THE NATURE OF LINGUISTIC PROCESSING IN READING A SECOND LANGUAGE

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ABSTRACT

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The purpose of this thesis is to examine native/non-native speaker differences in reading English. In particular, this study approaches the desciption of reading in a second language through a two-process model of information processing. Native speakers are assumed to process syntactic information automatically, in a rapid and non-attentive way. Non-native speakers, who have not reached automaticity of syntactic processing, should process syntactic information in a slow and conscious way. A timed reading passage and cloze test were used to indicate speed of processing. Tests of recognition memory, one for the form and content of a prose passage and one for items deleted in a previously-administered cloze test, were used to assess allocation of attention. Thirty native English speakers, twenty-two high proficiency English language learners and forty-five medium proficiency English language learners participated in this study. Differences between native and non-native speakers were found for scores on both

timed tests. Moreover, high proficiency learners were found to have significantly better recognition memory than native speakers for structural changes in a text. These results were supportive of a two-process model of reading.

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INTRODUCTION

In many second or foreign language classrooms reading takes up a sizeable portion of overall instruction time. Since relative to native speakers second language learners read slower and seem to understand less, speed and comprehension are key issues for the language teacher concerned with improving her/his students' reading ability. And yet without a clear understanding of why such deficiencies exist it is difficult to develop methods and techniques for overcoming them.

The goal of this study is to propose and examine reasons why second language learners do not read as well as native speakers. It will focus on the specific performance variables involved in reading that, when assessed, can serve to separate native from non-native proficiencies. Working from an information processing model of reading, the study seeks to discover the aspects of linguistic processing in which non-native speakers are deficient in order to determine the way in which such processing actually occurs. Do native and non-native speakers process linguistic input to the same extent? Is the input processed in the same way? In addressing the hypotheses deriving from these questions the study can perhaps characterize not only the problems that a second language learner encounters reading a second language, but the nature of native speaker linguistic competence as well as the extent to which it is involved in reading.

Research in Bilingualism and Second Language Acquisition

Historically there have been two major approaches toward the description of non-native speakers. Research in bilingualism regards the non-native speaker as one who knows and is functional in two languages. Psycholinguistic studies that grow out of this approach generally seek to discover how two or more language are represented in the brain. The general debate in this area has centered around whether these languages are represented in two separate linguistic stores, one for each language, or in one store with separate language tags (McCormack (1978)). The issue becomes more complex when the individual differences among bilinguals are considered; it is possible that some bilinguals store their two languages in a single store, some in two separate stores. Ervin and Osgood (1954) developed the compound coordinate distinction in order to account for such a possibility. A compound bilingual is one whose languages are represented in a single store, while a coordinate bilingual represents her/his two languages in separate stores.

The concept of the bilingual speaker is a static one, for bilingualism is viewed not as a process but as a state. In decriptions of the bilingual state, the second language learner is conceived of as a type of dominant bilingual, an individual who is more fluent in one language than the other (Albert and Obler (1977)). Yet the specific fluency of the speaker is only relevant to bilingualism studies insofar as it is a variable in understanding the mental organization of the two languages.

Because of a concern with improving linguistic competence, second language acquisition studies consider the non-native speaker in a much more dynamic way. It is the process of acquisition, not its resultant state, that is fundamental to this second paradigm: how does the non-native speaker come to learn the target language?

Perhaps the most prominent description of the second language learning process is Krashen's Monitor Model (Krashen (1978a,1981)). He suggests that language is internalized via two separate psycholinguistic systems. "Acquisition" develops when the speaker focuses on the content and not the form of her/his utterances. In acquisition, the target language is internalized subconsciously, without focus on explicit linguistic rules. Self correcting is done by "feel" rather than by rule. "Learning" involves a conscious internalization of the target language. It is the result of a focus on the explicit rules of the language, which cultivates a metalinguistic rather than a linguistic competence. The use of conscious rules to self correct utterances characterizes what Krashen calls the Monitor user. Most second language production involves the integration of the two systems: generally the acquisition system initiates an utterance and the learning system, by means of the Monitor, modifies it in some way. According to Krashen's (1978b) model, individual non-native speakers vary in the extent to which they utilize the Monitor in second language performance. Individuals who overuse the Monitor, because of an overconcern with form, exhibit a hesitant, non-spontaneous style of speaking, while Monitor underusers use very few or no conscious rules.

The major problem with both approaches to describing the non-native speaker is that individual variation, both in terms of the compound/coordinate distinction and the acquisition/learning distinction, calls into question the predictive value of the model. There is no clear relationship between language proficiency and how a non-native speaker stores or internalizes language. The strongest and most widely used indicator of both the number of linguistic stores as well the system of language internalization has been the nature of the environment in which the target language was appropriated. In bilingualism studies, coordinate bilinguals are thought to be those individuals who learned the two languages in separate settings, perhaps one language with family at home and one among friends outside of the home. According to these studies, when a child speaks the two languages with bilingual parents, s/he is likely to develop a single set of representations for both languages, resulting in compound bilingualism. Subordinate bilingualism, a subcategory of compound bilingualism in which one language is clearly dominant over the other, is thought to be the result of the non-dominant language being learned through an indirect method, generally in a formal environment such as a classroom. Similarly, research into second language acquisition has pointed out that when second language appropriation takes place in a classroom setting, individuals tend to be Monitor users, more knowledgeable about the descriptive rules of the language than fluent in its use. "Acquisition" is thought to take place in more "natural" settings in which the focus is on communication and not correctness. And yet even the relationship between context of language appropriation and the storage or system of internalization of a second language is rather tenuous. Because the individual variation that both models allow does not correlate strongly with any single factor so far examined, neither description of the non-native speaker is capable of accurately predicting second language performance. And since such performance is the only measurable means of verifying the two models, their inability to operationally define their central dichotomies renders both models unfalsifiable.

In an attempt to overcome these inadequacies, this study takes a different approach toward describing the non-native speaker. It is based on the idea that language is linguistic information that must at some point be processed in order to be understood. In particular, the study focuses on how native and non-native speakers of varying language proficiencies differ with respect to how they process written information in the target language.

Like the second acquisition studies, this research is concerned with the way in which a second language learner internalizes the target language. Unlike these studies, however, learners are not assumed to differ as to whether they have "learned" or "acquired" the target language but as to the kind of processing which is involved in the appropriation; the learned/acquired distinction may be a useful one, but in terms of the model on which this study is based, a more operational distinction comes from looking at information processing, which can occur equally in the "learning" or "acquiring" systems. In addition, while language storage is a key concept in this study, it is used as an indicator of the nature of the processing, not to reflect the organization of language, as in the bilingualism studies.

Human Information Processing

If we assume that humans have a limited capacity for information processing, which constrains the amount of processing energy available, and that any information processing task will require depleting enough energy to accomplish the task, then a very relevant question is, on what basis is processing energy allocated? Kahneman (1973) suggests that the amount of processing energy used depends upon the nature of the task; certain mental operations require more processing capacity than others.

Several researchers, Posner and Snyder (1975), LaBerge and Samuels (1974), Schneider and Shiffrin (1977), Hasher and Zacks (1979), have conceived of the differences in the processing capacity necessary for various mental operations in a dichotomous way: either a task requires attention and therefore taxes processing capacity, or it proceeds automatically, does not require attention and demands little processing energy. Yet a task that once required attention may become, through repetition, so automatic, that attention is no longer required for its performance. Approached in this way, learning can be described as an evolution from attention-requiring processes to automatic ones that no longer tax processing capacity.

Shiffrin and Schneider conceive of memory as a large collection of nodes that become "complexly interassociated" through learning. Each node is a grouping or set of informational elements. Most of the nodes are inactive and passive, and when in this state the interconnected system of nodes is called long-term store (LTS). But when, because of some kind of external stimulus, a small number of these nodes are activated, the activated nodes constitute short-term store (STS).

There are two ways in which these nodes become activated -- two different kinds of controls on the information passing into and out of STS: Shiffrin and Schneider call these the automatic and controlled modes of information processing. Automatic processing involves the consistent activation of certain nodes in memory every time the appropriate inputs are present. It is a learned response that has been built up through the consistent mapping of the same input to the same pattern of activation over many trials. Once an automatic response has been triggered, not only does it work independently of the individual's control, but unless attention is directed to the process, it will not be remembered or retained in LTS. Other characteristics of automatic processing include the very short reaction time necessary to process a given piece of information and the fact that such processing does not use up work space in STS, thereby allowing the store, limited in its capacity, to be free to carry on other kinds of cognitive tasks.

Controlled processing, according to Schneider and Shiffrin, is not a learned response. It is a temporary activation of nodes in a sequence, and the entire process, from input to activation, requires the attention and conscious control of the individual. Because of such attentional requirements, much of the work space in STS is used up, and simultaneous controlled processes are prevented from occurring. Controlled processes are characterized by the large reaction times necessary to process information and the fact that the input that has stimulated such a controlled response is retained in LTS. (Schneider and Shiffrin are vague at this point on the way in which such an activation or encoding of information for subsequent access would occur, and whether what is encoded is the stimulus alone, the act of processing such a stimulus; or both.) Although controlled processing is not a learned response, it is through such conscious processing that a consistent mapping of input to activation can be built up, thereby fostering an automatic processing that is beyond the conscious control of the individual.

Much recent literature has focused on the way in which the automatic/controlled dichotomy is relevant to language processing. Hasher and Zacks suggest that the meaning of a word is associated with either its written or spoken representation by an automatic process. They claim that through extended practice a consistent mapping between a word and its meaning is built up, such that the presentation of a word will automatically activate its meaning in LTS. The strength of such an association is most clearly evidenced in the results of the Stroop test: in this test subjects are asked to label the color of ink used to print a given stimulus, where the stimulus is either a non-verbal shape, a word whose referent is the same color as the ink used to print the word, or a word whose referent is a color other than the one used to print the word. Subjects are much slower at labeling items where the color ink used is inconsistent with the color expressed by the meaning of the word. Clearly the meaning of the word has interfered with the processing of its formal features. Even when attention is focused, the word-referent mapping can not be supressed.

A way of more accurately assessing the strength of association between a word and its meaning is with the lexical decision task derived from the experimental paradigm of Posner and Snyder (1972). In their experiments, subjects are required to make a decision about a target stimulus for which they have been previously given either a priming signal that is the same as or different from the target stimulus, or a simple warning signal neutral with respect to the target. By varying the probability that the prime will be facilitative in the subsequent task, the amount of attention that the subjects focus on the prime is manipulated; those priming items that most often prove to be helpful in making a decision about the target will, in expectation of the associated target, be attended to best. In addition, by varying the amount of time between the onset of the prime or warning signal and the onset of the target, it is possible to discriminate between the kinds of processing operating: when little time is given, all processes that require subjects to commit significant amounts of processing capacity are excluded, and only the automatic processing of primes is possible. Reaction time for performing the decision-making task as well as accuracy of performance are measured.

