

Decoding, Reading, and Reading Disability

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To clarify the role of decoding in reading and reading disability, a simple model of reading is proposed, which holds that reading equals the product of decoding and comprehension. It follows that there must be three types of reading disability, resulting from an inability to decode, an inability to comprehend, or both. It is argued that the first is dyslexia, the second hyperlexia, and the third common, or garden variety, reading disability.

THE ROLE OF decoding in reading and reading disability has long been controversial. On the one hand, some of us (e.g., Fries, 1962; Gough, 1972; Rozin & Gleitman, 1977) have maintained that the ability to decode is at the core of reading ability, such that learning to decode is tantamount to learning to read. But others have argued that decoding ability is at most an epiphenomenon, and that instruction in decoding may distort, if not actually impede, the acquisition of literacy (e.g., Goodman, 1973; Smith, 1982).

In this paper, we will not try to settle the debate. The issue is surely an empirical one, and it should be settled by experiment, not polemic. We believe that it has not been settled because of some persistent conceptual confusions. Our intent here is to try to state our case more clearly, in the hope that its truth or falsity might be decisively settled by future research.

Process versus Instruction

We begin by noting that the issue we wish to discuss is *not* that of the place of decoding in reading instruction. The issue of whether and how to teach decoding (the great debate of Chall, 1967) is certainly interconnected with the issue of the role of decoding in skilled reading and reading disability, but it is not the same issue.

If decoding plays a central role in the reading process, then it seems sensible to give it a comparable place in instruction, while if decoding skill is merely epiphenomenal, then it is hard to see why it should be stressed in the teaching of reading. It is important to recognize, though, that the two questions are logically distinct. For example, if we were to learn that decoding plays no role at all in skilled reading, it does not follow that we should ignore decoding in reading instruction. It might well be that direct instruction in synthetic phonics is the fastest route to skilled reading. Or, to take another example, from the fact that reading instruction with a code emphasis appears to be superior to instruction with a meaning emphasis (Chall, 1967), we cannot conclude that decoding plays any role in skilled reading.

The question of the role of decoding in reading and that of its place in reading instruction are surely related, but they are distinct questions. We are here concerned only with the first, the question of the connection between decoding skill and reading ability.

The Definition of Decoding Skill

To consider this question, we must first say what we mean by decoding, for we find that the term means different things to different people: Some equate it with

"sounding out," others with (context-free) word recognition. Our position is closer to the latter, for we believe that sounding out is (at most) only a primitive form of decoding (we doubt even this; see Gough & Hillinger, 1980), and we believe that the skilled decoder is exactly the reader who can read isolated words quickly, accurately, and silently. Yet we are reluctant to equate decoding with word recognition, for the term decoding surely connotes, if not denotes, the use of letter-sound correspondence rules. We have argued (Gough, Juel, & Roper-Schneider, 1983) that beginning readers do not use such rules, and we must concede that expert readers may not always do so (Gough, 1984). But we firmly believe that word recognition skill (in an alphabetic orthography) is fundamentally dependent upon knowledge of letter-sound correspondence rules, or what we have called the orthographic cipher (Gough & Hillinger, 1980).

As spelling reformers have long noted, knowledge of this cipher is not sufficient for word recognition in English, for it will not enable one to read irregular words like *pint* and *yacht*, or even orthographically ambiguous words like *bead* and *bread* and *steak* and *area*. To concede that the knowledge of the cipher is not sufficient for word recognition, however, is not to concede that it is unnecessary; to the contrary, those of us who give allegiance to decoding hold that knowledge of English letter-sound correspondence rules is necessary to enable the reader to recognize the majority of English words.

In what follows, then, we will assume that decoding ability varies directly with knowledge of the spelling-sound correspondence rules of English. The purest measure of this is the ability to pronounce (or silently apprehend the pronunciation of) pseudowords like *clard*, or *phim*, or *stenk*, and it is the role of this ability in reading which we hope to pinpoint in the following discussion.

A Simple View of Reading

What, then, is claimed for decoding by its advocates? Our adversaries sometimes seem to think that the proposition we defend is that decoding is equivalent to reading, which they then try to refute by saying "I can decode Italian, but I can't read a word of it," or, "I've seen children who can decode anything you put in front of them, but they don't understand a word of what they're reading."

