Working Memory and L2 Linguistic Knowledge as Components of L2 Listening Comprehension

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Abstract

This article reports the results of a preliminary study that aims at examining the unique contributions of working memory capacity and L2 linguistic knowledge to L2 listening comprehension. Japanese EFL learners completed TOEIC listening test, L2 proficiency tasks, and memory span tasks. The results of the multiple regression analysis confirmed that L2 phonological modification knowledge and L2 syntactic knowledge were the significant predictors of L2 listening comprehension. The two variables accounted for 65 % of the variance in the model. In the case of lower-level group, L2 phonological modification knowledge and L1 working memory capacity emerged as the significant predictors of L2 listening comprehension. On the other hand, L2 vocabulary breadth and L2 syntactic knowledge were the significant predictors of L2 listening comprehension in the higher-level group. These findings suggest that listeners at different proficiency levels process the language differently.

1. Introduction

L2 listening comprehension is probably the least understood and least researched of all four language skills (reading, listening, speaking, and writing) because it is the least explicit in nature and because of the difficulty in accessing the process (Vandergrift, 2004, 2007). It is not simply a process of decoding language, and it involves complex cognitive processes at different levels (Buck, 2001). According to Just and Carpenter's (1992) capacity theory, any listener's cognitive processes are in competition for limited processing resources. L1 listeners will have processing capacity to spare, because they can process aural input automatically, with little conscious attention to individual words. On the other hand, lower-level L2 listeners who have limited linguistic knowledge are forced to devote more cognitive resources to lexico-grammatical processing because they process little of what they hear automatically (Lynch, 1998; Vandergrift, 2004, 2007).

The current approaches to teaching L2 listening, based on the achievement of comprehension tasks, have concentrated too much on higher-level non-linguistic factors such as background knowledge, and lower-level linguistic factors have been comparatively neglected (Field, 2003; Wilson, 2003). To achieve more effective teaching in L2 listening, it's important to find out

where the listener's misunderstanding occurs at several levels of processing: phonetic, phonemic, syllabic, lexical, syntactic, semantic, propositional, pragmatic, and interpretive. Field (2003) suggests that the breakdown of understanding from inadequate processing at the phonemic, lexical, or syntactic level possibly amplifies difficulty with semantic or pragmatic level understanding.

Researching into the factors that contribute to variance in L2 listening will be useful for model building and assessment of L2 listening. However, compared with other skills such as reading, there have been few theoretical and empirical models for L2 listening and little progress has been made during the recent years. Given the implicit nature of listening, listening processes, interacting in a complex way with different types of knowledge, are difficult to theoretically articulate and empirically verify. Moreover, cognitive processing in L2 listening varies depending on learners' proficiency level (Rubin, 1994). For example, the problems less-skilled listeners face during L2 listening are assumed to be caused by their lack of the subskills (Richards, 1983) to retain chunks, distinguish the word boundaries, and recognize the word in stressed and unstressed positions. It is worthwhile examining the variables which play a role in L2 listening at different proficiency levels.

2. Literature Review

2.1 The process-based approach to L2 listening

Listening comprehension is not a passive activity but an active process in which the listener must discriminate between sounds, understand vocabulary and grammatical structures, interpret stress and intonation, and interpret them within the sociocultural context. Listening is also a complex activity which involves physiological and cognitive processing at different levels, and deserves more attention and research on instruction in L2 listening (Field, 1998; Vandergrift, 1999). Integrating all of these involves a great deal of cognitive activity on the part of the listener (Vandergrift, 1999). From such a cognitive perspective, a number of complex sub-skills comprise L2 listening processing, and affect L2 listening performance by interacting with each other (Richards, 1983).

The three-phase model proposed by Anderson (1985) is viewed as one possible cognitive framework of L2 listening processing. Anderson (1985) proposed that the process of language comprehension consists of perception, parsing, and utilization. This was originally based on L1 comprehension. However, O'Malley, Chamot, and Kupper (1989) suggested that it is also applicable to L2 listening comprehension.

