programme (episode 40+).

Table 4.

Average episode performance of participants and typical learner data.

	Typical learners	Current participants
Average correct responding across completed episodes	94%	95%
Average interactions per completed episode	190	230
Average duration of completed episodes (mins)	17	14

Implementation fidelity and compliance

Episodes. The episodes were completed with the required accuracy (90%) and repeated when this was not attained. Similarly, according to the self-report fidelity checklists, participants were not prompted during the episodes and complied with the ‘speak-out-loud’ component of the episodes. However, as can be seen in Table 3, only 5 of the 11 participants completed 3 or more episodes per week.

Benchmark stories. Table 5 outlines the fidelity and compliance figures for the *benchmark stories*. This aspect of the programme was only used with fidelity with 38% of participants, and overall compliance (correct or attempted use) was 62%.

Targeted Practice. Table 6 outlines the fidelity and compliance figures for the *Targeted Practice* materials across each school. Overall fidelity of this aspect was 27% of all participants, and overall compliance was 72%. The following were noted as violations of procedure that resulted in coding as ‘used, but not with fidelity’: Missing activities (sporadic data or occasional missing data); deliberate skipping of difficult activities (e.g., nonsense

words or oral reading); conducting activities but not reaching frequency aim; conducting activities, reaching frequency aim, but not three times.

Table 5.

Fidelity and compliance figures for use of benchmark reading assessments in each school.

School	Used with fidelity	Used but not with fidelity	Not used	% of children used with fidelity	% compliance (correct or attempted use)
1 (<i>n</i> =4)	3	0	1	75	75
2 (<i>n</i> =5)	2	1	2	40	60
3 (<i>n</i> =2)	0	1	1	0	50
All	5	2	4	38	62

Table 6.

Fidelity and compliance figures for use of Targeted Practice materials in each school.

School	Used with fidelity	Used but not with fidelity	Not used	% of children used with fidelity	% compliance (correct or attempted use)
1 (<i>n</i> =4)	1	2	1	25	75
2 (<i>n</i> =5)	2	2	1	40	80
3 (<i>n</i> =2)	0	1	1	0	50
All	3	5	3	27	68

Staffing

No requirements were specified by the research team for staffing prior to beginning HER, as long as it could be implemented with fidelity. Staffing levels and organisation, therefore, varied across settings. Teaching assistants predominantly implemented the programme, with the exception of two children (from schools two and three) for whom the class teacher was also involved. All schools chose to implement HER on a 1:1 basis. Initially, all schools allocated a staff member who was working in each child's class to be responsible for the programme. Schools two and three continued with this model throughout the study, with the number of participants (five and two, respectively) matching the number of staff members involved. Due to difficulties fitting episodes in within the classroom and other

responsibilities of the assistant, school one changed their model of staffing approximately one month into the research period. One assistant was then responsible for implementing the programme with three of the four participants, taking them out of their respective classes for the episodes and additional activities. HER was still conducted 1:1 for these children.

There was no notable difference in progress of participants (Table 3), fidelity of implementation (Tables 5 and 6) and outcomes (Table 7) across settings and modes of delivery.

Training

Although initial training and support was reported by staff to be adequate, the low fidelity and compliance rates with some aspects of the programme suggests that training had not resulted in sufficient competence or adherence to the protocols to ensure high fidelity and quality implementation.

Defining ‘Treatment as usual’

Both the form and the frequency of reading instruction varied between each school. One school reported use of a specific programme once per week, with generic class reading each day; one reported use of a different programme with varying frequency, whereas another reported more general work on alphabetic knowledge and sight words that varied from daily to weekly depending on the child.

Baseline data

Tables 7 and 8 outline the baseline age and DRA Reading age and Accuracy scores of participants in both groups. Pre-test DRA reading ages were similar between groups, ranging from <5years to 6yrs 4months in the HER group, and from <5yrs to 6yrs 2months in the Control group. However, there was a marginally significant difference in DRA accuracy scores at pre-test, with the HER group scoring higher prior to enrolling in HER ($F(1,19) =$

1.30, $p = .062$). Based on Cohen's d , a large effect size was found for this difference ($d = 0.85$). Group means for all reading measures can be seen in Table 9.

Table 7.

HER Group Ages at Pre-test, Reading Ages, and Reading Accuracy DRA scores at Pre-test and Post-test

School	Participant	Age (years,months)	Pre-test Reading age (years,months)	Pre-test Reading accuracy	Post-test Reading age (years,months)	Post-test Reading accuracy
1	1	17,1	<5	36	<5	32
	2	12,1	<5	40	6,0	80
	3	14,4	<5	30	<5	38
	4	14,8	<5	39	<5	42
2	5	11,6	<5	20	<5	20
	6	7,6	6,4	90	6,6	95
	7	18,0	<5	41	6,2	89
	8	5,5	<5	28	8,3	130
	9	17,6	<5	42	<5	43
3	10	11,10	<5	52	<5	40
	11	11,2	<5	41	8,6	136

Table 8.

Control Group Ages at Pre-test, Reading Ages, and Reading Accuracy DRA scores at Pre-test and Post-test

School	Participant	Age (years,months)	Pre-test Reading age (years,months)	Pre-test Reading accuracy	Post-test Reading age (years,months)	Post-test Reading accuracy
1	12	13,1	<5	4	<5	13
	13	16,3	6,2	86	7,0	109
	14	13,1	<5	1	<5	11
2	15	9,4	<5	28	<5	27
	16	14,2	<5	12	<5	15
	17	13,0	<5	0	<5	0
	18	12,7	<5	47	<5	11
	19	18,7	<5	19	<5	12
3	20	12,3	<5	0	<5	0
	21	10,5	<5	29	<5	42
	22	12,0	<5	25	<5	27

Exploratory statistical analysis of reading assessment outcomes

Table 9 shows the mean scores, results of ANCOVA and t-test analysis, and effect sizes for all measures for the HER and Control group. To control for potential pre-test differences between the groups despite initial random assignment, a one-way analysis of covariance model was used. Because no Control group participants attained a standardised score on the DRA at pre-test, an independent samples t-test was conducted to compare post-test scores only for this outcome measure. Effect sizes based on Cohen's *d* were calculated using the mean change scores for the HER and Control group and the pooled pre-test Standard Deviation (Rosnow & Rosenthal, 1996). For the DRA reading age and WRaPS word recognition age, effect sizes based on Cohen's *d* were calculated using the means at post-test for each condition and the pooled post-test Standard Deviation.