No reasonable proponent of decoding has ever equated decoding and reading, for we recognize that what is decoded must also be understood. Decoding is clearly not sufficient for reading. But at the same time we argue that decoding is necessary for reading, for if print cannot be translated into language, then it cannot be understood.

The simplest view of the relation between decoding and reading which anyone has ever seriously entertained is this: Reading equals the *product* of decoding and comprehension, or $R = D \times C$, where each variable ranges from 0 (nullity) to 1 (perfection). We trust it is clear that by comprehension we mean, not reading comprehension, but rather *linguistic* comprehension, that is, the process by which,

given lexical (i.e., word) information, sentences and discourses are interpreted.

Proponents of decoding are quite willing to concede that if there is no comprehension, then reading is not taking place; if $R = D \times C$ and $C = 0$, then $R = 0$. So the fact that someone can decode but fail to read a language which they do not know is far from an embarrassment to us; rather, it is exactly what we would predict. Decoding is not sufficient; comprehension is also necessary.

At the same time, we argue that the converse holds as well: Comprehension is not sufficient, for decoding is also necessary. Knowing a language does not suffice to make one literate; the average 5-year old is living proof. Without the ability to decode, no amount of linguistic comprehension will make a reader; if $R = D \times C$ and $D = 0$, then $R = 0$, whatever the value of C .

It is this simple view, that $R = D \times C$, which should be the focus of the debate over decoding. It offers considerable meat for debate, for it has a number of testable implications. For example, the simple view clearly asserts that reading ability should be predictable from a measure of decoding ability (e.g., the ability to pronounce pseudowords) and a measure of *listening* comprehension.

There is abundant evidence that decoding and comprehension do make separate contributions to reading ability. Using multiple regression, a number of investigators (e.g., Curtis, 1980; Stanovich, Cunningham, & Feeman, 1984) have shown that pseudoword reading and listening comprehension make independent contributions to silent reading comprehension. But this shows only that some linear combination of the two is a better predictor than either alone. The simple view makes the much stronger claim that their *product* is superior to even this (i.e., that $D + C + [D \times C]$ will correlate with R better than $D + C$). The difficulty one faces in testing this prediction is that in most data sets (e.g., Stanovich, Cunningham, & Feeman, 1984; Stanovich, personal communication), the linear combination of decoding and listening comprehension predicts reading so well that there is no room for improvement due to the product.

Implications for Reading Disability

Perhaps the more interesting implication of the simple view, though, concerns reading *disability*. According to the simple view, reading ability can result only from the combination of decoding and comprehension. But reading disability could result in three different ways: from an inability to decode, an inability to comprehend, or both.

We suggest that all three forms do exist. We propose that the first is what is usually called *dyslexia*, the second what is usually called *hyperlexia*, and the third we call *garden variety* reading disability.

Dyslexia

The existence of a specific reading disability (that is, a seemingly inexplicable deficiency in reading alongside nor-

mal or superior achievement in other areas) has been noted for nearly a century. Once named *congenital word blindness* (Hinshelwood, 1900; Morgan, 1896) or *strephosymbolia* (Orton, 1928), it has come to be called (developmental) *dyslexia*. There has been spirited debate over whether dyslexia constitutes a medical disorder with a neurological basis (Downing & Brown, 1967; Franklin, 1962). But in current usage, dyslexia is defined solely by exclusion: The dyslexic is an individual who has failed to learn to read despite normal intelligence and sensory function, adequate opportunity for learning, and an absence of severe neurological or physical disability, emotional or social problems, or socioeconomic disadvantage (Vellutino, 1979). There can be no doubt that such individuals exist.

Literally hundreds of studies have been conducted in pursuit of the cause of dyslexia (Benton & Pearl, 1978; Vellutino, 1979). Many causes have been postulated, ranging from incomplete cerebral lateralization (Orton, 1928) through dysfunction in intersensory integration (Birch & Belmont, 1964) or temporal sequencing (Bakker, 1972), to verbal processing (Vellutino, 1979). Evidently in despair of finding a unitary cause, a number of scholars are now searching for subtypes (e.g., Doehring, Trites, Patel, & Fiedorowicz, 1981).

