Faster L2 sentence reading times, better L2 listening proficiency: a preliminary study of automaticity in L2 sentence processing

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Processing speed in a second language (L2) is considered an important characteristic of L2 proficiency level assessment. However, all characteristics of processing speed in L2 learning remain unclear. The current study demonstrates that L2 listening proficiency is more associated with processing speed than L2 reading proficiency. In this study, participants were asked to take an L2 proficiency test consisting of listening and reading sections, and to perform an L2 sentence comprehension task that measured the speed of sentence and word processing in the L2. The result indicates that speed of L2 sentence comprehension correlates with L2 listening proficiency level, whereas all other results showed no statistical significance. This finding supports the assumption that the speed of L2 sentence reading reflects the speed of the real-time sentence comprehension performance that is required in L2 listening performance.

1.Introduction

Processing speed in a second language (L2) is an important index in L2 proficiency, because actual L2 communication requires a rapid response to the person one is communicating with. In previous literature on L2 learning, L2 processing speed or response/reaction times have been considered an index of automaticity in L2 processing[1-12]. Hence, L2 processing speed has been considered an important characteristic in L2 proficiency level assessment.

In previous studies of automaticity, it has been assumed that L2 processing speed is important, but it is difficult to simply use L2 processing speed as an index of automaticity[6]. It is easy to imagine that non-fluent L2 learners can recognize words in their first language (L1) faster than those in their L2 do, because the L1 can be processed automatically. In addition, if L2 learners can improve their recognition speed for L2 words, it can be assumed that the learner can recognize those words more automatically. However, whereas we can say that automatic processing entails fast processing, not all fast processing is automatic processing. For example, it is possible for non-automatic processing to speed up. In addition, it is possible for non-automatic processing by one L2 learner to be faster than automatic processing by another L2 learner. Hence, it is difficult to use processing speed alone as an index of automaticity.

However, whereas it is scientifically important to clarify the mechanism of automaticity through L2 processing speed, in terms of assessment or measurement of L2 proficiency level, it is also important to consider L2 processing speed *per se* as an index of L2 proficiency. As described previously, in our daily life, actual communication in L2 requires rapid response to the person one communicates with. Hence, regardless of whether the processing by one L2 learner is automatic, if the L2 processing speed of the learner is acceptable in terms of real time communication, it can be evaluated as a sufficiently suitable L2 processing performance.

In order to examine how L2 processing speed is related to L2 proficiency level, the current study tested whether L2 reading proficiency level correlates with speed of L2 sentence reading or not, and whether L2 listening proficiency level correlates with speed of L2 sentence reading or not. Generally, language proficiency can be divided into four kinds of proficiency: listening, reading,

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speaking, and writing. Listening and reading are grouped together as language comprehension, and some neuroimaging studies have even reported that listening and reading are supported by common or highly similar neural substrates[13]. Hence, listening and reading are associated with each other in terms of processing speed and proficiency. In addition, listening processing performance may require fast processing more than reading processing performance, because whereas we can re-read texts in reading activities, we cannot usually re-listen to utterances in listening activities. This leads us to predict that L2 listening proficiency is associated with processing speed more than L2 reading proficiency.

2.Methods
2.1.Subjects

Thirty-five Japanese native speakers who are learning English as a foreign language in Japan participated in this experiment. All participants began learning English after the age of 10. All participants had no experience of living in foreign countries for more than one month. They took the pre-level 2 English Language Proficiency test, which was prepared by the Society for Testing English Proficiency. This test includes listening and reading sections, and is generally used to assess the proficiency of English as a foreign language in Japan. The test has seven grades: one, pre-one, two, pre-two, three, four, and five; five refers to the lowest level of proficiency, and one to the highest. Written informed consent was obtained from each participant in accordance with the guidelines approved by the ethical committee of Tohoku University Medical School and the Helsinki Declaration of Human Rights, 1975.

2.1.1.Materials and procedure

In order to measure L2 processing speed, the current study used reaction times in an L2 sentence semantic judgment task. Subjects were asked to indicate whether an L2 sentence (e.g., "The boy was cooked by the fish.") visually presented in a phrase-by-phrase manner was semantically acceptable or not. The stimuli were all either simple transitive active sentences or transitive passive sentences written in the participants' L2 (English). The stimuli were presented visually in a phrase-by-phrase manner on a black projection screen (e.g., The boy / was cooked / by the fish.). Half of the stimuli were semantically acceptable. If the subjects could understand the answer, they were asked to indicate

yes or no as quickly as possible by pressing one of two buttons. In addition, as a baseline, the current study prepared reaction times of an L2 word reading task. In this control task, subjects were asked to indicate whether the same L2 words appeared or not (e.g., "the boy, the fish, the boy") by pressing one of two buttons as quickly as possible. The stimuli were all words used in the sentence semantic judgment task. The L2 sentence task comprised 24 trials, while the L2 word task comprised 12 trials. Stimuli presentation and collection of behavioural data were conducted on E-prime 2.0.

