Reading as Reasoning: A Study of Mistakes in Paragraph Reading

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It seems to be a common opinion that reading (understanding the meaning of printed words) is a rather simple compounding of habits. Each word or phrase is supposed, if known to the reader, to call up its sound and meaning and the series of word or phrase meanings is supposed to be, or be easily transmuted into, the total thought. It is perhaps more exact to say that little attention has been paid to the dynamics whereby a series of words whose meanings are known singly produces knowledge of the meaning of a sentence or paragraph.

It will be the aim of this article to show that reading is a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relations one to another, the selection of certain of their connotations and the rejection of others, and the cooperation of many forces to determine final response. In fact we shall find that the act of answering simple questions about a simple paragraph like the one shown below includes all the features characteristic of typical reasonings.

J

Read this and then write the answers to 1, 2, 3, 4, 5, 6, and 7. Read it again as often as you need to.

In Franklin, attendance upon school is required of every child between the ages of seven and fourteen on every day when school is in session unless the child is so ill as to be unable to go to school or some person in his house is ill with a contagious disease, or the roads are impassable.

1. What is the general topic of the paragraph?

.....

2. On what day would a ten-year-old girl not be expected to attend school?

.....

3. Between what years is attendance upon school compulsory in Franklin?

.....

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4. How many causes are stated which make absence excusable?

.....

5. What kind of illness may permit a boy to stay away from school, even though he is not sick himself?

.....

6. What condition in a pupil would justify his non-attendance?

.....

7. At what age may a boy leave school to go to work in Franklin?

.....

Consider first the following responses which were found among those made to Questions 1, 2, 5 and 6 above by two hundred pupils in Grade 6. (All are quoted exactly save that capitals are used at the beginning here regardless of whether the pupils used them.)

		Percent	*Number per thousand*
J 1.	Unanswered	18	180
	Franklin	4½	45
	In Franklin	1	10
	Franklin attendance	1	10
	Franklin School	1½	15
	Franklin attending school	1	10
	Days of Franklin	½	5
	School days of Franklin	½	5
	Doings at Franklin	1	10
	Pupils in Franklin	½	5
	Franklin attends to his school	½	5
	It is about a boy going to Franklin	½	5
	It was a great inventor	½	5
	Because its a great invention	½	5
	The attendance of the children	½	5
	The attendance in Franklin	½	5
	School	7½	75
	To tell about school	½	5
	About school	4	40
	What the school did when the boy was ill	½	5
	What the child should take	½	5
	If the child is ill	2	20
	How old a child should be	½	5
	If the child is sick or contagious disease	½	5
	Illness	1	10
	On diseases	½	5
	Very ill	3	30
	An excuse	2	20
	The roads are impassable	1	10
	Even rods are impossible	½	5
	A few sentences	½	5
	Made of complete sentences	½	5
	A sentence that made sense	½	5
	A group of sentences making sense	½	5
	A group of sentences	3	30
	Subject and predicate	½	5

		Percent	Number per thousand
	Subject	½	5
	The sentence	½	5
	A letter	½	5
	Capital	5½	55
	A capital letter	½	5
	To begin with a capital	2	20
	The first word	½	5
	A general topic	½	5
	Good topic	½	5
	Leave half an inch space	2½	25
	The heading	½	5
	Period	½	5
	An inch and a half	½	5
	An inch and a half capital letter	½	5
	The topic is civics	½	5
	The answer	½	5
J 2.	Unanswered	6	60
	Unless the child is so ill as to be unable to go to school	41	410
	Unless the child is unable to go to school	½	5
	Unless she is ill or the roads are impassable	1	10
	Roads are impassable	1	10
	When his baby or brother have some kind of disease	1	10
	When a parent is ill	½	5
	If her father or mother died	½	5
	On her birthday	6½	65
	On her fourteenth birthday	½	5
	On every day	4	40
	On any day	½	5
	Expected every day	1½	15
	On Monday and for 5 days a week	½	5
	On Monday	1	10
	On Friday	1	10
	When school is in session	1	10
	The beginning of the term	½	5
	Fourteen year	½	5
	Age 11	½	5
	She is allowed to go to school when 6 years	½	5
	A very bad throat	½	5
	When better	½	5
J 5.	Unanswered	2	20
	If mother is ill	5½	55
	Headache, ill	½	5
	A sore neck	½	5
	Headache, toothache or earache	½	5
	When a baby is sick	½	5
	Playing sickness	½	5
	Serious	½	5
	When the roads cannot be used	½	5
	Contagious disease, roads impassable	1½	15
	He cannot pass the hall	½	5
	A note	½	5

		Percent	*Number per thousand*
J 6.	Unanswered	15	150
	Ill with a contagious disease	5	50
	Seven years old	½	5
	By bringing a note	6	60
	When going with his mother to his cousin	½	5
	Is to go his mother	½	5
	When he is well and strong	½	5
	To have a certificate from a doctor that the disease is all over	½	5
	Somebody else must have a bad disease	½	5
	Torn shoes	½	5
	Neat attendance	½	5
	When he acts as if he is innocent	½	5
	Being good	½	5
	By being early	½	5
	Get up early	½	5
	Come to school	1½	15
	Be at school every day	½	5
	If he lost his lessons	½	5
	Illness lateness or truancy	½	5
	A bad boy	½	5
	By not going to school	½	5
	None	½	5
	Not sick no condition and mother not ill	½	5
	Not very good	½	5
	When you come you get your attendance marked	½	5
	Of being absent	½	5
	His attendance was fair	½	5
	Truant	1	10
	If some one at his house has a contagious disease	6½	65
	When roads	½	5
	If he was excused	½	5
	Not smart	½	5
	If his father or mother died	½	5
	By not staying home or playing hookey	½	5

In general in this and all similar tests of reading, the responses do not fall into a few clearly defined groups—correct, unanswered, error No. 1, error No. 2, and so on. On the contrary they show a variety that threatens to baffle any explanation. We can, however, progress toward an explanation, by using the following facts and principles:

In correct reading (1) each word produces a correct meaning, (2) each such element of meaning is given a correct weight in comparison with the others, and (3) the resulting ideas are examined and validated to make sure that they satisfy the mental set or adjustment or purpose for whose sake the reading was done. Reading may be wrong or inadequate (1) because of wrong connections with the words singly, (2) because of over-potency or under-potency

of elements, or (3) because of failure to treat the ideas produced by the reading as provisional, and so to inspect and welcome or reject them as they appear.

Everybody, of course, understands that (1) plays a part but it is not so clearly understood that a word may produce all degrees of erroneous meaning for a given context, from a slight inadequacy to an extreme perversion.

Thus *Franklin* in the paragraph quoted (J) varies from its exact meaning as a local unit through degrees of vagueness to meaning a man's name (as in "Franklin attends to his school" as a response to question 1), or to meaning a particular personage (as in "It was a great inventor" as a response to question 1). Thus *Contagious* in paragraph J permits responses to question 5 (What kind of illness may permit a boy to stay away from school, even though he is not sick himself?) ranging from "Scarlet fever, chicken pox, measles or diphtheria," through "Scarlet fever," "headache," "Serious," "Hay fever," "Pimple," to "Contagious or roads impassable," and "All kinds of disease." Thus *Paragraph* in J 1 when over-potent produces responses ranging from "A group of sentences making sense" through "A group of sentences," and "A few sentences," to "The sentence," "Subject and predicate," "Begin with a capital," "A letter," and "Commas and periods."

