Teaching Spelling to Singaporean Chinese Children with Dysorthographia in English Language: Lexical Versus Lexical Phonological Approach

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Abstract

Singaporean Chinese children diagnosed with dysorthographia in English language undergo an intensive spelling intervention program that teaches them to use either of the two spelling methods: lexical and/or phonological spelling strategies. Nevertheless, many of them continue to perform poorly in their spelling. A pretest-posttest experimental design was used to determine whether 20 children ages 9 to 10 years old diagnosed with dysorthographia who were taught both lexical and phonological spelling strategies would improve in spelling more than a matched control group of 20 children, also diagnosed with dysorthographia who were taught lexical spelling strategies alone. Both groups of children received five lessons per week over seven weeks. The results showed that while both groups improved in spelling performance significantly from pretest to posttest, the experimental group which was taught both lexical and phonological spelling strategies improved significantly more than the control group which was taught lexical spelling strategies alone.

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What is dysorthographia?

The term dysorthographia begins with dys announces that the symptom, condition or state of being is dysfunctional or faulty. Orthography refers to correct or standard spelling in general (Richards, Platt, & Weber, 1985). When the dys is added to orthography, dysorthographia becomes a term referring to a specific learning disability (SLD) associated with poor performance in spelling (Pierangelo & Giuliani, 2006). It can be a developmental disorder which means it is of constitutional origin or it is an acquired disorder due to an external insult to the brain, characterized by a durable defect of assimilation of morphological and/or phonological rules resulting in the deterioration of the spontaneous written expression or under dictation. Bosse (2008) has identified a dysorthographic child as one who is unable to remember lexical spelling as a result of the core deficit in phonological processing. However, this

phonological processing deficit cannot fully explain why there are children, who are able to read words using an analytic procedure, still unable to memorize their spelling.

Studies (see Sterling & Robson, 1992) on children with SLD in spelling or dysorthographia (both terms are considered synonymous here and will be used interchangeably throughout this paper) have identified the following problems they encounter such as, slowness and poverty of written expression with lots of hesitations (Tay, 2005); committing linguistic errors relating to grammar, conjugation and spelling (Funnell, 1992); writing difficulties similar to those relating to dyslexia (see Bosse, 2008; Nicolson, Pickering, & Fawcett, 1992); errors in copying with arbitrary misspellings (Funnell, 1992; Sterling & Seed, 1992); and spelling errors due to additions, omissions, substitutions and reversals of letters and/or syllables (Chia, 1996).

Dysorthographia is neither an officially recognized term nor it is listed in either the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition-Text Revision (DSM-IV-TR) (American Psychiatric Association, 2000) or the International Statistical Classification of Diseases and Health Related Problems-Tenth Revision-Second Edition (ICD-10-2) (World Health Organization, 2004). However, the term can be found listed in the recently published Educator's Diagnostic Manual of Disabilities and Disorders (EDM) (Pierangelo & Giuliani, 2007) under the disability category of learning disabilities (see LD 5.00, p.31). This official manual of the American Academy of the Special Education Professionals has listed the following diagnostic symptoms of dysorthographia: "addition of unneeded letters, omission of needed letters, reversals of vowels, reversals of syllables, phonemic spelling of non-phonemic words, and/or difficulty in understanding the correspondence between sounds and letters" (p.31).

Very little research, if any, has been done and published on children identified and/or diagnosed to have SLD in spelling or dysorthographia. Besides, the term itself is not widely known or used in the literature of special education. Most of the time, such children severely poor in spelling are treated as dyslexic and are seldom or never grouped as dysorthographic to be intervened differently from others. In addition, the teaching of spelling is not at present either a fashionable or an exciting topic of discussion amongst educators and more so if they are special professionals. It involves various skills and is something that many children especially those learning English as a second language find difficult. Correct spelling of English words seems to involve both phonological and visual skills (Bradley, 1985). For both teachers and their students, spelling is probably most troublesome because the English language is so variable and so vast (Bromley, 1988). It becomes tougher for regular teachers (not to talk about the special professionals) if the students they are teaching have SLD in spelling or dysorthographia.

Problems in spelling of English words

Before examining the spelling process in detail, it is worth considering how children might spell highly familiar words like their own names, or highly irregular words like through, tough and rhythm. They may have the spellings of these words stored in their mental lexicon and can look them up when required. In fact, such a spelling mechanism based around a mental lexicon is vital if children are to spell irregular words at all (Jorm, 1983). Words with irregular spellings cannot be spelled purely by application of sound-to-print (i.e., phoneme-grapheme) conversion rules. In fact, there are many words that cannot be correctly spelled using such rules (Sterling & Robson, 1992). There are inevitably occasions when children have to spell a word for which they do not have complete information stored in their mental lexicon. As such, they may turn to the use of sound-to-print rules, or some related

mechanism, like spelling by analogy. However, the application of rules in English spelling is by no means a simple process.

One interesting thing to note about sound-to-print rules in English is that most sounds can be represented several different ways in print. For instance, the word cat could also be spelled phonetically as catt, katt or kat. If English words are to be spelled correctly using rules, there is a need for children to develop some method of selecting the appropriate letters to represent each sound. However, the problem with English is that the relationships between sounds and spellings are too often ambiguous or idiosyncratic (Sterling, 1992). Fortunately, in some cases the ambiguities are rule-governed. For instance, the spelling of /k/ is generally spelt with a "c" if it precedes "a", "o" or "u" (e.g., cat, cot, cut) but with a "k" before "e" or "i" (e.g., keg, kit). In other cases, the spelling of a sound depends systematically on where in the word the sound occurs. For example, /ei/ is spelt "ay" at the end of words (e.g., day, stay) but as "ai" or "a-e" when it occurs in the middle (e.g., raid, fade). Unfortunately, in many cases there is no obvious rule or regularity that enables the speller to predict which alternative should be used. The most obvious examples of this ambiguity are those words called homophones, which have the same sound but different spellings (maid/made, been/bean). Finally, while alternative spellings such as "ea" and "ee" do at least have the merit of occurring in large numbers of words, the notoriety that English spelling has achieved is probably most attributable to the so-called exception word, the spelling of which is both unprincipled and infrequent (e.g., laugh, colonel) (Barry & Seymour, 1988).

There are some important constraints that can help children in selecting the correct letters to represent each sound in English spelling. For instance, the position of a sound in a word influences the way it is spelled or written. The word cat could not be spelled as ckat because "ck" never happens at the beginning of words. However, in the word tack, "ck" is a perfectly acceptable spelling for exactly the same sound. A second constraint on spelling is provided by the grammatical function of a word in a sentence. For example, dogs could be more appropriately spelled as dogz on phonetic grounds, but "s" is used to mark the plural or a noun in English spelling and "z" is not. Yet another constraint is provided by the historical origin of a word. Many English words are of Germanic, Roman, or Greek origin. A particular sound may be spelled differently depending on the historical origin of the word in which it occurs. For example, in words derived from Greek, /k/ is written as "ch" (e.g., chaos, cholera, psychology), while in words of Roman origin it is written as "c" (e.g., compose, concert, concord).

It can be seen that the print-to-sound (grapheme-phoneme) rules that can be applied in reading unfamiliar words are somewhat different in kind from the sound-to-print (phoneme-grapheme) rules of spelling; the speller often has to make a choice between several plausible spellings, whereas the reader does not encounter this problem to such a degree. This is one reason why a child with dysorthographia (SLD in spelling) faces problems that are different from those of another with dyslexia (SLD in reading). For instance, reading the word cat by print-to-sound rules is unambiguous because there is only one possible pronunciation. However, spelling the word cat is by no means so simple because the speller has several possible spellings to choose from (cat, catt, kat, katt), each of which is plausible on phonetic grounds. Hence, if spelling by rules is to be even marginally successful, children need to be able to use some extra process involving the selection of the most appropriate alternative. Jorm (1983) has referred to the constraints in English spelling, which have been discussed earlier, as "orthographic rules" that allow this selection to take place. Frith (1980) has used the term "orthographic stage" to describe the speller's increasing experience or skill in using visual, semantic and syntactic representations in addition to phonology in their spelling. Hence, a child diagnosed with dysorthographia has obviously failed to attain the orthographic stage, which means he/she has

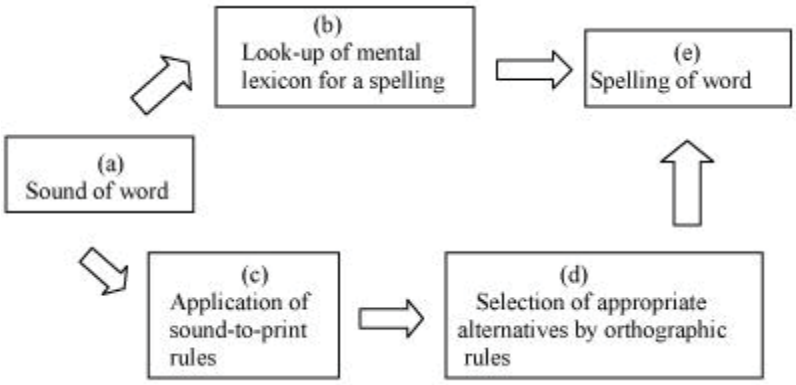
experiential or skill deficiency in utilizing visual, semantic, syntactic and phonological elements in the spelling process.