Table 9.

Results of ANCOVA analysis including all participants on measures of reading outcome.

		HER		Control		ANCOVA		
		Pre-test	Post-test	Pre-test	Post-test	<i>F</i> (2, 19)	<i>p</i>	<i>d</i>
		<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)			
Diagnostic Reading Analysis	Standardised score ¹	7.73 (25.63)	17.55 (39.57)	0 (0)	0 (0)	13.76	.086	<i>n/a</i> ²
	Accuracy Score	41.73 (18.12)	67.73 (40.46)	22.82 (25.79)	24.27 (30.66)	3.48	.078	0.99
	Reading age (months)	6.91 (22.91)	38.63 (45.31)	6.73 (22.31)	7.64 (25.33)	5.06	.036	1.39
WRaPS	Word recognition Raw score	34.18 (6.15)	38.55 (5.45)	18.36 (9.37)	20.45 (8.99)	4.84	.04	0.22
	Word recognition stage	6.82 (1.54)	8.00 (1.18)	3.18 (2.14)	3.64 (2.02)	8.13	.01	0.31
	Word recognition Age (months) ¹	82 (5.88)	86.18 (5.04)	56.73 (28.97)	63.27 (22.53)	2.09	.164	0.09

DIBELS	Oral Reading Fluency (correct words per minute)	22.45 (9.85)	35.18 (16.90)	10.64 (19.87)	14.09 (19.97)	3.48	.078	0.51
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¹ An Independent samples T-Test was conducted on post-test scores for this output due to no participants in the control group attaining scores at pre-test.

² Cohen's *d* could not be calculated for this output due to no participants in the control group attaining scores at pre or post-test.

The results indicate that for the DRA Reading Age, WRaPS Raw Score and word Recognition Stage, there were significant differences in the HER group at 6 months post-baseline assessment compared to the control group, and marginally significant differences in Standardised score, Accuracy Score, and DIBELS Oral Reading Fluency. Large effect sizes were found for DRA Accuracy Score and Reading Age. A medium effect size was found for DIBELS *ORF* and small effect sizes for WRaPS Raw Score and Stage.

Discussion

The current study investigated the feasibility of evaluating an online reading programme with children with ID in special schools in the UK. This discussion will outline what we have learned from the current study in relation to the specified feasibility objectives, before discussing considerations and recommendations for a future, full-scale RCT.

Recruitment, retention rates and assessing

An important feasibility objective in the current study was to ascertain the acceptability of randomisation to condition. The current study demonstrated that schools and parents were willing to consent to randomisation, in which each child would either be allocated to immediately receive HER, or to receive this in the following school year. No schools objected to this, and 100% consent was obtained from parents.

Due to the length of time taken from recruiting schools to beginning the intervention (up to 4 months), an entire school term was lost from the intervention period. Beginning recruitment of schools and selecting suitable participants in the Summer term prior to the

year intended for the research period for future studies would enable valuable additional intervention time.

Eligibility criteria did not appear to be unduly exclusive; each school was able to put forward the requested number of potential participants according to these criteria. However, whilst there was a favourable retention rate of 85% of participants in the intervention group, there were a number of participants that were not taken through the programme according to the protocol set out by the programme developers. It is therefore unclear whether such retention rates would be achieved with the application of stricter criteria.

The current study also demonstrated that assessors can be blind to condition. Whilst only 36% of post-test assessments were conducted blind to condition, this was only due to resources to fund assessors and training. No assessments were unblinded; we planned for the remaining 64% of assessments to be conducted by the lead researcher (who was not blind to condition), due to limited resources. If funding allowed for further independent assessors, it appears that all assessments could be conducted blind to condition.

Equipment availability

Although all schools had seemingly adequate computing facilities prior to beginning HER, staff interviews indicated this was a factor that affected implementation and programme intensity.

Rates of progress

No participants completed the programme in the 6-month research period, and some of those reaching the second half of the programme had not received the *Targeted Practice* element of the programme with the recommended intensity. This suggests that a longer intervention period would be required to give participants the opportunity to complete the programme prior to post-test assessment. As mentioned, beginning school and participant recruitment in the preceding term would allow for this.

Implementation fidelity and training

Implementation fidelity with HER is perhaps not as complex as with other educational interventions, namely because all the instruction in the lessons is delivered directly from the programme. However, the use of the *Benchmark Assessments* to ensure children do not progress prior to mastering the concepts taught in each episode, and the addition of the *Targeted Practice* tier of support – both involving specific delivery protocol – do require fidelity checks to monitor implementation. The poor levels of implementation fidelity for these aspects of the programme indicate that the staff training and monitoring of these aspects (which occurred via self-report checklists) was not adequate in the current study, despite staff reporting their satisfaction with the training provided. It was mentioned in a number of staff interviews that the implementation session checklist (adapted from Huffstetter, et al., 2010) served the functions of reminding staff of important aspects of delivery and providing an easy way to allow other staff to supervise a child on the episodes if required. However, the self-report checklist incorporated two months into the research period was only partially successful; it did alert the researchers to some difficulties, but some staff members continually reported no difficulties when in fact there were violations of procedure and sometimes complete omissions of aspects of the programme. This indicates that both checklists might be best accompanied by periodic observations of implementation to ensure fidelity in all aspects of delivery.