In particular, the relational words, such as pronouns, conjunctions and prepositions, have meanings of many degrees of exactitude. They also vary in different individuals in the amount of force they exert. A pupil may know exactly what *though* means, but he may treat a sentence containing it much as he would treat the same sentence with *and* or *or* or *if* in place of the *though*.

The importance of the correct weighting of each element is less appreciated. It is very great, a very large percentage of the mistakes made being due to the over-potency of certain elements or the under-potency of others.

Consider first the over-potency of elements in the questions. The first question about paragraph J was, "What is the general topic of the paragraph?" A large group of answers show over-potency of *paragraph*. Such are those quoted above to show variation in the understanding of the word. We also find an over-potency of *top* (in topic) combined with that of paragraph, resulting in such responses as: "Leave a half-inch space," "An inch and a half," "An inch and a half capital letter," "The topic of paragraph is one inch in."

The second question was: "On what day would a ten-year-old girl not be expected to attend school?" We find under-potency of *not* resulting in answers like "When school is in session" or "Five days a week." We find under-potency of *day* resulting in responses like "She is allowed to go to school when 6 years," "Age 11," and "Fourteen years."

We find over-potency of *day* shown by "Monday," "Wednesday," and "Friday"; of *ten-year-old girl* in "The ten-year-old girl will be 5 a."

Ten-year-old is over-potent in an interesting way, namely, in the very large number of responses of "On her birthday." Over-potency of *Attend school* seems to be one part of the causation of "To attendance with Franklin," "Ever morning at half past 8," "She should," and "Because he did learn."

Consider next over- and under-potency of the words or phrases in the paragraph. The following list of responses shows that each of ten words taken from the paragraph is over-potent so as to appear clearly influential in the response to each of the first three questions (and in seven of the cases to the fourth question as well). These occur within five hundred responses made by children within grades 5 to 8. Cases of under-potency would be still easier to collect.

The questions, I may remind the reader, were as follows:

1. What is the general topic of the paragraph?
2. On what day would a ten-year-old girl not be expected to attend school?
3. Between what years is attendance upon school compulsory in Franklin?
4. How many causes are stated which make absence excusable?

(The numbers refer to the question to which the words were the response.)

Franklin	1. Franklin. 1. Franklin and the diseases. 1. Franklin topic. 2. Franklin. 3. Because it is a small city. 3. Franklin was in school 141 years.
attendance	1. Attendance. 2. To attendance with Franklin. 3. In Franklin attendance upon school is required. Attending school 130 days.
school	1. School. 1. They must know their lessons. 2. In the beginning of school. 3. School in session. 3. In the years of school.
seven..	1. Seven and fourteen. 1. How old a child should be. 2. He should attend school at 7 years. 2. Between seven and fourteen. 3. Seven years. 4. Under seven.
fourteen	1. Every child between seven and fourteen. In Franklin how old they are.

	2. Fourteenth of every day. 2. Fourteen years.
	3. Fourteen years. 3. Fourteen.
	4. 7 to 14.
every	1. Every child.
	2. Expected every day. 2. On every day.
	3. Every year. 3. Every child between fourteen or thirteen.
	4. Every day.
ill	1. Illness. 1. Very ill. 1. If the child is ill.
	2. Ill. 2. A very bad throat.
	3. He cannot go to school unless ill.
	4. When child is ill. 4. Must be sick.
contagious	1. Contagious disease.
	2. If she is sick or has a contagious disease.
	3. Contagious disease.
	4. Contagious disease.
disease	1. Fever. 1. About disease.
	2. Often sick.
	3. Unless ill or contagious disease. 3. Disease.
	4. A terrible disease going out. 4. Because when a boy has disease.
impassable	1. The roads are impassable. 1. Snow.
	2. When roads are impassable.
	3. Seven to fourteen years or the roads are impassable.
	4. Or the roads are impassable.

To make a long story short, inspection of the mistakes shows that the potency of any word or word group in a question may be far above or far below its proper amount in relation to the rest of the question. The same holds for any word or word group in the paragraph. Understanding a paragraph implies keeping these respective weights in proper proportion from the start or varying their proportions until they together evoke a response which satisfies the purpose of the reading.

Understanding a paragraph is like solving a problem in mathematics. It consists in selecting the right elements of the situation and putting them together in the right relations, and also with the right amount of weight or influence or force for each. The mind is assailed as it were by every word in the paragraph. It must select, repress, soften, emphasize, correlate and organize, all under the influence of the right mental set or purpose or demand.

Consider the complexity of the task in even a very simple case such as answering question 6 on paragraph D, in the case of children of grades 6, 7 and 8 who well understand the question itself.

John had two brothers who were both tall. Their names were Will and Fred. John's sister, who was short, was named Mary. John liked Fred better than either of the others. All of these children except Will had red hair. He had brown hair.

6. Who had red hair?

The mind has to suppress a strong tendency for *Will had red hair* to act irrespective of the *except* which precedes it. It has to suppress a tendency for *all these children . . . had red hair* to act irrespective of the *except Will.* It has to suppress weaker tendencies for *John, Fred, Mary, John and Fred, Mary and Fred, Mary and Will, Mary Fred and Will,* and every other combination that could be a "*Who,*" to act irrespective of the satisfying of the requirement "had red hair according to the paragraph." It has to suppress tendencies for John and Will or brown and red to exchange places in memory, for irrelevant ideas like *nobody* or *brothers* or *children* to arise. That it has to suppress them is shown by the failures to do so which occur. The *Will had red hair* in fact causes one-fifth of children in grades 6, 7 and 8 to answer wrongly,* and about two-fifths of children in grades 3, 4 and 5. Insufficient potency of *except Will** makes about one child in twenty in grades 6, 7 and 8 answer wrongly with "all the children," "all," or "Will Fred Mary and John."

Reading may be wrong or inadequate because of failure to treat the responses made as provisional and to inspect, welcome and reject them as they appear. Many of the very pupils who gave wrong responses to the questions would respond correctly if confronted with them in the following form:

Is this foolish or is it not?
The day when a girl should *not* go to school is the day when school is in session.
The day when a girl should not go to school is the beginning of the term.
The day etc. . . . is Monday.
The day is fourteen years.
The day is age eleven.
The day is a very bad throat.
Impassable roads are a kind of illness.
He cannot pass the ball is a kind of illness.

They do not, however, of their own accord test their responses by thinking out their subtler or more remote implications. Even very gross violations against common sense are occasionally passed, such as letting Mary give Tom a blue dog, or giving "Thought the man fat out" as an answer to I 1. Usually, however, the irrelevance or inconsistency concerns something in the question or the paragraph and the failure to heed it is closely akin to the underpotency of certain elements.

I.

Nearly fifteen thousand of the city's workers joined in the parade on September seventh, and passed before the hundred thousand cheering spectators.

There were workers of both sexes in the parade, though the men far outnumbered the women.

1. What is said about the number of persons who marched in the parade?

* Some of these errors are due to essential ignorance of "except," though that should not be common in pupils of grade 6 or higher.

