Automaticity of Lexical Access in Reading

Hiroshima University Graduate School　　T a t s u h i r o　Y o s h i d a

1 Introduction

With the development of reading theory in cognitive psychology, study of reading in ESL/EFL has become remarkably developed. The trend of the study in the field seems to be directed toward an interactive process of reading, and many researchers focus their attention on the reader's background knowledge, i.e. schema theory. By investigating this area, considerable findings have been obtained (See Carrell et.al., 1988). Surely, whether a reader has appropriate schemata will affect his/her comprehension of the text. However, I assume that major problems ESL/ EFL readers have do not lie in this area. They cannot read without knowing how to read in the language. This seems to be a plain truth, but this factor seems to have been put aside in the recent study of ESL/EFL reading. I suppose it is local process, such as word recognition, that strongly affect reader's ability differences.

The purposes of the present study are 1) to investigate the factors affecting individual differences in reading ability by reviewing the Verbal Efficiency Theory (Perfetti, 1985, 1986), 2) to focus on and examine automaticity of lexical access, which seems the most possible candidate for the factor infuluencing the individual differences, and 3) to apply the findings to the EFL reading process. In 3), in particular, I will present a hypothetical lexical representation of an EFL reader to clarify the weakness of lexical access in EFL reading.

2 The Overview of Reading Process

2.1 Components of Reading Process

In recent cognitive psychology the notion o reading process has shifted from a liner process, i.e. "bottom-up" and "top-down", to an interactive process. Actually many researchers have established their own models of interactive process (e.g. Rumelhart, 1977, Stanovich, 1980). Although there exist some differences among these models, they are very similar in principle. In this paper I will not evaluate each of these models. Instead, I will examine Perfetti's (1985, 1986) model because, unlike the others, this model accounts for the individual differences in reading process.

According to Perfetti (1985, 1986) the reading process consists of several components (See figure 1). The process is largely divided into two sub- process; lexical access and comprehension process. Lexical access here is defined as follows: "Contact with a word stored in permanent memory, given the word as a visual string
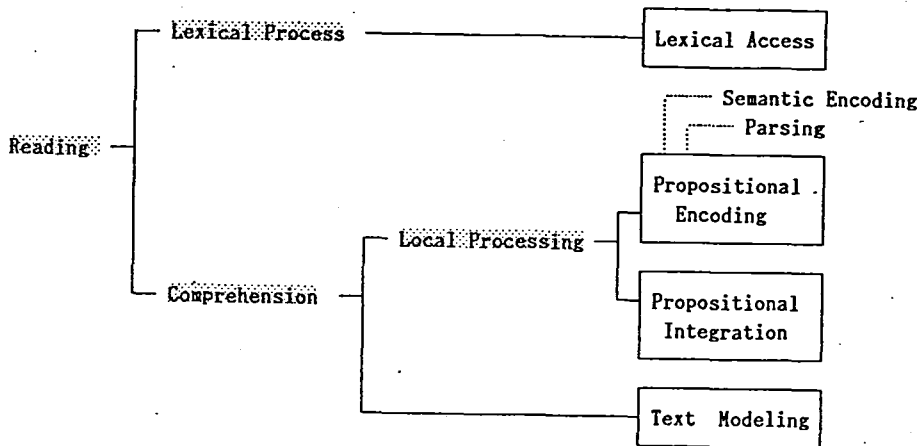
Figure 1. Components in reading process

of letters" (Perfetti and Curtis, 1986). What is important in this definition of lexical access is that it does not necessarily involve meaning of the word. Rather, lexical access acitivates the word's meaning appropriate for the context (semantic encoding); what is done in lexical access is to identify visual information with a word stored in permanent memory. The other process, comprehension, is divided into local processing and text modeling. Local processing includes proposition encoding and proposition integration. Propositions are defined as essential units of meaning of the text (e.g. phrases and clauses). Their essential property is predicate. Thus, propositional encoding is a component where words are encoded as a meaning unit after they are syntactically grouped (parsing). These encoded propositions are, then, integrated as a larger unit. In the other component of comprehension, text modeling, a reader mentally constructs a text by activating his/her background knowledge, i.e. schemata. Since this is an interactive model, these components have to influence each other. The information formed as a result of comprehension is considered to affect the local processes. It may affect the choice of the meaning of a word and propositional encoding as soon as the reader's mental text model is constructed. However, lexical access itself is not affected by it. This "neutralness" of local access is important in further argument.