2.1.2.Data analysis and results

For reaction times of both L2 sentence and word tasks, the current study used correlation analyses (two-tailed) between the reaction times/accuracy rates and proficiency test scores of L2 reading, and between these reaction times and proficiency test scores of L2 listening. The results demonstrated a statistically negative correlation between the reaction times of L2 sentences and proficiency test scores of L2 listening performance ($r = -.40$, $p < .05$, see Figure 1). In contrast, there was no correlation between the reaction times and proficiency test scores of L2 reading performance ($r = -.17$, $p = .33$). Regarding the L2 words, there was no significant correlation both between the reaction times of L2 words and proficiency test scores of L2 listening performance ($r = -.24$, $p = .16$) and between the reaction times and proficiency test scores of L2 reading performance ($r = -.7$, $p = .69$). Regarding accuracy, there was no significant correlation both between the accuracy rates of L2 sentence and proficiency test scores of L2 listening performance ($r = .51$, $p = .77$) and between the accuracy and proficiency test scores of L2 reading performance ($r = .17$, $p = .31$). In contrast, there was a significant correlation between the accuracy rates of L2 words and the proficiency test scores of L2 listening performance ($r = .34$, $p < .05$), but no significant correlation between the accuracy and proficiency test scores of L2 reading performance ($r = .09$, $p = .59$). A significant result in the accuracy rates of L2 words was found, but it was strongly affected by the ceiling effect. A summary of the results is shown in Table 1.

3.Discussion

In order to examine how L2 processing speed is related to L2 proficiency level, the current study tested whether L2 reading proficiency level correlates with speed of L2

sentence reading or not, and whether L2 listening proficiency level correlates with speed of L2 sentence reading or not. It can be assumed that listening processing performance may require fast processing more than reading processing performance, because whereas we can re-read texts in reading activities, we cannot usually re-listen to utterances in listening activities. Hence, the current study predicted that L2 listening proficiency is associated with processing speed more than reading proficiency in L2.

The results of the current study demonstrated that, as predicted, there was a statistically negative correlation between the reaction times to L2 sentences and proficiency test scores of L2 listening performance (see Results and Figure 1). In contrast, there was no significant correlation among the other variables. These results indicate that speed of L2 sentence reading correlates with L2 listening proficiency level, whereas it does not correlate with L2 reading proficiency level. This finding supports the assumption that listening processing performance may require fast processing more than reading processing performance, suggesting that speed of L2 sentence reading reflects the speed of real-time sentence comprehension performance that is required in L2 listening.

The results of the current study are completely in line with previous findings, because it has generally been assumed that higher L2 proficiency causes faster L2 processing speed[1-4,7-12]. From this perspective, the current finding is reasonable. In contrast, in the current finding, speed of L2 sentence reading did not correlate with L2 reading proficiency test scores. The possible reason for this finding is that the L2 reading proficiency test primarily assesses the ability to read and understand long L2 texts. Hence, speed of L2 sentence reading may not be assessed by the L2 reading test, but speed of L2 sentence reading measured in the current study may be relatively associated with speed of comprehension of an L2 sentence, because this task asked subjects to understand the meaning of L2 sentences as quickly as possible, which may be required in L2 listening comprehension. In addition, the current study tested whether speed of L2 word reading correlates with L2 listening and reading test scores or not. The results demonstrated that there was no statistical correlation between these variables. These results indicate that speed of L2 word reading does not reflect speed of L2 listening proficiency, but speed of L2 sentence reading *does* reflect

speed of L2 listening proficiency. This enables us to postulate that the speed of semantic interpretation processing of L2 sentences is more necessary for higher L2 listening proficiency than speed of L2 word recognition.