It thus appears that reading an explanatory or argumentative paragraph in his text-books on geography or history or civics, and (though to a less degree) reading a narrative or description, involves the same sort of *organization and analytic action of ideas as occur in thinking of supposedly higher sorts.* This view is supported by the high correlations between such reading and verbal completion tests, Binet-Simon tests, analogies tests and the like. These correlations, when corrected for attenuation, are probably, for children of the same age, as high as +.80.

It appears likely, therefore, that many children fail in certain features of these subjects not because they have understood and remembered the facts and principles but have been unable to organize and use them; or because they have understood them but have been unable to remember them; but because they never understood them.

It appears likely also that a pupil may read fluently and feel that the series of words are arousing appropriate thoughts without really understanding the paragraph. Many of the children who made notable mistakes would probably have said that they understood the paragraph and, upon reading the questions on it, would have said that they understood them. In such cases the reader finds satisfying solutions of those problems which he does raise and so feels mentally adequate; but he raises only a few of the problems which should be raised and makes only a few of the judgments which he should make. Thus one may read paragraph I with something like the following actual judgments:

Fifteen thousand did something—there was a parade—September seventh was the day—there were two hundred thousand something—there was cheering—workers were in the parade—both sexes in the parade—the men outnumbered the women.

Contrast these with the following which may be in the mind of the expert reader:

Nearly fifteen thousand—not quite, but nearly—of the city's workers— people who worked for a living—joined in the parade—a big parade of nearly 15,000—on September seventh—the parade was in the fall—they passed before two thousand hundred cheering spectators—two hundred thousand saw the parade—they cheered it—

there were workers of both sexes—there were men workers and women workers in the parade—the men far outnumbered the women. Many more men than women were in the parade.

In educational theory, then, we should not consider the reading of a text-book or reference as a mechanical, passive, undiscriminating task, on a totally different level from the task of evaluating or using what is read. While the work of judging and applying doubtless demands a more elaborate and inventive organization and control of mental connections, the demands of mere reading are also for the active selection which is typical of thought. It is not a small or unworthy task to learn "what the book says."

In school practice it appears likely that exercises in silent reading to find the answers to given questions, or to give a summary of the matter read, or to list the questions which it answers, should in large measure replace oral reading. The vice of the poor reader is to say the words to himself without actively making judgments concerning what they reveal. Reading aloud or listening to one reading aloud may leave this vice unaltered or even encouraged. Perhaps it is in their outside reading of stories and in their study of geography, history, and the like, that many school children really learn to read.

Thorndike's "Reading as reasoning": influence and impact

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Edward L. Thorndike announced and elaborated his theory of learning around the turn of the century (Thorndike, 1898; 1911). Often referred to as "bond" psychology or "connectionism," the system he described was the original stimulus-response learning theory and it dominated the field for many years. Hilgard acknowledged the preeminence of Thorndike's work in the 1956 edition of his *Theories of Learning* with a quote from Tolman (1938, p. 11):

> The psychology of animal learning—not to mention that of child learning—has been and still is primarily a matter of agreeing or disagreeing with Thorndike, or trying in minor ways to improve upon him. Gestalt psychologists, conditioned-reflex psychologists, sign-gestalt psychologists—all of us here in America seem to have taken Thorndike, overtly or covertly, as our starting point.

Few psychologists would quarrel with Tolman's assessment. Whatever the attacks or the rivals or the modifications that followed, Thorndike provided the starting point. Furthermore, his work is truly classic in the area of learning theory, for it has both recognized value and enduring appeal.

Thorndike's theoretical formulations have unquestionably affected much of the work that relates to the teaching and learning of reading in many subtle ways. But the effect of his article on reading as reasoning (Thorndike, 1917) has been quite explicit and unmistakably profound. The 1917 article is still cited in most discussions of "what reading is." Perhaps it is no exaggeration to say—as Tolman suggested with regard to learning theory—that attempts to define reading are largely a matter of agreeing or disagreeing with Thorndike.

Downing (1969/1970) offered some support for the latter point in a recent article. Having observed that linguists and psycholo-

gists come up with different definitions of reading, he offered two examples. One excludes comprehension and places emphasis on the association of graphemes with phonemes:

> Reading is a reconstruction of the sound forms of a word on the basis of its graphic representation. Understanding, which is often considered as the basic content of the process of reading, arises as a result of correct recreation of the sound forms of words. He who, independently of the level of understanding of words, can correctly recreate their sound form is able to read (Elkonin, 1963).

The other avoids any mention of speech sounds and places the emphasis on comprehension:

> Reading involves the recognition of printed or written symbols which serve as stimuli for the recall of meanings built up through past experience, and the construction of new meanings through manipulation of concepts already possessed by the reader. The resulting meanings are organized into thought processes according to the purposes adopted by the reader. Such an organization leads to modified thought and/or behavior, or else leads to new behavior which takes its place, either in personal or in social development (Tinker and McCullough, 1962).

Downing noted that the ". . . emphasis on meaning has been particularly strong in American definitions of reading since the influential satement of Edward L. Thorndike" (1917) . . . and that Thorndike's influence led to a ". . . kind of description of reading with the emphasis on meaning and the omission of specific references to the phoneme (sound)—grapheme (written symbol) connections which has been popular for the past forty years."

There is, of course, no denying that disagreements have been registered, particularly by certain linguists. Nor is there any intent to suggest that extensions and modifications of Thorndike's 1917 article have not been made. To the contrary, efforts to modify and extend are the best evidence of its influence. One purpose of the present paper, then, is to examine some specific evidence of that influence. A second purpose is to consider the practical impact of Thorndike's conception of reading as reasoning.

Influence of the Article

As already indicated, attempts to define reading amount, at least on the face of the matter, to agreeing or disagreeing with Thorn-

dike's perception of reading as reasoning. Workers who claim that the essence of reading is the transformation of graphemes to phonemes are clearly in disagreement with Thorndike's position. They see reading as a simple, straightforward process that involves the translation of symbols into sounds. Workers who insist that reading must involve the understanding of what is read are in general agreement with Thorndike's position. They see reading as a complex process that goes considerably beyond simple decoding. While there is not complete agreement among the latter on the ultimate scope of their definition, most of them readily acknowledge Thorndike's influence.

There is yet another point of view to be considered. Some workers would argue that the decoding-meaning hassle is in truth a false issue when it is confined to reading education. Moffett (1968, p. 16), for example, has made a most legitimate point: "A child who fails to understand a text either cannot decode letters, or else cannot understand the text for reasons having nothing to do with printed words; he would not understand even if the text were read aloud to him. In other words, reading comprehension is merely comprehension." Clearly, comprehension is not something that belongs exclusively to readers or to teachers of reading. That view is totally consistent with Thorndike's. He considered reading as reasoning, not reasoning as reading.

Reduced to essentials, Thorndike's position was that "correct" reading involves (a) attaching the *correct* meaning to each word encountered (note that decoding is subsumed here); (b) giving each word a proper weight in relation to other words encountered; and (c) examining the resultant ideas in order to validate them in terms of the given context. The same process—sans decoding—would be needed for "correct" listening. If Thorndike thought about the matter at all—and it may be too trivial to have troubled him—he apparently made a decision to avoid the decoding-meaning issue. He assumed that if reading is to be a worthwhile activity it must yield meaning; that if children fail to read successfully it is because they fail to understand what they read; and that ". . . the demands of mere reading are also for the active selection which is typical of thought." The poor reader, he said, may be content to say the words to himself without engaging in the work required to discover their collective meaning.