In the lexical decision task, the target stimulus is a word that the subject must make a decision about (e.g. is the target an English word or not). The priming signal is either a string of non-letters or a word. The semantic relatedness of the prime word to the target word, the time between prime and target, as well as the extent to which subjects expect primes and targets to be semantically related, are all manipulated.

Results from the lexical decision task are supportive of the two-process model. When subjects are shown, with high probability, word primes similar to the target, the reaction time for the subsequent task is shorter than when a neutral signal is shown. This confirms the facilitation effect of a consistently-mapped, similar prime; which, according to Posner and Snyder, is due to the relative closeness in long-term memory of the semantic representations of the prime and target. In this condition as well, subjects given primes different from the target showed higher reaction times than when shown the neutral signal, indicating an inhibitory effect caused by the dissimilarity of the two stimuli; when attention is focused in one area of long-term memory it takes a relatively long amount of time to be reallocated to an area of memory distant from the initial one. In this case, the processing of the unrelated word prime has interfered with the processing of the target. Both automatic and controlled processes are thus implicated in the processing of the target when attention is focused on the prime. But when, because of low probability of occurrence, attention is not focused on a prime, the presentation of similar primes still show a decrease in reaction time, while dissimilar primes prove to be no different from neutral warning signals in affecting the speed of target processing. This suggests that while the automatic processing of the target words can take place without attention (as indicated by the faciliation effect of the similar word prime for the target), attention is a prerequisite of controlled processing (as indicated by the absence of an inhibitory effect for the dissimilar word prime); when a condition of non-attention is created, only automatic processes are maintained.

The extent of the delay of the target word onset was also shown to affect its processing in the predicted way: when the delay was short, reaction times following similar word primes were faster than those following either neutral signals or dissimilar word primes. The same facilitation effect is evident for similar primes when the delay is longer. But in this condition, interference, as indicated by longer reaction times, is found following dissimilar word primes. Time available for processing, therefore, can determine if processing will be solely automatic, as in the short delay condition, or a combination of automatic and controlled, as in the long delay condition.

LaBerge and Samuels extend the two-process model to a theory of reading. They conceive of reading as a process of translating lines on a page into meaning by a progression through sets of hierarchically-arranged levels in long-term memory. Each level is made up of one modality-specific processing system. The visual memory system constitutes the first level. Here, written stimuli on the page are processed by means of feature detectors which allow non-differentiated graphemic information to be identified as individual letters. The letter code then activates spelling-pattern codes and subsequently, word codes and possibly word-group codes. According to this view, it is possible, too, for graphemic information to pass directly from the level of feature detectors to the spelling pattern or even word code. This is perhaps the case when very familiar words like 'the' or 'and' appear in a text: the words are detected as words, and not analyzed into their letter components.

Much of visually-encoded linguistic material is phonologically recoded. The phonological memory system is conceived of as analogous to the visual memory system: acoustic input is subject to a set of feature detectors which allows phonemes to be identified and subsequently classified as words. There are several ways that the visual and phonological memory systems can interact. For instance, a word can be visually processed to the word level and then phonologically processed directly at the word level. Or, a word may activate the visual spelling code and then activate the phonologial spelling code directly.

LaBerge and Samuels claim that during fast reading no attention is focused on the visual memory system and that the phonological memory system is automatically activated by the highest level processed in visual memory at the corresponding phonological level. During slow reading, on the other hand, attention is focused on the previous visual memory codes, and activation of the corresponding codes in phonological memory is non-automatic.

There are, according to LaBerge and Samuels, two kinds of non-automatic associations between visual and phonological memory: one is direct but requires attention, and the other involves the processing of information via episodic memory. This latter association provides additional information about the code, thereby allowing processing to continue. Such contextual information includes not only the string's position in a larger linguistic unit, but also the memory of its previous decoding. Episodic memory and its role in language processing will be discussed in greater detail later. It is important at this point to note how LaBerge and Samuels have described its function in the earlier stages of learning to read: an individual will often use supplemental information stored in episodic memory to trigger a new association. For example, a child may attempt to learn the pronunciation of a new word by recalling the "episode" in which s/he first heard the orthographic and phonological connection made -- perhaps the first time her/his teacher pronounced the printed word.

A third memory system handles the processing of semantic information. LaBerge and Samuels assume a direct connection between the phonological code and a semantic code. They suggest that the flow of information is in this direction because of the fact that the connections between spoken words and their referents are generally formed in spoken language long before visual representations of the language are understood. Once the association between visual and phonological memory has been accomplished, the phonological representation of the word is, in most cases, automatically assigned a meaning. If the word is unfamiliar to the reader, attention would be required to assign it a meaning. And as in the former association, non-automatic processing of phonological information may either be direct or involve additional cues from episodic memory for the retrieval of the word's meaning from semantic memory.

Comprehension entails the organization of the single-word meaning units into larger groups of meaning. LaBerge and Samuels postulate that the organization is accomplished by a controlled integration of the single-word units. For the fluent reader, this final organization is the one process that requires attention; the decoding of information from the visual to semantic systems is automatic at every other level. But when attention is required in the earlier decoding stages, not only is the entire procedure slow and labored, but comprehension, reliant upon the same limited-capacity attentional system, is impeded as well.

LaBerge and Samuels examine the role of attention in information processing by measuring latency times for different processing tasks in which differing amounts of attention are required. And yet while reaction times almost exclusively have been used as indicators of different kinds of processing, the authors point out another phenomenon that also covaries with the nature of the processing: the fluent reader processing familiar text is not aware of the lower-order processes that allow comprehension of the text being read. The reader is not, for example, conscious of letter detection or even the visual or phonological code that represents word formation. What is within the fluent reader's awareness is what is attended to -- the organization process involved in comprehension. The poor reader, on the other hand, attends to, and is therefore conscious of, the various subskills that are essential components of reading; for the reader not totally familiar with the alphabet of the text, distinctive features of individual letters are attended to and consequently within the reader's awareness. When an unfamiliar word is encountered in an otherwise familiar text, attention is shifted away from organization into word groups, and the reader is aware of the process at the level that it has broken down, that is, at the lowest level of non-automaticity; both the unfamiliar word and the process of assigning a meaning to it are within the reader's awareness. Another dependent measure of automaticity, then, would seem to be an assessment of an individual's awareness of the process in question.

As noted earlier, one of the ways that Schneider and Shiffrin differentially characterize automatic and controlled processes is by the retention in LTS of the information processed: information automatically processed is not retained in LTS, while information processed in a controlled way is retained. In addition to the memory storage that results from the non-automatic activation of nodes in LTS, the LaBerge and Samuel model of the sequencing of modality-specific codes suggests that another conception of long-term memory -- its division into episodic and semantic stores -- is useful for understanding the kind of information stored as a result of processing.

A Concept of Long-term Memory

Tulving (1972) proposes that episodic and semantic memory represent two separate but related information processing systems that can be differentiated by 1)the nature of the information that each internalizes, 2)the way that such information is encoded, 3)factors that impinge on retrieval and 4)the extent to which each memory is susceptible to information loss (forgetting).

Information that maintains its connection to the individual encoding it (i.e. has some kind of autobiographical reference) is stored in episodic memory. Such information includes events or episodes in the individual's life, like remembering "the last time I saw Jane", or that "I have an appointment today at 10:00". Items encoded in episodic memory are related to each other either in terms of order of acquisition (temporal order), spatial sequencing or a strength of encoding that would reflect the relative frequency of occurrence of stimuli. Successful retrieval of information from episodic memory requires that one of these three types of relationships among internalized items be specified in order to locate a given event or episode; if unspecified, retrieval is blocked and forgetting (which is seen by Tulving as the inability to retrieve information) occurs. Episodic memory is prone to loss of information because of the large amount of autobiographically-referenced material that is internalized. Even the act of inputting or retrieving information is an event related to the individual, and consequently encoded into episodic memory.

Semantic memory is a store for information that is cognitively, not autobiographically, referenced; stimuli internalized into this memory are related to each other not through contextual cues such as temporal sequencing but by the nature of the referents themselves. Similarly, the organization of semantic memory reflects these relations and is conceived of as a multidimensional association of concepts, where association is determined by the semantic relatedness of the referents. Tulving claims that our linguistic knowledge is stored here as a "mental thesaurus" and a set of rules for utilizing this. In addition, all information abstracted from context of acquisition, as well as rules necessary for any kind of cognitive operation, are stored in semantic memory. Loss of information from this memory is minimal, and retrieval and encoding procedures do not affect its internal state. While the input to episodic memory is primarily through perception, input to semantic memory is through both perception and thought; various cognitive processes (for example, inference), can operate on information in semantic memory and replace new, "inferred" information there.

Episodic memory, on the one hand, is used as a facilitator of processing; as described earlier, information encoded here can be consciously retrieved and used as a mnemonic trigger for a not yet well-learned phonological or semantic code. On the other hand, it serves as a record-keeper not only of its own functions, in that it encodes its own access, but of the non-automatic accessing of semantic and phonological memories as well. It is in this latter capacity that episodic memory can serve as an indicator of the nature of the processing taking place. For according to the LaBerge and Samuels model, if information has been encoded into episodic memory, automatic processing has not occurred, and non-automatic processing, either direct or indirect, is implicated. Memory for processing, like reaction time, can then act as an indicator of the nature of the processing.

Memory for Language

Sachs (1967) and Bransford and Franks (1973) use memory for speech as a means of determining which aspects of a sentence are encoded into memory and which are not. They dichotomize language into its formal and ideational aspects, hypothesizing that the former is only useful in that it allows a hearer to extract the latter, which is subsequently encoded into memory. Sachs, working within a transformational-generative framework, tries to assess empirically the extent to which the surface structure and the deep structure of an utterance are differentially processed. To this end, she uses recognition memory as an indirect yardstick of cognitive processing. Her assumption is that the comprehension of any utterance involves the encoding in memory of meaning. If comprehension has occurred, it should be evident in recall or recognition for content; the form is only processed, and therefore only remembered, insofar as it is necessary for the extraction of meaning through various syntactic transformations. Once this has been performed, surface structure features are no longer functional in comprehension and are consequently not encoded into long-term memory.

