The Effects of the PESTS Strategy on the Spelling Skills of a Third Grader With Severe Literacy Difficulties

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In this single-case study, we evaluated the effects of PESTS, a simple mnemonic strategy to help students remember how to spell difficult words. Our participant was a 9;6-year-old girl with a suspected learning disability in reading and writing. We applied a multiple-baseline design across word sets with one follow-up measurement two weeks after the end of the intervention. The dependent measure was the number of correctly spelled words from a list of 15 difficult nouns. After only a couple of days, the student reached a perfect score on the test and even after two weeks did not commit a single spelling mistake. Although this is only a small single-case study, the findings give reasons for optimism that PESTS can be a very effective tool in supporting students with learning disabilities to overcome their spelling problems.

Keywords: **Spelling disorders, mnemonics, single-case study, learning disabilities, elementary education**

Introduction

Being able to spell correctly is pivotal for several reasons with regard to both reading and writing. For example, proper spelling facilitates written communication. If universal conventions and rules concerning the correct order of letters are applied, understanding a text becomes much easier than if everything were left to one's personal discretion. The same goes for writing something intended to be comprehended by another reader. Moreover, spelling errors can have grave consequences for one's livelihood as adult, where job applications or resumés make a bad impression if they contain errors. And even though spell-checkers are helpful in many ways, nevertheless, it is risky to rely on them exclusively (Joshi & Carreker, 2009).

Most students acquire acceptable spelling skills by the end of their elementary school years. However, many of them do not. In fact, between 3 and 11% of all children and adolescents suffer from a spelling and/or reading disorder (Galuschka & Schulte-Körne, 2016) and are at a heightened risk of academic failure. In addition, their chances of finding adequate employment

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are comparatively low (Joseph & Powell, 2022). Finally, individuals with poor literacy skills are prone to developing psychological problems, including depression and anxiety (Willcutt & Gaffney-Brown 2004).

Thus, it is of fundamental importance to provide students who struggle with spelling with appropriate and effective instruction. Fortunately, quite a few reliable studies are available in this area and have come up with successful interventions. In a recent meta-analysis by Galuschka et al. (2020), summarizing the effects of 34 sound experiments, the authors concluded that there are many very beneficial approaches to remedy spelling difficulties. What all serviceable methods seem to have in common is their potential to "… help build and automate spoken and written language structures and, in turn, reduce cognitive load" (p. 14).

One of the most effective ways to lower the demand on mental resources needed to perform an otherwise complex task such as spelling is the use of so-called mnemonics. These "memory-aiding strategies" (Cook, 1989, p. 3) are designed to help with information retention and retrieval. Common mnemonic devices include acronyms, acrostics, rhymes, and songs, all linking unfamiliar content to already known and concrete materials (Fontana et al., 2007; Mastropieri et al., 2000; Scruggs & Mastropieri, 2000).

An especially effective memory-aiding strategy uses eye-catchy pictures connected to short sentences. Howard and colleagues (2008) developed a specific technique called PESTS using this kind of mnemonic to assist students in spelling difficult words. In their paper, the authors give the example of helping children to remember how to write the word "trouble" by presenting them with a drawing of two people in a car before a fork in the road and the sentence "Turn right off uncle Ben's last exit." By recalling the picture and connecting the first letter of each word in this short instruction, students can easily deduce how to spell "trouble" correctly.

As part of their study, Howard et al. (2008) compared PESTS with the "look, cover, write, check" technique (Cook, 1997). Without giving further details, they concluded:

> In our comparison of the spelling approaches we found that, on average, students did not learn any sight words beyond what they initially knew on the weekly pretest when they were taught using the traditional "look, cover, write, check" method. However, when using PESTS, all of the children improved their spelling. The average gain scores were 1.5 to 2.5 words spelled correctly from the list of five target words. (p. 6)

The purpose of the present study was to shed further light on the effectiveness of PESTS. We found no papers published in peer-reviewed journals on

verifying this strategy meeting the standards for acceptable professional research. To fill this gap in the literature, we conducted a short single-case analysis with a female third grader, trying to teach her the correct spelling of 15 tricky, but commonly used words.

