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Automaticity of reading in sentence processing in an EFL context

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Abstract
This study aims to investigate Taiwanese EFL students' automaticity of reading in sentence processing, which includes identifying syntax and semantic features. Any communication task involves assessment and coordination of information from a multitude of perceptual, cognitive, and social domains. A foreign language learner must follow great amounts of rules and communicate the intended message unambiguously. However, humans are limited-capacity processors. In order to learn a language, learners need to integrate a number of different skills, and each of them must be practiced and routinized. In this study, twenty-three students participated in the experiment. They were divided into 'High Proficient Learners' and 'Low Proficient Learners'. The results showed that 'High Proficient Learners' achieved a degree of automaticity with respect to processing form that the 'Low Proficient Learners' had not yet attained. Also, the greatest difficulty for students to automatize semantic processing was their insufficient vocabulary knowledge.

Keywords: information processing approach, automatic processing, controlled processing, sentence processing, syntactic processing

1. Introduction
Many experimental psychologists have approached language as linguistic information that must be processed in order to be understood, but few studies have been done on first and second language learning. In Sachs' classic study (1967), he found that recognizing memory for semantic features of an utterance was superior to recognize memory syntax. However, Rossman (1981) [21] disagreed and pointed out that nonnative speakers have not yet achieved the degree of automaticity in processing syntax that characterizes native speakers. Wolfe (1981) [29] tested fifty-five English–speaking children learning French as a second language in California. He found that more proficient children had achieved a degree of automaticity with respect to processing form that the less proficient children had not yet attained. In Taiwan, students whose mother tongue is Mandarin and they learn English as a foreign language. This paper investigated students' reading automaticity within sentence processing, including identifying syntax and semantic features in English.

2. Review of the literature
Among the theories of second language acquisition, Krashen (1977) stated that the starting point for all language performance is acquisition, which is thought of as an unconscious process similar to the way children learn their native languages. Learning is a conscious process in which learners attend to form, figure out rules and are generally aware of their own process. Krashen (1981) also pointed out that fluency in second language performance is due to what students have acquired, not what they have learned. Adults should acquire as much as possible in order to achieve fluent communication.
In 1983, Mclaughlin, Rossman and McLeod presented a challenge to Krashen's acquisition/learning dichotomy. They drew on extensive research from Schiffrin and Schneider (1977), who identified two principal processing modes: controlled and automatic processing. Before discussing these two kind of processing, it is necessary to examine the information processing approach first. In contrast to Krashen's model, McLaughlin *et al*. (1983) argued for a distinction between controlled and automatic processing. McLaughlin rejects the terms 'conscious' and 'unconscious' by stating they have acquired too much surplus meaning and should be abandoned in favor of clearly defined empirical concepts (1990). Krashen (1987) does operationally identity conscious learning with judgments or grammaticality based on 'rule' and subconscious acquisition with judgments based on 'feel'. The difficulty is that it is impossible to know whether the subjects are really operating based on 'rule' or 'feel'. Also, another difficulty with the learning-acquisition distinction is that what one has 'learned' is not available for initiating utterances, but only what has been acquired can be used for this purpose. Mclaughlin (1978) suggested that Krashen does not provide evidence on this behalf, and he seems to have restricted the model to 'somewhat advanced stages of second language acquisition/learning', since 'a fair amount of time may be required until enough of the target language is acquired so that a basis is present for utterance initiation'.
Cognitive psychologists are concerned with the way in which people take in information, process it, and act upon it. There are some factors involved: attention, perception, and memory. They construct models or scripts to explain the way in which the human mind works. They also claim to be able to predict the mental processes that will be necessary for effective learning to take place, and to be able to identify how and where any malfunctioning is occurring when a person has learning difficulties. This approach is drawn an analog with the human body, a motorcar engine or a computer. It is

essentially mechanistic and not at all related with meanings or emotions. Much of work on learner strategies has been based on such information processing models (Long, 2009).

From psycholinguists' point of view, learning a language and understanding a language are not so much different. They are both involved with parsing an auditory stimulus and connecting that parsed string to a semantic representation. For a skilled learner, some strings are hard because they contain novel lexical items, acoustically unclear elements or obscure referents. Also, skilled learners more readily question or reject a string if interpretation proves difficult, whereas learners are under greater pressure to try to incorporate all newly encountered structures into their system (Gleason & Ratner, 1998).