The prediction that derives from Sachs' hypothesis is that memory for the surface features of a text should deteriorate much more rapidly than memory for its content. To test this prediction she designed an experiment in which subjects were asked to decide whether a test sentence heard after listening to a short passage was either the same or different from a sentence heard in the text. The two manipulated variables were the amount of time elapsed between the subjects' exposure to the original and the test sentences, and the relation between the original sentence and the sentence to be recognized. Test sentences occurred after either 0, 80 or 160 syllables of interpolated text. After one of these three intervals, subjects were asked to decide if the test sentence represented a structurally exact replica of the corresponding sentence in the passage, or an altered version of the sentence, changed either formally or semantically. Where formal changes were made, only the order of the words was altered; no new lexical items were inserted.

Sachs found that the rate of recognition for formal changes and semantic changes, when subjects were questioned just after hearing the original sentence (intervening syllables =0), was approximately the same. But at 80 and 160 syllables away from the original sentence, recognition memory for form dropped off drastically, almost to chance, while memory for content, although it declined linearly, was still significantly above chance even at 160 syllables. The author uses the data as evidence for her prediction that recognition memory for the surface features of an utterance declines much more rapidly than recognition memory for its meaning.

Bransford and Franks assert that memory for connected discourse is a direct reflection of the acquisition of ideas, and takes the form of semantic abstractions from sentences connected consecutively in time. It is a process of linking together all of the semantically related elements of a text by essentially disregarding its formal properties. The authors argue that subjects believe that they heard a complex sentence expressing a complete idea which they actually heard expressed as several shorter sentences. This implies that what the subjects do is to encode into memory the whole idea underlying a set of sentences. What occurs in a recognition task is an attempt to match the part of the idea expressed in the test sentence with the representation of the complete idea in memory. The extent to which the two match is a function of how much of the whole idea is expressed in the test sentence. The authors found that the more complex the sentence to be recognized, the more subjects believed that what they had heard was just such a single, complete representation.

In the studies of both Sachs and Bransford and Franks, subjects were tested on their memory for spoken English. If, like LaBerge and Samuels, we assume that reading involves the phonological recoding of visually-presented linguistic information, and therefore that similar results would be obtained for written English, then the conclusions drawn from both studies seem to corroborate the two-process models of information processing examined above: for normal, native speakers/readers of English, the processing of linguistic information (either spoken or written) is automatic until the level at which the meaning of an utterance is abstracted, at which point controlled processes are necessitated. And because controlled processes result in storage in long-term memory while automatic processes do not, only the meaning of a text, and not its syntactic organization, is encoded.

All of the above studies were carried out using subjects working in their mother tongue. What results might we expect if the individuals processing a text are not native speakers of the language? More specifically, how can the two-process model account for native/non-native differences in reading?

Reading in a Second Language

In a review of the research on second language acquisition and bilingualism carried out in Canada between 1970 and 1980, Gardner and Desrochers (1981) note that most of the studies on reading in a second language have focused on the characteristics which differentiate native and non-native readers. These are primarily the non-native reader's poorer comprehension and slower reading speed. Favreau (1981) claims that some fluent bilinguals, even when equated for comprehension in their two languages, read 33% slower in their second language than in their first. The non-native reader's insensitivity to orthographic redundancies (Favreau, Komoda and Segalowitz (1980)), syntactic and semantic redundancies (Macnamara, Feltin, Hew and Klein (1968)) as well as discourse constraints (Cziko (1978)) in the target language have been cited as reasons for difficulties in second language reading.

Favreau claims that in addition to an inability to take advantage of the language's redundancies, difficulties at the level of word retrieval from long-term memory may contribute to the non-native speaker's deficiency in reading. Using the Posner and Snyder model of information processing as her theoretical framework, she claims that in reading, a less fluent bilingual must employ attentional processes to retrieve meaning from memory whereas a truly balanced bilingual processes word meaning automatically, without necessarily focusing attention on the retrieval process itself.

In order to test her hypothesis, Favreau employed a lexical decision paradigm to look at the extent to which there is a semantic facilitation effect (i.e. where a prime that is semantically related to a target word will increase the speed with which the target word is processed) for both balanced bilinguals and dominant bilinguals highly skilled in their second language, when the time between the prime and target is manipulated. Having been shown a prime that was either semantically related or unrelated to the target, and having either been told to expect such a relation or not, subjects were asked to decide as rapidly as possible whether the target formed a word. If information is processed solely automatically, expectations should not affect reaction time; only semantic facilitation for related words should decrease reaction time. When the time between the prime and the target is short, only automatic processes could have time to operate, and therefore only when subjects had efficient automatic processing would they show semantic facilitation in this condition.

Favreau found that both groups showed evidence of such semantic facilitation in their first language, but only the balanced bilinguals showed the same semantic facilitation in the "short" condition in their second language. And as predicted, expectation of semantic relatedness did not affect reaction times for the balanced bilinguals in their second language. Favreau concluded that it is very likely to be inefficiencies in the non-balanced bilingual's automatic processing that cause her/him difficulties in reading the second language.

An interpretation of the results of Hatch et al. (1974) in light of the automatic/controlled dichotomy would suggest that native and non-native speaker differences in attention can account not only for inefficiencies in word retrieval but for difficulties in processing larger units of language as well. The authors asked native and non-native speaking subjects of different levels of proficiency to cross out all of the instances of certain letters occurring throughout a text. They reported that while the least proficient non-native speakers found the instances of occurrence of the letters with equal frequency in both content and function words, native speakers ignored letters much more often in the function words than in the content words. Such a non-native speaker advantage can be explained in terms of the amount of attention required by the non-native speaker to process language both syntactically (as represented by the function words) and semantically (as represented by the content words). Native speakers, who normally process the syntactic elements of a sentence automatically, seldom focus their attention on function words and so miss these words when scanning a text.

McLaughlin (1978) also asserts that there are qualitative as well as quantitative differences between the way in which linguistic information derived from reading is processed by the native speaker and the second language learner. He cites the automatic/controlled distinction of Schneider and Shiffrin, suggesting that these qualitative differences are a function of both the type of processing that different kinds of informational input receive in memory as well as the proficiency of the learner:

> In L2 learning ... the initial stage will require moment-to-moment decisions, and controlled processes will be adopted and used to perform accurately, though slowly. As the situation becomes more familiar, always requiring the same sequence of processing operations, automatic processes will develop, attention demands will be eased, and other controlled operations can be carried out in parallel with the automatic processes as performance improves. In other words, controlled processes lay down the "stepping stones" for automatic processing as the learner moves to more and more difficult levels. (p. 319)

An intriguing possibility that the foregoing description of second language acquisition suggests is that the proficiency of the non-native speaker can be psycholinguistically characterized by the ratio of controlled to automatic processing involved in any learner's second language skills; a beginner will employ controlled processes for handling even the most rudimentary aspects of the language (for example, the alphabet, if unfamiliar) and consequently will show automaticity of few second language skills. On the other hand, a learner at the advanced stages will process automatically up to perhaps the retrieval of word meaning, and few of her/his skills will necessitate controlled processing.

The classroom correlate of the move from controlled to automatic processing can be recognized by the second language teacher as a sudden "clicking" into fluency of structures that the student had previously struggled over. When enough controlled processes achieve automaticity, a learner can be said to "think" in the target language. Pike (1964) coins the term 'nucleation' to describe this spontaneous move into fluency. He suggests that nucleation occurs for each of the the three language system hierarchies -- grammatical, phonological and lexical. Once each level as well as the interrelations betwen the levels are controlled by the learner automatically, her/his mind will be free to "get on with the business of communicating meanings, making choices and building social rapport" (p. 294). For Pike, nucleation is the process of transferring learned second language information to some mental store where the information is available for the purposes of production in the target language. Perhaps the most important characteristics of such a transfer (because they are the most objectively measurable ones) are the speed with which the transfer occurs in contrast to the lengthy period of prior accumulation of learned material, and the resultant shift in the learner's perceptual focus -- from target language structures to meaningful communication. Both increased speed and reallocated attention are salient features of the shift from controlled to automatic processing.

Lamendella (1977) takes a neurofunctional approach to the phenomenon of nucleation. He postulates that there are two anatomically different areas of the brain that house two qualitatively different sets of neural systems: the first set of systems he calls the communication hierarchy. It is within this hierarchy that any language acquired between the ages of 2 and 5 is represented as a particular neural system. Each system consists of numerous infrasystems, which are "functional constructs of brain systems derived in relation to particular environmental experience ... [and which] operate to accomplish bevavioral goals" (p. 159).

The other set of neural systems is the cognitive hierarchy, which is responsible for cognitive information processing. Foreign languages learned in formal environments find neural representation in this second metasystem and are processed in the same way as other kinds of cognitive information. Second languages acquired in an informal environment where language content and not form is stresed are represented in the communicative hierarchy in the same general area as the primary language but by different neural networks.

In terms of second language development, the author descibes nucleation as "the point at which the first SL [second language] infrasystem becomes operational and takes its place in the flow of information within the communication hierarchy" (p. 185). Behaviorally, such an operational infrasystem manifests itself as an automaticity of processing of target language structures within a specific communicative domain, where such structures are no longer consciously focused on or translated into the primary language. The installation of a complete set of second language infrastruqtures into the communication hierarchy would mark the ability of the second language learner to handle large aspects of linguistic information automatically. The implication is that until infrastructures representing certain target language mastery are operationalized within the communicative hierarchy; such structures, to the extent that they can be processed at all, are processed within the cognitive hierarchy as relatively new pieces of cognitive information. Thus, their use in target language communication is both conscious and slow (controlled).

The Focus of this Study

The goal of the present study is to further characterize the differences between native and non-native readers of English in terms of the two-process model. This study differs from previous studies in two important respects. First and perhaps most significant is the attempt to assess the nature of the processing primarily through recognition memory rather than precise measurements of reaction time. Sachs' paradigm was expanded to include recognition memory for written English in hopes of capitalizing on the particular features of the two processes: that a conscious, controlled processing is necessary for long-term storage whereas automatic processing is not. Consequently, native speakers of English and non-native speakers at different levels of proficiency were compared for their ability to remember prose.

A second way in which this study differs from other studies that explore language processing in terms of the two-process model is its focus on units of language larger than the word. Thus, while single-word processing is considered and determined with a modified lexical decision task, the words used are only relevant as indicators of the formal (in this case, functional) or content aspects of language. Similar to the way Hatch et al. employed the function/content distinction, subjects in this study are assessed for their ability to remember a word based on its syntactic or semantic function in a context. In another task, the memory for the form and meaning of a complete prose passage is measured. The total time required to perform a task is here used to assess gross processing differences rather than to determine the exact amount of time required for the processing of a single lexical item.