Thorndike's essentials have continued to recur in subsequent discussions of the reading process. No attempt is made here to recite the dozens of instances. Three fairly recent examples will suffice.

In a 1960 review for the *Encyclopedia of Educational Research,* William S. Gray (1960, pp. 1100-1103) began his discussion of the apprehension and interpretation of meaning by citing Thorndike's 1917 article. Gray's entire discussion amounts to an elaboration of Thorndike's main points. Interpretation in reading, he said, comprises three broad aspects: (a) word knowledge, (b) apprehending the meaning of the passages, and (c) thoughtful reaction to and the use or application of ideas read. The three broad aspects are very similar to the three identified by Thorndike. The process starts with attaching appropriate meanings to printed symbols; it continues through literal comprehension; and, when the reader's purpose and/or the situation require, goes beyond to any or all relevant aspects of critical reaction.

In the 1963 *Handbook of Research on Teaching,* Russell and Fea (1963, pp. 865-928) focused on two aspects of teaching reading: (a) teaching the identification and recognition of symbols, and (b) teaching meaning. "Word recognition," they said, "is a prerequisite to reading, but it does not guarantee understanding" (p. 883). They, too, pointed out three aspects of comprehension quite similar to Thorndike's: (a) knowledge of the meaning of words, (b) knowledge of the relationships of words in sentences, paragraphs and longer passages, and (c) understanding of literal meaning, the intent of the author, and—when appropriate—the hidden meanings or implications. But Russell and Fea added a certain, very worthwhile bit of elegance to Thorndike's gutsy stuff. They considered the multisensory nature of the exploration of meaning, and they discussed the acquisition of meaning in reading in terms of (a) percepts (sensations and images), (b) concepts (symbolization of meaning), (c) verbals (standardization of symbols), and (d) relationships of verbalized concepts (multiple meanings, denotation-connotation, figurative language, grammar-syntax).

In the current edition of the *Encyclopedia of Educational Research,* Theodore L. Harris (1969) identified three views of the reading process, but he said that they ". . . differ more in emphasis than in the components involved" (p. 1075). In the first, reading is viewed as the visual perception of word forms and their meaning; the second view is that reading is essentially a process of thinking or elaborating meaning in relation to printed symbols; and the third is that reading is a two-stage process that comprises both decoding printed symbols and comprehending the written messages once they

are decoded. Thus, Harris demonstrates his point, for meaning as well as decoding is inherent in each view. While Harris acknowledges the direct influence of Thorndike in the second view, the concession to meaning in each of the other two can be attributed at least to some degree to the influence of Thorndike. One needs only to examine the references cited by proponents of the latter to see that influence acknowledged.

Among the dictionary definitions of a classic are "having recognized or permanent value," and "of enduring interest and appeal," and "standard or recognized, especially because of great frequency or consistency of occurrence." By any of these definitions, Thorndike's 1917 article is clearly a classic. Its influence is readily acknowledged by a host of writers and that influence continues to the present.

Practical Impact of the Article

While the influence of Thorndike's article is undeniable, its practical impact is questionable at best. Not only did the basic study reported fail to provide a viable model for subsequent research, but also the subsequent work has not yielded anything that has been very useful in eliminating the kinds of mistakes Thorndike found in children's paragraph reading over a half century ago.

Although the ideas expressed in Thorndike's article have been given pre-eminence, data are in fact reported and discussed. The article is presented primarily as a research report. As such, it has severe limitations. There is only the most cursory description of the methods employed. Little or nothing is said about the characteristics of the subjects, the full range of materials used, the construction of the materials, the reliability of the test items, or the testing conditions. Literal replication of the study would be impossible. There is only partial reporting of the data. Incorrect responses are tallied and categorized, but there is no indication of what were considered correct responses. Foremost among the questions that present themselves are these: Were the subjects chosen at random? Did they represent a cross section of sixth graders? Did the directions the subjects received adequately prepare them for the task? What, exactly, is a "paragraph"? Couldn't the "paragraphs" have been written in a more readable style? *Shouldn't* they have been written in a more readable style? Are the questions reasonable (valid)? Are they reliable? How were the correct answers stated? Were degrees of "correctness" ac-

ceptable? Answers to or, at least, consideration of any or all of these questions would have made the study more credible and, probably as a consequence, more heuristic in terms of empirical study.

The fact is, of course, that by present day standards the research study would never have been published in any journal, much less the rigorous *Journal of Educational Psychology*. But present standards did not prevail in 1917, nor did present practices and beliefs regarding reading instruction prevail. The context was different; and out of context, criticism can become stricture without good reason. Nevertheless, there is little doubt that had the basic study been more soundly planned and adequately reported it might have had a greater impact on subsequent research.

Unfortunately, many of the very questions Thorndike left unanswered in his report remain unanswered—or unanswerable in any definitive way—to this day. That this is so is evidence that, despite the lip service to the ideas expressed, the practical impact of Thorndike's work is extremely limited. Furthermore, it seems safe to assume that if it were possible to replicate Thorndike's 1917 study with 1971 children, the results would not be very different. Bits of evidence from a variety of sources (Woody, 1923; Keneally, 1939; McCullough, 1957) support this gloomy assumption, but the present writer is most familiar with the evidence derived from his own experience with attempts to study children's ability to formulate and state a main idea in reading (Otto & Barrett, 1968; Otto & Koenke, 1970).

The primary intent in this work was to examine children's approaches to and success in deriving a literal main idea from paragraphs in which a main idea is implicit but not stated. Thus, the concern was not different from Thorndike's in that the focus was on the basic understandings derived from reading. The research task was, however, greatly complicated by the fact that existing studies did not provide adequate methodological guidelines or systematic descriptive data that were relevant in setting up the study. Consequently, it was necessary to focus simultaneously upon the development of an operational approach—e.g., operational definition of *main idea*, appropriate reading materials, directions to subjects, a method for evaluating responses—and the collection of descriptive data. Thus, more than fifty years after Thorndike's influential classic appeared little or nothing had been provided to expedite closely related research efforts.

Also relevant in the present context are the results of the two studies that were completed (Otto & Barrett, 1968). In Study I

pupils in Grades 1 through 6 were asked to formulate and state the main idea for brief, carefully constructed paragraphs with one specific but unstated main idea. The salient finding was that although the children's age/grade placement and the readability of the paragraphs were critical factors in determining response quality, their main idea responses were generally of low quality as evaluated by a scale and rating procedure developed for use in the study. In Study II children were asked to formulate hypotheses about the main idea after each successive sentence in a paragraph was presented. As expected, increasingly more adequate main idea statements were given as more information became available, but the number of children to arrive at a completely adequate statement was not great. A major implication, in line with Thorndike's suggestions, was that children might profit from being encouraged to formulate a hypothesis about the main idea of a selection very early in the reading sequence and to continue to revise the hypothesis so long as additional information is forthcoming. But again, more than fifty years after Thorndike's influential classic appeared, children were still making mistakes in paragraph reading. And, most significantly, the lacks had to do not with remembering and/or organizing facts and principles but with *understanding* them.