For teachers in both mainstream and special schools, the teaching of spelling, and hence, the development of their students' ability to spell accurately, is a day by day matter of concern that is considered important in school and in the eyes of the general public. In other words, education is often strongly associated with accurate literacy (Aranas, 1992; Chia, 2007;Taaffe, 1990) and all students must learn to spell accurately if they are to be orthographically literate.

Dual-route model of spelling

It is generally accepted that there are two central processes in spelling that skilled spellers can use (Ellis, 1984; Goulandris, 1992; Jorm, 1983). They can use a lexical process, in which the precise spelling of word is retrieved directly from the mental lexicon; and/or they can use a sub-lexical, or phonological (sound-to-print), process that is used primarily for assembling unfamiliar words in which words are broken into their constituent phonemic elements, and phoneme-grapheme rules used to generate a plausible spelling. This dual-route model of spelling has been summarized in the following diagram by Jorm (1983):

Figure 1:
Dual-route model of spelling (Jorm, 1983)



The diagram shows that when (a) a word is to be spelled, its spelling can be achieved by either (b) looking up in the mental lexicon to find out whether a spelling for the word is stored there, or (c) using the sound-to-print (phoneme-grapheme) rules to generate possible spellings and (d) selecting the most appropriate spelling from the options available using orthographic rules (Jorm, 1983). Finally, whichever route is taken, the result is (e) a spelling for the word. Though the diagram shows two separate routes, these routes are unlikely to be completely separate. Both routes may be followed in parallel and they may interact with each other (Jorm, 1983).

This dual-route model shows how a normal speller of English can produce both correct spellings of the many irregular words (e.g., colonel) and phonologically plausible spellings of non-words (e.g., ig, homseld). Irregular words could not be spelled correctly by any purely non-lexical sound-to-spelling conversion and so lexical knowledge is necessary. Non-words require some non- or at least sub-lexical sound-to-spelling conversion process because, by definition, they have no full representation in the

lexicon (Barry, 1992). In other words, the speller can turn to either of the two systems, lexical or phonological, whichever is most feasible at the moment of spelling need. While all known words can be spelled by a lexical route, if they have representations stored in the mental lexicon, low-frequency words may need to spelled using the phonological systems as they may have only partial or non-existent representations in the mental lexicon.

Beginning and poor spellers as well as those diagnosed with dysorthographia frequently remember their spellings in much the same way as they remember pictures – perhaps partially, with only some distinctive components being remembered. They often use a lexical or visual/logographic strategy to spell: a known word stored in memory is retrieved and its mental representation is then written down. For an accurate spelling, both the identity and order of the letters have to be stored in memory (Funnell, 1992). The accuracy of a spelling also depends on how well the word is known (Sterling & Seed, 1992). Evidence for visual/logographic spelling in young children comes from Seymour (1992), Seymour and Elder (1986), and Seymour and Evans (1988), who reported that young children can often spell their names and certain words although they cannot spell phonologically. Peters (1985) has claimed that visual imagery may be the important factor in the learning and recall of word spellings. Another study (Price & Finkelstein, 1994) has shown that using appropriate pictures associated with the words apparently helped to improve young children's scores on spelling tests, although the major problem with this strategy is finding appropriate pictures for abstract words such as hope and faith. Nevertheless, Goulandris (1992) argued that a lexical strategy alone does not explain young children's ability to recall word spellings. New words are learned by referring to orthographic memory, in which recurrent spelling patterns are gradually abstracted by using basic sound-spelling mappings as a framework. At the moment, this author has not found any current research done on whether children with dysorthographia have a deficit orthographic memory and it would certainly be an interesting study. For this framework to be available, the child must have acquired at least rudimentary phonological skills. Goulandris (1992) has cited evidence from the research on invented spellings and stage-based error analyses (Huxford, Terrell, & Bradley, 1992; Mann, Tobin, & Wilson, 1987; Read, 1986).

Phonological versus lexical spelling strategies

Both phonological and lexical approaches may be used in spelling, but the debate is still going on as to the relative importance of each to good spelling. Whether the spelling strategies prove appropriate or inappropriate will depend upon how well adapted they are to the task (Taylor & Martlew, 1992). English spelling involves an accurate representation of its orthography which is described as consisting of two major systems (Pyles & Algeo, 1982). One system is comprised of words and morphemes, while the other contains phonemes. However, theorists disagree as to which system is fundamental to contemporary spelling structure. Read (1986) has argued that spelling represents phonemes rather than morphemes. However, Chomsky (1970) stated that spelling embodies abstract lexical meanings. Venezky's (1970) conclusion, that phonological, morphological and syntactical patterns all co-exist and interact synergetically within the orthography , offers a compromise between these opposing views.

Many children, who are identified as poor spellers, may not necessarily have dysorthographia, and they have become poor spellers because they do not use either a phonological or a lexical strategy appropriately during their spelling tasks (Taylor & Martlew, 1992). As a result, it is never easy to diagnose a child with dysorthographia as one has to consider the psycholinguistic factors in addition to the nosological factors that help to define and classify the SLD in spelling. Though some young children might have learnt the names of letters, many are not aware of the phonemes these letters

represent in a particular context (phonemes change according to context). Associating a letter with its name rather than with the phonemes it represents can actually hamper the acquisition of both reading and spelling skills. For example, the name of upper-case "A" as well as lower-case "a" is read as /ei/, but is pronounced differently as /ei/ in apron, /a:/ in father, and /ae/ in cat. Seymour (1992), and Seymour and Bunce (1992) have suggested the need for a speller to use both lexical and phonological processes, as the two systems form a dual-route process that encodes information about words and more general correspondences between the spoken words and their conventional graphic representations used in spelling. Ehri (1985) argued that accurate spellings are mastered when a learner is able to use both lexical and phonological strategies to fuse the visual and phonological representations of the word.

Statement of the problem

Singapore is a multi-cultural, multi-lingual country, where most children (non-native speakers of English) learn English as a second language in both mainstream and special schools. The teachers encounter many problems in teaching the spelling of English words. As students make many spelling mistakes, and the English language curriculum is often crowded with equally pressing demands for more reading and writing, the actual teaching of spelling is often confined to a short 15-minute session per week, at the beginning of a lesson. Under such circumstances, the teacher has to be very selective as to what he/she teaches. Quite naturally, many choose to teach only very simple distinctions as "minimal pairs" (e.g., pin/bin, meat/neat) in the hope that if the students can hear and make these minimal sound distinctions, they are on the road to successful spelling, as well as pronunciation (Tay, 1993). Other teachers, not confident about correcting misspelled English words, allow their students to spell freely with mistakes in the hope that so long as the students attempt to spell and combine a string of words into satisfactorily constructed meaningful sentences, they will "catch" the correct spelling in the end (Chan, 1993; Tay, 1993).

Formal spelling instruction in lower and middle primary levels is often done in two ways (provided the teachers are trained in phonics as not every teacher knows):

(1) phonics is explicitly taught in the lower primary classes (P1 and P2) as a spelling, as well as a reading strategy; and

(2) spelling rules are formally introduced and taught in the middle primary classes (P3 and P4).

Later, students in the upper primary classes (P5 and P6) are taught to correct misspellings, and grammatical and punctuation errors, but this is no the concern in the current study.

Despite going through this spelling instruction in school, there are still many students who do not spell well and who do not reach Frith's (1985) orthographic stage of spelling development. This is particularly true of Singaporean Chinese students who are poor spellers of English words and who come from non-English speaking backgrounds. While it is necessary to examine the linguistic environments of Singaporean Chinese children as the first step to helping them improve their spelling skill in English, it is outside the scope of this paper and has been discussed elsewhere (see Chia, 1996). Another group of students is those who have been identified and diagnosed to have SLD in spelling or dysorthographia. Most of them have been originally assessed to have dyslexia before a further evaluation confirms them to be dysorthographic. Very often, these students continue to rely on non-orthographic memory mechanisms for recalling word spellings (Morton, 1987). Coming from non-

English speaking families, most Singaporean Chinese students, for instance, treat and spell English words as if they were Chinese characters through the use of whole-word or logographic strategies (Maideen, 1982; Toh, 1982).

If accurate spelling is to be the aim of the English language curriculum in Singapore's mainstream as well as special schools, teachers from both types of schools need to recognize the fact that it is misleading to assume that the main medium of pedagogical instruction is also the students' first or main language. Singaporean Chinese students are taught English as a medium of instruction and also learn Chinese (Mandarin is spoken Chinese) as their Mother Tongue, but they also speak various Chinese dialects (e.g., Cantonese, Hainanese, Hokkien, Shanghainese, and Teochew) and are not native speakers of Mandarin. This is because a Chinese child born in Singapore invariably falls into any one of the following categories (Chia, 1996; Lee, 1983): (i) a predominantly dialectic community; (ii) a predominantly Mandarin/English-speaking environment; (iii) a predominantly English-local dialectic environment; (iv) a predominantly English-Mandarin environment; or (v) other minor linguistic environments. Though Mandarin and the Chinese dialects may share the same logographic writing system, they differ in their phonological systems and this alone is enough to create difficulties when a child is learning to speak Mandarin. In addition to this, these Singaporean Chinese children have to learn English, whose phonological system differs from both Mandarin and Chinese dialects and whose orthographic system also differs from theirs. Thus, their problem in language learning increases further and more so for those students with dysorthographia.