Several predictions about differences in native and non-native language behavior derive from the automatic/controlled distinction described above. Specifically, this research is an attempt to determine the validity of the following two hypotheses: non-native speakers should exhibit 1) a higher recognition memory than native speakers for the surface features and 2) a lower recognition memory than native speakers for the semantic aspects of a text. In order to assess differences in LTS retention of linguistic information in reading for native and non-native speakers, there are two recognition memory tasks involved in this study: the first is a test of memory for both surface representation and meaning, to be administered after a short passage has been read. The second test involves recognition memory for deleted items in a previously administered cloze test.

In addition, if the non-native speaker processes syntax in a conscious, controlled way, and the native speaker processes it in an automatic, non-conscious way, then the time taken to accomplish such a task should be a function of both the kind of processing used and the level of proficiency of the second language learners. Until automatic processing is achieved, the time taken to process information reflects the efficiency of the controlled processing at a paricular linguistic level. In that the shift from controlled to automatic processing is accompanied by a drastic reduction in the processing time required, the difference between the time taken to process information automatically and to process it by means of highly efficient controlled processes should be much greater than the diferences found between various stages of non-automatic processing. Consequently, hypothesis three is formulated in the following way: 3) the difference in speed between high proficiency second language learners and native speakers on a task of linguistic processing should be significantly greater than the performance differences between medium and high proficiency second language learners. Therefore in this study there are two measurements of time for each subject, one for the amount of time taken to read a short text, the other for the time necessary to complete a cloze test.

METHOD

Subjects

Thirty native and sixty-six non-native speakers of English participated in the study. Native speaking subjects were undergraduate students at Drexel University in Philadelphia, Pennsylvania. Non-native speaking subjects were enrolled in the intermediate (ESL 100) and high (ESL 201) levels of the two accredited English as a second language courses at Concordia University in Montreal, Quebec.

Instruments

Four passages of approximately 230 words each were chosen for their general interest and comprehensibility to both native and non-native speakers of English. Each passage measured no less than 10.6 and no more than 10.8 on the Fogg index of readability (Gilliland (1972)). Two passages were retained intact and used experimentally as reading tasks (See appendices A and C). The remaining two were altered by deleting several words and replacing them with blanks, thus creating two separate cloze-type tests (See Appendices B and E).

The cloze-type tests served two functions. Oller (1973,1979) maintains that cloze tests are a measure of global language proficiency. He suggests that we process linguistic information in chunks which fade quickly in short-term memory if they are not further processed. Further processing of the chunks is facilitated by information about the language stored in long-term memory, what Oller describes as an expectancy grammar. The ability of a speaker to process a given piece of linguistic input is a direct reflection of the sophistication of her/his prior linguistic knowledge. This expectancy grammar is brought to bear in the processing of contextual cues important in determining the lexical items appropriate for filling in the blanks of the cloze test. Language proficiency, a measure of an individual's linguistic competence, can be evaluated in terms of accuracy of performance on the test. It was hoped that the cloze test could provide for the present investigation an assessment of proficiency that would allow native and non-native speakers to be easily and reliably compared. For if comparisons between the two groups are to be made, then it is important to know the relative proficiency of native to non-native speakers.

The second function that the cloze test serves in this study, analogous to the role of the lexical decision tasks in studies of single-word processing, is as a task that requires both sentence and discourse level language processing. As

Oller has pointed out, the more rapid the subsequent processing of information once the chunk is in short-term memory, the less loss of information (i.e. loss of comprehension) there will be at this initial stage. In terms of the two-process model, automatic processing will be much more conducive to comprehension than controlled processing. Accuracy on the cloze test, inasmuch as it is a reflection of reading comprehension ability (Bormuth (1969), points to the general effectiveness of language processing and implies a trend toward its controlled or automatic nature.

Potter (1968) has determined that for a cloze test to be maximally effective, no more than one in/five words and no less than one in 12 words must be deleted. With this in mind, the two cloze tests were formed in the following manner: single words were randomly deleted from the passages such that there was no consistent or predictable number of words between deleted words. Uniformly-sized blanks replaced each deleted word, where no more than 11 words and no less than 4 words intervened between any two blanks. There were 28 blanks in each test.

Recognition memory was assessed through two different tests. In the Reading Recognition Test, each of 15 sentences in a previously-read passage was either unaltered, slightly changed in its surface structure with its original meaning maintained, or slightly changed in surface structure with corresponding changes in the meaning of the sentence. The sentences, in one of these possible conditions, were fashioned into a passage in the order in which they or their original untransformed counterparts appeared. Subjects had to determine whether each sentence in the reconstructed passage was either A, B, or C, where A = unaltered, B = changed in form alone, and C = changed in both form and meaning (See appendix D).

After completing a cloze test, subjects were asked to complete the Cloze Recognition Test. This second task of recognition memory was a reproduction of the intact 230-word passage from which the cloze test was constructed, with no deletions or blanks. The subjects were to determine which lexical items in the text had been formerly deleted and replaced with blanks in the cloze test (See Appendix F).

<u>Procedure</u>

Testing for all subjects was done in two sessions spaced one week apart. In the first session, subjects were given a two-paragraph text and instructed to read it as quickly and as carefully as possible. The time taken to read the passage in this manner was recorded. Following this, the reading passages were collected and subjects were given a series of five comprehension questions based on the material previously read. The final task of that session was a cloze test (Cloze Test 1). Subjects were instructed to fill in as many blanks as possible, working as quickly as they could. Again the time taken to complete the task was measured.

The first task of the second session was a two-paragraph passage to be read as carefully as possible within two minutes. The passages were collected and the Reading Recognition Test was administered. Following this, subjects were given a cloze test (Cloze Test 2) and told that they had 10 minutes to complete it to the best of their ability. The cloze passages were collected and subjects were administered the Cloze Recognition Test.

RESULTS

The Timed Tests

The means for the time taken to read passage 1, to complete Cloze Test 1 (CT1) and for the number correct on CT1 for the three groups are presented in Table 1. In order to insure that comprehension was not sacrificed to reading speed, only reading scores of subjects who had scored at least 60% on a short comprehension test following the timed passage were considered.

The mean Z scores for each measure across groups is shown in Figure 1. Three one-way analyses of variance, one for each of the three sets of scores, all revealed group effects (Reading times: $F_{2,48} = 81.63$, $p < .01$; CT1 times: $F_{2,66} = 57.51$, $p < .01$; CT1 scores: $F_{2,66} = 3.61$, $p < .05$), post-hoc Scheffe tests indicating the following: there are significant differences between ESL 100 and native speakers on all tests (Reading times: $F = 160.52$, $p < .01$; CT1 times: $F = 105.11$, $p < .01$; CT1 scores: $F = 6.97$, $p < .01$). The ESL 100 and 201 groups performed significantly differently only on the timed reading test ($F = 12.39$, $p < .01$). But while significant differences were found between ESL 201 and native speakers for both the reading time ($F = 79.92$, $p < .01$) and the cloze test time ($F = 52.32$, $p < .01$), no significant

Table 1

Mean times taken to read a passage, complete a cloze test and mean number correct responses on cloze test for native speakers, ESL 201 and ESL 100

	Reading Time (sec.)		Cloze Test 1 Time (sec.)		Cloze Test 1 Score	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Native Speakers	47.6	8.0	245.0	57.8	13.1	3.2
ESL 201	83.2	15.2	478.4	63.9	11.5	2.6
ESL 100	99.8	20.0	542.1	131.5	10.7	3.3

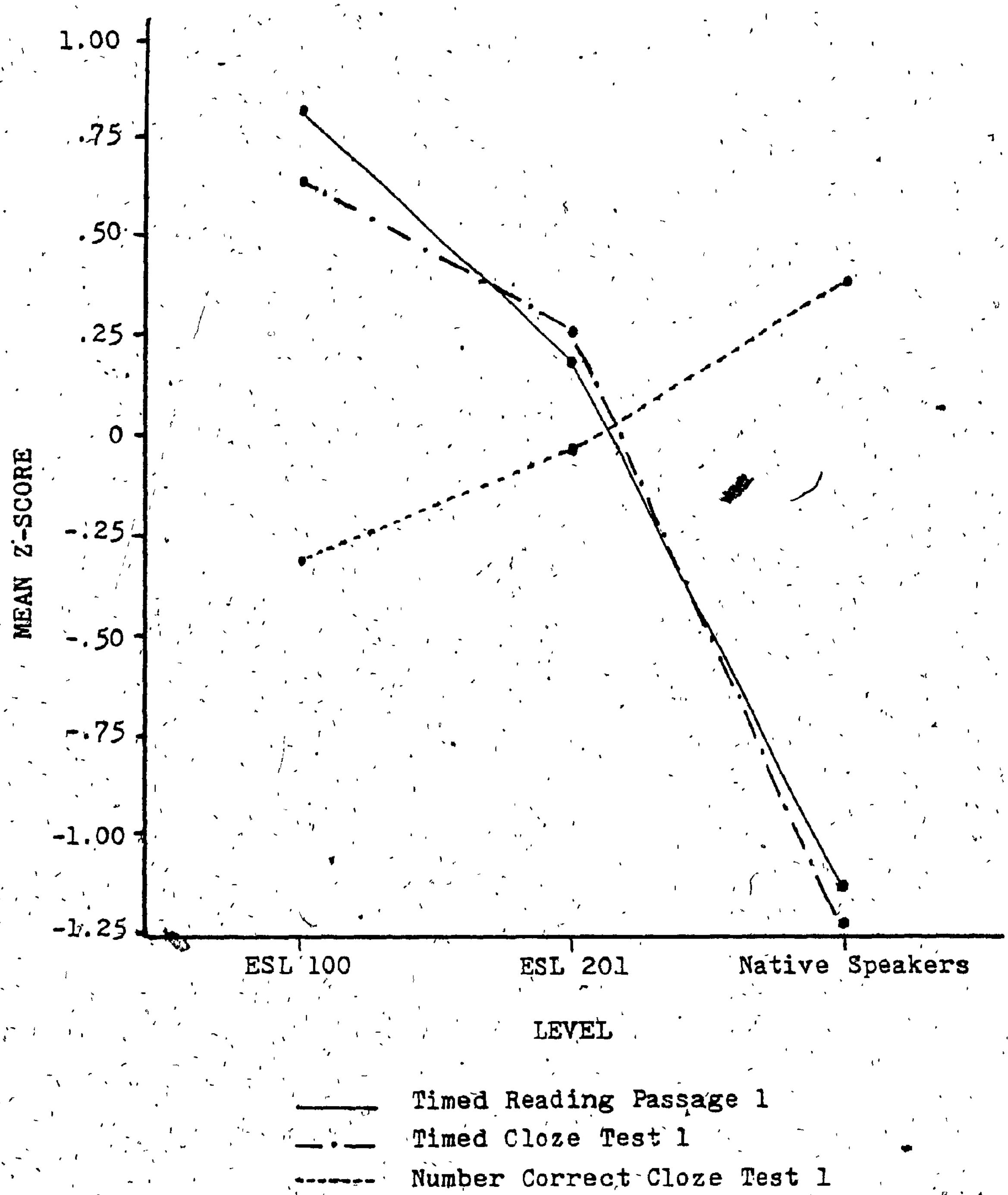

Figure 1. Mean z-score of time taken to read Passage 1, time taken to complete Cloze Test 1 and mean number correct on Cloze Test 1 for ESL 100, ESL 201 and native speakers

difference was found between these two groups with respect to their cloze test scores.

