Schema: An Integral Element of Reading Comprehension

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Abstract

Traditionally, reading was viewed as a passive language skill in which the reader absorbed what the writer had written. However, it has gradually been realized that reading in fact requires an active participation from the reader and that reading comprehension is an interactive process between the reader's background knowledge, or schema, and the text. This paper explains what a schema is and how it contributes to our understanding of reading comprehension. Furthermore, it also discusses some pedagogical implications of schema theory for educational practice.

Introduction

Traditionally, reading comprehension was viewed as a result of the reader's linguistic knowledge of word recognition and simplistic identification of larger language units, and the reader was believed to play a passive role of unidirectionally absorbing the message in the text. Later, it has gradually come to be realized that what used to be viewed as a passive skill actually requires active participation of the reader. Comprehension has come to be recognized as an interactive process resulting from the multi-dimensional relationship between schema, the reader's background knowledge, and the text. The purpose of this paper is, therefore, to present a definition of a schema and its contribution to reading comprehension, as proposed by some of its major advocates. Then, the paper will discuss some pedagogical implications of schema

theory for educational practice. It should also be noted here that although there are other important factors needed in an interactive reading process apart from schema, and that there are other theoretical models apart from schema theory, they are not under the scope of this paper.

Schema and Schema Theory

The role of background knowledge in language comprehension has been asserted and formalized in a theoretical model known as *schema theory,* a theory which stated that any given text does not simply carry meaning in and of itself. Instead, it provides directions for the learner to construct meaning from his previously acquired knowledge (Omaggio, 1986). The idea of background knowledge can be traced as far back as Kant (1781), who claimed that new concepts could be meaningful only when they were related to something one already knew. Yet, it was Bartlette (1932) who is generally acknowledged as the first psychologist to introduce the term "schema" with the meaning that it is used today (Anderson & Pearson, 1984).

According to Bartlette (1932), schema is

> ...an active organisation of past reactions, or of past experiences, which must always be supposed to be operating in any well-adapted organic response. That is, whenever there is any order or regularity of behaviour, a particular response which is possible only because it is related to other similar responses which have been serially organised, yet which operate, not simply as individual members coming one after another, but as a unitary mass. Determination by schemata is the most fundamental of all the ways in which we can be influenced by reactions and experiences which occurred some time in the past. (p. 201)

In Bartlette's experiments, subjects read North American Indian folktale which was a story from an unfamiliar culture for them. Their recall of the story, especially after a long interval, was found to be changed in order to fit the schemata from their own culture. The results of his experiments, thus, support his claim that

> ...an individual does not ordinarily take...a situation detail by detail and meticulously build up the whole. In all ordinary instances he has an overmastering tendency simply to get a general impression of the whole; and, on the basis of this, he constructs the probable detail. (p. 206)

However, despite his attempts to understand the relation of background knowledge and reading comprehension, Bartlette was still not so clear about how schema functions, as he stated "I wish I knew exactly how it was done" (p. 206).

It was not until the mid 1970's that there was a resurgence of interest in the influence of schema and reading comprehension among theorists (Rumelhart & Ortony, 1977; Rumelhart, 1980; Schank & Abelson, 1977; among others). The role of schema in comprehension then was defined and described in more precise ways.

Definition of Schema

Rumelhart and Ortony (1977) defined schemata as

> ...data structures for representing the generic concepts stored in memory. They exist for generalized concepts underlying objects, situations, events, actions, and sequences of actions...A schema contains, as part of its specification, the network of interrelations that is believed to generally hold among the constituents of the concept in question. Schemata, in some sense, represent stereotypes of these concepts. (p. 101)

Rumelhart (1980) further stated that schemata are "the building block of cognition" since they are essential elements upon which all information processing depends (Rumelhart, 1980, p. 33). If the reader is unable to find pertinent schemata for a given context of the text, the text will appear "disjointed and incomprehensible" (Rumelhart, 1980, p. 38)

Anderson, Reynolds, Schallert & Goetz (1977) postulated that schemata are knowledge structures which the reader brings to the reading text and they are more important than the linguistic structures within the text itself, saying that schemata

> ...represent the generic concepts underlying objects, events, and actions. Schemata are abstract in the sense that they contain a "variable", "slot", or "place holder" for each constituent element in the knowledge structure. An important aspect of a schema is the specification of the network of relations that hold among the constituents. (p. 369)

In their study, Anderson, Reynolds, Schallert & Goetz (1977) examined the effect of schemata on reading comprehension. Thirty physical education students and thirty music education students read a passage which could be interpreted either as a convict planning a prison escape or as a wrestler hoping to break an opponent's hold, and another passage which could be interpreted either as an evening of playing cards or as a rehearsal of a woodwind ensemble. Then they did a recall and completed a ten-item multiple-choice test after reading each passage. The study results revealed that the interpretation given to the passages of the subjects was highly correlated with their background knowledge. Anderson, Reynolds, Schallert & Goetz thus concluded that people's personal history, knowledge, and belief influence the interpretations that they will give to reading passages.