In the case of listening, perceptual processing is the encoding of the acoustic signal. In this stage, listeners segment the continuous speech stream into phonemes and retain the aural input in the echoic memory. During parsing, the words recognized at the perceptual stage are converted into a mental representation of the combined message while an utterance is segmented with the help of syntactic structures and cues to meaning. During utilization, this

mental representation is related to existing knowledge and stored in long-term memory (henceforth, LTM) as propositions. Lower-level processing is mainly employed during the perception and parsing stage of aural comprehension. Higher-level processing is employed during the utilization stage.

Based on the process approach, Goh (2000) identified 10 processing problems that occurred during the perception, parsing, and utilization stage for a group of ESL learners' self-reports. Five problems out of 10 were perceptual problems linked to word recognition and attention failure. Parsing problems were linked to difficulty with retaining what is heard and forming the mental representation of the words. The problems reported in the utilization stage included difficulty with understanding the intended message and the main idea in it because of a lack of prior knowledge or inadequate application of it.

2.2 L2 Listening Processing and Automaticity

The success of listening processing will also depend on the speed and automaticity with which it happens (Buck, 2001; Segalowitz, 2005). For listeners with less automatic processing skill, comprehension will suffer (Buck, 2001).

Information processing theories distinguish between automatic processing and controlled processing. Automatic processing requires few cognitive resources, and separate processing threads can run in parallel. Controlled processing requires more cognitive resources. Controlled processing, handled by the central executive, cannot operate in parallel (Ortega, 2009). From such an information-processing point of view, listening comprehension is also subject to a trade-off between the storage and processing functions of working memory. Given the real-time nature of spoken language and the inability of working memory to process all the information under time constraint, unskilled listeners need to focus more strongly and consciously on what they are listening to. When the task demands are high due to storage and processing needs during listening comprehension, comprehension breakdowns occur and some partial results from working memory processing may be forgotten (Just & Carpenter, 1992).

Segalowitz (2005) defines automaticity as fast, ballistic, holistic, and implicit processing which requires less cognitive resources. Once lower-level skills are automatized, more cognitive resources are available for higher-level processing in L2 listening.

2.3 The Componential Approach to Define the L2 Listening Construct

Among a variety of means of researching L2 listening, the componential approach can be one of the most useful methods to identify the factors affecting complex cognitive processes, or assist with the modeling of such a processes (Joyce, 2008). Linguistic knowledge and psycholinguistic factors such as grammar, vocabulary, and working memory have featured as variables in studies related to L2 reading (Harrington & Sawyer, 1992; Kato, 2003; Shiotsu,

2010; Shiotsu & Weir, 2007). Researching such factors with respect to their contribution to variance in L2 listening is potentially useful for model building and assessment of L2 listening. However, compared with other skills such as speaking and reading, there have been few theoretical and empirical contributions to the L2 listening aspect and little progress has been made during recent years (Joyce, 2008).

With respect to speaking, three components emerged in Levelt's (1995) speaking model: the acoustic-phonetic processor, the parser and the conceptualizer and these seem to match the three phases posited by Anderson (1985). In the case of L2 reading, the literature on componential analyses suggests that individual differences in L2 reading ability may be accounted for by linguistic and cognitive factors such as L2 vocabulary and syntactic knowledge (Shiotsu & Weir, 2007), and working memory capacity (Harrington & Sawyer, 1992; Kato, 2003; Shiotsu, 2010). The most recent research on components of L2 reading conducted by Shiotsu (2010) includes evidence that L2 syntactic knowledge and L2 vocabulary breadth are significant contributors in the prediction of reading comprehension test performance.