The Reading Recognition Test

The mean number of correct responses for each group on the Reading Recognition Test (RRT) is presented in Table 2. T-tests revealed that the only significant difference between native and non-native speakers with respect to the average number of correct responses was for the number of C correctly identified ($T = 2.67$, $p < .005$), indicating that even though native speakers are not significantly less able to recognize structural changes in the text, they are better able to recognize semantic changes.

In order to examine more carefully differences between group performance on the RRT, a two-way 3 x 3 analysis of variance, in which the factors were GROUP (ESL 100, 201, native speakers) and number correct RESPONSE (A correct, B correct, C correct), was performed (See Figure 2). Main effect for both GROUP ($F_{2,222} = 4.15$, $p < .02$) and RESPONSE ($F_{4,222} = 22.46$, $p < .001$) were found, as well as a significant GROUP x RESPONSE interaction ($F_{4,222} = 3.78$, $p < .01$). Post-hoc Scheffe tests revealed that significant differences between both the ESL 100 and 201 groups and ESL 100 and the native speakers accounted for the GROUP effect.

Table 2

Mean number of A, B and C correct on Reading Recognition Test for native and non-native speakers

	A correct		B correct		C correct	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Native Speakers	2.95	.95	2.55	1.47	2.65	.99
Non-native Speakers	3.23	1.27	2.56	1.36	1.88	1.55

A- The sentence is exactly as it appeared in the text.

B- The sentence is changed in form (wording) from what appeared in the original text, but it has the same meaning.

C- The sentence is changed in both form (wording) and meaning from the original text.

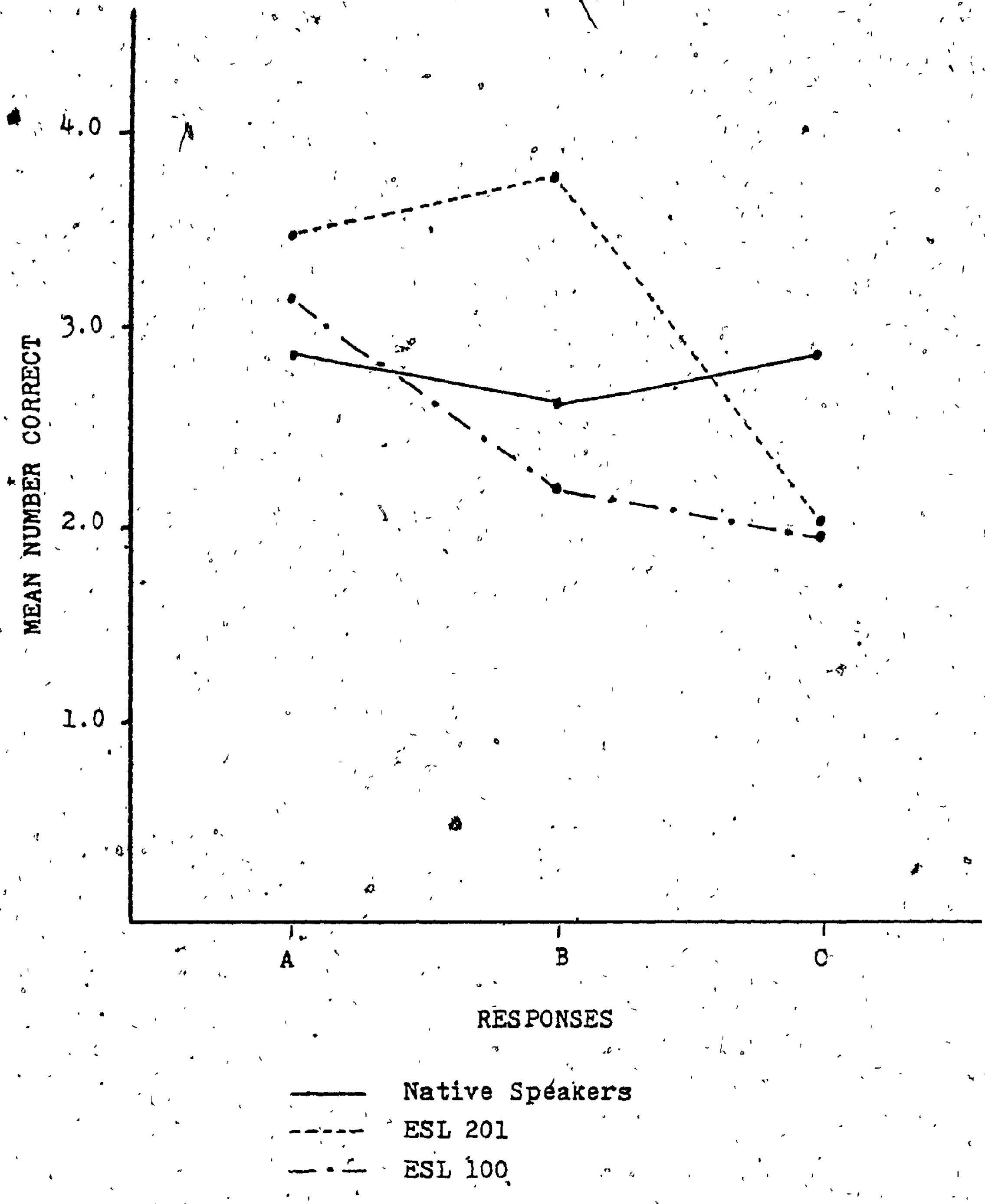

Figure 2. Mean number A, B, and C type responses correct on Reading Recognition Test for native speakers, ESL 201 and ESL 100

Significant differences between each of the responses (A correct with B correct: $F = 8.25$, $p < .005$); A correct with C correct : $F = 14.36$, $p < .001$; B correct with C correct: $F = 5.48$, $p < .02$) appears to be primarily due to the advantage of the ESL 201 group over the native speakers in recognizing structural changes, which in turn becomes a native speaker advantage at recognizing semantic changes in the text.

Another intriguing result was obtained upon performing Chi-Square tests on response means in each group. These revealed that subjects across all groups recognized exact word sentences and those changed structurally and semantically at a level well above chance (See Table 3).

The Cloze Recognition Test

Of the 28 blanks that made up Cloze Test 2 (CT2), 16 necessitated completion by closed class words (prepositions (6), pronouns (6), articles (3) and conjunction (1)) and the remaining 12 required open class words (nouns (5), adverbs (5) and verbs (2)). The frequency with which open and closed class words were correctly filled in on the cloze test as well as the frequency with which the two classes of words were respectively recognized on the subsequent Cloze Recognition Test were determined for each subject. The mean frequencies for each group for open and closed class words on

Table 3

Chi-Square values for mean number A, B and C correct on Reading Recognition Test for native speakers, ESL 201 and ESL 100

	χ^2		
	A correct	B correct	C correct
Native Speakers	16.50*	8.46*	17.20*
ESL 201	28.97*	20.57*	34.16*
ESL 100	16.77*	11.15*	64.52*

* $p < .005$

both tests are presented in Figures 3 and 4. As is readily evident, for all groups, while open class items were much more difficult to correctly fill in on CT2, these items were significantly easier to recognize on the CRT than closed class items. Conversely, although relatively easy to correctly supply on the cloze test, closed class items were much more difficult to recognize on the subsequent recognition test. These trends are highlighted in a two-way 3 x 2 analysis of variance, where the factors are GROUP X WORD CLASS (open, closed). Both CT2 and the CRT show significant main effects for WORD CLASS (CT $F_{1,78} = 7.01$, $p < .01$; CRT $F_{1,78} = 6.08$, $p < .01$) and GROUP (CT $F_{2,78} = 3.13$, $p < .05$; CRT $F_{2,78} = 5.57$, $p < .05$), while only CT2 yielded a significant GROUP X WORD CLASS interaction ($F_{2,78} = 3.13$, $p < .05$). This latter interaction appears to be due to the fact that while the 201 and 100 groups are statistically indistinguishable from each other but together are significantly different from the native speaker group in completing open class item blanks, it is the 201 group and native speakers that, for closed class item completion, are statistically indistinguishable but together perform significantly better than the ESL 100 group.