The notion of a schema as an abstract representation of a generic concept for an object, event, or situation is probably best illustrated by Omaggio (1986), who maintained that each individual has an abstract representation for the concept "house". This concept can be altered if it is modified by different adjectives like "elegant", "enormous", "ramshackle", or "squalid". Moreover, the abstract representation for a

given concept can be altered because of cultural differences. For example, the concept of "house" and "maison" may share some similar characteristics but because of cultural differences, these two terms may also have different mental representations.

Characteristics of Schemata

Rumelhart and Ortony (1977) postulated that there are at least four essential characteristics of schemata:

1. Schemata have variables.

To explain this first characteristic, Rumelhart and Ortony (1977) compared a schema to a play. They maintained that a schema has variables which can be associated with different aspects of the environment on different situation, just like a play has characters which can be played by different actors at different times without changing the essential nature of the play. For instance, a schema for GIVE would consist of three variables: a giver, a gift, and a recipient. These variables may be associated with different aspects of the environment on different situations, but their internal relationship will remain constant. That is, in general cases, the giver will cause the recipient to get the gift, regardless of the identity of the giver or recipient, or the nature of the gift.

In addition, a schema specifies information about the variables of the schema, just like a playwright often exactly mentions characteristics of the characters in his play such as age, sex, etc. For example, in the BREAK schema, which includes at least three variables–the breaker, the object, and the instrumental method in the breaking, one might expect the breaker to be an agent that does the breaking, the object to be rigid or fragile, and the method to be some action, which the breaker is capable of, to break the object.

Rumelhart and Ortony (1977) referred to such knowledge about the typical values of the variables and their relationships as variable constraints. They claimed that those constraints play two important functions:

(a) They specify what types of values can be associated with the variable. For instance, with the guiding of the variable constraints, one

would not map the giver variable into the object that should serve as the gift.

(b) When there is not enough information, the variable constraints would help to make initial guesses, or "default values" (Rumelhart & Ortony, 1977), for variables whose values have not yet been observed. For example, in the BUYING schema, although one does not notice the money, one can infer that there is money which would be equal in value to the value of the merchandise. Thus, this function of the variable constraints enables the schema to make inferences about unobserved aspects of a situation.

2. Schemata can embed one within another.

Schemata consist of subschemata, each of which would further comprise a set of its subschemata. A schema for a face, for instance, would include subschemata which represent different parts of a face e.g. eye, nose, mouth, etc. The EYE schema, in turn, would consist of such subschemata as an iris, pupil, eyelashes etc.

3. Schemata represent knowledge at all levels of abstraction.

Schemata represent all levels of experiences, at all levels of abstraction, ranging from knowledge about word meaning to knowledge about cultures and ideologies.

4. Schemata represent knowledge rather than definitions.

According to Rumelhart and Ortony (1977), schemata are different from dictionary entries. This is because schemata represent knowledge which is associated with concepts while dictionaries provide meanings of words. In addition, schemata represent knowledge in a flexible way that allows human tolerance for ambiguity, deviations and imprecision. For example, a one-eyed face is still regarded as a face.

Rumelhart (1980) further added two more features to the above list of characteristics of schemata:

5. Schemata are active processes.

According to Rumelhart (1980), a schema is an active process of determining whether and to what degree it accounts for the pattern of observations.

6. Schemata are recognition devices whose processing is aimed at evaluating their goodness of fit to the data being processed.

According to Rumelhart (1980), the primary activity of schema is to determine whether it adequately accounts for some aspects of a

situation. If a selected schema fails to account for some aspects of a situation, one may accept the schema as adequate despite its flawed account or reject the schema and look for another promising one. Thus, the basic processes of comprehension are like hypothesis testing and evaluation of goodness of fit. That is, as postulated by Rumelhart (1980), in a reading comprehension process, the reader will constantly evaluate his/her hypotheses about the most possible interpretation of the text. If he/she can find schemata which give accurate account of the text, he/she is said to understand the text. If not, then the text would be incomprehensible to the reader. Yet, it should be noted here too that empirical research has revealed that schema might account for a part, but not all, of comprehension. Furthermore, schema can not only enhance but also impede reading comprehension.