Description of the study

Despite receiving the normal spelling instruction currently used in classrooms in Singapore (i.e., phonics and spelling rules), many Chinese students are unable to spell well in English. This becomes even more evident for those children diagnosed with dysorthographia. The purpose of this study was to investigate whether a combined strategy using a lexical (visual) and a phonological approach was more effective than a lexical approach alone in teaching spelling to children with dysorthographia. The phonological approach was designed to help children use the alphabet effectively, while in the lexical approach, children could use the visual strategies they have developed in the reading of Chinese characters.

Bradley (1985) has shown that for monolingual English children, both phonological and visual strategies are necessary for spelling proficiency. Nevertheless, it is possible that for Chinese Singaporean children, who are learning to read and spell in English and who have failed to spell well after spelling-sound rule instruction, phonological instruction may interfere with the visual strategies they have acquired in learning Chinese characters.

The phonological approach involved the following phoneme analysis tasks (Chia, 2003): sound-to-word matching, word-to-word matching, recognition of rhyme, phoneme isolation, phonemic segmentation, counting phonemes in a word, blending phonemes into a word, phoneme deletion, identifying missing phonemes, and phoneme substitution.

In the lexical approach, word shapes, concrete poems and storybooks with picture-word associations were used. A concrete poem is defined as a poem, usually of one word, without a line, rhyme, rhythm, stanza or even a title and in which the letters in its single word act out its meaning (Mueller & Reynolds, 1990; Yeo, 1986). For example, the word look can be written as l⁄k or another way as lô-ôk as if a pair of glasses has been put on. In other words, a concrete poem expresses the meaning through

the way the letters are drawn, arranged and sometimes, colored (Chia, 1991, 1993, 1994; Lim, 1994). In a concrete poem, the visual appearance of letters is very important. In this study, the following factors: the shape of each letter in a word, the size of each letter in the word, and the physical layout of all the letters in the word.

In this study, 40 Singaporean Chinese children were taught by either a lexical spelling strategy, or a combination of lexical and phonological spelling strategies. The aim of the study was to find out if children with dysorthographia demonstrated a significant increase in spelling performance after training in lexical (visual) spelling strategies, and also if children with dysorthographia demonstrated a significantly greater increase in spelling performance after training in lexical and phonological spelling strategies than those children who were trained in lexical spelling strategies only.

The Study

This is a pretest-posttest experimental design, in which children diagnosed with SLD in spelling or dysorthographia in the experimental and control groups were matched on spelling-related tasks, as measured at pretest. All children then received five lessons per week from Monday to Friday for seven weeks, either in spelling using lexical strategies (control) or in spelling using both lexical and phonological strategies (experimental). The dependent variable was the Schonell Graded Spelling Test (Schonell, 1955).

The purpose of this study was to determine whether (a) teaching lexical spelling strategies would increase the spelling scores of children diagnosed with dysorthographia, and (b) teaching phonological spelling strategies in addition to lexical spelling strategies would result in a greater increase in the spelling scores of children diagnosed with dysorthographia than the teaching of lexical spelling strategies alone.

Subjects

From 135 Singaporean Chinese children, aged between 9 and 10 years, diagnosed with SLD by psychologists and therapists within the last two to three years, using the Wechsler Intelligence Scale for Children, third edition or WISC-III (Wechsler, 1991) or fourth edition or WISC-IV (Wechsler, 2003), as well as various standardized reading and spelling tests such as the reading and spelling subtests from the British Ability Scales (Elliot, Murray, & Pearson, 1979) or the Wide Range Achievement Test-Third Edition (Wilkinson, 1993), a sample of 40 SLD children who displayed more severe problems in spelling than reading (also known as SLD in spelling or dysorthographia) was randomly selected (see Table 1).

Table 1:
Psycho-educational information of the 40 dyslexic children

Groups	Psycho-educational results (based on WISC-III/IV and standardized reading and spelling tests)	
Experimental group (N = 20)	Mean FSIQ = 119 Mean VIQ = 110 Mean PIQ = 126	Mean Chronological Age: 9:04 Mean Reading Age: 7:06 Mean Spelling Age: 6:01
Control group (N = 20)	Mean FSIQ = 121 Mean VIQ = 112 Mean PIQ = 128	Mean Chronological Age: 9:05 Mean Reading Age: 7:05 Mean Spelling Age: 6:03

In addition, the author of this study also used the diagnostic symptoms of dysorthographia specified under the Code LD 5.00 taken from the EDM (see Pierangelo & Giuliani, 2007, p.31) to confirm the psycho-educational diagnosis of the specific spelling disorder.

All the 40 children were attending intensive spelling programs at various learning clinics and remedial learning centers in different parts of Singapore. All of them are currently attending regular schools where English is the medium of instruction. Back in their respective primary schools, they are still being given additional help with English language by the learning support teachers and/or special needs officers.

The author administered the Schonell Graded Spelling Test, which is the seventh subtest of the Aston Index-Revised (Newton & Thomson, 1982), and six other spelling-related subtests chosen from the same assessment battery to the selected 40 children. Next, these children were systematically assigned to either the experimental group (Group A) or the control group (Group B) in the following manner: the first child on the ranking list was assigned Group A, the next on list to Group B and so on until two groups of 20 each were formed.

A formal consent to take part in the study from parents or guardians of each child was obtained. The information about the results of the Schonell Graded Spelling Test and the six spelling-related subtests selected from the Aston Index-Revised (Newton & Thomson, 1982) was shown to them.

Instrumentation

For this study, the Level 2 (for children who have begun their first year of primary education for at least six months) spelling-related subtests of the Aston Index-Revised (AI-R) (Newton & Thomson, 1982) were selected for psycho-educational test administration. The major purposes of the AI-R are to assist in the early identification of children who are at risk educationally and to suggest constructive interventions (Pumfrey, 1985; Vincent, Green, Francis, & Powney, 1983). Its usefulness as a screening device enables an examiner to assess an important range of skills such as the reading and spelling skills necessary for literacy (Newton, Thomson, & Richards, 1978).

The AI-R (Newton & Thomson, 1982) is divided into two areas, each of which provides different sorts of information concerning the child. The first measures general underlying ability and attainment, and one subtest – the Schonell Graded Spelling Test – was chosen. The second measures the performance and six subtests – visual discrimination, visual sequential memory (pictorial), auditory sequential memory, sound blending, visual sequential memory (symbolic), and sound discrimination – were chosen for use. All these seven subtests were selected because they are designed to focus attention on aspects of the children's skills important for their spelling (Quin & Macauslan, 1988). The seven subtests are briefly described below:

Subtest 7: Schonell Graded Spelling Test

An examinee is required to spell a number of words graded for difficulty to obtain a raw score that can be used to calculate his/her spelling age using the following formula:

Spelling Age (SA) = (Number of words correctly spelled ÷ 10) + 5

The examinee has to write each word given to him/her orally by the examiner and testing is discontinued when 10 consecutive words are spelled incorrectly.

Subtest 8: Visual Discrimination

An examinee is required to match 10 pairs of letters and words to determine his/her ability to discriminate visually similar letters or words, only one of which is exactly the same as each original. This subtest can help to reveal the examinee's letter knowledge, particularly in letter recognition and identification.

Subtest 12: Visual Sequential Memory (Pictorial)

An examinee is required to arrange a series of pictures to match an array presented by the examiner. The examinee's array should match an item order and left-right orientation of each picture. This is to test the examinee's visual sequential memory which is essential for his/her correct and accurate letter-sequencing in spelling words when the Look-Cover-Write-Check spelling routine is used.

Subtest 13: Auditory Sequential Memory

An examinee is required to repeat a series of digits from memory. The subtest is useful in determining ability to sequence letter-sounds of a given word correctly, as he/she spells the word from what he/she has heard being spoken.

Subtest 14: Sound Blending

An examinee is required to blend orally, sets of sounds presented by the examiner. This subtest is used to determine the examinee's ability to blend the discrete consonants and vowels together to spell a word phonetically.

Subtest 15: Visual Sequential Memory (Symbolic)

An examinee is required to arrange a series of symbols, which also includes letters from the English alphabet, in the correct order to match a series which has been presented by the examiner. This appears to make similar demands on the examiner as subtest 12 but its purpose is to determine the examinee's ability to arrange the symbols or letters correctly according to the correct shapes shown.

Subtest 16: Sound Discrimination

An examinee is required to repeat and to distinguish between similar sounds. This subtest is used to find out if the examinee is able to differentiate and match sounds.

Each subtest lasted about between five and 15 minutes was administered to all 40 children. The reliability of this instrument is determined by internal consistency measures, with the nine subtest reliabilities in the range of .90 to .98 (Newton & Thomson, 1982; Pumfrey, 1985). The standard errors of measurement are not provided. The degree of correlation among the nine subtests is in the range of .27 (p=0.05) to .64 (p=0.001) (Newton & Thomson, 1982).