Methods

Setting and Participant

Our participant was a 9;6 year old girl (Lea – her name was changed to maintain her anonymity) who was attending third grade in an elementary school in a major city in Germany. She did not have an immigrant background and was described by her teacher as reserved, quiet, and friendly. Testing Lea's spelling skills using a standardized orthography test (Stock & Schneider, 2008) revealed a very low percentage of 5 – far below the level of her classmates. Apart from language arts, her school achievement could be considered mediocre. She was tested for a learning disability in the areas of reading and writing at the time of the study (the results were not yet available when this paper was being prepared). Lea was very conscious of her academic shortcomings and was motivated to work on them.

Experimental Design

We applied a multiple-baseline design across three word sets consisting of a baseline and a treatment phase. The study stretched across 10 school days with daily performance measurements. We did not include a maintenance phase. However, two weeks after the last probe, the second author went back to the school and tested Lea again to determine if she was able to maintain her performance. All sessions were delivered in a 1:1 format with an instructor (the second author) and the student.

Dependent Variable

We selected 15 nouns from a collection of words that are most commonly used in the German language, but difficult to spell (see www.duden.de/Liste-der-rechtschreiblich-schwierigen-Woerter). To be included, a word had to consist of a maximum of seven letters (the complete list is available from the authors upon request). Lea was dictated the 15 problem nouns. The number of correctly spelled words served as the dependent variable. Every day, the sequence in which the nouns were dictated varied randomly. To ensure reliability, about 30% (27.27%) of all dictations were independently reviewed by a research assistant who was blind to the purpose of the study. The interrater-agreement reached 100%.

Procedures

Before the intervention started and the PESTS strategy was introduced, the second author played a game with Lea for approximately 15 minutes. This was done to control non-specific intervention effects and increase the internal

validity of the study. After play time was over, the second author dictated the 15 nouns. No feedback was given on Lea's performance. At the beginning of the first treatment session, the second author presented Lea with the first set of five words on an 8.27 x 11.69-inch sheet of cardboard (the selection was drawn randomly from the pool of 15 nouns). She then introduced the corresponding mnemonic pictures along with the associated sentences (all materials are available from the authors upon request). Subsequently, the second author described what was happening in each picture, put it aside, thought out loud about the sentences and the first letters in each word, and then wrote down the corresponding noun. Next, she asked Lea to repeat this procedure. The second author intervened whenever the student needed assistance. Attending to each of the five nouns of the first word set in the described manner lasted for approximately 15 minutes. Finally, Lea's performance was evaluated as outlined above.

At the beginning of the second session, the second author went over any spelling errors the student had committed the day before and discussed the correct responses with her. Afterwards, she went over the five words for the day, first demonstrating how to use the strategy and then letting Lea try it out herself. The following sessions were mainly dedicated to rehearsing the nouns that she had already learned to spell. For the second and third word sets, the procedures were carried out in the same way as for the first. The more words Lea spelled correctly, the less time was spent rehearsing them. Instead, the intervention focused on the nouns she still had trouble spelling.

Treatment sessions lasted between 15 and 25 minutes (this does not include the time spent on evaluating past performance). Naturally, practicing three word sets at the end of the intervention phase lasted longer than practicing one or two. However, as soon a series of five nouns was given specific attention twice in a row, Lea picked up on them pretty quickly and did not need to go over the pictures and sentences any more. A follow-up measurement was carried out two weeks after the treatment.

Results

Descriptive statistics are presented in Table 1.

Table 1. *Descriptive Statistics for the Three Word Sets*

	Word Set 1	Word Set 2	Word Set 3
Min. A Phase	0	0	0
Min. B Phase	4	5	4
Max. A Phase	0	1	0
Max. B Phase	5	5	5
M A Phase	0.00	0.25	0.00
M B Phase	4.71	5.00	4.60
SD A Phase	0.00	0.50	0.00
SD B Phase	0.49	0.00	0.55

As illustrated in Figure 1, Lea was not able to spell any of the 15 problem words correctly during baseline conditions. The only exception was one noun that she got right once before the intervention. As soon as the PESTS strategy was introduced, Lea's performance reached the maximum of five correctly spelled words for Sets 1 and 2. For Set 3, she instantly got four nouns correct. At the end of the treatment, Lea was able to spell out all 15 words without making a mistake. Because we conducted only one follow-up probe (instead of planning for a maintenance phase with multiple measurements), the results are not included in the tables and the figure. Fortunately, Lea remembered the spelling of every single word and was able to write all of them down correctly, achieving a perfect score of 15.

