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From Print to Meaning and from Print to Sound, or How to Read Without Knowing How to Spell

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Two groups of 12-year-olds, both of normal intelligence and reading age, were compared. One group consisted of good spellers, the other of poor spellers. The two groups were equally good at reading single words and sentences. However, they differed on other reading tasks, notably with nonsense words and other tasks involving conversion of print into sound. The differences indicated that the poor spellers were proficient at going from print directly to meaning, but were impaired at converting print to sound. In contrast, the good spellers showed mastery of both aspects of reading, converting print to meaning and converting print to sound.

Poor spelling ability can coexist with good and even excellent reading ability. This has not always been recognized because the combination of deficit and skill in two highly related functions is paradoxical enough to rouse suspicions. Most people suffering from spelling problems without reading problems seem to react to this handicap as if they too consider it paradoxical: they often disguise their spelling errors by poor handwriting; they have excuses for not writing at all; they make use of dictionaries at inordinate cost of effort and time; or they hold spelling in contempt as a pedantic and trivial matter. All this makes for successful camouflage of the problem, and it is therefore difficult to estimate its incidence. Nevertheless, in some circumstances this problem can be a serious handicap.

The question that deserves some explanation is how input processes (reading) and output processes (writing) can be divorced to such an extent that one functions well, the other poorly. To explore this question a series of experiments was carried out. The subjects were normal school children, aged 12, of average intelligence and with an average reading age as estimated by a standard reading test, the Schonell graded word list (Schonell, 1942). They were also given the Schonell Spelling test (Schonell,

Table 1

Performance on Schonell Graded Word Lists (Reading and Spelling).

		Good Spellers		Poor Spellers	
		$\overline{X}$	Sd	$\overline{X}$	Sd
n = 10	Reading Qu.	105.6	(5.6)	100.7	(9.0)
n = 10	Spelling Qu.	109.0	(6.1)	89.7	(3.9)

1942). Ten good spellers and ten poor spellers were selected from the population of 12-year-olds of three secondary schools, with the restriction that they were of equal reading achievement. The achievement in reading and spelling was expressed as the quotient of reading age or spelling age and chronological age, multiplied by 100. This is shown in Table I. By definition, there was no difference on reading ability between the two groups but a significant difference on spelling ability.

The present poor spellers differ from other poor spellers who, besides spelling difficulties, also suffer from reading problems. Poor spellers of this type differ qualitatively in both their spelling and reading from the children labelled "poor spellers" here (Frith, note 1). Nelson and Warrington (1973) have compared the spelling errors of similar groups of children, diagnosed as dyslexic. They found that those children who suffered from both severe reading and spelling problems showed an underlying language deficit, while those children who suffered mainly from spelling problems and had largely overcome their reading difficulties did not show a language deficit.

Experiment I

The obvious question to ask was how well the poor spellers would be able to read their own misspellings. It seemed possible that the orthographic structure of words in general was perhaps less important to poor spellers, not only for output but also for input processes. Therefore words were taken from the Schonell Spelling test that each child had previously written after dictation. For each child individually, his last 12 misspelled words and his last 12 correctly spelled words were chosen. These words were typed, presented in random order, and the children were asked to read the words as quickly as possible. Poor spellers found their own misspellings harder to read (78%) than the correctly spelled words (94%), $p<.02$. Good spellers found both equally easy (96% to 91%). The interaction just missed significance at the .05 level.

Thus, it appears that poor spellers benefit more from intact orthographical structure than do good spellers. Spelling conventions are not an irrelevant aspect of reading for the poor spellers. This sensitivity to orthographic structure is not reflected in their awareness of whether a misspelling has occurred. The poor spellers thought that 74% of their own misspellings, as presented in the list, were actually correct, while the good spellers thought this in only 50% of the cases. This was significantly fewer.