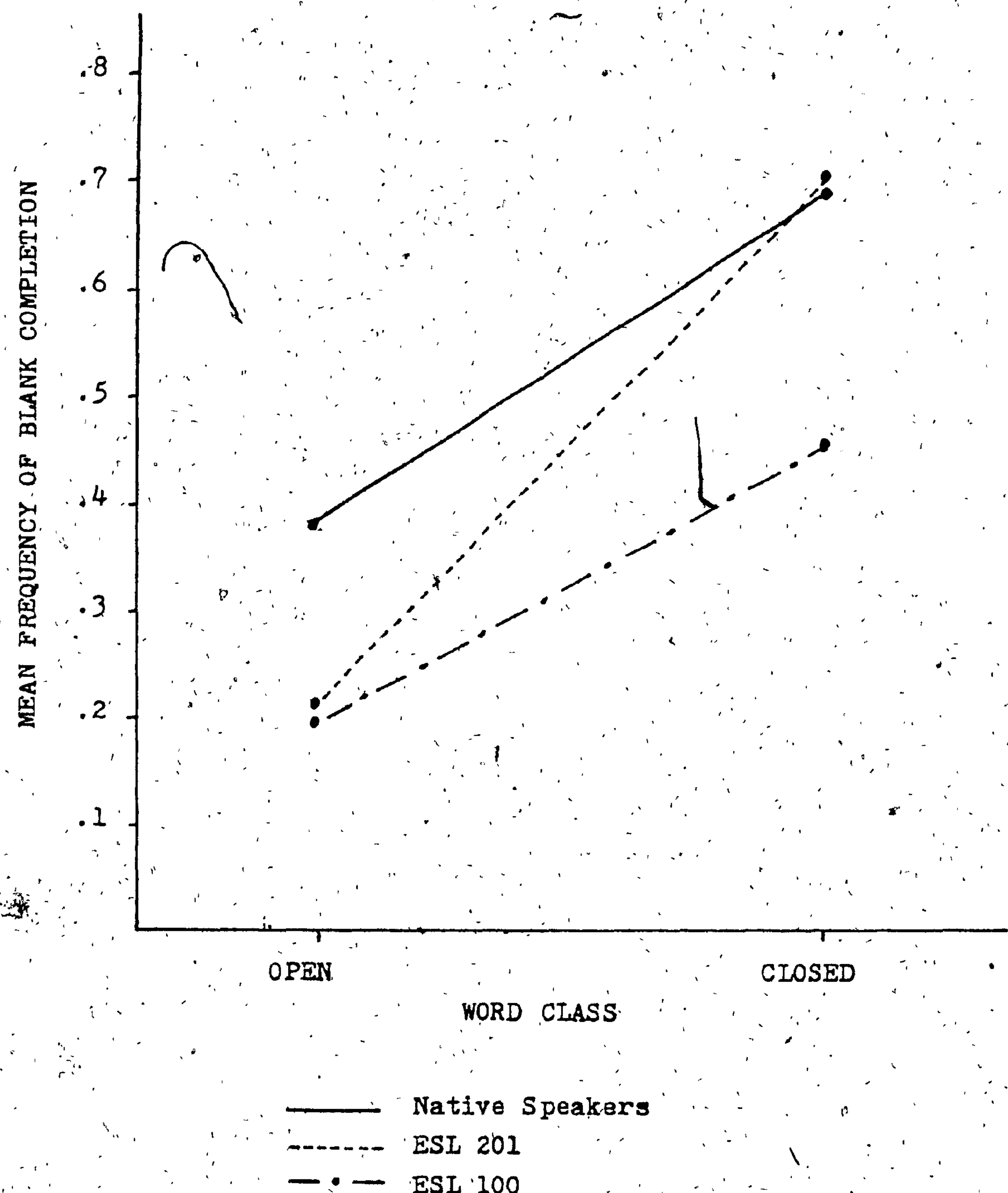

Figure 3. Mean frequency of correct completion of open and closed class words on Cloze Test 1 for native speakers, ESL 201 and ESL 100

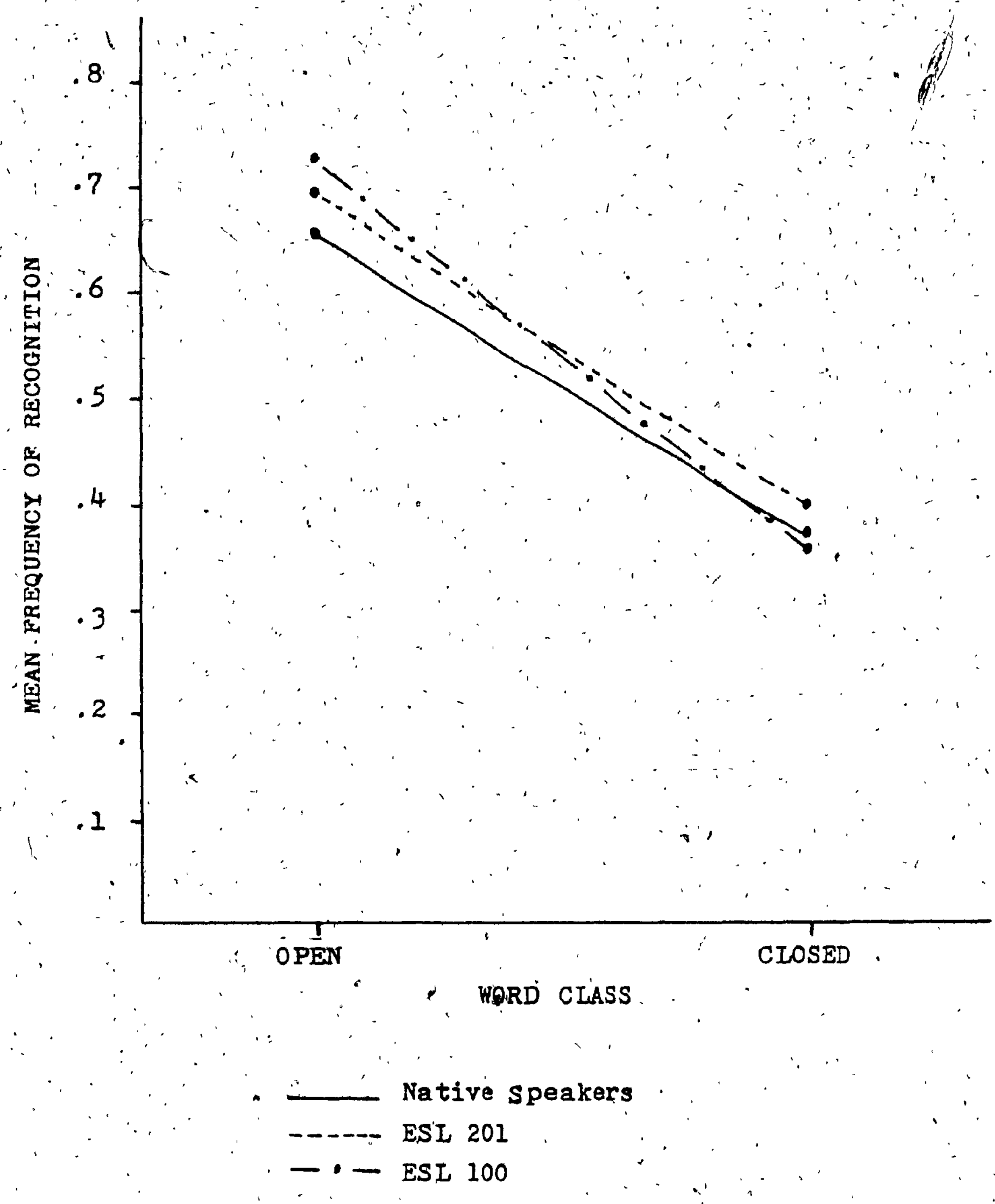

Figure 4. Mean frequency of recognition of open and closed class words on Cloze Recognition Test for native speakers, ESL 201 and ESL 100

DISCUSSION

Hypothesis 3: Evidence from the Timed Tests

Although native speakers were not found to perform significantly better than the high proficiency learners on the cloze test, they were considerably faster than the ESL 201 group at both reading the passage and completing the cloze test. These results lend support to the idea that it is the presence or absence of automatic processing that serves to differentiate native from non-native speakers. As the high proficiency non-native speaker approaches the native speaker in terms of accuracy of performance, s/he is still far behind in speed of processing. And it is precisely this relative slowness of performance that characterizes the capacity limitations of processes requiring attention.

The results of this study also support those of LaBerge and Samuels, who, in evaluating the degree to which a task is learned according to both the accuracy and automaticity of its performance, note that automaticity is only achieved after accuracy. In that the ESL 201 group did not prove to be significantly less accurate than the native group on the cloze test, it is perhaps at this high level of non-native proficiency that necessary but not sufficient conditions for automaticity are met. At this level accuracy is maintained through an efficient channeling of attention, and so the demands of both the reading and the cloze tasks are reflected not as deficits in comprehension, but in speed. The ESL 100 subjects, on the other hand, significantly differentiated themselves from the native speakers both in their accuracy on the cloze test as well as their speeds on the two timed tests. This suggests that for medium proficiency learners it is more than non-automaticity of syntactic processing that results in comprehension impairment.

Although the results of these three tests provide evidence in support of the third hypothesis of this study, the following considerations should serve to mitigate any strong claims or unequivocal interpretations of the data. First, the fact that no significant differences were found for the mean number correct on Cloze Test 1 between the ESL 201 group and the native speakers may be explained as an inadequacy of the instrument to clearly distinguish among the groups. Indeed, the fact that no significant differences were found between the medium and high proficiency learners also calls into question the discrimination ability of the cloze test itself. It could be that the text used to construct the task was not sufficiently difficult and created a ceiling effect, thus masking the true extent of the differences in proficiency among the three groups.

Another important possibility to consider is that perhaps the development of proficiency itself is not a linear function but some other (e.g. exponential) function. That is, it is possible that there is not a one-to-one correspondance between scores on the cloze test and levels of language proficiency; the difference between three mean scores, where the same number of points are interposed between each score and the next, may represent vastly different increments of proficiency. Therefore, before any adequate parametric comparisons for speed of performance between native and non-native speakers can be made, it is necessary to find an instrument capable of independently quantifying differences in group proficiencies.

The third important feature of this study to keep in mind when interpreting these results is that, as LaBerge and Samuels have suggested, reading is a multi-stage skill that involves the processing of information at many different levels. Such a characterization is at least as much the case for a multi-faceted language processing task such as the cloze test. Assessment of the time necesary to complete both tasks was never intended to serve in this study as an exact measure of the automatic and non-automatic processes for each subskill at each level of processing. Rather, these measures were intended to highlight tendencies in processing, and it is in this vein that the results supported the hypothesis that native speakers perform certain linguistic tasks much more rapidly than could be predicted from looking at differences between medium and high proficiency learners. In order to tease apart the relative contributions of each type of processing to the individual subskills as well as to reading as a whole, it would be necessary to ascertain in an extremely precise way the reaction times of individual subjects at several specific points in each task, similar to the way in which reaction times for a lexical decision task are measured.

Hypotheses 1 and 2: Evidence from the Recognition Tests

The results of the Reading Recognition Test support the hypothesis that native speakers have a better memory for the meaning of a sentence than non-native speakers. In this study the native group was significantly better able to recognize changes of meaning in a text than both non-native groups. Similarly, while not statistically significant, there was nevertheless a trend toward a native speaker advantage at recognition memory for the content-carrying words (The open class items) on the Cloze Recognition Test. The native speaker's ability to remember the meaning of a text would seem to highlight two important aspects of fluent reading: 1) because the processing of information up to the concatenation and interpretation of word-group meaning is automatic and does not require attention, higher order controlled processing involved in comprehension has adequate space in STS; and 2) because the processing at the level of word meaning organization does require attention and is therefore not automatic, this semantic information is encoded into LTS.