This is a brief description of components in reading process and how they work together. In the following section the individual differences are argued in terms of how these components are efficiently operated.

2 Individual Differences in Reading Ability and Verbal Efficiency Theory

In this section Perfetti's (1985, 1986) Verbal Efficiency Theory will be briefly reviewed and, based on his argument, individual differences in reading processes will be discussed.

2.1 The Core Proposal of the Verbal Efficiency Theory

Perfetti (1985, 1986) claims that individual differences in reading ability are attributed to the efficient operation of the components mentioned above. In Verbal Efficiency Theory it is assumed that;

> the outcome of reading, i.e. comprehension of what is read is
> limited by the efficient operation of local processes.... What
> processes can be made efficient ... is partly a matter of how
> processes contribute to the reader's text work. The distribution
> of resources is dependent on the reader's ability in low-level
> processes (Perfetti, 1985: 101).

Thus, the Verbal Efficiency Theory assumes that the limitation of resources, which is considered as a capacity of cognitive process, attributes to the efficiency. The reason the theory is called 'verbal' is that the most of the outcome of reading comprehension is verbal; that is, reading process consists of semantic, orthographic, and phonetic components.

2.2 Differences in the Distribution of Resources in the Components

There are some specific components in verbal efficiency. These are lexical access, propositional encoding, and schema activation. Among these components propositional encoding, which is the main component for comprehension, is assumed to be high in resource cost. Propositional encoding requires that words grouped together are linked with each other, and this is carried out in the working memory, which means that it needs to retrieve previously encoded propositions from the memory. If the encoded propositions are not properly retrieved, then the process will be effortful. The other two components, lexical access and schema activation, are likely to be low in resource cost. Lexical access will be facilitated through repeated activation. Schema activation is also less resource demanding, provided that a reader has background knowledge, or schemata, appropriate for the text, and that lower processes, i.e. lexical access can be operated well enough to activate the schemata.Thus, lexical access is the most possible candidate for becoming less resource demanding. The Verbal Efficiency Theory predicts that although the lexical access of a beginning reader may be a very costly process, it will be more efficient with much practice. Perfetti (1986) concluded that "individual differences in global reading ability can be due to differences in lexical access efficiency." (p.25)

3 Automaticity in Lexical Access

The efficiency of lexical access has bee recognized as important in the reading process. Then, what nature of lexical access will be important? In this section I will consider automaticity which seems to reflect efficiency. It will be considered in terms of attention-free process and in terms of the reader's lexical representation.

3.1 Automatic Process and Controlled Process

According to Shiffrin and Schneider (1977) human cognitive processes can be divided into two types: automatic and controlled process. A controlled process is a temporary sequence of the activation of the nodes under control of and through attention. Only one sequence is controlled by attention without interference. It is capacity limited, but easy to set up, altered and applied in a novel situation. A controlled process is carried out in short term store, which is activated when some external stimulus come into process, and the limitation of the capacity attributes to the limitation of short term store. On the other hand, an automatic process is a sequence where the nodes in the long term store are always activated automatically without necessity of active attention. It is acquired through a large amount consistent training, and, thus difficult to suppress or to modify. LaBerge and Samuel (1974) follow this notion of automaticity, and claim that lexical access can be automatic, i.e. attention-free processing through much practice. [1]

3.2 Automaticity and Accessibility of Lexical Representation

Perfetti (1986) accounts for the speed of lexical access, or "automaticity" from a different point of view. He assumes that the speed of lexical access reflects the accessibility of a reader's lexical representation. The accessibility can be accounted for in the following two ways. First, activation links between at letter level and at word level of the representation become effective. With practice links of a representation of a particular word will become strengthened and activated more efficiently. The second way to account for the accessibility is the quality of the representation. Thus, the incomplete state of the representation will be refined with practice.