In the case of L2 listening, there have been some studies that have considered L1 listening comprehension and L2 proficiency as multiple component variables (Feyten, 1991; Mecartty, 2000; Tafaghodtari & Vandergrift, 2008; Vandergrift, 2006). Mecartty (2000) examined the relative contributions of L2 vocabulary knowledge and L2 grammar knowledge to L2 comprehension, for both listening and reading comprehension in Spanish. Multiple regression analysis confirmed that only L2 vocabulary knowledge was a significant predictor of L2 listening comprehension and explained about 14 % of the variance. Joyce's (2008) multivariate approach has provided a more balanced perspective on L2 listening processing. He examined the unique contribution of 8 explanatory variables to L2 listening comprehension: L2 syntactic knowledge, L2 vocabulary knowledge, L2 phonological modification knowledge, L2 phonological awareness, L2 sentence-stress awareness, L1 and L2 STM, and metacognitive listening-strategy usage. Multiple regression analysis indicated that L2 syntactic knowledge made the greatest independent contribution to L2 listening comprehension. This was followed by L2 phonological modification knowledge. L2 sentence-stress awareness and metacognitive listening-strategy usage were also statistically significant, but much weaker predictors. These four variables combined accounted for 59 % of the variance.

3. Research Questions

As described in the previous section, more automatic lower-level processing is thought to be a prerequisite for effective higher-level processing. Based on a hypothesis that lower-level processing skills requires a greater cognitive resources in L2 listening for the lower-level listeners than the higher-level listeners, the present study aims at examining the unique contribution of the multiple component variables to L2 listening comprehension at different

proficiency levels. The research questions addressed in the present study were as follows:

RQ 1: To what degree do the selected contributory factors explain L2 listening performance?

RQ 2: To what extent does the contribution of the factors differ across L2 proficiency levels?

4. Method

4.1 Participants

Participants in this study were 90 Japanese 1st and 2nd year students aged between 18 and 24 from a technical college in Japan. Their major was English language and their level of English proficiency ranged from the TOEIC test scores 210 to 900 (The average of their TOEIC scores = 495.7, SD = 154.5). Before participating in the research, the participants were asked to read and sign a consent form.

4.2 Instruments

From the viewpoint of Joyce's (2008) research about linguistic knowledge and psycholinguistic skills as components of L2 listening, a total of five explanatory knowledge and skill areas identified as important in his study were operationalized. In his study, short-term memory capacity was measured by L1 and L2 digit span tests, because his study focused on the simple short-term storage aspect of working memory. In contrast, the present study focuses on both storage and processing components of working memory capacity measured through L1 and L2 Reading Span Tests. TOEIC listening test was used as an indicator of L2 listening comprehension.

4.2.1 L2 Listening Comprehension Test

In this study, the listening section of the TOEIC test was taken by the participants as a measurement of L2 listening comprehension. The listening section comprises four parts covered by 100 questions, and each of these questions has three or four options. The questions in the listening section are referenced to a variety of statements, questions, conversations, and talks. Scores for the listening section as well as the reading section are determined by the number of correct answers, which is converted to a scaled score ranging from 5-495. Scaled scores are transformed and derived from test takers' raw scores through a statistical procedure. The test lasts around 45 minutes.

4.2.2 L2 Phonological Modification Knowledge Test

For this study, a partial dictation test (Fujita, 2003) was administered as an indicator of L2 phonological modification knowledge. It comprised 20 segments, and focused on phonetic

features: reduction, contraction, liaison, elision, deletion, assimilation, and coalescence assimilation. The words related to each sound change were deleted from 20 dictation segments. The total number of eliminated words was 76. The students listened to the entire segment only once and they were given 10 seconds, after listening to each segment, to fill in the deleted portion in the blanks on their test paper. The dictation test responses were scored on the exact-word scoring basis. However, legible spelling errors were counted as correct (see Appendix A for examples of the test items).

4.2.3 L1 and L2 Reading Span Test

Osaka and Osaka (1992) suggest that working memory is thought to be language independent, but the learners' low proficiency in L2 might affect the performance of L2 Reading Span Test (henceforth, RST). More recent L2 research has employed L1 complex measures of working memory capacity (Sagarra, 2008). In the present study, L1 working memory capacity was measured through the Japanese version of RST developed by Osaka (2002). L2 working memory was measured through the ESL version of RST developed by Miyasako (2006), which was consisted of 6-7 word-sentences mainly taken from authorized course books for junior high school students to minimize the influence of the L2 proficiency. In the case of L1 RST, five sets of sentences were presented in each sentence condition, from the two-sentence condition to the five-sentence condition. In the case of L2 RST, three sets of sentences were presented in each sentence condition, from the two-sentence condition to the five-sentence condition. Scoring was conducted based on the total number of the target words recalled correctly (see Appendix B for examples of the test items).