Types of Schemata

There are two basic types of schemata which are used in the process of comprehension–content schemata and textual or formal schemata (Carrell & Eisterhold, 1983; Carrell, 1983a; Omaggio, 1986).

Content Schemata

Content schemata are schemata which relate to the individual's background knowledge about the content area of a text. One particular type of content schemata is the event schemata, which Schank and Abelson (1977) also referred to as script. Event schemata consist of information about stereotypical events or situations. When one comes across a situation or an event such as going to a restaurant, washing clothes, or going to see a doctor, a sequence of stereotypical events associated with that particular situation will be instantiated in his/her mind. For example, a "restaurant" script would include such participants as a customer, a waiter/waitress, a chef and a cashier and the sequence of events would involve entering the restaurant, being seated, being given a menu, ordering, eating, paying, and leaving (Schank & Abelson, 1977). Therefore, when one considers the following situation, as illustrated by Bransford (1979),

> Jim went to the restaurant and asked to be seated in the gallery. He was told that there would be a one-half hour wait, forty minutes later, the applause for his song indicated that he could proceed with the preparation. Twenty guests had ordered his favorite, a cheese soufflé.
>
> Jim enjoyed the customers in the main dining room. After Two hours, he ordered the house specialty– roast pheasant under glass. It was incredible to enjoy such exquisite cuisine and still have fifteen dollars. He would surely come back soon. (p. 184)

one will apparently see that the story does not seem to make sense simply because it violates his/her background knowledge of a "restaurant" script. Schank and Abelson also noted that apart from a basic "restaurant" script, there are also restaurant scripts for specific types of restaurants such as cafeterias, fast-food restaurants, Italian restaurants etc. which would require an activation of different sequences of events.

Another type of content schemata is a scene or spatial schemata, which Carrell (1983a, p. 26) defined as "a cognitive representation of what one expects to see when viewing or entering a scene". As Carrell (1983a) rightly observed, scene schemata, like event schemata, are hierarchically organized. For instance, a "room" schema comprises some obligatory variables or defining characteristics that must be satisfied e.g. a room must have some kind of walls in order to be considered a room, and it may contain some optional variables e.g. a room may have some furniture. Carrell also pointed out that this "room" schema is highly general. Less general, and lower on the hierarchy would be a scene for a Danish modern kitchen and least general would be specific kitchen.

Formal Schemata

Apart from content schemata, the other basic type of schemata used in the comprehension process is textual or formal schemata. This type of schemata refers to the individual's background knowledge of the organizational structures of different types of texts. There are several

researchers who have studied the influence of textual schemata on reading comprehension (Rumelhart, 1975, 1977; Kintsch & van Dijk, 1978; Mandler & Johnson, 1977; Meyer, 1975, 1977a, 1977b; among others). Their research can be roughly divided into two areas–one area focusing on narrative text and the other, on expository text.

Within the research area of narrative text, Rumelhart (1975, 1977), for instance, maintained that a story also has an internal structure like a simple sentence does. He referred to this internal structure of stories as "story grammar" (Rumelhart, 1975, p. 213). He said that a story grammar is similar to a sentence grammar in the sense that each contains a set of rules which specify the possible components of different parts in order to contribute to the "well-formedness" of stories or sentences. As an illustration, consider the following schematic representations of some story grammar rules as proposed by Rumelhart.

Rule 1: Story → Setting + Episode

The first rule says that a story consists of a setting and an episode.

Rule 2: Setting → (State)*

This rule states that a setting comprises a set of stative propositions.

Rule 3: Episode → Event + Reaction

In this rule, an episode is claimed to be composed of the occurrence of some kind of event followed by the reaction of the hero of the episode to the event (Rumelhart, 1975, pp. 213-214).

Within the area of expository prose, Meyer (1975, 1977a, 1977b, 1979; among others) conducted research to explore the effects of textual organization on memory. By using a propositional analysis of text into a hierarchically organized tree structure called the "content structure" (Meyer, 1975, p. 23), she found that passages can be classified into 5 basic types of expository prose depending on differences in the top-level structure in the content structure. These five types are: collection, description, causation, problem/solution, and comparison. Meyer (1979) further contended that these rhetorical organizations are schemata which are "abstract and general than schemata for such things as restaurant, face, or building a house" (p. 11).

