ANGELA'S STORY

Applying psycholinguistic principles to spelling and word learning

Suze Leitão

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This article presents a case study to illustrate the application of theory and research to intervention for a child with dyslexia and auditory processing disorder (APD). The use of the speech processing profile developed by Joy Stackhouse and Bill Wells provided a framework for psycholinguistic based intervention for spelling and word learning Strategies for addressing lexical retrieval/storage difficulties, word learning and spelling within this framework are discussed.

Keywords:
   lexical retrieval,
   literacy,
   phonological representations,
   psycholinguistics,
   spelling

Literature review

Psycholinguistic theory has been applied to the assessment of children's speech perception and production abilities (Baker, Croot, Mcleod, & Paul, 2001). This leads to principled intervention goals based on linguistic analysis with activities linked to processing strengths and weaknesses. Word finding or lexical retrieval difficulties are seen within a psycholinguistic framework as a surface manifestation of underlying phonological processing difficulties and inadequate storage of phonological and semantic information in the lexicon (Constable, 2001).

Psycholinguistic approaches, with their focus on processing skills, also provide a useful framework to explore underlying links between children's speech and literacy difficulties (Leitão, Fletcher, & Hogben, 2000). Both speech and literacy development are dependent on an underlying speech processing system comprising input and output channels and clear and precise stored lexical representations (Stackhouse & Wells, 1997) Problems in establishing accurate and distinct phonological representations in long-term memory are considered a key factor in accessing sublexical units (i.e., developing phonological awareness) and learning the alphabetic principle (Elbro 1996, spelling, in particular, is dependent on intact speech processing skills (both encoding and motor programming) and accurate representations Learning to spell a new word may require a child to rehearse the spoken form verbally while reflecting on the word's structure, segmenting the sounds and assigning letters/letter groups to the corresponding phonemes, while drawing on his/her morphological, linguistic and orthographic knowledge.

Historically, spelling has been seen as a literacy convention or a school subject and even a by-product of reading (Perfetti,

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1997). However, it is now generally accepted to be a psycholinguistic process in which not all words are spelled using the same pathway (Baker, 2002). Learning to spell involves the knowledge of phonological representations, grammatical and semantic knowledge as well as visual memory and the knowledge of orthographic rules and conventions (Lennox & Siegel, 1994) Phonological skills are of primary importance in the development of spelling, particularly in the early stages, but the importance of morphological and orthographic knowledge should not be underestimated. In fact, spelling is often described as morphophonemic (Moats, 1995) Phonological processing and phonemic awareness skills are critical in analysing a word's structure, but the morphological make-up of a word (how it is made up of meaningful parts) also influences its spelling (Bourassa & Treiman, 2001). An example of how even young children's spelling can be influenced by morphology is when they learn to use the past tense "-ed" spelling regardless of whether it is said as a voiced or voiceless plosive. In addition, orthographic considerations (which place constraints on permissible letter sequences) and the influence of other languages play a role in explaining seemingly unpredictable spellings.

Unfortunately, the ways that spelling is often "taught" do not reflect current thinking about the spelling process. It is often treated as a rote memory visual/motor activity. Spelling is tested, drilled through copying and rote learning but seldom explored, explained or discussed. Many students manage to learn the spelling of words well enough to pass the weekly tests but do not seem to transfer learning to long-term memory.

A compromise position needs to emerge reflecting a more balanced position (Scott, 2000). Spelling instruction should be direct but children must also be encouraged to become strategic spellers (Scott, 2000). It should be a process of learning through meaningful experiences with words, a scientific process of discovery and problem-solving. Rather than focusing on what words/rules to teach, considering how we can stimulate the spelling process would seem more useful. Questions such as the following could be asked:

- What is the best route to take when learning a new word?
- How can we accelerate the transfer of learning to long-term memory?
- How can we ensure a word stays in long-term memory?
- What cognitive restructuring could occur from engaging in this spelling activity?

Characteristics of good spellers include an interest in words, viewing spelling as a problem-solving process and deliberate use of strategies to learn and store new words (Bolton & Snowball, 1986). The ultimate goal is spelling efficiency – the development of accurate automatic visual representations of words, linked closely to the phonological/motor representations, that allow the child to retrieve the words in large chunks from the visual memory.

Investigating a child's speech, language and literacy difficulties within a psycholinguistic framework offers a

strong theoretical and practical rationale for the involvement of a speech pathologist in considering a child's spelling. A case study will be described to illustrate the application of psycholinguistic principles to spelling and word learning in a child who was struggling to achieve spelling efficiency.

Background

Angela was referred to me in late 2001 at age 8½ years with a diagnosis of dyslexia/specific learning disability. Compared to her strong intellectual ability, she had lower than expected scores on measures of reading accuracy, rate and comprehension. She had been receiving tutoring for some time but had made little progress with spelling. Her performance on the 2-minute spelling task from the Dyslexia Screening Test fell between the 5th and 11th percentile. She was referred to me for a speech pathology assessment because some minor articulation errors had been noted.