4.Conclusions

The results of the current study demonstrated that there was a statistically negative correlation between the reaction times to L2 sentences and proficiency test scores of L2 listening performance. This result of the current study suggests that speed of L2 sentence reading reflects L2 listening proficiency level through real-time sentence interpretation ability. From this finding, one may claim that speed of L2 comprehension should be somehow used in L2 proficiency tests. However, as pointed out in previous studies of automaticity, L2 processing speed is considered in a relative rather than an absolute sense[6]. Hence, it is necessary to consider a new method of how to measure and assess processing speed in proficiency tests in an objective fashion.
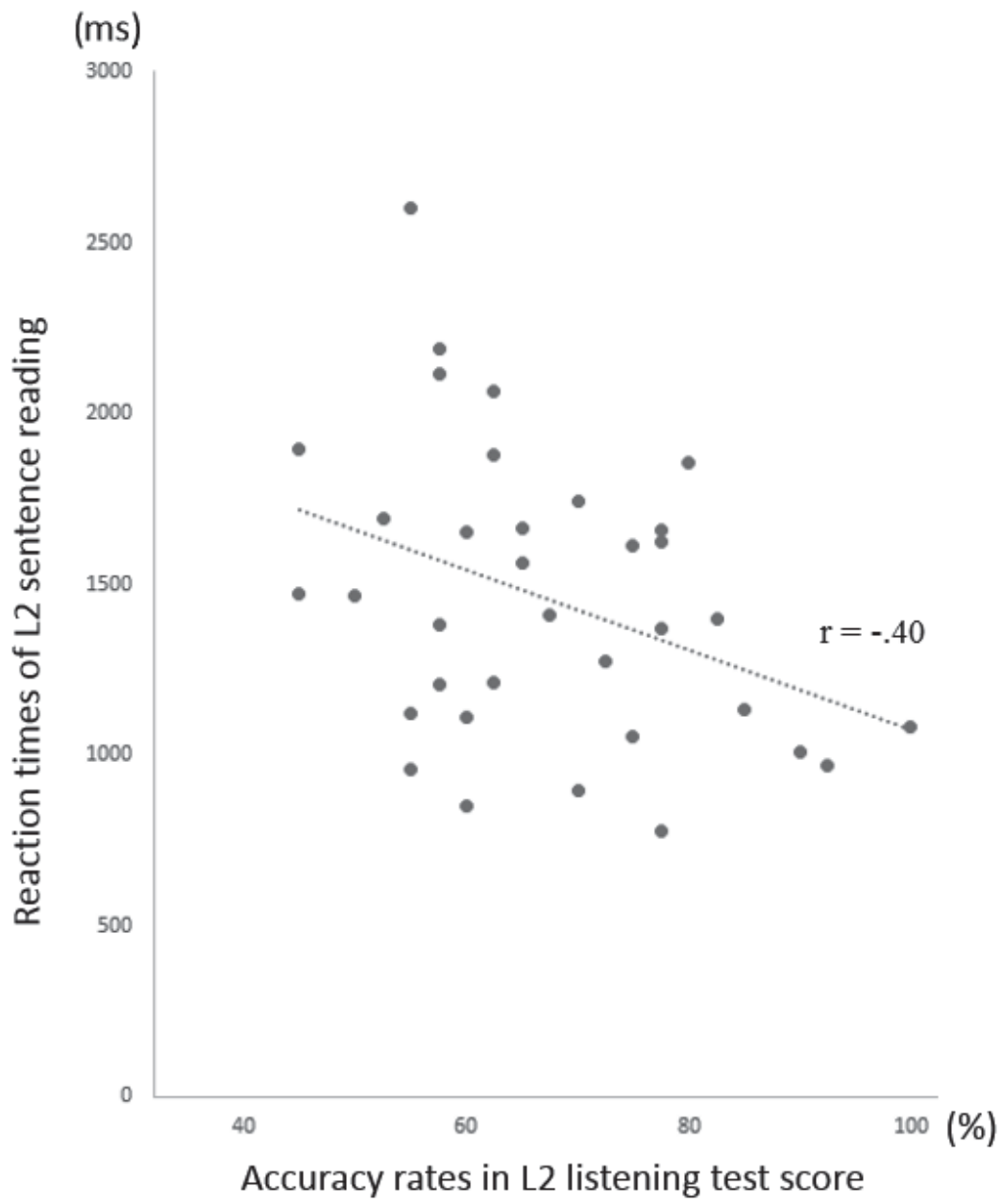
Figure 1. A statistically negative correlation between the reaction times of L2 sentences and proficiency test scores of L2 listening performance

Table 1. A summary of the results

	N	Min	Max	Average	SD
Listening score	35	45	100	67.28	13.38
Reading score	35	67	100	90.17	6.95
L2 sent RT	35	775.91	2600.94	1455.79	425.20
L2 sent AC	35	75	100	91.07	6.48
L2 word RT	35	731.33	2311.36	1224.82	401.33
L2 word AC	35	58.33	100	93.57	9.71

* N, Min, Max, SD, sent, word, RT, and AC denote the number of participants, Minimum, Maximum, standard deviation, sentence condition, word condition, reaction times, and accuracy rates, respectively.

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