In Meyer's view of discourse processing, a skilled reader approaches text with knowledge of how texts are conventionally organized. For a given text, he/she chooses the formal schema in his/her repertoire which offers the best account for the text. The schema used to comprehend a text then functions as an outline that guides him/her in organizing the text during the process of encoding and in reconstructing the text during recall.

In summary, from the literature reviewed above, schemata are abstract internal representations of generic concepts for objects, events, or situations, There are two basic types of schemata-content and textual schemata. Furthermore, with a number of research (Johnson, 1981; Omaggio, 1979; Carrell, 1983b; Taglieber, Johnson & Yarbrough; 1988; among others) conducted in this area, study results revealed that the reader's failure to interactively analyze the text and to activate an appropriate schema, either content or formal, during his/her process of reading will hinder his/her reading comprehension.

Pedagogical Implications of Schema Theory for Educational Practice

Research in both first language and second language reading on schema and schema theory has constantly provided empirical evidence that background knowledge plays a significant role in reading comprehension. The findings of these studies also reveal valuable pedagogical implications that schema theory has for educational practice, some of which are presented as follows.

1. Schema theory emphasizes the important role of the learner in the learning process. Unlike the traditional view of reading comprehension, the schema theoretic view of reading comprehension no longer regards the reader as playing a passive role in unidirectionally absorbing what is in the text. In contrast, the reader is now viewed as an active participant, with his/her background knowledge interacting with the text in order to attain comprehension. Therefore, schema theory makes the teacher realize that teaching and learning should not be based on the text and/or the teacher as sole authority that dictates meaning and learning. Instead, the teacher should also take the learner and the

background knowledge he/she brings to class into consideration in order to maximize the teaching/learning outcome.

2. Empirical research has shown that readers make use of background knowledge for comprehension (Johnson, 1982; Lee, 1986; among others). Therefore, it is reasonable to teach this type of background knowledge in reading. Krashen (1981) advocated teaching background knowledge to aid comprehension through "narrow reading" (p. 23). This concept of narrow reading refers to reading within one topic area. That is, the teacher can present reading passages in an order in which passages requiring little background knowledge are presented first, and those requiring more background knowledge later. The passages which are read first would provide background knowledge for passages read later. However, if there are a lot of topics to be covered in class and so the idea of narrow reading cannot be applied, at least the teacher should make sure whether there is any background knowledge that might be required for comprehending a particular reading or not. If there is, and if students are not expected to have that knowledge, the teacher should include it in the pre-reading activities which will prepare students for the reading passage.

3. Research both in first language and second language reading has indicated that by explicitly inducing schemata through pre-reading activities, comprehension is facilitated (Omaggio, 1979; Hudson, 1982; Taglieber, Johnson & Yarbrough, 1988; among others). Therefore, the findings of these studies support the use of pre-reading activities as valuable tools for the teacher to improve his/her students' reading comprehension. However, since all pre-reading activities are not equally facilitative of comprehension, as shown in, for example, Omaggio (1979) and Taglieber, Johnson & Yarbrough (1988), the teacher can try the various activities with his/her students in order to find out what works and does not work for them. Then, he/she can develop the pre-reading activities which will be the most suitable for his/her students' need and proficiency levels, the characteristics of the text, and also the reading purposes.

4. Since study results have shown that distortion in comprehension can occur as a result of lack of appropriate schema or of an activation of inappropriate one due to cultural differences (Steffensen, Joag-dev & Anderson, 1979; Johnson, 1981; among others), there should be an

integration of teaching cultural knowledge of text as one of the pre-reading activities to prepare students for the passage. In addition, there should be a consideration of using cultural background knowledge of the text as a criterion in selecting materials for reading lessons and for evaluating reading comprehension.

5. A large body of research has revealed that text structures affect reading (Kintsch, 1977; Meyer, 1975, 1977a, 1977b; among others) and that when the rhetorical structures of expository prose are used to guide comprehension and recall, both comprehension and recall are facilitated (Meyer, Brandt & Bluth, 1980; Carrell, 1984a, 1984b, 1985; among others). Therefore, the teacher should teach students the rhetorical organization of texts so that students can effectively comprehend and remember the materials they read or study. This is because the rhetorical structures will help the student understand the hierarchical relationship among the main idea and supporting details presented in the text.

References

Anderson, R. C., & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading comprehension. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 255-291). New York: Longman.

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1977). Frameworks for comprehending discourse. *American Educational Research Journal, 14,* 367-381.