Figure 2-a shows the representation of a word, 'stand'. The representation consists of letter level, word level and phoneme level representation. Suppose a reader meet a word, 'stand'. In the initial stage of the development of the reading process the word is represented each by each letter, s-t-a-n-d. While the reader encounters many words 'st' becomes strengthened as a pattern, and it also activates the words beginning with 'st-' other than 'stand', such as 'stone', 'store', etc. With practice the reader becomes able to distinguish 'stand' from other words beginning with 'st-' because the links between the word, 'stand', and 'a' , 'n' and 'd' will be effective.

In early development the states of the representation can be thought to be incomplete in two ways: 1) Only the word's letter (or graphemic) level is represented, or 29 either the word's letter level or the phonetic level (or both) is "unreliably" represented. Perfetti (1986) assumes that 1) is unusual in L1, but it is possible that the state of 1) can be found in L2 reading. In figure 2-b a word 'stand' is unreliably represented because of the unreliability of some word level

a. Later Complete Representation
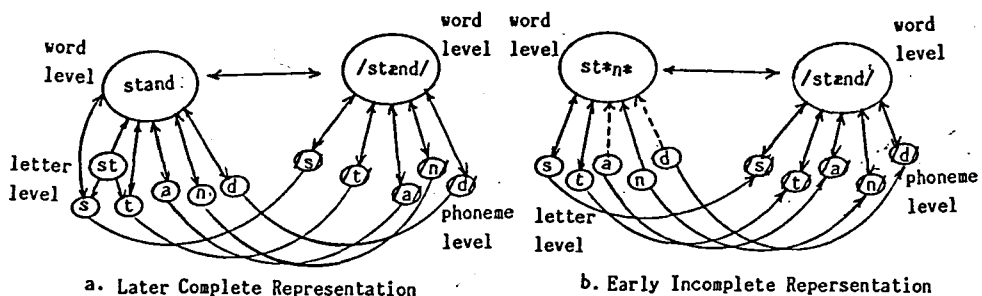**b.** Early Incomplete Repersentation

FIG. 2 Hypothetical representation of lexical knowledge of a child
(cited from Perfetti, 1986)

representation, i.e. 'a' and 'd'. These two graphemic representations are also unreliably linked with the phonetic level representation. In this state, the reader can sometimes spell the word but sometimes not, but he often can read, though it is not very efficient. This is so because letter level representation can activate the word level representation to some extent. In principle, the accessibility of the representation becomes effective with the representation refined. Perfetti (1986) stated:

> The redundancy of the representation system --- letters,
> orthographic patterns, phonemes, all linked to words that
> have both graphemic and phonetic representation --- is an
> important part of reading ability. It provides ample back-
> up representation to handle unfamiliar words. (p.36)

Thus, the speed, or automaticity, of lexical access can accounted for in terms of the accessibility of lexical representation. In the following section I will argue how efficient lexical representation is required.

4 Acquisition of Representation for Efficient Lexical Access

4.1 What is acquired in the early stage of learning to read?

Linguistic knowledge which is necessary in beginning learning to read depends of the graphonic symbols that the language uses. For example, in Chinese one begins to read by associating a word as a visual symbol with the meaning and speech sound of it. Alphabetic scripts, such as English, associates the meaningless

script units,or letters, with the meaningless sound units, or phonemes. Thus, a child's awareness of phonemes as linguistic knowledge is assumed to be critical, or at least helpful in forming associations, when he starts to read. Actually, Bradley and Bryant (1983, cited in Perfetti and Curtis, 1986) reported that there is a causal relationship between phoneme-knowledge and early achievement in reading.

4.2 Acquisition Phases

In learning to read in L1 phonemic awareness seems to be necessary. Then, another question arises: How is it acquired? Gough and Hillinger (1980) described the child's acquisition stages of learning to read. There are two phases; associative and alphabetic phase.