Influence and Impact

The present review of Thorndike's article on reading as reasoning yields a paradoxical summary statement: The article has exerted considerable influence, but it has had little practical impact. While its influence on present conceptions of what reading is has been profound and unequivocal, its impact on subsequent research and/or practice has been minimal. Despite general agreement that the outcome of the reading act ought to be understanding, the means for moving efficiently toward that end are not yet very well understood.

REFERENCES

DOWNING, J. Functional literacy: future needs and current progress. *Symposium*, 1969/1970, 9-15.

ELKONIN, D. B. The psychology of mastering the elements of reading. In Simon, B. and J. (Eds.) *Educational Psychology in the U.S.S.R.* London: Routledge & Kegan Paul, 1963.

GRAY, W. S. Reading. In Harris, C. W. (Ed.) *Encyclopedia of Educational Research*, (3rd ed.) New York: Macmillan, 1960.

HARRIS, T. L. Reading. In Ebel, R. L. (Ed.) *Encyclopedia of Educational Research*, (4th ed.) New York: Macmillan, 1969.

HILGARD, E. R. *Theories of Learning*, (2nd ed.) New York: Appleton, Century, Crofts, 1956.

KENEALLY, K. G. A study of the relative order of difficulty of several types of study skills. Master's thesis, Boston University, 1939.

MCCULLOUGH, CONSTANCE. Response of elementary school children to common types of reading comprehension questions. *Journal of Educational Research*, September, 1957, *51*, 65-70.

MOFFETT, J. *A student-centered language arts curriculum, grades k-13: a handbook for teachers.* Boston: Houghton Mifflin, 1968.

OTTO, W., & BARRETT, T. C. *Two studies of children's ability to formulate and state a main idea in reading.* Technical Report No. 57. Madison, Wisconsin: Wisconsin Research and Development Center for Cognitive Learning, 1968.

OTTO, W., & KOENKE, K. *Scaling children's statements of the main idea in reading.* Working Paper No. 31. Madison, Wisconsin: Wisconsin Research and Development Center for Cognitive Learning, 1970.

RUSSELL, D. H., & FEA, H. R. Research on teaching reading. In Gage, N. L. (Ed.) *Handbook of Research on Teaching.* Chicago: Rand McNally, 1963.

THORNDIKE, E. L. Animal intelligence. *Experimental Studies.* New York: Macmillan, 1911.

THORNDIKE, E. L. Animal intelligence: an experimental study of the associative processes in animals. *Psychological Review, Monograph Supplements*, 1898, 2, No. 4 (whole No. 8).

THORNDIKE, E. L. Reading as reasoning: a study of mistakes in paragraph reading. *Journal of Educational Psychology*, 1917, *8*, 323-332.

TINKER, MILES A., & MCCULLOUGH, CONSTANCE M. *Teaching Elementary Reading.* New York: Appleton, Century, Crofts, 1962.

TOLMAN, E. C. The determiners of behavior at a choice point. *Psychological Review*, 1938, *45*, 1-41.

WOODY, C. Measurement of a new phase of reading. *Journal of Educational Research*, 1923, *8*, 315-326.

Thorndike's "Reading as reasoning": a perspective

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The study on Reading as Reasoning was reported in June 1917. The decade from 1910 to 1920 has been referred to as the time when the scientific movement in Education was beginning to flourish. Almost four times as many studies were published in this period as had been since 1881. Standardized tests were being produced to measure the results of reading instruction. For this and other reasons, this decade was also referred to as one of transition.

Attempts were made to study mental processes in reading. Even though the motor processes seemed to be commanding most of the attention, an increasing number of studies were concerned with the apprehension of meaning. Edmund Burke Huey's classic text on *The Psychology and Pedagogy of Reading* had appeared in 1908. In it he discussed in detail the need for a reader to search diligently for meaning by examining carefully each word, phrase, and line, by blending together ideas, and by suspending judgment until all had been read.

This describes briefly some of the context in which Thorndike's study was done and reported. That he chose to study comprehension and interpretation is not astounding. The groundwork had been laid and the time appeared to be ripe for such a study.

This report on "Reading as Reasoning" is probably one of the most widely quoted studies in all of reading research. The essence of the report resides in one paragraph appearing two-thirds of the way along in the article.

> Understanding a paragraph is like solving a problem in mathematics. It consists in selecting the right elements of the situation and putting them together in the right relations, and also with the right amount of weight or influence or force for each. The mind is assailed as it were by every word in the paragraph. It must select, repress, soften, emphasize, correlate and organize, all under the influence of the right mental set or purpose or demand (p. 329).

One other historical aspect is worthy of noting. The decade of the 1920's is often referred to as the silent reading era. It is possible to conclude that this one article reflects quite clearly that Thorndike's thinking was in tune with that of the authors of the 18th Yearbook, Part II of NSSE and also with those of the authors of the 24th Yearbook, Part I of NSSE. Both of these publications placed major emphasis on silent reading. Perhaps Thorndike's thinking as reflected in the following statement was helpful in bringing about the silent reading emphasis in these publications:

> In school practice it appears likely that exercises in silent reading to find the answers to given questions, or to give a summary of the matter read, or to list the questions which it answers, should in large measure replace oral reading. The vice of the poor reader is to say words to himself without actively making judgments concerning what they reveal (p. 332).

The Study

The portion of the title *Reading as Reasoning* is almost the same as saying "reading as thinking." The word "reason" is an epistemological term that was given high status by Kant in particular when he wrote about "pure reason." The term is often used ". . . to denote the power of arriving at knowledge or truth by logical processes" (pp. 679-680). It may be that Thorndike deliberately selected this way of comparing reading and reasoning and thought.

If one could recapture the instructional spirit and classroom pomp of the times it may well be that what Thorndike was really trying to do in this article was to change reading instruction practices. If this is the case then it can be said that his choice of course was elegant. Reading is not a word by word addition whose sum yields a meaning "easily transmuted" into total thought. To the contrary, reading is a dynamic process, an elaborate procedure, a weighing and organizing of elements, a selecting of relevances and ". . . the cooperation of many forces to determine final response." "In fact," he said, "we shall find that the act of answering simple questions about a simple paragraph . . . includes all the features characteristic of typical reasoning."

At this point the reader must examine the task Thorndike prepared for his investigation.

> Read this and then write the answers to 1, 2, 3, 4, 5, 6, and 7. Read it again as often as you need to.
> In Franklin, attendance upon school is required of every child between the ages of seven and fourteen on every day when school is in session unless the child is so ill as to be unable to go to school, or some person in his house is ill with a contagious disease, or the roads are impassable.
>
> 1. What is the general topic of the paragraph?
> 2. On what day would a ten-year-old girl not be expected to attend school?
> 3. Between what years is attendance upon school compulsory in Franklin?
> 4. How many causes are stated which make absence excusable?
> 5. What kind of illness may permit a boy to stay away from school, even though he is not sick himself?
> 6. What condition in a pupil would justify his non-attendance?
> 7. At what age may a boy leave school to go to work in Franklin? (pp. 323-324)

A hasty reading might lead one to believe that Thorndike did not appreciate the true value of reader purpose or mind set to direct the reasoning of the mind. "Read this and then write the answers to 1, 2, 3, 4, 5, 6, and 7" represents a vague general command. He does not say, "find answers to questions 1-7 by reading the following paragraph." He does suggest rereading "as often as you need to." In short, efficiency of performance is not the object—take all the time you wish but find the answers—is what he was saying to the students.