The difference between good and poor spellers in Experiment I might have been due simply to the fact that poor spellers made more serious mistakes. Hence good spellers, too, should have found them difficult to read. To eliminate this possibility in the second experiment, both groups had to read the same misspellings. These misspelled words were presented in the context of a story because single word reading is rather atypical. Another reason for embedding the critical words in text was that many misspellings would be highly ambiguous without the aid of context cues, for example, the misspelling "ar" could stand for air, arc, an, or, etc.

Experiment II

Reading prose aloud was the basic task in the second experiment. Embedded in the text were misspelled words which the children were asked to read aloud as if correct. To ensure that all children would read for meaning a variant of the "cloze" procedure, the "maze" technique (Guthrie, 1973) was employed. At frequent points in the text there was a choice between three words of the same class, only one of which was meaningful in the context.

On the basis of a qualitative analysis of the spelling errors obtained from the children the following two contrasting types of misspellings were made up: one type largely preserves the sound, but not the visual appearance of the target word; the other type largely preserves the appearance but not the sound. The omission of just one letter in a word was considered an appropriate means of making up this second type of error.

The text was based on passages from Jules Verne's *20,000 Leagues Under The Sea.* It was divided into four paragraphs, each of exactly 150 words. There were 15 target words in each paragraph, and in addition there were 9 words (3 nouns, 3 verbs, 3 function words) which were presented as a triple choice, in terms of the maze procedure. A few examples including both phonetic and nonphonetic misspellings may illustrate the technique.

There were four versions (conditions) for each of the four paragraphs.

1) Normally typed next (baseline condition).
2) Normal text with multiple choices (correct condition).
3) Text with multiple choices and the 15 misspelled target words that preserved sound, but not appearance (phonologically similar condition).

That night about eleven o'clock, I rceived a most unexpcted

village
sky from Captain Nemo.
visit

far
"Mr Aronnax, so plenty you have only vsited the ocean depths
and

sing
by daylight. Would you care to see them in the drkness of
talk

the nght? "

"Most willingly."

flower
"I warn you, the bird will be tirng. We shall have far
way

to walk and we must clmb a big mountain.

4) Text with multiple choices and the same 15 misspelled target words that now preserved appearance, but not sound (visually similar condition).

Each child received all four paragraphs, each in one of the four conditions in random order. The specific content of a particular section would thus have no systematic influence on a particular condition. The experimenter used a check list to mark any errors while the child read aloud, and also unobtrusively timed the reading.

Results and Discussion

The time scores were unaffected by the different types of misspellings. The average time taken to read the three paragraphs with multiple choices—with or without misspellings—was 67 secs (Sd=10) by good spellers, and 100 secs (Sd=28) by poor spellers, $p<.01$. The baseline condition (normal text without multiple choices) was read significantly faster by each of the two groups. Good spellers took 56 secs (Sd=8) while poor spellers took 70 secs (Sd=19) on average, $p<.05$. Thus, the poor spellers were consistently slower readers and this slowness needs further exploration.

It was somewhat disappointing that the misspellings were almost always recognized correctly. The present groups of children were well able to cope with both the embedded misspellings and the multiple choice procedure. On average only 4% (Sd=4) of the misspellings were not recognized correctly and there was no difference between the two groups. There was however a suggestion of a group x type of misspelling interaction. Only one of the five good spellers who had made any errors at all found phonetically similar misspellings harder than visually similar ones, compared to four out of the six poor spellers who had made errors, $p=.16$. Using t-tests, it was found that poor spellers were worse than good spellers (5% vs 1% errors) with misspellings that preserved sound, but were equal (3% vs 5%) with misspellings that preserved appearance. One might speculate that poor spellers recognize words better from their visual appearance, while good spellers recognize words better from their sound. Thus, poor spellers may have a "visual" approach to reading, i.e. they convert print into meaning, but do not normally convert print into sound. This hypothesis would also be consistent with the result of the first experiment. The majority of spelling errors that both groups of children had made on the Schonell dictation test were those that preserved the sound rather than the appearance of the word. There too it was found that the poor spellers were less good at reading these misspellings. It is likely that the possibility of making use of context in the present task aided the recognition of misspelled words to such a large extent that differences in difficulty were swamped.