On assessment using the CELF-3 (Semel, Wiig, & Secord, 1994), Angela scored in the normal range for all subtests except Recalling Sentences (which taps auditory memory) and Formulated Sentences (which taps the ability to formulate compound and complex sentences). The Comprehensive Test of Phonological Processing (Wagner & Torgeson, 1997) demonstrated phonemic awareness and phonological memory scores to be below average, though phonological retrieval (rapid automatised naming) scores were in the normal range.

Although Angela presented with reasonable oral language skills in many areas, certain "surface level" indicators of underlying difficulties were apparent:

- her speech articulation was characterised by a few developmental processes (f/th, v/th, s/sh) as well as weak syllable deletion (typically in multisyllabic words during connected speech) and some short vowel distortions;
- she occasionally misheard words (e g , or/all, snail/snake, seeing/singing) especially when her auditory memory was under pressure;
- difficulties with auditory memory span and auditory working memory were apparent during the assessment tasks;
- phonological awareness, especially awareness and manipulation of phonemes was weak. Angela had difficulties phonemically segmenting words with initial/final clusters and deleting sounds from initial/final clusters and from within words (e.g., "say winter without /t/"). In addition, processing speed was quite slow;
- Expressive language, especially expressive semantics was weak. For example, word retrieval difficulties were apparent and she had problems being specific and expressing herself fluently in more formal language situations and when under pressure.

Angela was referred for an auditory processing assessment. Results showed normal hearing and discrimination skills but very poor figure-ground (speech-in-noise) skills and difficulties with short-term auditory memory.

Interpretation of clinical findings

I felt Angela presented with weak underlying speech processing skills that had been missed until her literacy difficulties became severe enough to warrant investigation. Her parents had been concerned since year 1 and finally took Angela to private psychology and then speech pathology services when she was in year 4.

Angela's strengths and weaknesses were therefore profiled using the speech processing profile developed by Joy Stackhouse and Bill Wells (Stackhouse & Wells, 1997). This profile is organised as a series of assessment questions that can be asked about different levels of possible breakdown in speech processing abilities. The assessment questions distinguish between input processing (necessary for decoding the speech signal) and output processing (encoding and producing speech). In addition, the levels of processing are classified according to how dependent they are on stored information about words in the lexical representation (Stackhouse & Wells, 1997)

Angela presented with input difficulties at the level of auditory perception. She also had difficulties with tasks at the higher input processing levels that tap into the accuracy/quality of underlying phonological representations stored in the lexicon and the child's awareness of their internal structure. From an output perspective, she exhibited difficulties accessing accurate motor programs, manipulating phonological units and repeating real words and non-words. Motor execution and sound production skills were unimpaired.

Angela's difficulties in processing phonological information were felt to provide a common thread underlying her surface difficulties. Processing phonological information accurately and quickly is important for laying down clear sound-based representations in the brain (Metsala & Walley, 1998). These representations support vocabulary development, accurate motor programs for clear speech output, the ability to analyse and manipulate sounds in words and of course are critical to the development of decoding and spelling skills The long-term impact of weak or fuzzy representations can be extensive (Leitão & Fletcher, 2002).

Angela's main surface indicators were her difficulties with reading and spelling. However, other more subtle indicators were apparent in her difficulties with phonemic awareness and manipulation and lexical retrieval In addition, more detailed testing pointed to problems with underlying phonological representations and motor programs. Examples of her responses on a picture confrontation naming task support this hypothesis:

A   ....I've lost it!............
S   What's it for?
A   It slows you down when you jump off a plane.
S   Do you know anything about the word?
A   It's long
S   What sound does it start with?
A   It's something with shoot.....um.......... ....
S   /p/
A   A parachute!........... ..I was thinking airchute or something!

A   heltinna? . ... .a..tenna?   (antenna)

A   screwdriver?
S   spa...
A   spannel!   (spanner)

Further evidence was provided by some of her more unusual spelling errors that seemed non-phonetic by traditional methods of analysis until the words were discussed with her For example, Angela's spelling of *mature* as *"putchoa"* became clear when she said the word for me! Her spelling was quite a good representation of her spoken output, her motor program Other spellings such as *"furcha"* for *furniture*, *"mtrila"* for *material*, also reflected speech output, characterised by weak syllable deletion and syllable transposition respectively.

Detailed analysis of writing samples and discussion with Angela indicated that her spelling errors did not all derive from the same underlying difficulty.

- some errors reflected poor syllabic or phonemic segmentation skills (phonological awareness difficulties);
- others reflected lack of knowledge of spelling rules (e.g, misapplication of a long vowel spelling rule or homophones);
- others were a reflection of poor underlying storage, inaccurate sound based representations and weak motor programs

Angela's overall performance led me to consider addressing her spelling and lexical retrieval difficulties in a "word learning" model based on psycholinguistic principles.