In discussion of human information processing, Shiffrin and Schneider (1977) regarded memory as a large collection of nodes that become 'complexly interassociated' through learning. Each node is a grouping or set of information elements. Most of the nodes are inactive and passive and the interconnected system of nodes is called a long-term store (LTS). When, because of some kind of external stimulus, a small number of these nodes are activated, the activated nodes constitute a short-term store (STS). There are two ways in which these nodes become activated: Shiffrin and Schneider called these the automatic and the controlled modes of information processing. Automatic processing involves the activation of certain nodes in memory every time the appropriate inputs are present. This activation is a learned response that has been built up through the consistent mapping of the same input to the same pattern of activating over many trials. Since an automatic process utilizes a relatively permanent set of associative connections in LTS (long-term storage), most automatic processes require an appreciable amount of training to develop fully. Once learned, an automatic process occurs rapidly and is difficult to suppress or alter. The functions of automatic processing are: a) they are used to perform habitual behaviors; b) they may be used to interrupt ongoing control processing and forcefully reallocate attention and resources; c) they may be used to bias or prime memory in preparation for later inputs (Schneider, Dumais, Shiffrin, 1984).

Controlled processing is not a learned response, but a temporary activation of nodes in a sequence. This activation is under the attentional control of the subject and since attention is required, only one such sequence can normally be controlled at a time without interference. Controlled processes necessarily intrude on the ability to perform simultaneously any other task that also requires a capacity investment. Controlled processes are thus tightly capacity-limited, and require more time for their activation. However, controlled processes have the advantage of being relatively easy to set up, alter, and apply to novel situations (Mclaughlin *et al*, 1983). The potential functions of controlled processing are:

a) It should be instrumental in the development of new automatic processes. For instance, storage in long-term memory seems to occur primarily when control processing occurs (Underwood, 1976).

b) It is used to handle various tasks that cannot be carried out by automatic processing.

c) It is used to maintain the activity of nodes in memory.

d) It is used to activate nodes in order to enable automatic processing.

e) Controlled processing may be able to block and modify existing automatic processes (Schneider *et al*, 1984).

Furthermore, if appropriate automatic processes are not available or are not activated in a given task, the primary resource at the individual's disposal is attention (Nagle & Sanders, 1986). Attention involves the application of mental energy to processing tasks and may range from focusing on specific features of input to controlled processing for retrieval. It is clear to any experienced teacher that some learners have difficulty in paying attention in class and this has a negative effect on their learning. But what can teachers do about it? There are two major views: (1) Klatzsky (1980) suggested that "attention should be seen as a processing of filtering out an overwhelming range of incoming stimuli and selecting out only those stimuli which are important for further processing". (2) Best (1986) regarded attention as a cognitive resource which can be drawn upon as a means of concentrating mental efforts. This resource is required most when a learning task is new or when it is just beyond the present capabilities of the learner. As one becomes more skillful in the continuum of processing, there could be focal or peripheral attention, that is, focusing attention either centrally or simply on the periphery.

Brown (2001) included automaticity as a cognitive principle because, "it relates mainly to mental and intellectual functions". He further explained that automaticity refers to the learner's access to knowledge. Knowledge that can be retrieved easily and instantly is automatic. Non-automatic processing is the knowledge that takes time and effort to retrieve. An important dimension between automatic and non-automatic processing is time (Brown, 2000). Processing time is a significant factor in second language performance; learners have pedagogical salience in the classroom. Mehnert (1998) found that time-planning has a significant effect on the accuracy and fluency of second language learners' production.

McLaughlin (1990) gave a more detailed explanation that automaticity refers to control over one's linguistic knowledge. In language performance, a learner must bring together a number of skills form perceptual, cognitive and social domains. The core each of these skills is routinized, making it easy for them to be put to use. Routinization helps learners to reduce the burden on their information-processing capacity. It happens when they have the opportunity to practice controlled processes, and it also results in quantitative changes in interlanguage use by making an increasing number of information chunks available for automatic processing (Ellis, 1999).

In the discussion of automaticity in language learning, McLeod and McLaughlin (1986) stated that beginning learners need to apply appropriate syntactic rules and develop s lexical system. Once one of the subtasks is learned, the learners have more processing energy free to devote to other subtasks. Nation and Mclaughlin (1986) found that "multilingual subjects performed better than did monolingual or bilingual subjects in learning a miniature linguistic system under 'implicit' conditions". They explained that multilingual subjects are good in organizing linguistic stimuli due to their

superior automatic processing skills.

Furthermore, Lehtonen and Sajavaara (1983) found that nonnative speakers require more time in making the judgments of deviant and non-deviant English sentences than do native speakers since they possess less automaticity in speech recognition and interpretation skills in a second language. They explain that native speakers' decisions as to acceptability are automatically primed by lexical, semantic, syntactic and pragmatic constraints. Segalowitz (1986) found "reduced automaticity of word recognition and associated slowed second language reading in otherwise bilinguals". According to his data, single words in the second language of fluent bilingual subjects activated semantic representations less deeply and for shorter duration than did translation equivalents in the first language. He further argued that the basic processing operation may be responsible for the relatively slow second language reading of many bilinguals. Lastly, DeKeyser (2001) explained that the ultimate example of automaticity is probably our ability to use language. Through a complex chain of mental operations, carried out in a fraction of a second, we can convert complex thoughts and feelings into sound waves and our interlocutor can convert them back into thoughts and feelings with the same amazing speed. For an adult learner, it takes years to acquire this complexity of skill and speed with which it is used, and thus it becomes a slow and frustrating process.