Experiment III

The tentative finding concerning the recognition of misspelled words was put to a further test in a proofreading task. Misspelled words were easy to read. Would the errors therefore be easily missed while proofreading? Again, two types of misspellings were embedded in text: one type of misspelling did preserve the sound of the target word (sissors for scissors), the other did not (scarely for scarcely). Unlike the previous experiment both types of errors preserved the visual appearance of the target word. This was achieved by omitting just one letter of each target word. The main reason for this matching of the stimuli in terms of visual similarity was that the effect of sound could be studied without the possibly confounding effect of appearance of misspellings. Another reason was that misspellings that are visually close to the target word would be quite difficult to detect in a proofreading situation and hence a ceiling effect would be avoided. For the same reason also, the misspelled words were placed in highly redundant phrases. Such words might again be scrutinized less and hence misspellings would be noticed less. Five-word phrases were made up for this purpose, for example:

A deep and *horse* voice.
He sharpened knives and *sissors*.
The doctor helped the *patent*.
He *scarely* knew the man.

The letter omission produced another word in half the cases, a non-word in the other half. This meant that while proofreading, it was necessary to read for meaning: scanning for misspelled words alone would result in a large number of misses.

In the previous experiment the poor spellers tended to show little effect of sound compared to the good spellers. Hence, in the present task, it would be predicted that the poor spellers should not show any difference between these two types of misspellings. If they bypass conversion into sound, which this silent reading task certainly permits, they should never "notice" that some misspellings preserve sound and some don't. A prediction for the good spellers if they do *not* avoid conversion of print to sound would be that they *should* "notice" this difference. If good spellers convert print into sound then they should miss more phonologically correct misspellings, as these preserve the sound of the target word and should therefore be more readily accepted as correct. They should miss fewer of the other misspellings since as soon as they are converted into sound, it is clear that they are incorrect.

A list of 32 phrases, all randomly mixed, was presented. Eight phrases contained no errors; 12 contained a misspelled word that preserved the sound of the target word, half of them resulting in a word, half in a non-word; 12 contained a misspelled word that did not preserve the sound of the target word, half again resulting in a word, half in a non-word. The children were given some examples and then asked to go through the list as fast as possible, marking either a cross for any word in the phrase that was wrong in any way, or a tick for all that were correct.

Results and Discussion

There was no difference between errors that resulted in words and those that did not, indicating that reading for meaning was involved, not just proofreading for misspelled words. Also, as one might expect, poor spellers missed on the whole more misspellings than good spellers. The poor spellers missed both types of error equally often, those that preserved sound (33%) and those that did not (42%). This is consistent with the hypothesis that poor spellers did not convert print into sound. For good spellers on the other hand, a very strong effect of sound was obtained. However, the direction of this effect was contrary to prediction. Surprisingly, good spellers missed fewer of the errors when the errors sounded correct (16%) and missed more when the errors sounded wrong (31%), $p<.01$.

The large effect obtained regardless of whether or not it points towards a group difference, is difficult to explain. It does not fit in with the notion that print is converted to sound first. If so, any incorrect sounding misspelling would be noticed more rather than less, as was the case here. A replication of the present task using the prose passages and misspellings of the second experiment showed again that both good and poor spellers noticed more of the correct than of the incorrect sounding misspellings. This indicated that the effect was not an artifact due to a particular set of target words and context phrases.