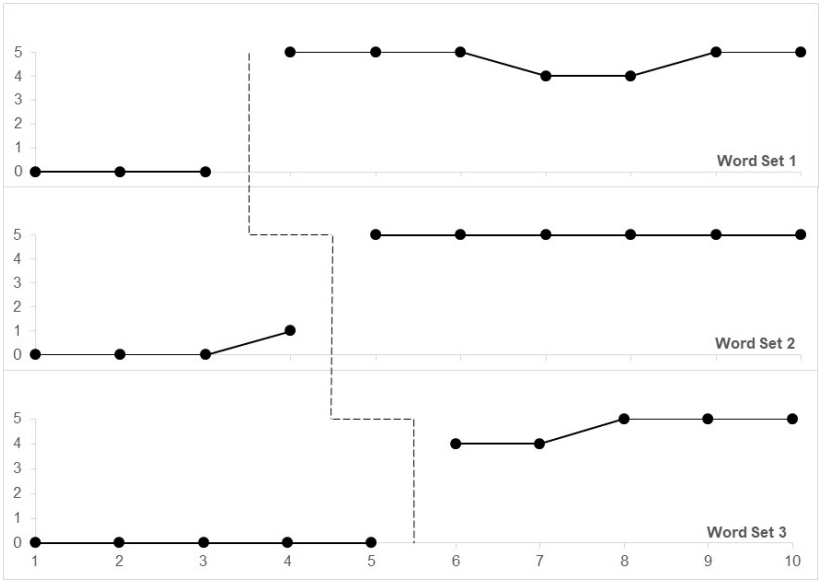

Figure 1. **Number of Correctly Spelled Words (y-Axis) on Each Day of the Study (x-Axis)**

As part of our analysis, we determined three commonly used non-overlap coefficients: percentage of non-overlapping data (PND), non-overlap of all pairs (NAP), and Tau-U (see Wolery et al., 2010). The computations were done using three online calculators: www.ktarlow.com/stats/pnd, www.singlecaseresearch.org/calculators/nap and www.ktarlow.com/stats/tau. Not surprisingly, all effect sizes reached very high values for improvements between Phases A and B. Although we collected only a small number of data points, all non-overlap measures turned out to be statistically significant (see Table 2).

Table 2. ***Overlap Indices for the Three Word Sets***

	Word Set 1	Word Set 2	Word Set 3
PND	100% (< .05*)	100% (< .05*)	100% (< .05*)
NAP	100% (< .05*)	100% (< .05*)	100% (< .05*)
Tau-U	0.82 (< .05*)	0.94 (< .01**)	0.90 (< .01**)

Discussion

The purpose of this study was to test the effects of a simple mnemonic technique designed to help students remember how to spell difficult words. Our results indicate that the strategy worked very well with the student participating in the experiment. In fact, it is remarkable how quickly she was able to spell all 15 problem words correctly. Even two weeks after the intervention, she did not make any errors. This squares well with the findings outlined in the paper by Howard et al. (2008) and confirms the great efficacy of mnemonics in general when used to help students memorize new content (Lubin & Polloway, 2016; Wolgemuth et al., 2008).

Of course, this research has some limitations. For example, the number of probes was relatively small and only one follow-up measurement was conducted. In addition, we did not measure treatment fidelity and did not capture social validity. Furthermore, the results from one short single-case study with only one participant do not allow for far-reaching conclusions.

Nevertheless, the fact that Lea picked up the words so quickly and was able to spell all of them correctly two weeks after the intervention ended is impressive. Although she learned only a very limited number of words (15), the motivational effects of such a quick and stable increase in performance must not be underestimated. Students with serious academic difficulties often stop even trying to succeed, because they have experienced too many failures in the past (Wehmeyer & Shogren, 2020). Being able to "prove" to them that they are, in fact, capable of learning fast and efficiently is usually very gratifying and an effective incentive. Given the results discussed here and in the original paper by Howard et al. (20088), strategies like PESTS should attract more attention of teachers working with struggling spellers. The intervention is easy to implement and cost-effective. By using it early with a struggling student, it can help prevent severe and lasting difficulties in the future.

This paper is the first to describe a detailed study on the effects of PESTS. Howard et al. (2008) just referred to having conducted an experiment, but never presented the particulars of their research. Thus, the knowledge base on the benefits of PESTS is small. Additional findings are needed to gain more insights into how this strategy can unfold its potential in the classroom. In our study, we presented Lea with ready-made mnemonic pictures and sentences. It would be interesting, for example, to determine to what extent students are capable of coming up with their own aids to remember the correct spelling of a word. The same goes for the opportunities that peer-tutoring might offer when using PESTS.

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