Staffing

Although there were poor rates of implementation fidelity, the current study indicates that teaching assistants (who are typically lacking formal teaching qualifications) can deliver HER. The nature of staffing (e.g., whether numerous staff in a school are involved in implementing the programme) did not appear to be related to outcomes and progress through the lessons.

Considerations and recommendations for a future, full-scale RCT

Choosing the control group treatment

Gueron (2002) suggests that defining the control group treatment is as important as implementing a well-defined treatment or programme in the intervention group. Defining control group treatment clarifies the question to be addressed, in that it specifies what the intervention is to be compared to. In the current study, we have compared HER with ‘Treatment as usual’ (TAU) in special schools. Therefore, the evaluation question for an RCT following the same design would be, what are the effects of HER compared with typical provision in special schools?

One of the feasibility objectives in the current study was to further define what ‘TAU’ looks like when it comes to reading instruction in special schools. Using information from the staff interviews, we learned that children in the control group received varying intensity of reading instruction (ranging from once a week of formal instruction, to more focused daily sessions) and varying types of reading instruction and programmes. Although there was some consistency in the use of programmes *within* each school (e.g., the use of the Ruth Miskin Phonics programmes; Miskin 2011), none of the three schools in this study reported using the same reading programme or specific approach. One staff member indicated that it was left to each teacher to decide a programme, and often comprised teacher-made resources rather than a specific, published programme. This picture of TAU is supported by the data obtained in a recent survey of reading practices in special schools in the UK (Chapter 3), in which 37 different programmes were reportedly used, and over 20% of respondents indicated that a specific programme was not used at their school.

Due to the varying nature of TAU in this context, an option to consider for a future RCT is comparing HER to another specified published programme. However, there would be some considerable difficulties affecting the feasibility of such a study (Moore, Graham &

Diamond, 2003). All (or at least the vast majority of) schools in the study would be required to implement a programme different to that which they were currently implementing. Considerable additional resources would be required to implement another programme, including the time and cost of staff training, and this would also significantly increase the disruption to all schools in the study. Furthermore, providing a specific published programme for the control group would likely lead to these participants receiving enhanced provision for the duration of the study, as compared to the provision that is more typical in these settings (Moore, 2003). Therefore, despite the variable provision a ‘TAU’ control group might receive, there are advantages to comparing HER with this mixed provision. Not least, this will inform us whether HER leads to better reading outcomes than typical current provisions. In the current study the HER group still participated in some TAU activities, however were not enrolled in any other specific programmes or receiving other direct reading instruction. We would therefore consider this design to be comparing HER with TAU, and would suggest such a design for a future evaluation.

Programme delivery

As discussed earlier, implementation fidelity in the current study was variable across settings and programme components. This variable delivery leads to an important consideration for a future, full-scale RCT: should we aim to conduct an efficacy trial or an effectiveness trial?

Efficacy and effectiveness trials address slightly different research questions, both of which provide useful information on an intervention (Rush, 2009). An efficacy trial is designed to investigate the effects of an intervention under ideal circumstances (e.g., highly controlled and less variable delivery, stricter inclusion criteria), whereas an effectiveness trial involves a more pragmatic approach, in which variable delivery is accepted as a likely reality if the intervention was to be implemented in general practice. A comprehensive qualitative

component is also important within effectiveness trials to investigate and monitor factors relating to delivery (Moore, Graham & Diamond, 2003).

In the case of a future RCT evaluating HER in special schools, there is a case for conducting either type of trial. It could be argued that the variability in implementation fidelity in the current study for important aspects of HER suggest the need for an efficacy trial in which HER is delivered only by trained researchers under tighter controls. However, it is arguably more immediately informative for educators and policy makers for the trial to be conducted in a more realistic manner, and there were some encouraging improvements made taking a more pragmatic approach in the current study. Therefore, an effectiveness trial might more immediately answer the question of whether HER can be an effective intervention in the current context of special schools. Furthermore, there is scope for tighter fidelity than the current study in a future effectiveness trial in which teaching staff and assistants deliver the programme (e.g., through improved initial training and more frequent direct observation of delivery).

Design

The current study used individual randomisation within each school; each school had some participants in the HER group and some in the control group. This procedure was successful in this context. However, the feasibility of individual randomisation in a larger, full-scale evaluation is important to consider. Moore, Graham and Diamond (2003) suggest that for most research in school settings, individual randomisation presents practical and administrative difficulties, because it involves some children in a class receiving different instruction. As indicated by the current study, this might not present the same challenges in special school settings in which highly differentiated instruction and timetabling is often the norm. However, individual randomisation would still present practical difficulties in a larger study involving more schools. If every school involved in the study were to be implementing

HER, this would greatly increase the resources necessary to provide the closer monitoring and training required to ensure high quality implementation. Furthermore, if some children are removed from a class to receive HER intervention, leaving fewer children in class, this could lead inadvertently to enhancing provision of reading instruction for the control group (i.e., the remaining children in the class).

An alternative approach that is increasingly common in RCT studies is to use a cluster randomised design, in which random allocation to groups is at the level of the group or cluster (Moore, Graham & Diamond, 2003; Donner & Klar, 2000). In the context of a HER evaluation in special schools using this design, randomisation would be at the level of the school. Schools and participants would be recruited on the basis that they would be allocated to enroll in HER or to a control group in which they continue to receive their usual provision.

If a cluster-randomised design were implemented in a future RCT, it would be important to take into account whether recruited schools are similar when compared on factors important to the primary outcome (Moore, Graham & Diamond, 2003). In this context, important factors might include: the deprivation level of the area, the type of SEN provision provided by the settings, and perhaps current levels of reading attainment if this information was available. These factors could be accounted for in the randomisation process, either through stratification of the clusters, or through a minimisation procedure (Treasure & MacRae, 1998). Using cluster-randomisation would also have implications for the sample size required for the study. Due to intracluster correlation (i.e., the extent to which variability within the clusters explains the overall variance in outcome between the clusters), to obtain comparable statistical power the sample size in terms of individual children required for a cluster-randomised design would be larger than for a study using individual randomisation (Campbell, Elbourne & Altman, 2004). The practical difficulties of individual

randomisation versus the greatly increased resources likely required for cluster-randomisation will need careful consideration in a future study.