The Teaching Program

- **Spelling Strategies**

  1. Lexical spelling strategies/approach
  This approach focused on spellings stored in orthographic memory and it was taught to the children in both experimental and control groups. If a word has to be spelled, the mental representation of the spelling is retrieved from memory and written down. For an accurate spelling, both the identity and order of the letters have to be stored in memory. All the tasks involved in this approach were as follows:

  (1) Word-picture association or matching activities

  (2) Creating concrete poems through the assembling of correct letter-shapes

  (3) Tracing letters of words in the air or in a tray of sand

(4) Reading books and story handouts with selected picture-word associations

(5) Making conventional word-shapes according to the entire word, or according to the phonemes, or according to individual letters

(6) Using plastic letters (uppercase and lowercase) of the English alphabet to form words

(7) Using the spelling routine as follows: Look-Cover-Write-Check

(8) Eidetic imaging: A printed word is held before a child to see before it is removed, and he/she attempts to continue to "see" it while writing and spelling it in the space in which he/she "sees" it. The child copies the word from "space" onto the top of a sheet of paper. When this is done correctly, the paper is folded to conceal the first effort and it is written again from memory and then once more after folding and covering the second effort (Manzo & Manzo, 1993).

2. **Phonological spelling strategies/approach**

This approach was taught to the children in the experimental group in addition to the lexical spelling strategies. It focuses on the analysis and synthesis of sounds in words. The following tasks (see Appendix 3 for an expanded example) were used in this approach (see Chia, 2003):

(1) Sound-to-word matching: e.g., does fish start with /f/?

(2) Word-word matching: e.g., does fish start with the same sound as fat?

(3) Recognition of rhyme: e.g., does fish rhyme with dish?

(4) Isolation of a initial/medial/final phoneme: e.g., what is the first sound of fish? What is the middle sound of fish? What is the final sound of fish?

(5) Phonemic segmentation: e.g., what are the three sounds in fish?

(6) Counting the phonemes: e.g., tap on the desk as many times as there are sounds in the word fish

(7) Phonemic blending: e.g., what word is made up of /f/, /i/ and /sh/?

(8) Phonemic deletion: e.g., say fish; now say it without the sound /fi/;

(9) Identifying missing phoneme: e.g., say man; now say an; what sound has been left out?

(10) Phonemic substitution: e.g., say fish; now say it with /d/ instead of /f/

(11) The spelling routine as follows: Look-Say-&-Listen-Feel-Cover-Write-Check.

A phonological spelling strategy was also applied to the words used in the concrete poetry to teach the children in the experimental group through the color phonics, which consists of color plastic letters of

lower case. For instance, blue was used to represent the initial consonant, red was used to represent the vowel, and green was used to represent the final consonant. Here is an example how the specialist teachers used the plastic letters (see Table 2):

1. The teacher stuck three letters of blue, red and green on the whiteboard to make the word **c a t** for all the children in the group to see.
2. The teacher read each sound of the letter and then the whole word *cat*. The children were encouraged to read along with her.
3. The teacher replaced the initial consonant **c** with other letters such as, **b**, **f**, **p**, and **m**.
4. The children read the new words formed as a result of the change of the initial consonant.
5. The teacher replaced the middle sound or vowel **a**, with other letters, **o** and **u**, for instance.
6. The children read the new words formed as a result of the change of the vowel.
7. The teacher replaced the final consonant with **p** and/or **b**.
8. The children read the new words formed as a result of the change of the final consonant.

Table 2:

Color phonics chart

BLUE	RED	GREEN
Initial consonant	**Vowel**	**Final consonant**
c	a	t
b		
f	o	p
p		
m	u	b

- ## Materials

1. ***Scheme of lessons***

The scheme consists of 35 lessons that were taught every weekday for seven weeks. It provides the specialist teachers with guidelines about the types of activities to be done with the children in their respective groups. In the scheme of lessons, activities described in normal print involved the lexical strategy and were carried out in both the experimental and the control groups (i.e., Group A and Group B). Words printed in italics describe the phonological activities that were carried out in the experimental group only. The scheme also lists the handouts and the worksheets to be given to the children. The duration of each lesson was 40 minutes (excluding the initial five minutes used for attendance taking).

2. ***Handouts/Supplementary handouts/Worksheets***

There were 34 handouts, 3 supplementary handouts and 128 worksheets which were developed for use for both phonological and lexical strategies, and they covered the various tasks that were discussed earlier. The children in the combined treatment (experimental) group were given handouts and worksheets covering both spelling strategies, while those in the lexical group only had handouts and worksheets covering the lexical strategy.

3. ***Spelling tests/Mini-spelling tests***

Twelve spelling tests, 12 oral mini-spelling tests or exercises and 23 written mini-spelling tests were administered to the children in both the experimental and control groups throughout the seven weeks. The words used in these spelling tests and exercises were those already taught to the children in the lessons. The oral mini-spelling tests were given to the children in form of a game. For children in the experimental group, the specialist teacher used the following spelling routine: Look-Say-&-Listen-Feel-Cover-Write-Check, whereas the other specialist teacher teaching the control group used the following spelling routine: Look-Cover-Write-Check.

4***. Storybooks***

Several storybooks were selected from three different reading schemes in which each book uses pictures as substitutes for some words. These selected reading schemes were the Read Along With Me series (Tanner, 1987), Let's Learn to Read series (West, 1988), and Landoll's Key Words series (Landoll, 1993). Selected words, either common or proper nouns in each book are replaced by pictures. The storybooks were used by the teachers to show meaningful associations between the words and their respective pictures or symbols. These pictures depict some of the characters and objects in the story. As the specialist teachers read the storybook to their respective groups of children, they would pause whenever they came to a picture, and point to the picture for the children to see and say aloud. In addition to the reading schemes, picture-word association stories taken from two children's periodicals, i.e., D'Light and Ladybug, were photocopied with written permission from the respective publishers and distributed to the children as handouts for their reading with their specialist teacher in class only, after they had done their worksheets.

5. ***Spelling games***
Five different games were selected for this study. These games were meant for the children to play only after they had completed worksheets given by their respective specialist teachers. The children in the control group were given two types of spelling games to play: Word-Picture Matching cards and Word-Picture Puzzle cards. For those in the experimental group, in addition to the two spelling games already mentioned, there were three other games involving phonics: Make-a-Word Bingo, Phonics flash cards, and Three-Letter Words cards. These three games involved children performing tasks such as, phonemic segmentation, blending, isolation of phonemes, and counting the phonemes.

6. *Whiteboards and markers*
The specialist teachers in both groups used their whiteboards during lessons. Colored markers were used in the color phonics approach to differentiate the initial consonants from the final consonants as well as vowels from consonants taught to the experimental group.

7. ***Overhead projectors and transparencies***
These teaching tools were also provided to the two specialist teachers for use during their lessons when they flashed their overhead transparencies.

The Training Procedure

- Specialist Teachers
  Two qualified specialist teachers with Diploma in Special Education (DISE) awarded by the National Institute of Education/Nanyang Technological University, Singapore, were selected for this study. Both had five years of teaching experience each. They had also undergone a three-month in-service course on teaching spelling at a private language training center in 2006. They were briefed in a three-hour session about this research study and the procedure for the seven-week program. Both were told that they would be teaching half the lessons with the experimental group and a half with the control group.
- Format of Lesson
  See Table 3 below.

Table 3:
Format of a daily lesson taught over seven weeks

Duration	Activities	Group A (Experimental)	Group B (Control)
5 minutes	Marking attendance and checking if all the children were present.	ST (I)	ST (II)
5 minutes	Introduction to the lesson: usually began with a rhyme or two, a short-story telling, a song to sing, a short dialogue or role-play.	ST (I)	ST (II)
10 minutes	Tasks involving phonological strategies Tasks involving lexical strategies	ST (I)	ST (II)
5 minutes	Spelling games involving phonological strategies. Spelling games involving lexical strategies.	ST (I)	ST (II)
10 minutes	Tasks involving lexical strategies. Extension of spelling games involving lexical strategies.	ST (II)	ST (I)
5 minutes	Spelling games involving lexical strategies. Extension of spelling games involving lexical strategies.	ST (II)	ST (I)
5 minutes	Spelling test/Mini-spelling test or exercise (oral/written)	ST (II)	ST (I)
Total time spent: 40 minutes	Note: ST = Specialist Teacher	Specialist Teacher (I): 20 minutes with Group A and 20 minutes with Group B	

		Specialist Teacher (II): 20 minutes with Group B and 20 minutes with Group A *(Excluding the first 5 minutes spent on marking attendance.)*

- **Experimental and Control Groups**
  The children with dysorthographia in both the experimental and control groups were taught to spell English words through lexical spelling strategies that were taught during each 40-minute lesson. Word shapes and concrete poems were taught in the lexical spelling strategy. The main reasons for teaching word shapes and concrete poetry were that these could help to:

  1. Increase their visual awareness of shape, size and physical layout of letters that form a meaningful word (Browne, 1994; Tang, 1994; Yeo, 1986)
  2. Express the meaning of a word through the shape, size and physical layout of its letters (Mueller & Reynolds, 1990)

  3. Enhance memory for word shapes so as to enable children to spell better (Browne, 1994)

  4. Provide a channel for the children to express themselves creatively (Chia, 1991, 1993, 1994; Walshe, 1986).

Since the visual appearance of letters was very important here, the specialist teachers teaching concrete poetry in the lessons using the lexical spelling strategy had to keep in mind the following factors:

1. The shape of each letter in a given word

2. The size of each letter in the word

3. The physical layout of all the letters in forming the word.

In addition to the lexical spelling strategies, the children with dysorthographia in the experimental group were also taught spelling through a phonological approach using the phonological analysis (awareness) training methods. The following principles were strictly observed by the specialist teachers during their lessons in this approach (Aaron, 1989; Chia, 2003):

- 1. Phoneme analysis requires a very slow "stretched" pronunciation of the word to be segmented

  2. All the tasks were firstly auditorily presented, and only after these tasks were mastered, were letters and words visually presented
  3. In auditory tasks, children with dysorthographia were taught first to analyze short words into phonemes, and later to blend phonemes into syllables and words

4. Plosive consonants such as /b/, /d/, /g/, /p/, /t/and /k/ were introduced first, while voiced and fricative consonants were introduced later

5. Analysis of words with two phoneme segments was mastered before segmental analysis of three phonemes was presented

6. Vowel-consonant syllables were taught before consonant-vowel syllables were introduced

7. Decoding of simple words was introduced after these skills were mastered.

Once these children with dysorthographia had completed their worksheets, they could choose their storybooks with picture-word associations to read or spelling games to play in class. Before the end of term in December 2008, the AI-R (Newton & Thomson, 1982) subtests were then administered as the posttest to all of them.