That native speakers are better able to remember the meaning of a prose passage is certainly no surprise. In that native speakers are generally better at understanding a text, their memory for what they have comprehended should also be better. Another possibility is that the native speaker uses her/his familiarity with redundancies at all levels of the language to make more educated guesses about whether or not a sentence has been altered semantically; s/he could determine, for instance, whether a given sentence violated the semantic expectancies set up in the text as it occurred in the recognition task without necessarily appealing to her/his memory of the prior passage. The two-process model does not have to be called upon in order to explain the results of the RRT, for it is altogether possible that other factors besides qualitatively different processing can account for the native speaker's advantage at remembering the meaning of a text.

Moreover, the tendency of native speakers to identify open class items on the CRT more often than the non-native groups can be explained by other factors as well. Perhaps, for instance, native speakers are more able than non-native speakers to recognize open class items because they were better able to fill them in on the previous cloze test and so have in fact seen the words before and encoded them into long-term memory. The trace would then act as an additional cue for recognition.

Thus, while memory for the meaning of a text, or for the specific words in a text that carry the meaning, may suggest that it is at this level that the native speaker must employ attention-requiring processes, the fact of a native speaker advantage for recognition memory is not sufficient evidence to posit the existence of such processes. Further substantiation must come from a comparison of native speaker performance on the semantic aspects of a text with performance for the same group on the syntactic elements of a passage. For if the role of attention is to be implicated in recognition memory, and not general knowledge of, or ability in, the language, then we need to look at memory for information that does not require attention for encoding.

In this study it was assumed that native speakers would encode automatically both the syntactic organization of a sentence, expressed as a particular surface structure, and specific words in a text that expressed syntactic function -- the closed class words. And if, as previous studies have suggested, automatic syntactic processing is not encoded into long-term memory, then native speakers should not have shown any significant recognition memory for either sentence structure or the syntactic items in a text. This was not the case for native speakers on the RRT, for they were no better at recognizing changes in sentence content than at recognizing changes in sentence form, and in both instances recognition was well above chance.

Evidence from the CRT, on the other hand, is particularly striking in the support that it affords the two-process model. For while native speakers accurately filled in closed class items on CT2 with almost twice the frequency of open class items, their recognition on the CRT for formerly deleted open class items was almost twice as good as for closed class items. If native speakers were to show better memory for those items successfully filled in on the cloze test, then these results would not have been obtained. Similarly, general familiarity with the appropriate use of closed class words does not seem to lead to memory for their use. In fact, the inverse relationship between ability to complete the blank and ability to recognize the word deleted is very characteristic of differences in processing: automatic processing leads to a high degree of accuracy on the task but does not result in long-term storage. Controlled processing, although fostering long-term storage, often results in inaccurate performance.

In addition, if native speaker memory for the syntactic features of a sentence is at least in part a function of automatic processing, then a comparison of this group to non-native speaking groups, whose performance utilized many more controlled processes, should serve to identify differences at those points where automaticity has been achieved by one group but not by the other. Contrary to what was predicted, however, non-native speakers showed no better recognition memory than native speakers for the surface structure of a text.

And yet the collapsing of the ESL 100 and 201 levels into one non-native group masked a very interesting effect: the high proficiency non-native speakers were significantly better able than either the medium proficiency group or the native speakers to recognize structural changes in the text. This suggests that factors other than the controlled or automatic nature of the processing influence long-term storage. In particular, memory for the surface features of a text seems to improve with proficiency up until the level of native speaker. Perhaps, then, the line of argumentation which asserts that memory varies with comprehension is partially correct: it is possible that medium proficiency learners do not remember the text as well as high proficiency learners because they have not understood it as well. This in turn implies that a certain degree of comprehension is necessary before linguistic information can be encoded into LTS, even when comprehension itself is a function of very consciously controlled processing.

Deficiencies in comprehension, though, can not account for the ESL 201 group's clear advantage over the native speakers in recognizing structural changes in the text. Rather, the direction of the difference is well predicted by the controlled/automatic distinction; the additional effort and attention that the high proficiency learner requires in order to process a second language at the level of syntax is reflected in a better recognition memory at that level.

The fact that the two-process model could only account for the results of the RRT when the non-native groups were teased apart serves to point out the inadequacy of hypotheses 1 and 2 as stated. In this regard, an alternative approach toward viewing the data within the model seems worthy of consideration. One possible revision of the hypotheses involves focusing on non-native performance alone. Because memory seems to be affected by factors other than those specified in the two-process model, comparing native and non-native speakers along this dimension would yield ambiguous results at best. Therefore, in addition to looking at absolute differences between these two groups, it would seem reasonable to explore the differences in the trends of native and non-native processing at the syntactic and semantic levels. On the RRT these latter differences would be expressed as the non-native speaker's greater ability to recognize whether or not the form of a sentence was altered than to recognize that its meaning was changed, in contrast to the native speaker's better recognition of semantic rather than syntactic changes. In the same way, second language learners, like native speakers, should be able to recognize on the CRT many more open class than closed class items.

Results from both tests are in accord with the amended hypotheses: unlike native speaker performance, non-native subjects recognize exact and formally changed versions of sentences considerably more often than sentences changed semantically. In addition, parallel to native speaker performance, non-native speakers were approximately two times better at recognizing previously deleted open class items than closed class ones. And like the native speakers, the second language learners were twice as good at filling in the closed class items on CT2.

Other Interesting Data

Having addressed the three hypotheses of this study, it is now worthwhile to note one aspect of the data that, while not bearing directly on the issue under investigation, is nevertheless an interesting and unique finding. Native speaking subjects not only showed a statistically significant memory for the formal arrangement of sentences, but in addition there were no significant differences between the native speaker's ability to recognize structural and meaningful changes in the text. If, as the studies of both Sachs and Bransford and Franks suggest, the surface structure of a sentence is only retained in short-term memory long enough for the gist to be abstracted from it, then subjects should show no long-term storage of the sentence's form. But this was not the case. Even if the time between the reading and subsequent recognition task were small enough to allow subjects to identify surface structure based on some short-term retention, one would not expect recognition of the formal features to be as good as identification of changes in meaning.

Arthur and Criss (1980) have noted a similar phenomenon among native speakers and bilinguals. They developed an experimental paradigm to assess whether the form of an utterance is remembered along with its content, and if so, whether these two linguistic parameters are dependently or independently stored. The authors found that there was no relationship between correct recognition of content and subsequent recognition of form. Using their results as support, they constructed a two-store model of memory for language: the form of the language in discourse is encoded into what the authors call "rote memory", and the content is encoded into what they refer to as "semantic memory" (not to be confused with either Tulving or LaBerge and Samuel's concept of semantic memory).

Theoretical support for a separate linguistic store to encode surface structure information comes from Hasher and Zacks and McCormack (1981). They propose that the mechanism for encoding the context of acquisition of any information is an intrinsic function, or fundamental attribute, of memory. That is, we are genetically predisposed to encode into memory certain contextual cues that would facilitate the processing of any information. These cues may be attended to, but such additional attention does not increase their retention. Hence, information about temporal sequence, spatial arrangement and frequency of occurrence is automatically encoded into memory. Yet while no attention or effort is required for encoding these contextual cues, they differ from the automatic responses described in the two-process theories in that they do not develop through consistent practice but are innate, and in that the cues can be retrieved through recall or recognition. If we consider that the surface structure of written or spoken language can be specified by its spatial or temporal coordinates as well as by the frequency with which any given element occurs in a linguistic string, then the formal properties of a sentence are essentially the contextual cues that assist in further semantic processing of the sentence. Consequently, the form of a sentence would be automatically encoded into memory.

There is a clear parallel between the fundamental attributes of memory and those characteristics of episodic memory that Tulving has elaborated. Yet unlike what LaBerge and Samuels conceive episodic memory in reading to be, episodic memory would be called upon to facilitate language comprehension even when information was automatically processed at the level of semantic memory. This new conception of episodic memory as a mechanism for encoding the context of acquisition of linguistic information without requiring effort or attention renders the results of this study more easily interpretable; native speakers show recognition memory for the surface features of a text because these features, corresponding to fundamental attributes, are automatically encoded into LTS.

CONCLUSIONS

This study provides considerable support for maintaining that linguistic information is not processed in the same way at each stage in the reading process. Both native and non-native speakers showed very different patterns of recognition for closed and open class words, suggesting very strongly that the syntactic and semantic aspects of a text are processed quite differently. The fact that for all subjects closed class words were so much easier to fill in on the cloze test than open class words highlights the positive correlation between both mental energy and attention and encoding into LTS. In addition, non-native speakers, as evidenced by their ability to recognize structural changes in a text more frequently than semantic changes, show a specific kind of differential processing of the form and the content of a text.

The question of whether or not such differential processing is accounted for by the automatic/controlled dichotomy is not clearly answered by this study. Characterizations of the two processes derived from previous studies suggested that automatic processing did not lead to long-term storage. Therefore in this study the primary means for assessing the nature of the processing was recognition memory: it was assumed that material processed automatically would distinguish itself by its absence of encoding on recognition tasks. While there was a distinct bias among all subjects toward remembering open class words, recognition memory for closed class words was far from absent.

An important issue that arises out of this ambiguity of evidence for the two-process model is the appropriateness of memory for determining the nature of the processing. For on the one hand, the processing by native speakers of syntactic items that would seem to be automatic resulted in some encoding. Indeed, recent research (Kellog (1980)) indicates that conscious attention is useful but not necessary for long-term storage. On the other hand, as exemplified by the results of the ESL 100 group on the Reading Recognition Test, controlled processing does not always result in long-term storage. Memory in an absolute sense (i.e. its presence or absence) does not unequivocally identify the kind of processing occurring. And yet the automatic/controlled distinction predicts well the direction of the differences derived from both the comparisons of the high proficiency learner's memory for changes in surface features with the native speaker's, as well as all groups' differential performance for closed and open class words on the Cloze Recognition Test.

The use of recognition memory to assess the extent to which an individual is automatically processing linguistic information has a clear methodological advantage over the lexical decision task. It is a much simpler technique to administer; it allows whole groups of subjects to be tested at the same time with no materials other than pencils and test papers.

Moreover, the instruments for measuring memory, the Reading Recognition Test and the Cloze Recognition Test, both promise to be useful and versatile techniques for determining the attentional requirements of a previous reading or cloze task. By manipulating the difficulty of the text used as the reading passage and to create the cloze test, it is possible to construct tests able to evaluate recognition memory when the task demands vary.