Randomisation

The loss of participants in the current study due to them not being assessable (i.e., providing no responses) raises the question of when to randomise participants. Randomising prior to baseline assessment runs the risk of exclusion following randomisation due to such unexpected issues with obtaining baseline data. Alternatively, randomisation could occur following assessments and any necessary exclusions based on assessment behaviour. This would also reduce the potential problems with bias due to unintentional unblinding at baseline. However, training in the programme(s) and relevant resource preparation could not realistically be conducted until it was known which schools were in the initial intervention group. As baseline assessments would ideally be conducted with a minimal delay prior to beginning the intervention, this would likely cause some logistical difficulties. These issues also need to be considered carefully in a future study.

Primary outcome measure

As previously outlined, three assessments were investigated in the current study: the DRA (comprising a reading accuracy score, a standardised reading score, and a reading age); the *Dynamic Indicator of Basic Early Literacy Skills* Oral Reading fluency subtest; and the *Word Recognition and Phonic Skills assessment*. The first two feasibility objectives related to these assessments were to investigate the appropriateness of the assessments for measuring reading skills with children with ID, and to ascertain whether the measures detected changes in reading skills. With the exception of the two participants excluded from the HER group due to non-compliance during baseline assessments, there were no difficulties in administering each of the assessments according to the respective published protocol. However, there were some notable observations concerning the WRaPS assessment with

some participants. Within the assessment, there are up to four distractor items alongside the target word. All assessors were trained to administer this at a slow pace and to remind participants throughout the assessment to read each word prior to selecting their answer, however, a number of participants continued to select their responses rapidly and seemingly without surveying the possible answers. Although there were significant differences in WRaPS scores between the groups at post-test, this could account for the variability in performance on this measure, with some participants – in both groups – giving fewer correct responses at post-baseline assessment. This brings into question the validity of this measure in the current study, and indicates it might not be a suitable measure in a full-scale RCT with this population.

The DRA did detect changes in reading skills. However, there was a floor effect for standardised scores in the control group at both baseline and post-baseline assessment. Although participants in the control group did attain an accuracy score, these scores were too low to attain a standardised score. This has implications for the use of standardised scores as the primary output of interest from this assessment, as without any mean or standard deviation values it is not possible to run ANCOVA or to calculate an effect size for this output. Because we are targeting children at beginning reading level – as HER is designed for – this problem is likely to occur with standardised scores. Similarly, although not the case in the current study, failure to attain a reading age in such a cohort is also a distinct possibility. It might therefore be necessary to use reading accuracy scores from the DRA as the primary output of interest from this assessment.

The DIBELS *ORF* also detected changes in reading skills. However, because correct words per minute can be calculated from the DRA output, this assessment would not be required in addition to the DRA.

The third feasibility objective related to these measures was to investigate whether there were any statistically significant effects of HER. In the current study we found that HER had a significant effect on reading skills when compared with TAU, with large effect sizes for DRA accuracy scores and reading age. Although the limitations of the current study are important to consider alongside the analysis (such as the small sample size, lack of blinding at post-test, and the non-equivalence of the groups on accuracy scores at pre-test), these results indicate that further and more robust evaluation of HER in this population would be a worthwhile use of resources.

Conclusion

This study demonstrates the importance of feasibility studies to inform aspects of a larger investigation that would require significantly more resources. Specifically, it demonstrates that, even with a relatively prescriptive intervention there are barriers to a robust evaluation in educational settings that might not be apparent prior to conducting feasibility studies.

Based on what we have learned so far, we would suggest that, prior to a full-scale RCT, a further pilot RCT is conducted in the form of a cluster randomised effectiveness trial. Such a pilot would enable the trialing of cluster randomisation (including whether consent to randomisation holds true if randomisation occurs at the school level), the use of the DRA as the primary outcome measure, the addition of ‘assessment compliance’ as participant inclusion criteria, and an estimate of the effects of the intervention in the case of high quality delivery, as compared to TAU to inform the sample size required for a large scale multi-site RCT. The knowledge gained from the feasibility research to date in addition to a further pilot RCT would increase the likelihood of a full-scale effectiveness trial being successful in informing researchers and educators as to the potential effects of using HER to improve the reading skills of children with ID.

Chapter 6: General discussion

Many children struggle to learn to read and are not attaining basic levels of literacy skills, despite policy changes in this area and despite what we know about effective approaches for teaching reading skills. There were three broad aims of this thesis: to investigate the effects of HER with typically developing children in a UK setting; to investigate current practices in reading instruction with children with an intellectual disability (ID); and investigate important feasibility questions relating to the potential use and effects of HER with children with ID. In the remainder of this discussion I summarise the findings of the four preceding research chapters and how they contribute to the current literature, before discussing the strengths and limitations, future research directions, and the implications of these findings for educational practices.

Chapter summaries and contributions to the literature

The study reported in Chapter 2 investigated the use of HER as supplementary reading instruction during beginning reading instruction with typically developing children in Y2. The results indicate that there was a significant difference in favour of the HER group at post-test across the majority of reading measures, with medium and large effect sizes. The HER group overall gained almost 22 months more in reading age than the control group over one school year, and more children in the HER group reached a level of reliable change than in the control group across all measures. This indicates that improvements at the group level were reflected at the level of individual children's response to the intervention. These findings suggest that using HER as supplementary reading instruction was more effective than typical classroom instruction alone for beginning readers.

This is the first study investigating the use of HER with typically developing children in a UK primary school setting, and thus provides an important contribution to the current evidence-base. Previous evaluations with typically developing children have been conducted

in the USA; these findings indicate that beginning readers in the UK can also make significant gains when enrolled in HER as supplementary reading instruction.