• **Lesson Format**

At the beginning of each lesson, five minutes was spent on taking attendance to check if all the children with dysorthographia were present for lesson by the two specialist teachers in their respective groups. This was followed by the next 40 minutes of teacher instruction. Both specialist teachers wrote and planned their lessons according to the scheme of lessons given to them by the LDcenter.

First 20 minutes:

(a) Group A (Experimental): Specialist Teacher (I)

As explained earlier in the section on spelling strategies, the emphasis was on phonological tasks relating to the analysis and synthesis of sounds in words:

1. Sound-to-word matching
2. Word-to-word matching
3. Rhyme recognition
4. Phonemic isolation
5. Phonemic segmentation
6. Phoneme count
7. Phonemic blending
8. Phoneme deletion
9. Identification of missing phoneme
10. Phonemic substitution
11. Spelling routine: Look-Say-&-Listen-Feel-Cover-Write-Check.

In each lesson, at least five phonological tasks out of the 11 were carried out in a rotational manner as follows:

Lesson 1: (1), (2), (3), (4) and (5)
Lesson 2: (6), (7), (8), (9) and (10)
Lesson 3: (11), (1), (2), (3) and (4) … so on

(b) Group B (Control): Specialist Teacher (II)

The emphasis was on tasks related to word formation in terms of letter shape done by tracing, concrete poetry or eidetic imaging, word-picture association through matching activities or reading story books or story handouts with selected picture-word association, and the spelling routine: Look-Cover-Write-Check.

Second 20 minutes:
(a) Group A (Experimental): Teacher (II)
There was an exchange of the two specialist teachers. Specialist Teacher (II) moved to Group A, and taught the same content that was already taught in Group B.

(b) Group B (Control): Teacher (I)
Teacher (I) moved to Group B. Her role was to extend the application of lexical spelling strategies into spelling games and quizzes, spelling tests/exercises and reading story books with picture-word association.

Results & Discussion

The two research questions of concern in this study are as follows:

(1) Did children with dysorthographia demonstrate a significant increase in spelling performance after training in lexical (visual) spelling strategies?

(2) Did children with dysorthographia demonstrate a significantly greater increase in spelling performance after training in lexical and phonological spelling strategies than those children who were trained in lexical spelling strategies only?

In this section, the results for the two research questions are presented.

Means and standard deviations for all tasks (that is, the Schonell Graded Spelling Test and the six spelling-related subtests used in the pretest and posttest analyses) are given in Appendix 1. The measures as a whole are normally distributed with wide variability, except for the visual discrimination task in which a ceiling effect was obtained: all children in the experimental group scored the maximum of 10 marks at posttest.

Schonell Graded Spelling Test

The mean raw scores for the Schonell Graded Spelling test for the experimental group at pretest was 19.5 (SD = 7.16) and at posttest it was 30.8 (SD = 8.08); and for the control group at pretest it was 18.7 (SD = 7.14) and at posttest it was 24.45 (SD = 7.5). When converted to standardized scores, the mean spelling age for the experimental group was 6.95 years at pretest which increased to 8.08 years at posttest and the mean spelling age for the control group was 6.87 years at pretest which increased to 7.45 years at posttest. The chronological ages of the two groups were between 9 years 2 months and 9 years 10 months. It must be noted that the spelling ages were based on the British norms set for the Schonell Graded Spelling Test. The children in both the experimental and control groups showed an improvement in their spelling performance over the seven weeks of the intensive spelling program.

A t-test was carried out on the pretest scores of the Schonell Graded Spelling Test to confirm that the groups which were matched on this variable were indeed not significantly different in spelling ability. The results indicated that there was no significant difference between the groups, $t(38) = 0.34$, $p>.05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in spelling between pretest and posttest, a 2 (time: pretest, posttest) x

2 (group: experimental, control) analysis of variance was carried out on the scores of the Schonell Graded Spelling Test. The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 1626.88$, $p < .001$, and there was also a significant interaction , $F(1, 38) = 174.48$, $p < .001$. These results show that whilst both groups improved in spelling performance, the experimental group improved more than the control group. In other words, children with dysorthographia who were taught to use lexical and phonological spelling strategies had improved significantly more than those who were taught to use lexical spelling strategies alone.

Spelling-related Subtests

- **Visual Discrimination**
  The means and standard deviations for the experimental and control groups on the visual discrimination tasks are shown in Appendix 1. The mean scores of the experimental and the control groups at pretest were 9.7 (SD = 0.64) and 9.45 (SD = 0.97) respectively. Their mean scores increased to 10.0 (SD = 0) for Group A and 9.75 (SD = 0.54) for Group B at posttest.

  A t-test was carried out on the pretest scores of the spelling-related subtest of visual discrimination to confirm that the groups which were matched on this variable were indeed not significantly different in visual discrimination ability. The results indicated that there was no significant difference between the groups, $t(38) = 0.935$, $p > .05$.
  In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in visual discrimination between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of visual discrimination. The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 7.43$, $p < .01$, but there was no significant interaction, $F(1, 38) = 0.00$, $p = 1.0$. These results are limited by the fact that the data were not normally distributed in view of the ceiling effects at posttest for the experimental group. However, it would be expected that there would be no significant interaction on visual variables as both groups were trained in visual strategies.

  • Visual Sequential Memory (Pictorial)
  The means and standard deviations for the experimental and control groups on the task involving visual sequential memory (pictorial) are presented Appendix 1. The mean score of the experimental group increased from 12.7 (SD = 1.1) at pretest to 13.7 (SD = 1.23) at posttest, and the mean score of the control group increased from 12.55 (SD = 1.07) at pretest to 13.2 (SD = 1.21) at posttest.

  A t-test was carried out on the pretest scores of the spelling-related subtest of visual sequential memory (pictorial) to confirm that the groups which were matched on this variable were indeed not significantly different in visual sequential memory (pictorial). The results indicated that there was no significant difference between the groups, $t(38) = 0.426$, $p > .05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in visual sequential memory (pictorial) between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of visual sequential memory (pictorial). The variance was carried out on the scores of the spelling-related subtest of visual sequential memory (pictorial). The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 62.51$, $p < .001$, but there was no significant interaction, $F(1, 38) = 2.81$, $p = .10$. In other words, while both experimental and control groups showed improvement in performing the visual sequential memory (pictorial) tasks from pretest to posttest, the resultant performance of the experimental group was not significantly better than that of the control.

• Visual Sequential Memory (Symbolic)

The means and standard deviations for the experimental and control groups on the task involving visual sequential memory (symbolic) are presented in Appendix 1. The mean score of the experimental group increased from 13.4 (SD = 1.24) at pretest to 14.5 (SD = 1.07) at posttest, and the mean score of the control group increased from 13.2 (SD = 1.44) at pretest to 13.6 (SD = 1.28) at posttest.

A t-test was carried out on the pretest scores of the spelling-related subtest of visual sequential memory (symbolic) to confirm that the groups which were matched on this variable were indeed not significantly different. The results indicated that there was no significant difference between the groups, $t(38) = 0.459$, $p > .05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of visual sequential memory (symbolic). The results, which are shown in Appendix 1 and Appendix 2 indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 44.0$, $p < .001$, and there was also a significant interaction, $F(1, 38) = 7.74$, $p = .008$. These results show that whilst both groups improved in their performance in visual sequential memory (symbolic), the experimental group improved more than the control group. In other words, the score of the experimental group, which was taught spelling using lexical and phonological spelling strategies, in the task involving visual sequential memory (symbolic) was significantly better than the control group, which was taught to spell using lexical spelling strategies only.

• Auditory Sequential Memory

The means and the standard deviations for the experimental and control groups on the task involving auditory sequential memory are shown in Appendix 1. The mean score of the experimental group increased from 11.85 (SD = 0.96) at pretest to 13.2 (SD = 0.96) at posttest,

and the mean score of the control group increased from 11.75 (SD = 0.77) at pretest to 12.4 (SD = 0.92) at posttest.