Examination of the paragraph might well cause linguistic eyebrow lifting. Syntactically the passage is a mutinous conundrum. Semantically it is a veritable pitfall, challenging the reader to dissect, analyze and comprehend. One linguist* noted that "The hallmark of jargon is a noun phrase as subject coupled by a minimal verb to a long noun phrase, as complement. Moreover," Palmer went on to say, "within the first communication unit the writer used 39 words, with 37 of them comprising the base clause or kernel sentence, one free modifier and 11 bound modifiers." Or viewed differently the one sentence paragraph has six prepositional phrases, two dependent clauses, with two infinitive phrases within the dependent clauses. Thus the reader is confronted with an awkwardness of structure that can indeed be baffiing.

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Of course, there is some likelihood that the paragraph is in a sense typical of reading instructional materials of the times. Certainly, Thorndike must have been aware of the nature of the construction of the one sentence paragraph. Perhaps, it is only fair to assume that his choice of material was to be representative. It must be remembered that this study was done a decade before research attention was focused on readability but not before the art of clear writing was proclaimed.

Analysis of the questions reveals an unnaturalness that is as puzzling as the irregularity of the paragraph. Only question three can be readily answered by a literal parroting of a passage—". . . between the ages of seven and fourteen." Question one requires ability to discern the essence of the paragraph, the main idea, or the newspaper headline. Certainly it requires a weighing of all the elements. Question two leaves room for doubt. "When school is not in session" seems most concise yet there are three other conditions that are equally as acceptable. Question four requires the reader to deal with required attendance time and count the number of excusable absences allowable. Question five requires reflection over the meaning of "kind of illness" and a decision that all "contagious diseases" are included. Question six involves almost a literal answer but because of the logical qualifier, "unless," poses a decision making problem. Question seven is answerable only by deduction.

If the reader is unacquainted with the article he might rightfully assume that the population Thorndike tested was at the senior high school or college freshman level. Not so, though. The test was administered to 500 children within grades 5 to 8. This represents a sizeable population and by today's statistical know-how would be more than adequate.

Next, Thorndike engages in interesting verbal gymnastics when he analyzes the responses of two hundred sixth-grade pupils to questions 1, 2, 5, and 6. He points out that the answers are baffling and indeed they are. Apparently most of the pupils did not understand either the questions or the passage or both. But he says explanation can be sought by following certain facts and principles.

> In correct reading (1) each word produces a correct meaning (2) each such element of meaning is given a correct weight in comparison with others, and (3) the resulting ideas are examined and validated to make sure that they satisfy the mental set or adjustment or purpose for whose sake the reading was done (p. 326).

His behavioral objectives seem sufficient enough. The reader starts with a "mental set" or "purpose" which requires adjustment of meanings through a careful and sometimes vigorous search for interrelationships and relevancies and finally a testing or validation against the purposes—to make sure that they are satisfied. Thus he forged an elegant and compact summation.

Then he engages in an analysis of pupil answers centered on "over-potency of certain elements or the under-potency of others" in the passage. His speculation is interesting reading but seems hardly relevant to the circumstances. The answers quoted show almost a total lack of understanding on the part of the pupils either because of the complexity of the paragraph, the nature of the questions, or the purpose or purposes for the reading. Thorndike tells us nothing about the reading ability of the population tested, the cultural nature of the population, their likely intellectual capacity; he says only that they range from fifth to eighth grade. By today's standards this would be considered a crude pilot study by an able student uneducated in experimental design.

He sums this portion of his report by saying "To make a long story short, inspection of the mistakes shows that . . . understanding a paragraph implies keeping these respective weights [over-potency and under-potency]* in proper proportion from the start or varying their proportions until they together evoke a response which satisfies the purpose of the reading" (p. 329).

To support his points, Thorndike next presents two other paragraphs and questions. Even though these paragraphs are structured more clearly, the questions are subtle. He recognizes the complexity of the questions and proposes that a different form of questioning might have produced more correct responses.

"It thus appears," he says, "that reading an explanatory or argumentative paragraph . . . involves the same sort of organization and analytic action of ideas as occur in thinking of supposedly higher sorts. . . . It appears likely, therefore, that many children fail [curriculum subjects]* . . . not because they have understood and remembered the facts and principles but have been unable to organize and use them; or because they have understood them but have been unable to remember them; but because they never understood them" (p. 331).

* Author's insertion.

To further illustrate his thesis he contrasts what may happen "in the mind" of the expert reader with the person who can read "fluently" orally but does not read for understanding. The introspective account of the expert's reflection and weighing of facts demonstrates the kind of reasoning that most likely does occur in the mind of the expert. The mind is not withdrawn into an exercise of mental gyrations predominated by the spirit and by intuition but remains strictly within the limits of the facts as the salient realm.

Finally, Thorndike raises the call for more silent reading to understand. This he does though with caution by commenting ". . . it appears likely that exercises in silent reading to find the answers . . . should in large measure replace oral reading" (p. 332). Then he goes on to add "The vice of the poor reader is to say the words to himself without actively making judgments concerning what they reveal. Reading aloud or listening to one reading aloud may leave this vice unaltered or even encouraged" (p. 332). Then with one last sentence he says almost as if in hopeless despair, "Perhaps it is in their outside reading of stories and in their study of geography, history, and the like, that many school children really learn to read" (p. 332).

Thorndike's grasp of the pedagogical circumstances of the time, the despotic stranglehold of textbook publishers and the reluctancy for change apparently led him to feel and write as he did. Unfortunately many of the same conditions prevail today. The need for critical, creative, versatile reading is just as acute now as then. Tin horns raise a din about reading skill issues that overshadow and all but obliterate the dire need for correct reading resulting in examining and validating ideas ". . . to make sure that they satisfy the mental set or adjustment or purpose for whose sake the reading was done," because the mind must ". . . select, repress, soften, emphasize, correlate and organize, all under the influence of the right mental set."

REFERENCES

HUEY, EDMUND BURKE. *The Psychology and Pedagogy of Reading*. New York: Macmillan Co., 1908.

Report of the National Committee on Reading. National Society for the Study of Education, Eighteenth Yearbook, Part II. Bloomington, Illinois: The Public School Publishing Co., 1919.

Report of the National Committee on Reading. National Society for the Study of Education, Twenty-fourth Yearbook, Part I. Bloomington, Illinois: The Public School Publishing Co., 1925.

THORNDIKE, E. L. Reading as Reasoning: a study of mistakes in paragraph reading. *Journal of Educational Psychology*, 1917, *8*, 323-332.

Webster's Dictionary of Synonyms, 1st Ed. Springfield, Mass.: G. S. Merriam & Co., 1942.