4.2.4 L2 Syntactic Knowledge

L2 syntactic knowledge was measured with an aural grammar test, which was reformatted and rerecorded by Joyce (2008) based on a commercially produced listening comprehension test, the English Language Institute Listening Comprehension Test published by the University of Michigan. The test contains items which assess the participants' knowledge of 15 basic structures, with three test questions allocated to each grammatical form. Each of the short listening texts consists of either a short question or statement to which the student responds on paper. After hearing the brief aural stimuli, the test taker is required to select one of the three written multiple-choice options provided. The correct response either answers the question correctly or is similar in meaning to the statement in the aural stimuli. The participant has 12 seconds to answer each question, and none of the test sentences are repeated. To systematically increase the probability of the words being known to the learners, Joyce used words for which the vast majority fall within the 1000 most frequent word families (Nation, 1990, p. 20). To reduce the effect of phonological modification knowledge, especially to minimize the influence of reduced forms, he also rerecorded the listening texts in

a relatively slow and formal manner. Moreover, the test was piloted to ensure that items/questions were appropriate for the target population. The test scores yielded an average of 57 % and a fairly good internal consistency (Cronbach's α = .82) in his main study. The measure used in the present study comprised 48 items (see Appendix C for examples of the test items).

4.2.5 L2 Vocabulary Breadth

L2 vocabulary breadth has been measured using an aural vocabulary test piloted and recorded by Joyce (2008). Regarding the selection of the test items, Joyce constructed the test by sampling lexical items from the spoken component of the British National Corpus. The appropriate Japanese definition for the test items was recorded by a Japanese translator. The distracters were the Japanese translation of words from a similar frequency level to the target L2 lexical items. The test involved the participants listening to a series of isolated English lexical items. After each target word was presented twice, the participants were required to match each item to its Japanese equivalent from among five options. The test was piloted to ensure its suitability. The test scores yielded an average of 68 % and fairly good internal consistency (Cronbach's α = .84) in his main study. The measure comprised 40 items (see Appendix D for examples of the test items).

4.2.6 L2 Sentence Stress Awareness

L2 sentence stress awareness was measured with a test developed and recorded by Joyce (2008). Joyce devised the test items for his study very carefully. To reduce the influence of reading on the construct, the test sentences were drawn from *Essential Grammar in Use* (Murphy, 2003), a self-study grammar book intended for elementary students of English. Furthermore, to minimize the influence of vocabulary breadth knowledge, it was ensured that all of the lexical items contained in the test were within the 1000 most frequent word families (Nation, 1990) or encompassed by the list of core vocabulary items that are taught at all Japanese junior high schools. The word that was selected to receive the primary stress was chosen at random. While the primary stress was placed on a pre-designated word, the sentences were uttered in a natural fashion. To ensure that there was a consensus on where the primary stress had fallen, the sentences were independently validated for such by a group of native speakers. The participants listened to a series of 30 decontextualised sentences, and indicated which of the lexical items carried the main stress after listening to each of the utterances. To simplify the task, the participants were asked to choose their answers from five possible choices for each sentence. The test scores yielded an average of 66 % and a fairly good internal consistency (Cronbach's α = .84) in his main study. The measure comprised 30 items (see Appendix E for examples of the test items).

4.2.7 L2 Metacognitive Listening Strategy Usage

L2 metacognitive listening strategy knowledge was measured with the Metacognitive Awareness Listening Questionnaire (MALQ) (Vandergrift, Goh, Maraschal, & Tafaghodtar, 2006) in the later studies. The instrument consists of a series of statements. Each of these statements corresponds to a strategy required for successful L2 listening comprehension. The participants provide information on the frequency of their strategy usage through a five-point scale. To ensure that the questionnaire could easily be understood by the participants, the instrument that was translated into Japanese (Joyce, 2008) was used in this study. The reliability of scores in his main study was a satisfactory .75 (Cronbach's alpha). The measure comprised 17 items (see Appendix F).