A t-test was carried out on the pretest scores of the spelling-related subtest of auditory sequential memory to confirm that the groups which were matched on this variable were indeed not significantly different in auditory sequential memory. The results indicated that there was no significant difference between the groups, $t(38) = 0.354$, $p > .05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in their performance on auditory sequential memory between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of auditory sequential memory. The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 134.4$, $p < .001$, and there was also a significant interaction, $F(1, 38) = 14.93$, $p < .001$. These results show that whilst both groups improved in their performance in auditory sequential memory, the experimental group improved more than the control group. In other words, the experimental group taught to spell using lexical and phonological spelling strategies performed significantly better than the control group taught to spell using lexical spelling strategies alone.

• Sound Discrimination

The means and standard deviations for the experimental and control groups on the task involving sound discrimination are shown in Appendix 1. The mean score of the experimental group increased from 17.4 (SD = 1.99) at pretest to 18.8 (SD = 1.64) at posttest, and the mean score of the control group increased from 17.2 (SD = 2.25) at pretest to 17.9 (SD = 2.07) at posttest.

A t-test was carried out on the pretest scores of the spelling-related subtest of sound discrimination to confirm that the groups which were matched on this variable were indeed not significantly different in sound discrimination. The results indicated that there was no significant difference between the groups, $t(38) = 0.291$, $p > .05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in their performance on sound discrimination between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of sound discrimination. The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 85.17$, $p < .001$, and there was also a significant interaction, $F(1, 38) = 8.56$, $p = .006$. These results show that whilst both groups improved in their performance in sound discrimination, the experimental group improved more than the control group. In other words, the experimental group taught to spell using lexical and phonological spelling strategies

performed significantly better in the sound discrimination task than the control group taught to spell using lexical spelling strategies only.

• Sound Blending

The means and standard deviations for the experimental and control groups on the sound blending task are shown on Appendix 1. The mean score of the experimental group increased from 13.25 (SD = 1.67) at pretest to 14.4 (SD = 1.36) at posttest, and the mean score of the control increased from 13.05 (SD = 1.66) at pretest to 13.4 (SD = 1.50).

A t-test was carried out on the pretest scores of the spelling-related subtest of sound blending to confirm that the groups which were matched on this variable were indeed not significantly different in sound blending. The results indicated that there was no significant difference between the groups, $t(38) = 0.371$, $p > .05$.

In order to investigate whether there was a difference between the experimental and control groups and whether these children improved in their performance on the sound blending task between pretest and posttest, a 2 (time: pretest, posttest) x 2 (group: experimental, control) analysis of variance was carried out on the scores of the spelling-related subtest of sound blending. The results, which are shown in Appendix 1 and Appendix 2, indicated that there was no significant difference between the groups. However, there was a significant difference between the pretest and posttest scores, $F(1, 38) = 77.03$, $p < .001$, and there was also a significant interaction, $F(1, 38) = 21.91$, $p < .001$. These results show that whilst both groups improved in their performance on sound blending, the experimental group improved more than the control group. In other words, the experimental group children, who were taught to use lexical and phonological spelling strategies in spelling of English words, displayed a better performance in the sound blending task than those in the control group, who were taught to use lexical spelling strategies only.

Summary

The ANOVA results showed that there was a significant improvement in the spelling performance of children with dysorthographia after they had been taught to use lexical spelling strategies. Further. The experimental group which was taught to use a combination of lexical and phonological spelling strategies showed significantly more improvement than the control group which was taught to use lexical strategies only. The results also suggested that the performance of the experimental group was better than that of the control group in the auditory-based tasks of auditory sequential memory, sound discrimination and sound blending. The experimental group did not improve more than the control group on the visual tasks of discrimination and sequential memory (pictorial) but showed a greater improvement on the visual sequential memory (symbolic) task.

Conclusion

The main purpose of this study was to investigate whether training children diagnosed with dysorthographia to spell using lexical spelling strategies in a combination with phonological spelling

strategies would make them more effective spellers than if they were taught to spell using lexical spelling strategies alone. The study extends the findings of previous research because the linguistic background of Chinese children born in Singapore is very different from the background of most children hitherto reported in the literature. The majority of studies in this area have been carried out in western countries, in monolingual contexts where the writing systems are alphabetic (either totally or partially phonological). Singapore is different from most other countries in that Singaporean Chinese are exposed to an alphabetic script as well as a logographic script.

Findings of the study showed that the spelling performance of the experimental group children displayed significantly more improvement after training in both lexical and phonological spelling strategies than that of the control group children who were taught to spell using lexical strategies alone. In fact, within a period of seven weeks of intensive spelling instruction, the experimental group children improved their mean spelling age by 1.13 years from 6.95 years to 8.08 years, whereas the control group children improved their mean spelling age by 0.58 years from 6.87 years to 7.45 years. Thus, over the seven weeks of the study, the mean spelling age of the experimental group improved six months more than that of the control group. Nevertheless, it must be noted that both groups did improve significantly, suggesting that the lexical spelling strategies taught to both groups were to some extent effective. What is important about this study is that the teaching of a combination of lexical and phonological spelling strategies was even more effective than the teaching of lexical spelling strategies alone.

From the teaching perspective, the results of the study are very gratifying. With the exception of the scores from the subtests of visual discrimination and visual sequential memory (pictorial), the teaching of both lexical and phonological spelling strategies led to increased competence in spelling as well as in several spelling-related tasks. It would be expected that the experimental group would not show a superior performance on visual variables as both groups were trained in lexical (visual) strategies. The results showed that for visual discrimination and visual sequential memory (pictorial), there was indeed no significant interaction in favor of the experimental group. However, there was a significant interaction for visual sequential memory (symbolic). One reason to explain this phenomenon is that the task involving visual sequential memory (symbolic) uses letters, whereas pictures are used in the visual sequential memory (pictorial) task. Most likely, the experimental group children who became better spellers would have been better able to sequence letters from memory than the control group. Remembering letters in sequence is required for effective spelling. Furthermore, the experimental group's training in phonological awareness might have helped them to use letter sounds in combination with their shapes to help them remember letter sequences better than the control group.

It would also be expected that there would be a significant interaction in favor of the experimental group for the auditory variables, as the experimental group children were trained in phonological spelling strategies which could well have improved auditory skills such as auditory sequential memory, sound discrimination and sound blending.

The findings reported in this study show that the experimental group children, who were trained to use phonological spelling strategies to apply spelling-to-sound rules efficiently, made more progress in spelling than those control group children. Hence, the findings are consistent with Barron's study (1980) that shows a phonological spelling strategy is related to a fast application of spelling-to-sound rules involving the assembly of constituent phonemes to generate a plausible spelling of an unfamiliar word (Jorm, 1983). The lexical spelling strategies, on the other hand, are related to a slow application of spelling-to-sound rules because the precise spelling of a word is retrieved directly from the mental lexicon (Jorm, 1983). In other words, the experimental group children who were taught both spelling

strategies had an additional route to use in their spelling, and it appeared that the phonological spelling strategy had given them an extra edge to become better spellers.

The fact that a combination of lexical (visual) and phonological spelling strategies was more effective than lexical spelling strategies alone supports the work of Ehri (1985), which shows that learning to spell involves both orthographic and phonological knowledge. This will be elaborated further later on. The study also supports the work of Bradley (1985) who has shown that children need to use a combination of visual and phonological spelling strategies to read and spell well. When they do not connect these strategies in reading and spelling, development in both areas is slow.

Further, the results of the present study also support the results of research which has focused on the role of phonological awareness in the spelling acquisition of monolingual speakers of English. Rohl and Tunmer (1988) found that the poor spellers in their study had particular problems with phonological awareness. Rohl and Pratt (1995) found that phonological awareness was highly related to spelling, even when the effects of verbal working memory were controlled. The results are also consistent with research by Castle, Riach and Nicholson (1994). In their study, young children, who received training in phonological awareness in addition to their class writing program, were better able to spell words than a control group who did not receive this training.

No studies on instruction in phonological awareness has taken place in Singapore with children diagnosed with dysorthographia (or specific learning disability in spelling), but there are at least a few studies done with Chinese speaking children. One such study was carried out by Ho (1993). She showed that Singaporean Chinese children in Primary 4, who were good readers and spellers, were effective users of both phonological and visual strategies. Thus, her results agree with the findings of the current study. The present study also supports the findings of another research study carried out by Read, Zhang, Nie, and Ding (1986) with a group of Chinese students. They took advantage of the fact that some of these Chinese students had been taught only the traditional Chinese orthography (i.e., xiangxin wenzhi), which is logographic, while others had, in addition, been taught a Romanized version of written Chinese, called hanyu pinyin (i.e., the phoneticization of the Chinese script). The two groups were compared on phoneme deletion and addition tasks. Results showed that on both tasks the hanyu pinyin group performed significantly better than those who had learnt the xiangxin wenzhi. In other words, phonological learners of Chinese script performed better than logographic learners.