- In 2017, Kanduboda investigated sentence processing of frequency adverbs which represent the number of occurrences of an action or a condition. The results revealed that the sentences consisting of adverbs in between-positioning were processed faster than those in initial-positioning, assumedly due to the different information flow. English sentences consisting of frequency adverbs with the between-positioning [S (A (VO))] are likely to result in high acceptability among Japanese EFL learners compared to initial-positioning sentences [A (S (VO))]. Although sentence processing has been developed for many years, with the advance of technology, Zhai, Dong, and Wang (2018) developed eye-tracking sensors to examine how learners process reduced relative clause (RRC) sentences. They invited 60 university students to read three different types of RRC exemplars: left-branching, center-embodied and right-branching, and the sentences of each type included frequent and/or infrequent verbs. Their results show that learners had the highest cognitive load when processing the center-embedded type of RRC, followed by the right-branching type and the left-branching type. Also, when a participant's cognitive load is at a high level, the influence of verb frequency tends to be diminished.

Wolfe (1981) [29] tested fifty five English–speaking children learning French as a second language in California. The result showed that more proficient children had achieved a degree of automaticity with respect to processing form than had the less proficient children. The research questions of this study are formulated as follows:

1. Do more proficient EFL learners recognize more semantic changes than less proficiency learners?
2. Do more proficient EFL learners recognize less syntactic changes than less proficiency learners?
3. Why do students have difficulty in identifying semantic or syntactic features?

3. Method

3.1 Participants

Twenty-three students from a college in northern Taiwan participated in this study. They were divided into two groups: 'High Proficient Learners' and 'Low Proficient Learners' in accordance with their GEPT scores in the first phase of the Intermediate Level. The GEPT was developed by the Language Training and Testing Center at National Taiwan University. It is divided into five levels: Elementary, Intermediate, High-Intermediate, Advanced and Superior. The GEPT is commonly recognized by various government institutions, companies, and schools in Taiwan. There are two sections in the first phase of GEPT: the 'Reading Section' and 'Listening Section'. Their scores on the 'Reading Section' were the first priority to consider. If they got the same score, then their scores on the 'Listening Section' were considered. Eleven students were assigned to the 'High Proficient Learners' group and their scores ranged from 96 to 113 (see Table 1). The other eleven students were placed in the 'Low Proficient Learners' group and their scores ranged from 62 to 96. Three students had the same score – 96, and two of them were assigned to the 'Low Proficient Learners' group according to their scores in the Listening Section. One student, who got a 52 on reading section, was eliminated due to her score was much lower than the others.

Table 1: Score distribution of participants

GEPT Score on Reading Section	High Proficient Learners (Student no/M)	GEPT Score on Reading Section	Low Proficient Learners (Student no/M)
110-120	1/113	90-96	3/94
100-109	9/103	80-89	5/86.6
96-99	1/96	70-79	1/76
		60-69	2/65.5
Total	11/103.7		11/83.8

*Note: M= Mean scores, SD= Standard Derivation

3.2 Materials

Two articles were used in this experiment and they were adopted from the books '*Master GEPT (General English Proficiency Test) Cloze & Reading*' written by Osman and '*Issue for Today*' written by Smith and Mare (1995). All questions were modified to fit the scope of the study. The content covered tourism and the court system. The test consisted of two parts. In the first part, five reading

comprehension questions were provided. Students were first asked to identify the semantic differences from the text and then wrote down the reasons why the sentences were different from the text. In the second part, there were also given five sentences and asked to identify syntactic differences. The five sentences contained relative clauses and students had to point out the relative pronouns and explain the reasons. Students were given forty minutes to finish the test.

3.3 Procedure

Before the experiment, students were told that their identities, scores, and responses would be kept confidential. Only the researchers had access to process these data and information. The participants in both groups, 'High Proficient Learners' and 'Low Proficient Learners', were given a four-page paper test. They were asked to answer each question page after page. They were not allowed to use any dictionary or translation machine. Upon the completion of the experiment, the data were analyzed using an SPSS (Statistical Package for the Social Sciences), 17.0 Program for Windows and Microsoft XP, Excel.

4. Results and Discussion

From Table 2, students in both groups identified about the same number of correct semantic differences, but students in the 'High Proficient Learners' group scored higher than the ones in 'Low Proficient Learners' group in pointing out syntactic differences.