One explanation is based on a critical examination of the types of misspellings. They did not differ only in terms of sound, i.e., whether or not they preserved the sound of the target word. This must be so since the two types of misspellings could only be derived by taking advantage of certain peculiarities of English orthography. As Chomsky and Halle (1968) have shown, English orthography represents linguistic knowledge on different levels. In particular there is a phonological level and a morphological level. The same sound can often be represented by different letters. Which letters are chosen is then decided on a morphological basis: e.g. "sign" could be spelled sighn, sine, syne, cyne, etc. If it relates to "signature" in meaning, then its spelling must be s-i-g-n. This example of a morphological rule shows that a misspelling that preserves sound by necessity must break such rules. Thus the reason that these misspellings are noticed more, probably means that broken morphological rules are readily detected.

The other type of misspelling that did not preserve sound had been contrived by omitting one letter at a more or less random position in the word. Thus, the omitted letter was not usually critical in terms of deeper level linguistic rules. This explanation is in need of further testing and can only be put forward here very tentatively. However, regardless of the interpretation of the present result, it throws considerable doubt on the notion that the silent reading/proofreading of either poor or good spellers is characterized by conversion of letters to sound. None of the experiments involving reading for meaning gave unequivocal evidence for the hypothesis that poor spellers are less skilled than good spellers at converting letters to sound. It appears that this may well be due to the fact that good spellers, too, when reading for meaning bypass the conversion of print to sound, and thus the hypothesis could not be tested.

There has been a controversy as to whether direct access from the printed word to its meaning without an intervening conversion into sound is in fact possible. This has been reviewed for example by Allport (1977), Coltheart, et al. (1977), and by Massaro (1977). All these authors conclude that, at a minimum, there is no reason to reject the possibility of "direct visual access" from print to meaning. Moreover, there are suggestions that "phonological coding prior to meaning" may not apply to normal reading of prose by any one: by skilled or unskilled, normal or disabled readers (Snowling & Frith, note 3). With meaningful words sounds may always be derived after their meaning has been identified.

One situation where we can be sure that letter to sound conversion must occur is in the reading of nonsense words. Written nonsense words cannot be decoded into meaning, but they can be decoded into sound. If poor spellers are less skilled at converting letters to sounds, then they should be poorer than the good spellers at reading nonsense words.

Experiment IV

Twenty nonsense words were made up on the basis of words in the Schonell Reading list that were well within the reading ability of all the children. Usually just one or two letters were changed, e.g. laucer for saucer, knobbedge for knowledge. Each word selected and hence each nonsense word tested one particular grapheme-to-phoneme correspondence rule, e.g., soft c before e as in laucer, silent k before n as in knobbedge. The child's response was scored as correct if this crucial correspondence rule was correctly applied, even if the pronunciation of the whole word was not as we had anticipated, i.e., analogous to the word it was derived from. Only this scoring was used, since in many nonsense words pronunciation must be considered ambiguous. We did not want to penalize for this inherent problem and hence only scored the critical grapheme-to-phoneme rule which at least in the opinion of two judges was unambiguous.

The good spellers scored 90% correct, the poor spellers 73%, $p<.05$. Ten of 12 given rules were mastered by at least 8 out of the 10 people in the group of good spellers. The poor spellers only mastered 7 rules. This result is interesting, as one might have expected perfect performance from both groups—who had all read the base words correctly. E.g., the word "antique" was read easily by all children, but the derivation "sentique" gave considerable problems. Therefore, it was not entirely knowledge of specific grapheme-phoneme rules which enabled the children to read the words previously. Indeed it is possible to hypothesise that the words had been read without use of such rules at all.

The experiment supports the hypothesis that the poor spellers are poorer at letter-sound conversion than the good spellers. However, the finding that they mastered some of the grapheme-phoneme rules shows that they are capable of using this skill to some extent. Would the two groups also differ on other tasks where phonological coding was required, for example, when judging whether word pairs rhyme or not?