When investigating the literature around reading instruction in ID, and in special schools in general, I found there was very little information available regarding reading attainment, and even less around practices in reading instruction in special schools. Some figures were made available through a series of freedom of information requests to both the English and Welsh governments (namely those reported in previous chapters). However, many children in special schools are working at the level of P-Scales (which enable recording of achievement for children with SEN who are ‘working towards’ National Curriculum Level 1) rather than National Curriculum levels, and data are not held on P-Scale attainment (See Appendix 6). Furthermore, when beginning to investigate the use of HER in special schools, many teachers commented on how little training and guidance they had received on teaching reading to the children they were supporting. I therefore devised the survey study presented in chapter 3 to further elucidate some of these issues. The aims of the survey were: to collate information on current practices related to reading instruction provided for children with ID in special schools across the United Kingdom (UK); investigate the putative effects of age and severity of ID on teachers’ choice of instructional approaches; and, examine teachers’ perception of barriers to improving reading skills in this population. The results suggest that age and severity of ID influenced responses on some items relating to choice of approaches and expectations, and that access to training and suitable curricula were seen as greater barriers to improving reading skills than factors relating to time or staffing.

There are few studies investigating approaches that include the essential components of reading instruction outlined by the NRP (2000) for children with ID, and very few studies investigating specific programmes and their effects when used with children with ID.

Chapters 4 and 5 investigated important feasibility questions pertaining to the use and

evaluation of HER with children with ID, as well as further investigating the use of HER in a UK context.

Chapter 4 investigated whether children with ID can access HER and what adaptations may be necessary to achieve this, and whether there were measurable effects of the programme on key early reading and language skills of children with ID. Six children with mild to moderate ID were able to access and complete the programme with minimal additional input, and demonstrated improved reading skills following completion. This is the first paper investigating the use of HER with children with mild to moderate ID in the UK, and as far as we know, the first internationally.

Having demonstrated that children with ID can access (i.e., progress through) HER, and with some encouraging improvements in reading skills following completion, the feasibility study presented in chapter 5 aimed to investigate specific feasibility objectives that would help inform a future, full-scale RCT evaluation of HER with children with ID in special schools. Employing a randomised pre-test post-test group design, in addition to informing the design of a future study, we also found that HER had a significant effect on reading skills when compared with ‘treatment as usual’, with large effect sizes on the main outcome measure. This indicates that further more robust evaluations using HER with children with ID are a worthwhile pursuit.

Chapters 2, 4 and 5 also further contribute to the evidence-base for computer-assisted instruction having a positive effect on reading skills for both TD children and children with ID. Specifically, the results reported in these chapters further support the notion that computer-assisted instruction could provide expert instruction in remedial reading when resources for staff training are limited (Chambers, Abrami, McHaw & Therrien, 2001).

Methodological limitations

Whilst each research chapter included in this thesis makes a valuable contribution to this area, there are some limitations that are important to consider. Although chapter 2 was a randomised study, and the first evaluation of HER with typically developing children in the UK, there was a relatively small sample size, thus limiting the statistical power of the findings. Furthermore, because those enrolled in HER received this intervention as *additional* instruction, it is not clear whether improvements made were specifically due to effects of HER rather than simply increased intensity of reading instruction. Therefore, further studies including more participants and including some alternative supplementary reading instruction for those in the control group would enable us to more clearly determine the effects of HER. However, this study does demonstrate that using HER during beginning reading instruction can have a significant effect on reading skills, and with the minimal training required, HER could provide a cost-effective way of delivery supplementary reading instruction for more children at this age. This is an important issue because a significant number of these children would be expected to experience problems in reading that could have profound implications for their academic achievements and their life choices (Roman, 2004; National Literacy Trust, 2008). Any intervention that can be delivered in a cost effective way, at scale, and one that does not require extensive training to deliver could make a significant positive impact on this issue.

The aims of chapter 4 were to investigate some initial feasibility questions related to the accessibility of HER for children with ID, and the potential effects on reading skills. Whilst this series of case studies clearly demonstrates how children with ID can access the programme, we cannot draw any clear conclusions regarding the effect on reading skills due to the absence of any control data. We could have attempted a single-case experimental design with these participants. However, there are some inherent difficulties of such designs

when measuring skill development (e.g., the impossibility of returning to baseline levels), particularly early reading skills, and especially within a population where expected rate of skill development is unknown and likely variable, as is the case with children with ID. A similar design to that used in Whitcomb et al., (2011), in a multiple-baseline across behaviours (word sets from within HER) was employed, could have been attempted; however, there are limitations of this in terms of the generality of skill improvement beyond the specific curriculum taught.

Furthermore, Chapter 5 compensates for some of the methodological weaknesses in chapter 4; namely that a randomised group design was employed. HER was found to have a significant effect on reading skills. Although the sample size was relatively small, the main purpose of this study was to investigate specific feasibility objectives relevant to conducting a full-scale RCT evaluation, including the investigation of potential outcome measures and effects of the intervention.

Future research

Further larger evaluations with typically developing children in the UK would be beneficial to more clearly determine the effects of HER, including the effects of targeting specific groups. For example, children at-risk of reading failure, or children who are learning English as an additional language (for whom the effects of HER were anecdotally reported to be beyond expectations; see Chapter 2). The potential for home-based implementation for struggling readers or those at-risk would also be invaluable to explore.

Chapter 5 highlights importance of feasibility research prior to conducting RCTs, in that it demonstrates even with a relatively prescriptive intervention there are barriers to a robust evaluation in educational settings that might not be apparent prior to conducting feasibility studies. With the recently renewed interest in quantitative data on effective educational approaches, such work will be increasingly necessary. As recommended in

chapter 5, we would recommend that even further feasibility work be conducted prior to a full-scale RCT evaluation of HER with children with ID in special schools in the UK. This would increase the likelihood of such a trial being successful in informing researchers and educators as to the potential effects of using HER to improve the reading skills of children with ID, which is the ultimate goal of evaluation research.