Thorndike revisited—some facts

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In the last issue of this journal Edward L. Thorndike's "Reading as Reasoning: A Study of Mistakes in Paragraph Reading" was republished, together with two commentaries on this article's influence on the study of reading in the following decades (*Reading Research Quarterly,* 1971, 6, 425-448).

The purpose of the present paper is *not* to offer further speculations on Thorndike's influence on our present conceptualization of reading behaviors. Rather, an attempt will be made to supply and interpret some historical facts surrounding the Reading as Reasoning publication, which will allow us to put Thorndike's study in its proper perspective, both as a "research study" and as a content contribution to the psychology of reading.

Thorndike's reading as reasoning in perspective

Thorndike's thinking was strongly influenced by the so-called bond psychology, i.e., stimulus-response psychology. His view of reading as a reasoning process is thoroughly shaped by his psychological perspective. This becomes very much apparent in Thorndike's writings which appeared at approximately the same time as his "Reading as Reasoning" article.

"Reading as Reasoning" is but one of a series of three articles published by Thorndike in 1917, all dealing with the same topic and closely similar in format. In May 1917 "The Psychology of Thinking in the Case of Reading" appeared in the *Psychological Review* (Thorndike, 1917a). This article was then followed by the publication of "Reading as Reasoning" in the June issue of the *Journal of Educational Psychology* (Thorndike, 1917b). A few months later, in October of that year, the *Elementary School Journal* published "The Understanding of Sentences: A Study of Errors in Reading" (Thorndike, 1917c). In spite of a great deal of repetition, each

article makes a contribution of its own. In the first publication the emphasis is distinctly on psychological theory; in the last article Thorndike addresses himself explicitly to pedagogical implications of his theses. The second article seems to incorporate both psychological and pedagogical points of view. Moreover, the paragraphs used as examples vary somewhat from article to article.

Thorndike's preoccupation with reading passages and reading errors is readily explained by his involvement in the construction of standardized reading scales between, say, 1910 and 1930. The famous one sentence passage J, used in "Reading as Reasoning," was originally part of the set of passages published as an extension to America's first published standardized silent reading scale, Scale Alpha (Thorndike, 1914a). Passage "D," also referred to in "Reading as Reasoning," appears as "Set a or 4" in the same scale (Thorndike, 1914a, p. 250) and as "Set I, Difficulty 4" in Scale Alpha 2 (Thorndike, 1915, p. 446). Passage J itself can also be found verbatim, though minus questions 2, 3, and 7 in the 1915 scale (p. 451). As part of the (then not so) routine prepublication collecting of information on test items, Thorndike gathered data on a variety of paragraphs, including those in the series A through Z. In the three 1917 publications he merely drew on examples from his item analysis data to illustrate his main points (1917a, paragraphs D, H, I, J, M, T; 1917b, D, I, J; 1917c, A, B, C, H, F, I, M). For a rather detailed picture of Thorndike's methods see Thorndike, 1916a, 1916b.

Thorndike in defense of his paragraphs

Invariably readers of "Reading and Reasoning" ask themselves questions such as: "Why such difficult paragraphs?", or "Why are the questions so complicated?" Thorndike addressed himself to these questions at various points, either directly or indirectly. His comments not only answer such queries, but they also throw additional light on other issues raised by his analysis of reading.

In 1914, Thorndike addressed a conference on educational measurement at Bloomington, Indiana. First he reported on a demonstration session on how to give a group reading test. Later he discussed some test items not used during that demonstration (Thorndike, 1914b). It is worth noting that Thorndike himself described his topic as dealing with the measurement of the "reconstructional side of reading." It appears from another source that

he meant by this phrase "the measurement of understanding" as conditioned by the constructional difficulties of a paragraph rather than by the difficulties of single words (Thorndike, 1914a, p. 248).

In his speech Thorndike addressed himself directly to the issue raised at the beginning of this section: "Why such difficult material?"

First he gave an example test. The passage was very simple: "Tom gave a gray cat to Mary. She gave him a black dog." (this test was actually used as a warm-up exercise in Scale Alpha) The questions were equally void of complexity. For example: "What did Tom give the girl?" Then Thorndike presented his audience with a much harder task, "almost at the other extreme." He cited a passage which eventually wound up in Scale Alpha 2, with the same degree of difficulty as passage J. One of the questions belonging with this passage is: "What is it that might at first be thought to be true, but really is false? (Thorndike, 1914b, p. 39) But note Thorndike's comments:

> This is a little bit like the old question, "Who drove how many times around the walls of Jericho?" They would be very bad questions for instruction, but are very good to test a person's ability to read complex sentences (ibid, p. 39).

Then follows a sentence which takes away all doubt whether Thorndike was aware of what he did when phrasing his sometimes perplexing paragraphs and intricate questions.

> We have to arrange the things to be read and the questions to be read and answered so that in every case there is no difficulty whatever in answering the question if the child can read it understandingly. The questions are simple, except in the difficulty of reading them (ibid, p. 40).

Thorndike was well aware of the controversial nature of his items though. This becomes clear from the following statement taken from a 1915 publication.

> It is possible to devise paragraphs and questions such that the pupils response will in every way be unambiguous, sharply differentiated as proof of perfect reading and proof of failure to read or misreading. Such paragraphs are likely, however, to be unrepresentative of ordinary reading (Thorndike, 1915, p. 45).

The use of questions for the measurement of comprehension was a deliberate decision on Thorndike's part. This method was not immediately accepted by all of the profession. In later

tests such as the Starch scale and the Brown scale (Starch, 1915) students were asked to reproduce as much of the story as they could remember and then the number of words used to express relevant ideas was counted in order to arrive at an estimate of comprehension. When Starch developed his test, he actually tried the questioning method but rejected it because it was "less accurate and more difficult to score" than the word count scoring scheme (Starch, 1915, p. 13).

Understanding, in Thorndike's view, is a function of both the passage and the question asked about it. He therefore measures it by a passage-question unit. For each of these units, difficulties for various grades were carefully calculated. As Thorndike points out, one may increase difficulty or degree of understanding either by replacing paragraphs or by rewording questions. His Scale Alpha contains an example of the latter procedure. The test's 3rd and 4th passages are identical. At the higher level the questions are noticeably harder, though.

Thorndike's view on reading as thinking

What did Thorndike mean when he described reading as reasoning? In this section an attempt will be made to synthesize his ideas on this issue as they were expressed in the 1917 triad.

For Thorndike, thinking, when responding to a reading question, is a two part process. First, elements in the passage question trigger off, alone or in conjunction, a flow of associations or bonds each strongly competing for answer status. The second phase involves inspection and validation of the many potential responses. In reference to this second phase, it seems true then that,

> . . . we should not consider the reading of a textbook or reference as a mechanical, passive undiscriminating task, on a totally different level from the task of evaluating or using what is read (1917b, p. 332)

It must be noted, however, that Thorndike insisted on subordinating even this "active" behavior under the general principle of bond-psychology. He wrote of this "evaluating and judging":

> These welcomings and rejectings, retainings and letting go, are however, themselves nothing more than situation-response bonds, when the response is attending to or turning from, cherishing, repeating, saying *yes* or *no* to, or the like (1917a, p. 234).

He states explicitly that in his view thinking and reasoning are not to be thought of as opposite of custom, habit, and automatism, but "simply the action of habits in cases where the elements of the situation compete and cooperate notably" (1917a, p. 233).