Experiment V

In order to appreciate whether two words rhyme or not, it is necessary to compare the sound of the words. If the poor spellers were less skilled or simply less practiced at converting print into sound, then they should be slower at this task than the good spellers. In contrast to reading aloud, which may well have been disadvantageous to the poor spellers in Experiment II, the rhyming task required silent reading. The sound of words in this case refers to a mental image. If an impairment was again shown then it would seem that the problem is one of internal coding and not of, say, motor programs for articulation. The material was a list of pairs of words, half of which rhymed and half of which didn't, randomly mixed together. Each rhyming pair was visually dissimilar (e.g., might—kite) while each non-rhyming pair was relatively visually similar (e.g., peat—pear). This control ensured that a rhyming judgment could not be based on graphic similarity, but had to be based on sound similarity. The children were shown some examples and asked to put a tick next to every rhyming pair and a cross next to every non-rhyming one. They were given 60 seconds to judge as many word pairs as possible. The good spellers were able to judge 36.5 pairs correctly, the poor spellers 29.1 pairs, $p<.05$. Both groups made the same number of errors (4.1 and 3.8 respectively). This means that the poor spellers were performing about as accurately as the good spellers but were slower. Their slowness in the present experiment supports the hypothesis that the poor spellers are less adept at converting print into sound than the good spellers. Moreover, it suggests that this weakness applies even when only covert sound is involved. It also suggests that the hypothesis could be extended to state that conversion to sound is impaired, at whatever stage in the reading process this conversion was required. This would also account for slower performance when reading aloud, as in Experiment II. Thus one would expect poor spellers to read more slowly than good spellers when reading aloud but not when reading silently.

Therefore, it was now necessary to test the prediction that silent reading of meaningful text would be as efficient and fast in the poor spellers as in the good spellers. If it is true that reading for meaning does not necessarily rely on letter to sound conversion, but can be described as a letter to meaning conversion, and if the poor spellers possess this skill, then they should do as well as the good spellers. Therefore, the following experiment was carried out.

Experiment VI

This task was based on a technique described by Baron (1973). The children were given a list of 10 phrases that they had to read silently as quickly as possible judging whether or not the phrases made sense. There were five of each type randomly mixed. The children were given a practice list and were asked to place a tick next to each phrase that made sense, and a cross next to each phrase that did not. The critical words in the phrases that did not make sense were all visually similar to the target word, in order to ensure a certain degree of difficulty. Examples are:

please wait for me	✓
don't forget to write	✓
bigger that a horse	×
the time war near	×

As predicted, both groups did this task equally well (23.5 sec for good spellers vs 24.2 sec for poor spellers) with equal accuracy (11% and 16% errors on average). Thus the poor spellers are indeed as fast as the good spellers when reading silently. Their apparent slowness in Experiment II may thus well have been due to the requirement of reading out loud.

The present task has been used by Baron (1973) and Baron and McKillop (1975) in an ingenious way so as to impose a particular strategy: they presented a list of phrases, all of which contained a wrong word, and hence all phrases were nonsense. However, half the phrases still sounded as if they made sense. The subjects were now instructed to tick all the phrases that sounded as if they made sense, and cross all those that did not. Below are some examples:

by her a present	✓
she was there mother	✓
a gloss of wine	×
the rain his stopped	×

The hypothesis of a weakness in sound conversion in the poor spellers would predict that they should be impaired in this task. The children were again given examples and instructed to work as fast as possible. The result was in line with the prediction: the poor spellers took 28.8 seconds to complete the task while the good spellers took 19.9 seconds, $p<.05$. The interaction of groups x conditions, based on a t-test on difference scores for both tasks was significant on the .05 level. Hence we can say that poor spellers were less efficient when conversion to sound was required compared to their normal reading strategy. Curiously, the good spellers made only 2% errors in the second condition, while the poor spellers made a similar amount as before (14%). Thus, one may wish to conclude that the good spellers were particularly efficient at this task when instructed to convert print into sound, but did not spontaneously choose this strategy.