We take no position on whether there is one or more ultimate causes of dyslexia. But we suggest that there is a common denominator in every case of dyslexia, a deficit which could well stand as the *proximal* cause of the disorder. This is an inability to decode.

What we propose is that every dyslexic is a poor decoder. Obviously, we have not seen every dyslexic. But two major studies have found dyslexic readers to have not merely weak, but almost nonexistent, decoding skills. In the first of these, Firth (1972) asked large groups of average and poor readers, all of average intelligence, to read a list of 170 nonsense words. His average readers "sailed through" the test, achieving an average of 118 correct. In contrast, the poor readers averaged only 35, and the worst of them "could not produce any pronunciation at all for these nonsense words" (Firth, 1972, p. 123).

In a similar vein, Vellutino (1979) administered a test of phonics skills to 20 dyslexic and 20 normal readers, matched in intelligence, in each grade from 2 through 6. The test consisted of 35 three- and four-letter monosyllabic pseudowords, like *vox* and *nime* and *choo*. Vellutino's normal second graders correctly pronounced half (17.50) of the pseudowords, and the normal readers' scores increased to 25.45 by the sixth grade. In contrast, his poor (dyslexic) readers averaged a mere 2.75 in the second grade, increasing to only 14.30 in the sixth. What this means is that the sixth grade dyslexics (to say nothing of their younger counterparts) did not yet even know all of the simplest letter-sound correspondences.

These studies (see also Seymour & Porpodas, 1980; Snowling, 1980) provide clear evidence that dyslexics are seriously deficient in decoding skill. We submit that one need look no further for the answer to why they cannot read. This is not to say that we claim to have identified the

ultimate cause of dyslexia; for this, one would have to push the question one step back and ask why they cannot decode. We suspect that the answer to this is that they lack phonemic awareness (Gough & Hillinger, 1980), but this only raises the further question of why that might be. The ultimate answer to the question may well be biological, for there is certainly evidence of both a genetic linkage (Smith, Kimberling, Pennington, & Lubs, 1983) and abnormal cerebral anatomy (Galaburda & Kemper, 1979) in dyslexia. But we submit that the simple view of reading provides an adequate immediate answer to the question of why dyslexics cannot read: It is because they cannot decode.

Hyperlexia

Skill in decoding is usually accompanied by skill in comprehension (Curtis, 1980; Perfetti & Hogaboam, 1975), but exceptions to this rule have long been noted (Russell & Goldsbury, 1845). In recent years, this condition (i.e., superior skill in decoding accompanied by average or even inferior comprehension) has been labeled *hyperlexia* (Huttenlocher & Huttenlocher, 1973; Silberberg & Silberberg, 1967, 1968, 1971). The existence of this condition is taken by some to show that since skill in decoding need not be accompanied by skill in reading, decoding cannot be crucial to reading.

But as we have observed, even the simple view of reading does not claim that decoding is sufficient for reading, only that it is necessary. Decoding is only a step toward comprehension, for after print is decoded, it must be understood. The simple view does not assert that perfection in decoding will lead to perfection in reading. Rather, perfection in decoding will make you read exactly as well as you can listen: If $R = D \times C$ and $D = 1$, then $R = C$.

Happily, Healy's (1982) recent study of hyperlexia presents the data necessary to test this prediction. Healy describes 12 children, each of whom showed early and exceptional skill in decoding accompanied by average or inferior comprehension: Their mean chronological age was 8.2 years, while their mean age equivalent in reading comprehension was only 6.3 years. Thus these superior decoders were inferior readers, and Healy takes this to suggest that "advanced development of decoding skills may actually impede the acquisition of (*reading*) comprehension abilities" (Healy, 1982, p. 337). Fortunately, Healy also measured their age equivalent in listening comprehension; this was 6.0 years. Thus these hyperlexic children appeared to read almost exactly as well as they listened, which is exactly what the simple view would predict.

It would seem, then, that hyperlexia does not present a difficulty for the simple view of reading, but instead provides strong support for it.