For further evaluations in both mainstream and special school contexts, there are important considerations regarding the fidelity and quality of delivery of HER. Both of these dimensions were highly variable across all three HER studies, and whilst considerable improvements were noted despite this variability, it would be beneficial to further control these aspects in future studies. Increased training, observation and coaching of those delivering HER would therefore be recommended.

A further area to explore is whether alternative methods for informing practice might be employed in future research. For example, Twyman, Layng & Layng, 2011 (who report the results of HER in terms of the *instructionally beneficial* effect) suggest that we consider adopting paradigms of analysis that more practically inform educators as to the likely benefits of a programme or approach. Similarly, Layng and Layng (2012) report on the positive effects of using *local evidence* to encourage the adoption of evidence-based programmes by individual school districts in the USA. Further research investigating the effects of providing more practically useful data for local authorities in the UK might provide invaluable insight into how to bridge the research-to-practice gap and positively influence educationally practices in a more timely manner.

Chapter 3 contributes important information to aid our understanding of the current practices and challenges faced by teachers in relation to improving reading skills in special schools in the UK. However, further research into practices in reading instruction in special schools would also be hugely beneficial. By furthering our understanding of the current

context, we can focus our research efforts and consider policy changes that might minimise or remove current barriers to addressing the problem of low reading attainment in these settings. For example, as it appears that training in reading instruction is a concern of many teachers in special schools, investigating effective training programmes – both during initial teacher training, and for in-service teachers – would clearly be beneficial.

Implications for practice

In addition to implications and contributions of these findings to the current literature, there are a number of implications for practice to consider.

We might not know with certainty that all children with ID can develop reading skills. However, the feasibility work included in this thesis indicates encouraging potential for HER to help improve reading skills for children with mild to moderate ID. Although expectations have improved over recent years, the potential of many children with ID is still underestimated, particularly in relation to literacy capabilities. Through this feasibility work, many children with ID have had the opportunity to access high quality instruction and to experience reading success. A number of participants in special schools have made progress previously thought impossible due to failure of previous attempts at teaching them to read, and this picture has now extended to many other children who have since accessed the programme beyond this research as part of the standard practice in the schools where we conducted the research. Despite the responses of teachers in the survey study reported in chapter 3 indicating that literacy expectations for older children with ID who have not learned to read are lower than for younger children, a number of older children with ID have made significant progress using HER as part of this research. Similarly, this also demonstrates that the learners themselves have willingly participated in HER despite the interface of the programme and its design for young children, indicating that the age-appropriateness of the material need not always be of great concern.

Furthermore, many assistants and teachers have benefited from their involvement delivering the programme; through observing this high quality instruction and learning to support the development of reading fluency, many of those involved in this research report to have learned a considerable amount regarding reading instruction that they have been able to use with other pupils and even their own children. This has had a hugely positive impact on the expectations of special schools regarding the development of reading skills.

A valid concern in applied research is always whether interventions will continue and infiltrate practice beyond the period of research. The most pronounced impact of this research locally in terms of influencing practice has been in special schools; all of the four special schools involved in our HER evaluations have continued to use the programme, purchasing licences for use with children of various ages with a range of difficulties, and in some cases employing additional staff to ensure it is feasible to implement the programme effectively (i.e., with appropriate supervision of learner progress, and implementing additional tiers of support where necessary). The adoption of HER in these settings certainly seems to correspond to the findings of the survey reported in chapter 3. Teacher responses in the survey study indicated many are dissatisfied with the level of training provided and the lack of specific programmes suitable for use with their learners; therefore, it is not surprising that the provision of a programme which delivers high quality instruction with minimal training, as well as providing incidental insight into reading instruction for those implementing it, has been welcomed by special schools. Furthermore, through research involvement, most of these schools have learned the value and importance of adequate, objective measures of progress, and thus have conducted their own baseline and post-test assessments. This is encouraging practice that demonstrates the kind of shift in culture towards seeking evidence of effective practices proposed by Fletcher-Campbell (2000).

Current and future developments

We have also learned a considerable amount about the effective implementation and potential challenges associated with using HER in different settings. Most notably with regard to the appropriate use of benchmark assessment scores and the benefits of a conservative attitude towards progression through the episodes to ensure learners reap the benefits of the programme. This has enabled us to support the implementation of HER beyond the research reported in this thesis. For example, as a result of this programme of research, a group of five schools – only one of which was involved directly in our research – are currently implementing HER with our support. Each school is targeting different groups, including: all children in Y1 (aged 5-6 years); children who are struggling in Y1 through to Y3 (7-8 years); children who are struggling in Y1 through to Y6 (9-10 years); children who are struggling in Y7 and Y8 (10-12 years); and a special school who are targeting children from Y1 through to Y12 (5 to 17 years). In addition to the potential to assist readers currently struggling in these schools, this could also be an important step in gathering local data to provide educators with information that might have a more timely impact on practice and policy than other forms of evidence.

Additionally, through a current funding scheme aimed at increasing parental involvement for ‘communities first’ areas (in which individuals are considered to be at-risk of low employment and educational opportunities), we are exploring the possibilities of enabling home-based access to the programme for children at-risk of reading failure in these areas. Considering the unpublished outcome data on the effects of using HER at home over the summer, this could have a considerable positive effect on children’s reading skills as well as equipping parents with the skills and support to assist their childrens’ reading development.

Considering the significant effects of HER when used with children with ID, we are also pursuing opportunities for funding to further explore this, and continue to support schools in their efforts to implement the programme effectively.

Conclusions

This thesis has evaluated the use of HER with typically developing children and children with ID, and demonstrated that it can have a significant positive impact for many children. Additionally, it has further elucidated current practices and challenges related to reading instruction in special schools, highlighting the need for further training and further investigation of effective curricula. Further research has been suggested across these areas, and the implications for improving educational practices have been outlined.