Intervention

Angela needed an intervention program that incorporated phonemic awareness training, aimed to develop clear and accurate phonological representations and awareness of their internal structure (which might require "lexical updating"), and then linked this knowledge to morphological knowledge and spelling rules/decoding/word recognition. Angela had been taught to use a visual strategy (look/cover/write/check) to learn rules, but I felt she would benefit from being shown how to treat spelling as a psycholinguistic "problem" (Perfetti, 1997). Rather than teaching her how to spell, I decided my role was to facilitate what she could learn about the spelling process for herself (Baker, 2002)

The first stage of intervention involved raising her awareness of how words are learned and stored. This was achieved using a simplified model based on the work of Stackhouse and Wells to explain speech processing and lexical storage (Stackhouse & Wells, 1997). Diagrams and analogies to filing systems were used. Some basic information about how and where sounds are made was also discussed. Angela found this interesting and remarked on her difficulties with word finding for speech and accessing spellings.

We decided to work on a simple system of word learning. This involved identifying the type of error in her writing and then applying the most useful strategy While spelling was the main focus, overall word learning, lexical updating and sharpening up underlying representations was also a key goal. This addresses the important principles in psycholinguistic intervention of strengthening the whole system and the links in the lexicon by working on different forms of representation and highlighting their connections (Rees, 2001)

Table 1. Word learning strategies	
Type of error	Examples of strategies
Phonological awareness	Say the word clearly Syllabify if appropriate (dashes used to represent each syllable) Break each syllable into phonemes (boxes used to represent each sound) Map phonemes to letters
Spelling "rules"	Use resources (e.g , THRASS chart, *The Complete Phonic Handbook*) Discuss rules Try out different ways of spelling the target sound Which one "looks" right? Check homophone list
Weak storage	Use the strategic steps to spelling framework (see table 2)

We identified errors in word spellings and classified them as errors of:
- phonological awareness
- spelling "rules'
- weak storage

Table 2. Word learning strategies
1. What does the word sound like? Can I say it clearly? Does it sound similar to any other words? Are there any tricky parts?
2. What parts does the word have? How many syllables or beats does it have? What are the sounds (phonemes) in it?
3. Do any parts of the word have a meaning? A grammatical use? Does it have a prefix/suffix? Is there a base word?
4. What does the word mean? How does it fit in with other words I know?
5. Can I use the word in a sentence?
6. What does the word look like when I read it? Are there any words that look similar? Are there any tricky parts?
7. Can I write the word? Can I write it smoothly? Are there any tricky parts?
8. Is there a special way I can remember this word's spelling (e.g., rules, visual, meaning, grammar, mnemonic, etc.)?
9. Does knowing this word help me learn any other words?

Factors to consider

- The steps to spelling and word learning were not designed to be introduced "cold" to a student. Angela and I built up this framework over a few sessions.
- The language content and complexity in the steps can be adapted according to the age/reading ability/cognitive skills of the child Key words can be used with younger children. For example: say/meaning/grammar/write I have also used the framework in a diagrammatic form, drawing a "brain" in the centre with lots of arrows and key words showing how information gets in and out.
- Not every step needs to be followed to learn every word. Angela and I have worked through the whole set of steps to learn some words but now tend to consider each question and decide if we need to follow it through. The order of the steps may be varied according to factors such as the word to be learned and the child's learning style. The most "critical" levels seem to be:
  - saying
  - meaning/sentence
  - reading
  - spelling/writing.

Summary

Angela has made considerable progress during the year we have tried this approach During August 2002, she completed the Western Australian Literacy and Numeracy Assessment and her spelling skills fell comfortably in the average range of achievement for year 5 students in WA. Her results on

standardised spelling tests show about a 6–12 month delay She continues to experience difficulty spelling some words in her writing especially those for which she lacks a clear representation. Homophones also continue to prove tricky. We plan to continue intervention using the framework, though we are now focusing more on text writing and comprehension. We refer back to "steps" whenever we encounter a word that needs learning.

It has been a pleasure working with someone as bright and interested as Angela. It has given me the opportunity to explore the application of psycholinguistic frameworks to spelling and word learning. I see the benefits in Angela's spelling, word retrieval and overall knowledge of words She has become far more conscious of the processes involved in spelling and word learning. I have also been able to adapt the ideas to use with younger students and those with weaker oral language skills. I would like to leave you with Angela's perspective on the process.

Angela's thoughts

Throughout the years Suze has taught me that if I want my spelling and ~~comperention~~ comprehension to improve, I have to break it up. I have to say the word clearly, if there are syllables in the word. And is there a trick for the word that I can ~~remeber~~ remember so next time I spell the word I can think of those things. Overall I think that this pattern is quite usefull to use because a normal way just trys to teach us but this pattern makes me think why and how am I spelling these words

Acknowledgements

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Dr Suze Leitão is a speech pathologist who runs a private practice in Fremantle, WA. Her workload is a combination of clinical work and running workshops, with a special interest in speech and literacy difficulties. She holds an adjunct teaching fellow title in the School of Psychology at the University of Western Australia. She has recently commenced a part-time lecturing position on the Human Communication Science course at Curtin University of Technology.

Correspondence to:
Suze Leitão
Speech Pathology Services
11 Girton Lane, Fit i '' WA 6160
email s.t: i nt.net au