How then, are "thinking errors" or "reading errors" to be explained? In the "Psychology of Thinking" article, Thorndike identifies three mechanisms causally related to thinking, e.g., reading errors. First of all he discusses the potency variable. Elements in a paragraph or question can have over-potency, correct potency, or under-potency. It is important to note that Thorndike distinguishes between content words and structure or "relational" words and that he recognizes that under-potency is particularly dominant in the latter class of elements. The second mechanism called up to explain reading errors is referred to as "dislocation or disrelation of elements." When elements have the proper potency, that is, if the right elements acquire "answer status," the resulting response can still be wrong because of improper relating of these elements. One of Thorndike's examples is: "That men work only because they must" becomes "That men must work" (1917c, p. 113, 114).

The third mechanism held responsible for reading errors is the wrongness or inadequacy of connections:

> Incorrect thinking due to wrong or inadequate bonds leading from one or more elements of the situation is a simple consequence of the general facts of connection forming that does not need demonstration here. We know *a priori* that every element tends to call up what has followed or accompanied it (1917a, p. 230).

The basic problem with inadequate connections as Thorndike sees it, is that human beings are apt to accept ideas that come to their minds on a come first, trust first basis. Hence the crucial importance of keeping a close watch over the connections formed in automatic response to paragraph and/or question elements:

> It is healthy to trust the ideas which the laws of habit produce, provided we maintain an active watch for other ideas which may tell whether the first ones are appropriate (1917c, p. 107).

There probably is no way of doing Thorndike's ideas on reading as reasoning more justice than by reproducing his own summary of what is involved in the understanding or misunderstanding of a paragraph. At the end of his third 1917 article he writes:

Each word (sometimes a part of a word) tends to call up those responses which are bound to it by the pupil's past experience working under the conditions of the present mental set. Of these responses some may be discarded from thought as soon as they appear. The one that is left as the determiner of meaning may be "right" or "wrong" or one that contributes zero meaning (such as the mere approximate sound of the word "paragraph" or "effect" or "condition" to a child who has never heard those words used). For the meaning attached to a word to be "right" means to be right for the purpose of understanding the paragraph—to be adapted to meanings of the other words. Tendencies for words to call up universally wrong meanings or meanings right in other connections but wrong here have to be felt in the right relations. The relations are indicated by the relational words, by the order of words in the paragraphs, and by the word-forms and sentence structure.

The bonds leading from relational words, word-orders, and word-forms to the appropriate responses are often not so strong as they need to be for correct reading. There are consequently tendencies for the non-relational words to call up their customary relations, even though the conjunctions and sentence structure show that these customary relations do not hold in the paragraph in question. Thus, *Every boy and girl who goes to school ought to do all the work that the teacher wishes done* is understood as it is in disregard of the *It may seem at first thought that* which precedes it and the *But* which follows it. Thus, *men work . . .* is related to *for food, clothing, and luxuries* according to past habit in disregard of the *it may seem that* and the *to the contrary.*

As one would expect, elements right in themselves will be transposed into wrong relations. *That men work only because they must* becomes, "That men must work." *When you want a cool kitchen a gas range is better* produces "For a gas range you need a cool kitchen." The contributory tendencies of each word and word-group have to be right not only in nature, but also in their amounts of potency or influence or force, each in comparison with the others. Understanding is "thinking things together." For each problem or purpose of understanding, the elements have to be organized in a balanced system. The complexity of this task is great in reading even a simple sentence. So the commonest cause of errors in the material we have examined is the under-potency or over-potency of certain elements in the questions or paragraph. The successful response to a question or to a paragraph's meaning implies the restraint of tendencies of many words to be over-potent and the special weighting of other tendencies. This task is quite beyond the power of weak minds, and is of the same selective and coordinating nature as the more obvious forms of reasoning in mathematics or science. It is this task which shows the comprehension of textbooks and lectures to be far above

> the level of merely "passive" or "receptive" work. When the reading of textbooks and the hearing of lectures is really passive or receptive, comprehension will rarely result.
> Understanding a spoken or printed paragraph is then a matter of habits, connections, mental bonds, but these have to be selected from so many others, and given relative weights so delicately, and used together in so elaborate an organization that "to read" means "to think," as truly as does "to evaluate" or "to invent" or "to demonstrate" or "to verify" (1917c, p. 113, 114).

A comment on Thorndike's relevance now

There it is: Thorndike's speculation on mistakes in the perspective of his psychology. What is its relevancy to reading instruction and reading research in the 70's? A final quote from Thorndike himself to answer that question at least in part:

> The errors made by pupils when tested by the scale provide an instructional picture of their mental operations. It will be well worth the while of any group of teachers to discuss the wrong response . . . trying to explain each one of them (1915, p. 461).

It should be well worth the while of any researcher, too, to follow this advice. The convenience of multiple choice testing may have led to a definite underusing of error analysis as a routine hypothesis generating device.

What about Thorndike's "under-potency" and "over-potency"? Is his explanation of reading errors of any use to the student of reading in 1971? Analysis of responses to blanks in cloze tests never fails to reveal a number of apparently completely incongruous and idiosyncratic responses—responses which do not seem to fit the semantic and syntactic constraints present in the passage. The explanation Thorndike sought for his wrong answers is largely the explanation needed for accounting for not attending to linguistic constraints when taking a cloze test. Labels such as "over-potency" and "under-potency" are descriptive of a yet largely unexplained and multifaceted phenomenon. Can one change potencies by forcing the reader to attend to certain key elements in the visual display? A more basic question: will such a manipulation result in reduction of all kinds of "reasoning" errors? Is it possible to train children to reduce errors resulting from overemphasizing or underemphasizing elements in a message; that is, can proper processing of the various linguistic and extralinguistic information in a passage be directly taught?

These questions are still very much alive. The continuing debate around context clues is just one example; the studies of perceptual processes as related to the linguistic structure of sentences forms another.

REFERENCES

STARCH, DANIEL., The measurement of efficiency in reading. *Journal of Educational Psychology*, 1915, 6, 1-24.

THORNDIKE, EDWARD L., The measurement of ability in reading. *Teachers College Record*, 1914a, *15*, 207-277.

THORNDIKE, EDWARD L., Tests of oral and silent reading. *Indiana University Bulletin*, 1914b, *12* (10), 37-51.

THORNDIKE, EDWARD L., An improved scale for measuring ability in reading. *Teachers College Record*, 1915, *16*, 445-467.

THORNDIKE, EDWARD L., An improved scale for measuring ability in reading—(concluded). *Teachers College Record*, 1916a, *17*, 40-67.

THORNDIKE, EDWARD L., The measurement of achievement in reading: word knowledge. *Teachers College Record*, 1916b, *17*, 430-454.

THORNDIKE, EDWARD L., The psychology of thinking in the case of reading, *Psychological Review*, 1917a, *24*, 220-234.

THORNDIKE, EDWARD L., Reading as reasoning: a study of mistakes in paragraph reading, *Journal of Educational Psychology*, 1917b, *8*, 323-332.

THORNDIKE, EDWARD L., The understanding of sentences: a study of errors in reading, *Elementary School Journal*, 1917c, *8*, 98-114.