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Appendix 1: HER Scope & Sequence

Instructional Scope and Sequence



The following sequence, tested extensively with children, has been found to be very effective in ensuring reading success.

Covered in Episodes	1-5	6-11	12-18	19-23	24-30	31-40
Phonemic Awareness <i>Goal: To establish the ability to hear, identify, and manipulate the individual sounds—phonemes—in spoken words</i>						
Listening to Sounds: phonemes in words	✓	✓	✓	✓	✓	✓
Segmentation: initial, middle, and final phonemes in words	✓	✓	✓	✓	✓	✓
Vocalization and Blending: phonemes, words	✓	✓	✓	✓	✓	✓
Auditory-Visual Matching: phonemes	✓	✓	✓	✓	✓	✓
Listening, Seeing, Responding: phonemes	✓	✓	✓	✓	✓	✓
Vocalization: phonemes	✓	✓	✓	✓	✓	✓
Structured Discovery Learning: phonemes	✓	✓	✓	✓	✓	✓
Phoneme Isolation: recognizing individual sounds in words	✓	✓	✓	✓	✓	✓
Phoneme Identity: recognizing the same sound in different words	✓	✓	✓	✓	✓	✓
Segmentation, Blending, Vocalization, and Identification: phonemes in words	✓	✓	✓	✓	✓	✓
Phonics <i>Goal: To establish an understanding of the predictable relationship between phonemes and graphemes</i>						
Identification: phonemes	✓	✓	✓	✓	✓	✓
Vocalization: phonemes corresponding to graphemes	✓	✓	✓	✓	✓	✓
Blending and Identification: phonemes and words	✓	✓	✓	✓	✓	✓
Vocalization and Blending: phonemes and words	✓	✓	✓	✓	✓	✓
Listening, Seeing, Responding: phonemes and words	✓	✓	✓	✓	✓	✓
Structured Discovery Learning: phonemes corresponding to graphemes	✓	✓	✓	✓	✓	✓
Segmentation, Blending, Vocalization, and Discovery Learning: words		✓	✓	✓	✓	✓
Segmentation, Blending, Vocalization, and Identification: phonemes and words		✓	✓	✓	✓	✓
Segmentation, Blending, and Vocalization: nonsense words						✓
Fluency <i>Goal: To fluently recognize sounds and words, and to accurately and quickly read text</i>						
Segmentation and Identification: phonemes in words	✓	✓	✓	✓	✓	✓
Identification: words	✓	✓	✓	✓	✓	✓
Fluent Oral Reading (reading without hesitation)*	✓	✓	✓	✓	✓	✓
Vocabulary <i>Goal: To establish print and spoken words needed to communicate effectively</i>						
High-Frequency Words	✓	✓	✓	✓	✓	✓
Picture Selection Vocabulary*	✓	✓	✓	✓	✓	✓
Suffixes		✓	✓	✓	✓	✓
Comparatives and Superlatives						✓
Text Comprehension <i>Goal: To establish an understanding of what is read</i>						
Main Idea: sentences	✓	✓	✓	✓	✓	✓
Predicting, introduction of: story *			✓	✓	✓	✓
Fluent Oral Reading (Reading with Meaning, Reading with Prosody)*			✓	✓	✓	✓
Print Awareness <i>Goal: To become familiar with print and text conventions, and the relationship between spoken and printed language</i>						
Left-to-right, Top-to-bottom*	✓	✓	✓	✓	✓	✓
Picture/Text Relationship*	✓	✓	✓	✓	✓	✓
Capitalization		✓	✓	✓	✓	✓
Font "Generalization"				✓	✓	✓
End Punctuation				✓	✓	✓
Quotation Marks					✓	✓

*Many of these skills and strategies are also carried over in specific enrichment activities that accompany the online instruction.

Instructional Scope and Sequence



Page 2	Covered in Episodes	41-47	48-56	57-66	67-80
Phonemic Awareness					
<i>Goal: To establish the ability to hear, identify, and manipulate the individual sounds in spoken words</i>					
Auditory-Visual Matching: phonemes		√	√	√	√
Listening, Seeing, Responding, and Vocalization: phonemes		√	√	√	√
Segmentation, Blending, Identification, and Vocalization: phonemes in words		√	√	√	√
Phonics					
<i>Goal: To establish an understanding of the predictable relationship between phonemes and graphemes</i>					
Identification and Vocalization: phonemes		√	√	√	√
Segmentation, Blending, Identification, and Vocalization: phonemes and words		√	√	√	√
Segmentation, Blending, Vocalization, and Structured Discovery Learning: words		√	√	√	√
Structured Discovery Learning: phonemes corresponding to graphemes		√	√		
Identification of Word Families		√		√	√
Decoding of Nonsense Words			√	√	√
Fluency					
<i>Goal: To fluently recognize sounds and words, and to accurately and quickly read text</i>					
Segmentation and Identification: phonemes in words		√	√		
Word Recognition, Word Identification Towards Fluency		√	√	√	√
Fluent Oral Reading (reading without hesitation, reading with meaning and prosody)		√	√	√	√
Vocabulary					
<i>Goal: To establish print and spoken words needed to communicate effectively</i>					
High-Frequency Words		√	√	√	√
Picture Selection Vocabulary		√	√	√	√
Story Vocabulary				√	√
Question Words				√	√
Suffixes/ Comparatives and Superlatives: ed, ing, s, er, est				√	√
Text Comprehension					
<i>Goal: To establish an understanding of what is read</i>					
Main Idea: sentences		√	√	√	√
Main Idea: paragraphs				√	√
Main Idea: stories					√
Completion of Thought: main idea and detail			√	√	√
Understanding Leveled Texts Based on Skills and Controlled Vocabulary		√	√	√	√
Story Meaning: inferential		√	√	√	√
Story Meaning: literal		√	√	√	√
Literary Form: narrative		√	√	√	√
Literary Form: metered and rhymed		√			√
Literary Form: expository					√
Theme: setting, plot, character		√	√	√	√
Theme: conflict and resolution, feeling		√	√	√	√
Theme: problem solving, helping		√	√	√	√
Print Awareness					
<i>Goal: To become familiar with the relationship between spoken and printed language</i>					
Conventions of Text: left-to-right, top-to-bottom, wrapping, sentence continuity, paragraphing, page-to-page, chapters		√	√	√	√
Conventions of Grammar: subject-verb agreement, pronoun-antecedent agreement, adjective-noun agreement, pronoun reference, contractions		√	√	√	√
Conventions of Print Mechanics: capitalization, end punctuation, quotation marks, apostrophe		√	√	√	√
Understanding that Printed Materials Provide Information		√	√	√	√