Bartlette, F. C. (1932). *Remembering*. Cambridge: Cambridge University Press.

Bransford, J. D. (1979). *Human cognition: Learning, understanding and remembering*. Belmont, CA: Wadsworth.

Carrell, P. L. (1983a). Background knowledge in second language comprehension. *Language Learning and Communication,* 2(1), 1-32.

Carrell, P. L. (1983b). Three components of background knowledge in reading comprehension. *Language Learning, 33,* 183-207.

Carrell, P. L. (1984a). The effects of rhetorical organization on ESL readers. *TESOL Quarterly, 18,* 441-469.

Carrell, P. L. (1984b). Schema theory and ESL reading: Classroom implications and applications. *Modern Language Journal, 68,* 332-343.

Carrell, P. L. (1985). Facilitating ESL reading by teaching text structure. *TESOL Quarterly, 19,* 727-752.

Carrell, P. L., & Eisterhold, J. C. (1983). Schema theory and ESL reading pedagogy. *TESOL Quarterly, 17,* 553-573.

Hudson, T. (1982). The effects of induced schemata on the "short circuit" in L2 reading: Non-decoding factors in L2 reading performance. *Language Learning, 32*(1), 1-31.

Johnson, P. (1981). Effects on reading comprehension of language complexity and cultural background of a text. *TESOL Quarterly, 15,* 169-181.

Johnson, P. (1982). Effects on reading comprehension of building background knowledge. *TESOL Quarterly, 16,* 503-515.

Kant, L. (1781). Critique of pure reason. (translated by N. K. Smith). London: Macmillan.

Kintsch, W. (1977). On comprehending stories. In M. A. Just & P. A. Carpenter (Eds.), *Cognitive processes in comprehension* (pp. 33-62). Hillsdale, NJ: Lawrence Erlbaum Associates.

Kintsch, W., & Dijk, T. van. (1978). Toward a model of text comprehension and production. *Psychological Review, 85,* 363-394.

Krashen, S. (1981). The case of narrow reading. *TESOL Newsletter, 15,* 23.

Lee, J. F. (1986). The effects of three components of background knowledge on second language reading. *Modern Language Journal, 70,* 350-354.

Mandler, J. A., & Johnson, N. S. (1977). Remembrance of things parsed: Story structure and recall. *Cognitive Psychology, 9,* 111-151.

Meyer, B. J. F. (1975). *The organization of prose and its effects on memory.* New York: North-Holland.

Meyer, B. J. F. (1977a). The structure of prose: Effects on learning and memory and implications for educational practice. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge* (pp. 179-200). Hillsdale, NJ: Lawrence Erlbaum Associates.

Meyer, B. J. F. (1977b). What is remembered from prose: A function of passage structure. In R. O. Freedle (Ed.), *Discourse production and comprehension* (pp. 307-336). Norwood, NJ: Ablex.

Meyer, B. J. F. (1979). Organizational patterns in prose and their use in reading. In M. L. Kamil & A. J. Moe (Eds.), *Reading research: Studies and applications* (pp. 109-117). Clemson, SC: The National Reading Conference.

Meyer, B. J. F., Brandt, D. M., & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. *Reading Research Quarterly, 16*, 72-103.

Omaggio, A. C. (1979). Pictures and second language comprehension: Do they help? *Foreign Language Annals, 12,* 107-116.

Omaggio, A. C. (1986). *Teaching language in context: Proficiency-oriented instruction*. Boston, MA: Heinle & Heinle.

Rumelhart, D. E. (1975). Notes on a schema for stories. In D. Bobrow & A. Collins (Eds.), *Representation and understanding: Studies in cognitive science* (pp. 211-236). New York: Academic Press.

Rumelhart, D. E. (1977). Understanding and summarizing brief stories. In D. LaBerge & J. Samuels (Eds.), *Basic processes in reading: Perception and comprehension* (pp. 265-303). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Sprio, B. C. Bruce & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension: Perspectives from Cognitive Psychology, Linguistics, Artificial Intelligence and Education* (pp. 35-58). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rumelhart, D. E., & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge* (pp. 99-135). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Steffensen, M. S., Joag-dev, C., & Anderson, R. C. (1979). *A cross-cultural perspective on reading comprehension. Reading Research Quarterly, 15,* 10-29.

Taglieber, L. K., Johnson, L. L., & Yarbrough, D. B. (1988). Effects of pre-reading activities on EFL reading by Brazilian college students. *TESOL Quarterly, 22,* 455-472.