Conclusion

The findings of the present series of experiments point to the fact that the two groups of 12-year-olds of similar reading levels but of dissimilar spelling levels compared here, differed on one specific aspect of reading. The poor spellers consistently showed weaker ability in converting letters to sounds at whatever stage in the reading process this conversion applied, whether sound was overt or covert. This weakness is decidedly not a lack of this ability, rather a lack of preference for, or an avoidance of, this aspect of reading. The other aspect of reading, the conversion of letters into meaning, was, however, much used and skillfully applied by this group. This was the case in reading meaningful words alone and in context. This shows that reading can go a long way with a preferred strategy of direct access to meaning.

The good spellers have been shown to be able to convert letters into sound very skillfully, when this was necessary for the task. This was the case with nonsense words, the rhyming judgment, the judgment of whether phrases sounded as if they made sense, and the recognition of grossly distorted words that sounded correct. On all these tasks the good spellers were superior to the poor spellers. On tasks that did not necessarily require converting letters into sounds, the two groups were similar. Thus, it seems that the good spellers are equally adept at both aspects of the reading process.

The present experiments have demonstrated that good reading ability can indeed coexist with poor spelling ability. Does this discrepancy now seem less paradoxical? In some respects the paradox has perhaps lost some of its initial implausibility. A separation of input and output processes in visible language must be postulated. It seems very likely that a similar separation would apply to spoken language. Speech perception may exceed speech production (Dodd, 1975). For the special group of children who show spelling problems without reading problems, a minor deficit in terms of input processes has been demonstrated. The question remains how the minor difficulties in the input processes can be related to the major difficulties in the output processes. The aim of the present paper was not to explore these relationships, but to demonstrate that two kinds of skilled reading must be distinguished: conversion to meaning and conversion to sound. The evidence collected here shows that normal young readers, whenever possible, prefer to go directly from print to meaning.

Reference Notes

1. Frith, U.
Spelling difficulties with and without reading difficulties. In: *Cognitive Processes in Spelling,* U. Frith (Ed.). Y.Y.: Academic Press. To appear.

2. Frith, U.
Spelling difficulties: An annotation. *Journal of Child Psychology and Psychiatry.* In press.

3. Snowling, M. & Frith, U.
Is text that only sounds correct harder to read than text that only looks correct? Submitted for publication.

References

Allport, A.
Letter and word recognition. In: P. A. Kolers, M. E. Wrolstad & H. Bouma (Eds.), *Processing Visible Language.* Conference held at Eindhoven, September 1977. To appear.

Baron, J.
Phonetic stage not necessary for reading. *Quarterly Journal of Experimental Psychology, 25,* 241-246. 1973.

Baron, J. & McKillop, B. J.
Individual differences in speed of phonetic analysis, visual analysis, and reading. *Acta Psychologica, 39,* 91-96. 1975.

Chomsky, N. & Halle, M.
The Sound Pattern of English. New York: Haper and Row. 1968.

Coltheart, M., Davelaar, E., Jonasson, J. T. & Besner, D.
Access to the internal lexicon. In: S. Dornic (Ed.), *Attention and Performance VI.* Hillsdale, N.J.: Erlbaum. 1977.

Dodd, B.
Children's understanding of their own phonological forms. *Quarterly Journal of Experimental Psychology,* 27, 165-172. 1975.

Guthrie, J. T.
Reading comprehension and syntactic responses in good and poor readers. *Journal of Educational Psychology, 64,* 241-247. 1973.

Massaro, D. W.
Reading and listening. In: P. A. Kolers, M. E. Wrolstad & H. Bouma (Eds.), *Processing Visible Language.* Conference held at Eindhoven, September 1977. To appear.

Nelson, H. E. & Warrington, K. E.
Developmental spelling retardation and its relation to other cognitive abilities. *British Journal of Psychology, 65,* 265-274. 1974.

Schonell, F. J.
Backwardness in the Basic Subjects. London: Oliver & Boyd. 1942.

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