In the associative phase a child learns to read by associating visual symbols, or a word, with its meaning or speech sound in the same way as a child learning to read in Chinese does. Gough and Hillinger suggest that the critical features are a word's global shape, the shapes of constituent letters, word length, a particular typography, and so on. Details aside, a child acquires a considerable number of words by association between specific printed symbols and specific words (meaning, sound). However, as the memory becomes burdened, the acquisition phase is shifted into the next phase at some point; the alphabetic phase.

In the alphabetic phase the child learns different, more specific associations; that is, he learns that each letter corresponds to a sound, or grapheme. In other words, a child begins to shift attention from "extrinsic" features of words to "intrinsic" word features. Extrinsic features are those which guide the reader's "expectation" about word identity, such as context. Thus, a child starts to read in a true sense through applying alphabetic principles.

4.3 Lexical Representation and EFL Reading

In this section, based on the studies previously mentioned, I will discuss how an EFL reader acquires the lexical knowledge necessary to read. In addition a hypothetical lexical representation of an EFL reader will be presented.

It is assumed that EFL readers begin to read by association word form with its meaning or sound, as can be seen in associative phase in learning to read in English as L1. They may associate the whole printed word with its meaning (sometimes its equivalent meaning in Japanese, perhaps) without involving its speech sound at all. However, it is possible that some of the knowledge represented in the associative phase in EFL reading, unlike in L1 reading, may not be transformed into that in alphabetic phase. This may be due to the fundamental difference between L1 and EFL reading. That is, EFL readers lack the pre-existing speech representation which they can link the word form with. Thus, they may simply avoid or be incapable of associating a word form with its speech sound, or they may have to establish their own speech representation, which may be phonologically incorrect. Yanase (1988) claims that EFL readers do "functionally minimum coding", in which all they
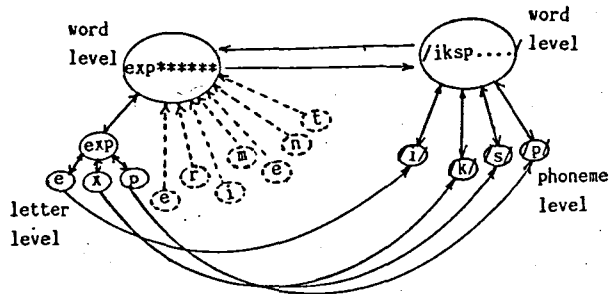
FIG. 3 Hypothetical representation of an EFL reader

actually do may be just to put some convenient speech label on words in the text, enough to secure reading comprehension. Suppose the reader encounters a word, "experiment". If he knows a different word, "exercise", all he has to do is to distinguish "experiment" from "exercise" by labeling a part of the word, such as 'exp-'. Thus, sounds like /iks-/ may be labeled. This can be represented as in Figure 3, where only 'exp' is reliably represented, and thus, the shape at the word level is unreliably represented. However, he will soon encounter a problem; when he further comes across the word, "experience" shares identical initial letters with "experiment". This lexical representation is hypothetical and has not been verified yet. However, this seems very plausible, because we can see those students who have difficulty identifying two similar words and pronouncing them. I suppose that EFL readers need to form correct phoneme level representation, which works as a back-up system and enable efficiency in reading.

5 Conclusion

In this paper I have described what causes the individual difference in reading ability, in terms of the difference in lexical access, based on Perfetti's verbal efficiency theory. It has been revealed that the accessibility of lexical access is reflected as automaticity of the process. This can be accounted for in terms of both activation link and the quality of the lexical representation. Finally, I have attempted to establish an EFL reader's lexical representation, and pointed out that EFL readers have to have complete representation both at the letter level and at the phoneme level. As a further study it can be suggested that the relationship between an EFL reader's phoneme awareness and overall reading comprehension be investigated. I assume this will provide further evidence to clarify what is needed for EFL readers to operate efficient lexical access.

Note 1) Automatic process is defined as a process which is carried out without interference when a different process is being attended. However, Perfetti (1985) considers that reading process cannot satisfy this test, but that the resources used for the process, such as lexical access, can be greatly reduced. Thus, in his term quatations are pur around "automaticity", referring to the process that is less resource costly.

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