4.3 Procedure

The study was conducted in December 2010. The TOEIC test was administered to all the participants on the same day. Within a week after the TOEIC was conducted, the participants took all the other tests in their TOEIC classes, which were divided into two lessons to reduce their burden.

5. Results

5.1 Results for RQ 1

5.1.1 Descriptive Statistics

The descriptive statistics for scores derived on the measures is shown in Table 1. The internal reliability for scores on five linguistic knowledge tests and two RSTs was calculated. Scores for the L2 phonological modification knowledge test and the L1 RST yielded very strong internal consistency. Scores for the L2 vocabulary breadth test and the L2 RST yielded strong reliability. Scores for the L2 sentence stress awareness test yielded fairly good reliability, as did scores for the L2 syntactic knowledge test and metacognitive knowledge test.

Table 1
Descriptive Statistics for all Measures (N = 90)

	k	*Mean*	*SD*	α
TOEIC listening test scores	76	298.39	78.62	---
L1 RST scores	70	51.96	10.71	.940
L2 RST scores	42	31.21	6.34	.857
L2 phonological modification knowledge	76	45.87	16.02	.959
L2 vocabulary breadth	40	23.16	7.84	.908
L2 syntactic knowledge	48	20.16	6.77	.768
L2 sentence stress awareness	30	17.26	4.85	.803
L2 metacognitive knowledge	17	61.28	7.03	.765

5.1.2 Correlation Analysis

Before conducting the multiple regression analysis, the correlations among the variables were examined. The full correlations are displayed in Table 2.

Table 2
Correlations between Scores for the TOEIC Listening Test and the Sub-Skill Variables (N = 90)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) TOEIC listening test	-						
(2) L1 RST scores	.264*	-					
(3) L2 RST scores	.123	.499**	-				
(4) Phonological modification	.782**	.262**	.041	-			
(5) Vocabulary breadth	.604**	.109	.079	.646**	-		
(6) Syntactic knowledge	.634**	.234*	.219*	.599**	.515**	-	
(7) Sentence stress awareness	.335**	.223*	.069	.322**	.185	.438**	-
(8) Metacognitive knowledge	.439**	.302**	.315**	.415**	.305**	.398**	.287**

Note. $^{*}p < .05$, $^{**}p < .01$

As can be seen in Table 2, almost all of the correlations among the variables were found to be statistically significant. The largest correlation was found to be between TOEIC listening test and L2 phonological modification knowledge ($r = .78$, $p < .01$). This was followed by the correlation between the TOEIC listening test and L2 syntactic knowledge ($r = .63$, $p < .01$) as well as the TOEIC listening test and L2 vocabulary breadth ($r = .60$, $p < .01$). L2 metacognitive strategies, L2 sentence stress awareness, and L1 working memory capacity also yielded a medium or weak correlation with the TOEIC listening test. There was found to be a high correlation between L2 vocabulary breadth and L2 phonological modification knowledge ($r = .65$, $p < .01$).

5.1.3 Multiple Regression Analysis

As stated above, the correlational findings offered an insight into the relationship among the variables. Next, to investigate the unique contribution of each variable on L2 listening comprehension, multiple regression analysis was performed with the TOEIC listening score as the dependent variable and the seven component variables as the independent variables. As a result of the analysis using stepwise method, a statistically significant regression model comprising two variables was generated ($F = 82.55$, $p < .001$. *Adjusted* $R^2 = .65$). The results for the individual variance are presented in Table 3.

As shown in Table 3, L2 phonological modification knowledge and L2 syntactic knowledge were the statistically significant predictors of L2 listening comprehension measured by TOEIC listening tests. The standard partial regression coefficients show that L2 phonological modification knowledge ($\beta = .63$, $p < .001$) made the greatest independent contribution to L2

listening comprehension, which was followed by L2 syntactic knowledge (β = .26, p < .001). The two variables accounted for 65 % of the variance.