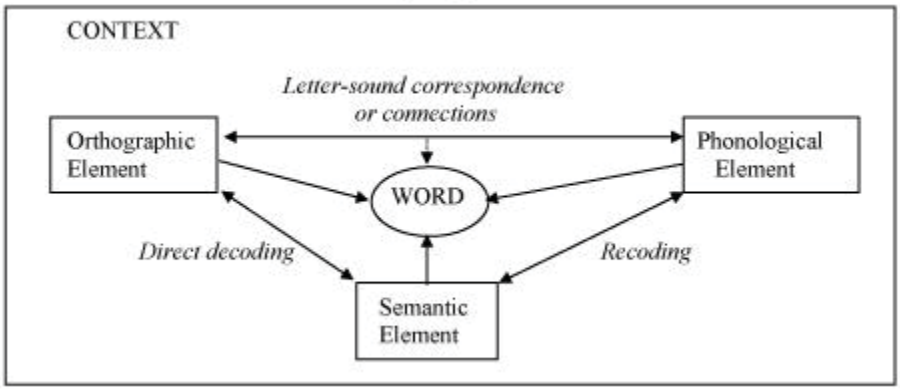
Why the experimental group did better in spelling

The study has demonstrated that under controlled equal time constraints, two different methods of teaching produced differences in spelling scores. The experimental group children taught to use lexical and phonological spelling strategies improved their spelling age six months more than those in the control group taught to use lexical spelling strategies alone. There are several possible explanations of these results.

One explanation why the experimental group children performed better than those in the control group could be that they could recognize words by remembering how they looked (visually) and were pronounced (phonologically) and/or spelled (orthographically). That is, the experimental group children could use both lexical and phonological spelling processes to form a dual-route process that encodes information about words and general correspondences between the spoken words and their conventional graphic representations used in spelling (Seymour, 1992; Seymour & Bunce, 1992). Thus the sight of a familiar target word triggers that word in memory, including information about its

spelling (orthographic element), pronunciation (phonological element) and meaning (semantic element) (see Figure 2).

Figure 2:
Components of a word and processes involved in word recognition for reading and spelling



An adequate account of this procedure must explain how these children with dysorthographia were able to look at specific printed words they had read and/or spelled before, and immediately locate their pronunciations and meanings in memory while by-passing thousands of other words, including those with similar spellings or meanings (Ehri, 1992). Moreover, an adequate explanation must cover how these children with dysorthographia were able to store and remember new words (Ehri, 1980; Reitsma, 1983). The kind of process thought to be at the heart of spelling is a connection-forming process (Ehri, 1995). Connections are formed that link the written forms of words to their pronunciations and meanings. This information is stored in the word memory bank or mental lexicon of each child.

Glushko (1981) suggests that when children store printed words in memory, they store the orthographic and phonological representations together. Then when they encounter new printed words containing letter sequences like those in familiar printed words, they activate phonological information stored with the orthographic information. This probably explains why the experimental group children in the current study performed better than those in the control group.

In the present study, the children with dysorthographia in both experimental and control groups were, of course, poor spellers of English words. Their learning to spell probably began as a non-alphabetic process involving memory for connections between selected visual cues and words. However, once the experimental group children had acquired more knowledge about the phonological system in the course of intensive training, learning to spell most likely changed into an alphabetic process involving connections between letters in written words and sounds in their pronunciation. In fact, they out-performed the other control group children, who might have been still very much at a logographic stage in their spelling, especially for unfamiliar and non-phonetic spellings (e.g., ice, little, write, light). It is hypothesized that at first, letter-sound (grapheme-phoneme) connections were partial, linking the most salient letters to sounds. When the experimental group children had acquired a better knowledge of the phonological system, complete connections could be formed between graphemes in spellings and phonemes in the pronunciations of words. As these children with dysorthographia became able to store

words in memory in fully analyzed forms, letter patterns recurring in different words could become consolidated into multi-letter units symbolizing phonological blends (e.g., /k/, /a/, /t/ blended to form cat; /sh/, /i/, /p/ blended to form ship). Letter-sound connections linking the letters in spellings to their pronunciations enable these children to represent thousands of words uniquely in their mental lexicons and to locate the pronunciations and meanings of these words accurately and automatically upon seeing them in print or learning to spell them (Ehri, 1987, 1992; Perfetti, 1992).

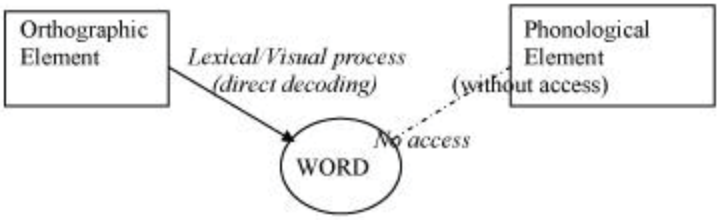
Another explanation for the superior spelling performance of the experimental group may lie in the fact that the children with dysorthographia in the control group were taught to spell English words using only lexical spelling strategies. The lexical approach to spelling requires these children to learn to recognize individual words as holistic units. As more and more words were added to the control group children's "sight words" vocabularies, they apparently became better spellers. However, the drawback of relying on lexical spelling strategies alone is that these children would be unable to decode or spell new English words without the specialist teacher to help them. If the control group children really learned to spell each new English word as a holistic unit, without any further analysis of its orthographic pattern, then it would be as though they were learning to spell Chinese words or characters. It was shown earlier that Chinese children have to learn a different kanji character (or xiangxin wenzhi) for every Chinese word, and their spelling performance in Chinese is consequently limited. It takes a long time to learn many patterns. Hence, the effectiveness of a lexical spelling strategy is limited by the fact that the mental lexicon has its own limitation in the storage of words. The retrieval of a word from the mental lexicon depends on whether it can be found in memory. For an accurate spelling, both the identity and order of the letters have to be stored in memory (Funnell, 1992). The accuracy of a spelling also depends on how well the word is known (Sterling & Seed, 1992) and visual imagery of words is also an important factor (Peters, 1985). Thus, the improvement of the control group's spelling may be more apparent than real. It is possible that further development in spelling for this group would be severely limited without some instruction in phonological spelling strategies.

On the other hand, the experimental group children learnt to spell using lexical and phonological spelling strategies which would have helped them to use the alphabetic principle underlying the spelling of English words, thus enabling them to generate the pronunciation of new words on the basis of words that they already knew. They might also have been able to use analogies which Goswami and Bryant (1990) have shown to be very important in learning to read and spell. For example, if they had a good representation of the word fight in their mental lexicon, they would have found the word night easy to learn if they were able to make the connection between the two words.

A third explanation of the superior performance of the experimental group may be found in the phonological recoding process which plays an important role in spelling. Jorm and Share (1983) noted that such a skill in making use of systematic relationships between letters and sounds gives children a strategy for processing unknown words and thus a way to acquire new words independently. Vandervelden and Siegel (1995), in their study, suggested the importance of phonological recoding in early literacy as a complex of skills in using systematic relationships between letters and sounds to recognize or to pronounce (i.e., retrieve the verbal labels of) unknown printed strings (words or pseudo-words) or to spell.

In this study, children with dysorthographia who spelled English words the logographic way used only lexical (visual) spelling strategies as a direct pathway to spelling. They have only the route of direct decoding to access the orthographic forms of words they want to spell (see Figure 3).

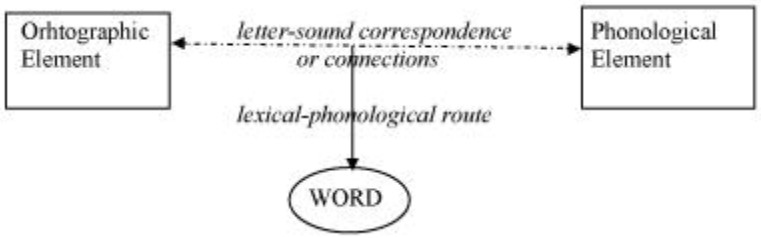
Figure 3:
Lexical/Visual process as a direct decoding process in word recognition for spelling (without access through the phonological route)



This route involves the direct retrieval of the precise spelling of a word from the mental lexicon on the condition that the word can be found in memory. Also, if the wrong spelling of the word were stored, the child would spell the word wrongly until the misspelling was corrected. It will thus be seen that if the control group children used only the lexical spelling strategies they were taught, their access to the correct spelling forms of words would be very limited.

However, the experimental group children, who were taught phonological strategies in addition to lexical strategies, have two more possible routes to access the spelling of words. Firstly, they could use a combination of lexical and phonological routes (see Figure 4) to ascertain the spelling of words and use either a lexical process or a phonological process to counter-check their spelling accuracy in terms of the identity and order of the letters (Funnell, 1992). In her amalgamation theory, Ehri (1978, 1980, 1984) explained early literacy learning as the adding of orthographic information for word spellings to known phonological and semantic/grammatical information. Once the orthographic form of a word has been stored in memory, a direct, visual/lexical pathway to associated semantic, grammatical and phonological information for that word becomes established.

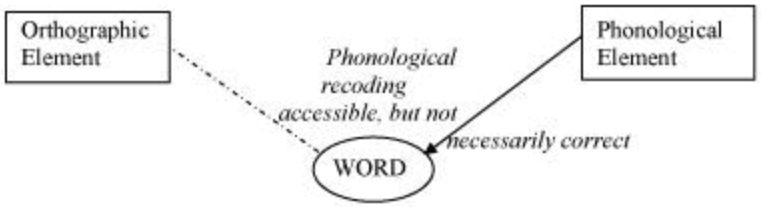
Figure 4:
Lexical-phonological route using orthographic and phonological elements in word recognition for spelling



Secondly, should they be still unsure of the orthographic form of a word, these experimental group children who were taught phonological spelling strategies could use phonological recoding as a further route to access spellings (see Figure 5). A component skill of phonological recoding is phonological

awareness, that is, the ability to recognize, segment and blend sounds in spoken language (Vandervelden & Siegel, 1995). Hence, it can be seen that the experimental group children would have had more routes available to them when accessing spellings of words from memory.