Garden Variety Reading Disability

The existence of dyslexia, on the one hand, and hyperlexia, on the other, shows that skill in comprehension need not be accompanied by skill in decoding, and vice

versa. As we have noted, however, they usually do go together: The good decoder tends to be a good comprehender, and the poor decoder a poor one (Curtis, 1980; Perfetti & Hogoboom, 1975). Given this, the simple view yields the trivial prediction that most poor readers will be deficient in *both* decoding and comprehension, and this is surely confirmed by common experience. But it also yields another prediction which is, we think, not so trivial.

In the general population, D and C are positively correlated. But note that if $R = D \times C$, then within the reading disabled population, decoding and comprehension should be *negatively* correlated, for to achieve a low score on reading, a skilled decoder must achieve a low score on comprehension, and vice versa. It should be clear that dyslexia and hyperlexia themselves offer instances of such a negative correlation. These disorders are striking just because they are exceptions to the rule that skill in decoding and skill in comprehension go together. But note that the dyslexic, a poor decoder, is a (relatively) skilled comprehender, while the hyperlexic, a skilled decoder, is a poor comprehender; as one factor goes up, the other must go down.

This, though, is mere hindsight; we already knew that dyslexia and hyperlexia existed. Much more importantly, the simple view predicts that if we were to examine a population of disabled readers (defined only as those deficient in reading achievement), we should find a correlation between decoding and comprehension that is just the opposite of that found in the general population.

The only data we have found which bear on this prediction are provided by Olson, Kliegl, Davidson, and Foltz (1985), who asked 41 younger readers (age less than 11.5 years) and 40 older ones (age greater than 14.5 years) to decide which of two pseudowords (e.g., *caik*, *dake*) "sounded like a common word." Responses were measured in terms of speed and accuracy. The authors called this *phonological skill*; we take it to be an index of D . They also administered the WISC-R to each subject and obtained from this a score on Kaufman's verbal factor (i.e., a single factor which Kaufman, 1975, found to underlie the vocabulary, information, similarities, and comprehension subtests); we consider this a reasonable estimate of C .

Olson et al. (1975) reported that the correlation between Kaufman's verbal factor and phonological skill (i.e., C and D) was significantly negative ($r = -.28$) for the older subjects, and negative ($r = -.18$) though not significant for the younger ones. Using a measure of accuracy alone for the younger group (i.e., their ability simply to pronounce the correct pseudoword), a significantly negative correlation ($r = -.28$) was also obtained with this group. These correlations are not large. But they are significant and in the opposite direction from what we know to obtain in the general population. More data are clearly needed, but we take this to be striking, if tentative, confirmation of the simple view of reading.

The simple view asserts only that both decoding and comprehension are essential to reading. This may be wrong: It may be that there are individuals who can both

decode and listen who cannot read, individuals who can do one but not the other and still read, or even individuals who can neither decode nor listen yet still read with understanding. The existence of any such individuals will

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falsify the simple view. Thus, while it may seem trivial, the simple view makes a strong claim.

Probably the safest prediction of the four is the last; we doubt that even our fiercest adversaries would spend their time looking for skilled readers who could neither decode nor listen. The other three categories, however, should not be readily conceded. The existence of a skilled listener who can read without knowing a single spelling-sound correspondence rule seems to us quite imaginable if reading is only a matter of psycholinguistic guessing (Goodman, 1967); the existence of a skilled decoder who can read well without good listening comprehension seems much less likely. But the most vulnerable quadrant of the simple view may well be the first: that skilled decoding combined with skilled listening must produce literacy.

A number of writers (e.g., Rubin, 1980) have argued that reading is fundamentally different from listening, that reading requires a whole new repertoire of skills different from those required for listening. At one level, even advocates of the simple view must agree (e.g., reading requires a sequence of eye movements presumably irrelevant to listening). The core of the simple view, though, is essentially the denial of this claim: The simple view presumes that, once the printed matter is decoded, the reader applies to the text exactly the same mechanisms which he or she would bring to bear on its spoken equivalent. This is clearly a claim that can be tested empirically: It would be falsified if Rubin (or anyone else) would show us someone who could decode and listen, yet could not read.

Conclusion

We conclude with the assertion that reading skill is adequately described as the product of decoding and comprehension. We have tried to show that the evidence known to us is consistent with this simple view. We suspect that the position we have proposed will appear obvious to those who agree with us, but preposterous to our opponents. If so, we hope the issue will be joined. 🙏

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