In order for this research to have relevance for second language learners and teachers it is important that the relationship between language processing and proficiency be firmly established. In particular, did the time taken to perform a linguistic task and memory for aspects of a text accurately indicate language proficiency? The major difficulty in answering this question comes from the inability of the two cloze tests to reliably separate the three groups according to proficiency. Yet despite this, clear differences were found between groups on the two timed tests, indicating that time taken to complete a linguistic task is highly correlated with proficiency. Similarly, if we take into consideration the intermediate learners' difficulties in comprehension, there is a definite relationship between proficiency and the ability to recognize both structural and semantic changes in a text.

Finally, the pattern of performance for the three groups on both the two timed tests and the Reading Recognition Test offers interesting evidence for 'nucleation', the phenomenon that both Pike and Lamendella have described as the "clicking" into fluency of a second language. The considerably shorter amount of time necessary for the native speakers to perform a linguistic task suggests that there is a turning point between high and native proficiency when a speaker begins to process language in a qualitatively different way. The fact that high proficiency non-native speakers have a better memory than native speakers for structural changes in a text indicates that the move from high to native proficiency is accompanied by further qualitative changes as well. What many teachers and researchers have vaguely described as the point at which a second language learner begins to "think in the target language" may perhaps be more empirically described as the non-native speaker's move beyond accuracy to automaticity.

IMPLICATIONS FOR THE ESL CLASSROOM

While the two-process, multi-staged model of reading that LaBerge and Samuels have proposed seems to be a valuable heuristic for conceptualizing the differences between native and non-native readers, it is necessary to keep in mind that reading is a complex, highly integrated skill. It is tempting to visualize the language learner as being fixed at a particular stage in the reading process, handling the more fundamental aspects of the language automtically and the more sophisticated aspects in a conscious, controlled way. The major problem with the notion of hierarchically-arranged levels of processing is that the syntactic and semantic levels referred to are, in both the comprehension and production of natural language, inseparable. Although knowledge of English syntax is at least in part a prerequisite of adequate meaning abstraction, comprehension both at the word and sentence level seems necessary for adequate syntactic processing; knowledge of each aspect of the language helps to reinforce, and is itself reinforced by, other aspects of the language. Consequently, the development of reading proficiency must not be seen as a unidirectional progression from the syntactic to the semantic, but rather as a simultaneous and interrelated development of several linguistic skills.

In that there is no clear implicational order of developing automaticity, methods of second language instruction that seek to tease apart the various linguistic levels and to develop automaticity at each before progressing to the next, seem inefficient at best. Lamendella (1979) questions the validity of methods that attempt to develop automaticity of student response to isolated parts of the the second language. He suggests that target language structures which are internalized through techniques such as pattern practice drills are not available for meaningful production.

The leap from theory to practice is a difficult one. For even if the second language learner's difficulties in reading were to be accurately and completely described by the two-process model, the means for remedying such deficiencies are far from unambiguous. The extent to which language processing is automatic may be a characteristic difference between native and high proficiency non-native speakers. Pedagogically, however, there is no clear basis for devising or choosing methods and techniques which are most appropriate for helping students to achieve such automaticity. Before any recommendations for the ESL reader can be made, further in-classroom research is necessary. The primary question in this regard is, how can the non-native speaker best develop both accuracy and automaticity in processing the target language? While the results of this study shed little light on possible solutions, they do suggest an interesting methodology for assessing the effectiveness of particular techniques designed to develop fluency in a second language. By tracking the learner's progress on both timed tasks and tests of recognition memory similar to the ones laid out in this research, it should be possible to see which of a number of methods and techniques are most effective in promoting rapid and accurate target language processing.

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APPENDIX A

Reading Passage 1

INSTRUCTIONS: Read this passage as quickly and as carefully as you can. When you are finished, write the time on the top of your sheet.

After having lived for over twenty years in the same district, Albert Hall was forced to move to a new neighbourhood. He surprised his landlord by telling him that he was leaving because he could not afford to buy any more chocolate.

It all began a year ago when Albert returned home one evening and found a large dog in front of his gate. He was very fond of animals and as he happened to have a small piece of chocolate in his pocket, he gave it to the dog. The next day, the dog was there again. It held up its paws and received another piece of chocolate as a reward. Albert called his new friend 'Bingo'. He never found out the dog's real name, nor who his owner was. However, Bingo appeared regularly every afternoon and it was quite clear that he preferred chocolate to bones. He soon grew dissatisfied with small pieces of chocolate and demanded a large bar a day. If at any time Albert neglected his duty, Bingo got very angry and refused to let him open the gate. Albert was now at Bingo's mercy and had to bribe him to get into his own house! He spent such a large part of his weekly wages to keep Bingo supplied with chocolate that in the end he had to move somewhere else.

APPENDIX B

Cloze Test 1

INSTRUCTIONS: Several words have been deleted from the passage below. Blanks have been substituted in their place. You are to fill in these blanks with the words that you think were deleted.

As the plane circled over the airport, everyone sensed that something was wrong. The plane was moving unsteadily through __________ air, and although the __________ had fastened their seat belts, they were suddenly thrown __________. At that moment, the air-hostess appeared. She looked __________ pale, but was quite calm. Speaking quickly but almost in __________ whisper, she informed everyone that __________ pilot had fainted and __________ if any of the __________ knew anything about machines- or at __________ how to drive a car. After a __________ hesitation, a man got up and followed the hostess into the __________ cabin.

Moving the pilot aside, the man __________ his seat and listened carefully to the urgent __________ that were being sent __________ radio from the airport below. __________ plane was now dangerously close to the __________, but to everyone's relief, it soon __________ to climb. The man __________ to circle the airport several times in __________ to become familiar with the controls. __________ the danger had not yet passed. The terrible moment came __________ he had to land. Following instructions, the man guided __________ plane towards the airfield. It __________ violently as it touched the ground and then __________ rapidly across the field, __________ after a long run it stopped safely. __________, a crowd of people who had been watching __________, rushed forward to congratulate the pilot on __________ perfect landing.

APPENDIX C

Reading Passage 2

INSTRUCTIONS: You will have two minutes to read the following passage as carefully as you can.

We were about to gather up our belongings and return to our car when a man appeared. He looked very annoyed indeed and asked us angrily if we realized that these grounds were private property. Father looked very confused and the man pointed to a notice which said that camping was strictly forbidden. Poor father explained that he had not seen the notice and did not know that camping was not allowed. Though father apologized, the man did not seem satisfied and asked him for his name and address. All the way home, we were so upset that hardly anyone spoke a word. This unpleasant event had spoilt a wonderful day in the country.

For the rest of the week, we wondered what would happen. The following Sunday, we stayed at home even though it was a fine day. About noon, a large and very expensive car stopped outside our house. We were astonished when we saw several people preparing to have a picnic in our small garden. Father got very angry and went out to ask them what they thought they were doing. You can imagine his surprise when he recognized the man who had taken our address the week before. Both men burst out laughing and father welcomed the strangers into the house. In time, we became good friends- but we learned a lesson we have never forgotten.

APPENDIX D

Reading Recognition Test

INSTRUCTIONS: Tell whether each of the above sentences, numbered 1 through 15, is

a) exactly as it appeared in the original text
b) changed in form (wording) from what appeared in the original text, but has the same meaning
c) changed in both form (wording) and meaning from the original text

1) We were about to gather up our belongings and return to our car when a man appeared. 2) Looking very annoyed, he angrily asked us if we realized that these grounds were private property. 3) The man looked very confused as he pointed to a notice which said that camping was strictly forbidden. 4) Poor father explained that he did not know that camping was not allowed and he had not seen the notice. 5) Though father apologized this did not seem to satisfy the man, who asked him for his name and address. 6) All the way home, we were so upset that hardly anyone spoke a word. 7) A wonderful day in the country had been spoilt by this unpleasant event.

8) For the rest of the week, we wondered what would happen. 9) We stayed home the following Saturday, even though it was a fine day. 10) About noon, a large but inexpensive car stopped outside our house. 11) We were astonished when we saw several people preparing to have a picnic in our small gardem. 12) Father got very angry and went out to ask them what they thought they were doing. 13) Can you imagine his surprise when he recognized the man who had taken our address the week before? 14) Father burst out laughing and he welcomed the strangers into the house. 15) We became good friends in no time- but we learned a lesson we have never forgotten.

APPENDIX E

Cloze Test 2

INSTRUCTIONS: Several words have been deleted from the passage below. Blanks have been substituted in their place. You are to fill in these blanks with the words that you think were deleted. You will have 10 minutes to complete this task.

Silas Minton's funeral was a quiet affair. It was attended by the only __________ he had in the __________, his niece and nephew, and by a few friends __________ priest who had travelled over a hundred miles __________ this wild part of the country was now getting ready __________ the simple ceremony. Minton, or __________ as his friends used __________ call him, had led __________ hard life looking for gold in __________ lonely part of Western Australia. He had __________ refused to work in a gold mine because he believed that __________ could do better on his own. Although __________ was not a boastful person, he had often __________ that one day he would find a lump of gold __________ big as his head and with that __________ would retire and live in comfort __________ the rest of his __________. But his dreams of great wealth never __________ true. For many years he had __________ earned enough money to keep himself alive.

Two men now __________ lifted the rough wooden box that contained Minty's body. __________ they almost dropped it when __________ heard a loud cry from the grave-digger. His __________ had struck something hard __________ the rocky soil and he was shouting __________. Then he held up a large stone. Though __________ was covered with dirt, the stone shone __________ in the fierce sunlight: __________ was unmistakably a heavy piece of solid gold.

APPENDIX F

Cloze Recognition Test

INSTRUCTIONS: The following is a complete, unobliterated version of the passage you have just werked on. You are to decide which words in the former passage were deleted and replaced with blanks. Circle these words on the text below.

Silas Minton's funeral was a quiet affair. It was attended by the only relations he had in the world, his niece and nephew, and by a few friends. The priest who had travelled over a hundred miles into this wild part of the country was now getting ready for the simple ceremony. Minton, or 'Minty' as his friends used to call him, had led a hard life looking for gold in a lonely part of Western Australia. He had always refused to work in a gold mine because he believed that he could do better on his own. Although he was not a boastful person, he had often declared that one day he would find a lump of gold as big as his head and with that he would retire and live in comfort for the rest of his life. But his dreams of great wealth never came true. For many years he had hardly earned enough money to keep himself alive.

Two men now gently lifted the rough wooden box that contained Minty's body, but they almost dropped it when they heard a loud cry from the grave-digger. His spade had struck something hard in the rocky soil and he was shouting excitedly. Then he held up a large stone. Though it was covered with dirt, the stone shone curiously in the fierce sunlight: it was unmistakably a heavy piece of solid gold.