Many of these skills and strategies are also carried over in specific enrichment activities that accompany the online instruction.

Appendix 2: HER session checklist

Tasks for each session	Checklist (Yes/No)	Mon		Tues		Wed		Thurs		Fri	
		Y	N	Y	N	Y	N	Y	N	Y	N
Implementation checklist for the week beginning											
CHECK FILE FOR HANDOVER NOTES (prior to session)	Does the previous episode need repeating? Are there any stories or fluency-building exercises to do before moving on?										
MONITOR START OF SESSION	Have you checked each child has logged into the correct account?										
MONITOR ORAL RESPONDING	Have you checked the volume is sufficient?										
	Have you checked every child is responding audibly to the speak-out-loud activities?										
CHECK FOR HS STORIES AND OTHER EXERCISES	Have you checked for a book icon and prepared the materials needed to monitor this if necessary?										
	Have you checked for any other exercises each child may need to complete?										
PROMPTING CHECK	Have you responded to any requests for help by redirecting the child back to the programme?										
CHECK PERFORMANCE DATA	Have you checked each child has achieved 90% accuracy immediately after episode completion?										
	If they have not, have you recorded this in the handover notes?										
REWARD EPISODE COMPLETION	Have you given each child verbal praise and a sticker for their chart after completing an episode with 90% accuracy?										
	Have you read the HS stories and scored performance on the appropriate sheets?										
READ HS STORIES	Have you entered this data into each child's online profile?										
	If there has not been time for this, have you written this in the handover notes?										
TIE-UP LOOSE ENDS	Is everything ready to start the next session smoothly?										
	Have you recorded anything important for other teachers/researchers to be aware of in the handover notes?										

Adapted from Hufstetter et al., (2010).

Appendix 3: Mousing Around screening checklist

Name	Moves the mouse and clicks on objects	Responds in reasonable time	Attends to the programme	Responds to instructions	Understands negation – ‘if it is <i>not</i> the fish click on the arrow’	Speaks out loud when asked

Appendix 4: Self-report progress checklist

	Class:	Class:	Class:	Class:	Class:
Are participants doing at least 3 episodes a week?					
Are students being supervised when on the program?					
Are the daily observation sheets being filled in?					
Are daily handover notes being recorded?					
Are students reaching adequate percentage of accuracy before moving on?					
Are support activities (SAFMEDS, Oral reading sheets) being used?					
Is the episode tracker (wall chart) being filled in?					
Are staff encountering any difficulties?					
How can we assist?					
Comments.					

Appendix 5: National Curriculum Level descriptions for reading.

Taken from the Department for Education guidelines, retrieved from:

<http://www.education.gov.uk/schools/teachingandlearning/curriculum/primary/b00198874/english/attainment/en2>

Level 1

Pupils recognise familiar words in simple texts. They use their knowledge of letters and sound-symbol relationships in order to read words and to establish meaning when reading aloud. In these activities they sometimes require support. They express their response to poems, stories and non-fiction by identifying aspects they like.

Level 2

Pupils' reading of simple texts shows understanding and is generally accurate. They express opinions about major events or ideas in stories, poems and non-fiction. They use more than one strategy, such as phonic, graphic, syntactic and contextual, in reading unfamiliar words and establishing meaning.

Level 3

Pupils read a range of texts fluently and accurately. They read independently, using strategies appropriately to establish meaning. In responding to fiction and non-fiction they show understanding of the main points and express preferences. They use their knowledge of the alphabet to locate books and find information.

Level 4

In responding to a range of texts, pupils show understanding of significant ideas, themes, events and characters, beginning to use inference and deduction. They refer to the text when explaining their views. They locate and use ideas and information.

Appendix 6: P-Scale descriptions for reading.

Taken from the Department for Education guidelines, retrieved from:

https://orderline.education.gov.uk/gempdf/1445950839/P_scales_level%20descriptors_2009.pdf

Reading**P4**

Pupils listen and respond to familiar rhymes and stories. They show some understanding of how books work, for example, turning pages and holding the book the right way up.

P5

Pupils select a few words, symbols or pictures with which they are particularly familiar and derive some meaning from text, symbols or pictures presented in a way familiar to them.

They match objects to pictures and symbols, for example, choosing between two symbols to select a drink or seeing a photograph of a child and eye-pointing at the child. They show curiosity about content at a simple level, for example, they may answer basic two key-word questions about a story.

P6

Pupils select and recognise or read a small number of words or symbols linked to a familiar vocabulary, for example, name, people, objects or actions. They match letters and short words.

P7

Pupils show an interest in the activity of reading. They predict elements of a narrative, for example, when the adult stops reading, pupils fill in the missing word. They distinguish between print or symbols and pictures in texts. They understand the conventions of reading, for example, following text left to right, top to bottom and page following page. They know that their name is made up of letters.

P8

Pupils understand that words, symbols and pictures convey meaning. They recognise or read a growing repertoire of familiar words or symbols, including their own names. They recognise at least half the letters of the alphabet by shape, name or sound. They associate sounds with patterns in rhymes, with syllables, and with words or symbols.

Appendix 7: Celebrating learner success