Table 2: Semantic and Syntactic differences identified by 'high proficient learners' and 'low proficient learners'

	High proficient learners			Low proficient learners		
	N	**M**	**S.D.**	**N**	**M**	**S.D.**
Semantic Differences	11	6.45	0.49	11	6.55	0.37
Syntactic Differences	11	8.00	0.38	11	6.45	0.31

* Note: N = number of items, M = Mean, S.D. = Standard Deviation

Table 3 shows a comparison of the two groups. There was a significant difference for students in 'High Proficient Learners' group in syntactic processing but there was no significant difference with the 'Low Proficient Learners' group in both semantic and syntactic processing.

Table 3: T-test on semantic and syntactic differences identified by 'high proficient learners' and 'low proficient learners'

	High proficient learners			Low proficient learners		
	M	**t**	***p*-value**	**M**	**t**	***p*-value**
Semantic Differences	6.45	-0.148	0.884	6.55	-0.148	0.884
Syntactic Differences	8.00	3.135	.005***	6.45	3.135	.005***

Note: * = significant at .05 level; ** = significant at .01 level; *** = significant at .005 level

A significant difference appeared for 'semantic differences' and 'syntactic differences' for students in the 'High Proficient Learners' group compared to the other group (see Table 4). As for the reasons for identifying semantic differences, students did not understand the meanings of the words, so they just took wild guesses. One student even compared the sentences with her own opinions instead of the original text. No one in 'High Proficient Learner' group correctly identified all the semantic differences. For syntactic difference, two students got all the correct answers. The results for students in the 'Low Proficient Learners' group are shown in Table 5. When asked how they identified the semantic differences, they said they had great difficulty in understanding vocabulary so they compared the length of the sentence or the word order. If they were not the same, they were probably different. Also, some of them just chose 'the same' because they did not know where the difference between the two sentences was. Few of them spent too much time reading the text and did not have enough time to write the reasons. In regard to syntactic processing, some students in the 'Low Proficient Learners' group made mistakes on grammar rules by pointing out that the relative clause was used to modify the sentence connected right after it, which was used to modify a place. This could explain why they got lower scores on identifying syntactic difference. Also, no one got all the correct answers.

Table 4: T-test on Semantic and Syntactic Differences identified by 'High Proficient Learners' and 'Low Proficient Learners'

	High proficient learners			Low proficient learners		
	Mean	**t**	**p-value**	**Mean**	**t**	**p-value**
Semantic differences	6.45	-2.85	0.019*	6.5	0.218	0.832
Syntactic differences	8.00			6.4		

Note: * = significant at .05 level

From the results mentioned above, the 'High Proficient Learners' had acquired automaticity in processing form, but 'Low Proficient Learners' had not yet achieved it. On the other hand, neither 'High Proficient Learners' or 'Low Proficient Learners' had not attained the ability to identify semantic differences. There are several possible interpretations for this finding. When identifying relative pronouns, great effort is not required to understand certain words or a higher level of input processing. They do not even need to understand the sentences. However, to compare the semantic differences, students need to understand the words. Therefore, students in both groups received low scores in identifying semantic differences. Also, some learners wrote down answers without paying attention to the content and thought they were almost the same. After giving the answers, they knew that there were differences and wished they had paid more attention. If they had, they may have chosen the right answers. The results conform to Wolfe's finding that

more proficient children have achieved syntactic processing but less proficient children have not yet attained it.

5. Research Implication

On the test in this study, students had to provide the answers and the reasons for why they chose them. It is valuable to analyze the reasons because we can see whether they understood the semantic difference and whether they have automatized the grammatical rules. An important issue is whether the students should use L1 (Chinese) or L2 (English) to write the reasons. L1 might allow the students to focus on the tests and their thoughts more so than L2. For semantic differences, most of the students used English because they simply copied parts of the original text and identified the difference, but for syntactic difference most of them used Chinese to explain the grammatical differences.

6. Pedagogical Implications

From the findings of this study, students, especially the 'High Proficient Learners', have automatized their grammatical rules, but their biggest problem was their limited knowledge of vocabulary. It was the insufficient vocabulary that brought the biggest obstruction in comprehension and caused the problems in identifying semantic differences. Therefore, it will be favorable to enhance students' knowledge of vocabulary.

7. Further suggestions and Conclusion

In future studies, the sample size can be enlarged in order to generalize the hypothesis. Also, Rossman (1981) [21] stated that for nonnative speakers have not yet achieved the degree of automaticity in processing syntax that characterizes native speakers. It would be better to have a group consisting of native speakers and then compare the differences. Lastly, the findings reflect that the High Proficient Learners had achieved a degree of automaticity with respect to processing form that the Low Proficient Learners had not yet attained. Also, the greatest obstacle for students to automatize semantic processing was their insufficient vocabulary knowledge.

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