Figure 5:
Phonological recoding in word recognition for spelling (without using direct decoding, that is, lexical/visual processes)



Limitations of the study

In this study all possible care was taken to control for extraneous variables. Children diagnosed with SLD in spelling or dysorthographia were carefully assigned to two groups (experimental and control) on the basis of a standardized spelling test and t-tests showed no significant difference between the two groups at pretest. Controls were made for possible specialist teacher effects by ensuring that both specialist teachers taught both groups for an equal amount of time. The training program was carefully controlled to ensure that both groups received the same lexically-based program for the same amount of time and that both groups received the amount of overall instruction in spelling. Nevertheless, it is possible that the improvement of the control group could have been due to the extra time spent in spelling activities, rather than to the lexical spelling strategies taught. It is also possible that the teaching of phonological spelling strategies alone could have led to a similar increase in spelling performance to that shown by the experimental group.

In order to have controlled for such variables, it would have been necessary to have included two more groups of children: one which was given the same amount of additional spelling instruction as the experimental group using regular class spelling instruction only; and another group which was taught phonological spelling strategies only. However, the inclusion of two more instructional groups would have been beyond the scope of this study. Further, it is unlikely that two more groups of Singaporean Chinese children diagnosed with dysorthographia could have been easily located.

Implications for the teaching of spelling

The findings of this study have interesting implications for the teaching of spelling to children with SLD in spelling or dysorthographia in Singapore or elsewhere.

In this study, experimental group children taught to spell English words using phonological spelling strategies in addition to lexical spelling strategies performed better than their counterparts in the control group who were taught to spell using lexical spelling strategies alone. This is most likely because there is a strong connection between children's awareness of the constituent sounds in words and their

success in learning to spell. The experimental group children, who developed an awareness of sound patterns, learned to spell better than those in the control group, who were not taught phonological awareness. This suggests that good phonological skills should be promoted among children diagnosed with SLD in spelling or dysorthographia, thus helping them to spell better through a phonological approach in addition to a lexical approach. Therefore, to improve the performance of such children in general, the method of instruction should aim to increase awareness of sounds, so that the phonological route can be made accessible. With the availability of this additional route, improvement in the performance of these children in their spelling of English words should follow.

However, it is important to note that the experimental group children, who were taught phonological spelling strategies, did not necessarily spell by working out the constituent sounds of words. Some of them may still have recognized words as visual patterns, without paying much attention to the individual letters or the sounds that they represent. What is important is that these children have two routes – lexical and phonological – available for spelling and they can choose whether to use one of these routes, or a combination of both.

Closing Conclusion

In summary, the results of the present study corroborate the results of previous investigations and suggest that phonological awareness plays an important role in learning to spell. On the other hand, it must be noted that both experimental and control groups improved significantly, suggesting that the lexical spelling strategies taught to both groups were to some extent effective. However, when phonological spelling strategies were taught in combination with the lexical spelling strategies, the experimental group performed better in spelling than the control group, suggesting that a combined instruction of lexical and phonological spelling strategies was even more effective than teaching lexical spelling strategies alone.

The findings of this study do not suggest that the only way to teach spelling to children diagnosed with dysorthographia is to switch wholesale from the lexical approach to the lexical-phonological approach to spelling. Rather, the study suggests that including some teaching about phonological spelling strategies during everyday spelling activities may benefit such children, by helping them to make connections between the orthographic patterns of lettes in words and the sounds at a psychologically accessible level. Previous research (e.g., Rohl and Pratt, 1995) shows that phonological awareness may be a necessary but not a sufficient condition for learning to spell. This means that children diagnosed with SLD in spelling or dysorthographia may possess some phonological awareness, but they fail to employ it because they are otherwise directed by a particular teaching method and rarely employ the alphabetic principle (McGuinness, McGuinness, & Donohue, 1995). However, since the present research was only concerned with the teaching of children diagnosed with SLD in spelling or dysorthographia, further research using similar strategies with other Singaporean children without specific learning disabilities appears to be warranted. There is also a need for further research to determine whether the introduction of hanyu pinyin (the Romanized version of Chinese) in Chinese instruction would lead to a greater awareness of sounds in the spelling of English words.

In conclusion, the results of this study show that children with SLD in spelling or dysorthographia who had made little progress in spelling English words, despite previous remediation programs, were able to show an average spelling of 1.13 years over the seven weeks of the program in which they were taught to use a combination of lexical and phonological spelling strategies.

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Appendices

Appendix 1: Mean scores (M) and standard deviations (SD) for all variables

Variables	Groups				Analysis of Variance		
	Experimental		Control		Group	Time	Interaction
	M	SD	M	SD	*F*(1, 38)	*F*(1, 38)	*F*(1, 38)
1. Schonell Graded Spelling					2.24	1626.88***	174.48***
Pretest	19.5	7.16	18.7	7.14			
Posttest	30.8	7.51	24.45	7.51			
2. Visual Discrimination					2.00	7.43**	0.00
Pretest	9.7	0.64	9.45	0.97			
Posttest	10.0	0	9.75	0.54			
3. Visual Sequential Memory (Pictorial)					0.82	62.51***	2.81
Pretest	12.7	1.1	12.55	1.07			
Posttest	13.7	1.23	13.2	1.21			
4. Visual Sequential Memory (Symbolic)					1.73	44.0***	7.74**
Pretest	13.4	1.24	13.2	1.44			
Posttest	14.5	1.07	13.6	1.28			
5. Auditory Sequential Memory					2.28	134.41***	14.93***
Pretest	11.85	0.96	11.75	0.77			
Posttest	13.2	0.96	12.4	0.92			
6. Sound Discrimination					0.68	85.17***	8.56**
Pretest	17.4	1.99	17.2	2.25			
Posttest	18.8	1.64	17.9	2.07			
7. Sound Blending					1.47	77.03***	21.91***
Pretest	13.25	1.67	13.05	1.66			
Posttest	14.4	1.36	13.4	1.50			

NOTE: * $p < .05$ ** $p < .01$ *** $p < .001$

Appendix 2: A Summary of 2-Way ANOVA of the Experimental Study

Tasks	Sources of Variation	Sum of Squares (SS)	Degree of Difference (df)	Mean Square (MS)	*F* value	Significance of *F* (*p*)
Spelling ability/ competence	Between groups	252.05	1	252.05	2.24	.14
	Error (between-subjects effects)	426.15	38	112.29	-	-
	Between pretest & posttest	1462.05	1	1462.05	1626.88	< .001
	Interaction	156.80	1	156.80	174.48	< .001
	Error (within-subjects effects)	34.15	38	0.90	-	-
Visual discrimination	Between groups	1.25	1	1.25	2.00	.165
	Error (between-subjects effects)	23.70	38	0.62	-	-
	Between pretest & posttest	1.80	1	1.80	7.43	.01
	Interaction	0.00	1	0.00	0.00	1.0
	Error (within-subjects effects)	9.20	38	0.24	-	-
Visual sequential memory (pictorial)	Between groups	2.11	1	2.11	0.82	.37
	Error (between-subjects effects)	98.28	38	2.59	-	-
	Between pretest & posttest	13.61	1	13.61	62.51	< .001
	Interaction	0.61	1	0.61	2.81	.10

	Error (within-subjects effects)	8.28	38	0.22	-	-
Visual sequential memory (symbolic)	Between groups	5.51	1	5.51	1.73	.196
	Error (between-subjects effects)	121.17	38	3.19	-	-
	Between pretest & posttest	12.01	1	12.01	44.0	< .001
	Interaction	2.11	1	2.11	7.74	.008
	Error (within-subjects effects)	10.37	38	0.27	-	-
Auditory sequential memory	Between groups	3.61	1	3.61	2.28	.140
	Error (between-subjects effects)	60.28	38	1.59	-	-
	Between pretest & posttest	19.01	1	19.01	134.41	< .001
	Interaction	2.11	1	2.11	14.93	< .001
	Error (within-subjects effects)	5.38	38	0.14	-	-

Tasks	**Sources of Variation**	**Sum of Squares (SS)**	**Degree of Difference (df)**	**Mean Square (MS)**	***F* value**	**Significance of *F* (*p*)**
Sound discrimination	Between groups	5.51	1	5.51di	0.68	.416
	Error (between-					

	subjects effects)	310.17	38	8.16	-	-
	Between pretest & posttest	21.01	1	21.01	85.17	< .001
	Interaction	2.11	1	2.11	8.56	.006
	Error (within-subjects effects)	9.38	38	0.25	-	-
Sound blending	Between groups	7.20	1	7.20	1.47	.234
	Error (between-subjects effects)	186.75	38	4.91	-	-
	Between pretest & posttest	11.25	1	11.25	77.03	< .001
	Interaction	3.20	1	3.20	21.91	< .001
	Error (within-subjects effects)	5.55	38	0.15	-	-

NOTE: Between-subjects effects and within-subjects effects (errors) have no *F* values because they are used as denominators of the various *F* ratios and are not themselves the subjects of any statistical test.

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