Table 3
Summary of Multiple Regression for Variables Predicting TOEIC Listening Test Score (N = 90)

Variables	β	t	*Adjusted* R^2
L2 Phonological modification knowledge	.628	7.986***	.647
L2 Syntactic knowledge	.258	3.278**	

Note. **p < .01, ***p < .001

5.2 Results for RQ 2

5.2.1 Descriptive Statistics

For further investigation of the relationship between language proficiency and the seven variables, better listeners and poorer listeners were compared. The 45 upper participants who scored 300 and above on the TOEIC listening test were regarded as the higher-level group, and the 45 lower participants who scored 290 and below on the TOEIC listening test were regarded as the lower-level group. Table 4 presents the descriptive statistics for each group on each dependent measure.

Table 4
Descriptive Statistics for Each Proficiency Group

		n	*Mean*	*SD*
TOEIC listening test	higher-level	45	361.56	52.90
	lower-level	45	235.22	39.28
L1 RST	higher-level	45	53.62	10.10
	lower-level	45	50.29	11.16
L2 RST	higher-level	45	31.09	6.28
	lower-level	45	31.33	6.45
L2 phonological modification knowledge	higher-level	45	56.56	11.43
	lower-level	45	35.18	12.45
L2 vocabulary breadth	higher-level	45	25.96	7.57
	lower-level	45	20.36	7.13
L2 syntactic knowledge	higher-level	45	23.49	6.28
	lower-level	45	16.82	5.54
L2 sentence stress awareness	higher-level	45	19.16	4.03
	lower-level	45	15.36	4.90
L2 metacognitive knowledge	higher-level	45	63.91	5.61
	lower-level	45	58.64	7.36

5.2.2 Correlation Analysis

The correlations for scores on the measures for each proficiency group are shown in Table 5 for the higher-level group and Table 6 for the lower-level group. Some differences were found between the two sets of correlations. Most notably, the correlations between scores for L2 listening comprehension and both L1 and L2 WM capacity in the lower-level group were greater than the corresponding correlations in the higher-level group. A similar pattern emerged for L2 phonological modification knowledge. On the other hand, the correlation between scores for L2 listening comprehension and L2 syntactic knowledge as well as the correlation between scores for L2 listening comprehension and L2 vocabulary breadth in the higher-level group were greater than the corresponding correlations in the lower-level group.

Table 5
Correlations among Scores on the Measures for the Higher-level Group (n = 45)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) TOEIC listening test	---						
(2) L1 RST	-.013	---					
(3) L2 RST	.175	.483**	---				
(4) L2 phonological modification knowledge	.475**	-.057	-.043	---			
(5) L2 vocabulary breadth	.580**	-.014	.124	.531**	---		
(6) L2 syntactic knowledge	.521**	.196	.434**	.458**	.435**	---	
(7) L2 sentence stress awareness	-.049	.244	.054	.027	.087	.234	---
(8) L2 metacognitive knowledge	.278	.085	.349*	.139	.241	.348*	.066

Note. $*p < .05$, $**p < .01$

Table 6
Correlations among Scores on the Measures for the Lower-level Group (n = 45)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) TOEIC listening test	---						
(2) L1 RST	.550**	---					
(3) L2 RST	.322*	.532**	---				
(4) L2 phonological modification knowledge	.665**	.441**	.178	---			
(5) L2 vocabulary breadth	.566**	.126	.060	.639**	---		
(6) L2 syntactic knowledge	.364*	.172	.076	.373*	.392**	---	
(7) L2 sentence stress awareness	.122	.130	.108	.129	.018	.377*	---
(8) L2 metacognitive knowledge	.233	.391**	.352*	.305*	.164	.198	.224

Note. $*p< .05$, $**p < .01$

5.2.3 Multiple Regression Analysis

To compare the better listeners and the poorer listeners, multiple regression analysis was performed with either the higher or lower level group's TOEIC listening test score as the dependent variable, and the seven variables as the independent variables. The independent variables were entered into the statistical model using the stepwise method.

In the case of the 45 higher-level listeners, despite the limited n size, a statistically significant regression model (F = 15.59, p < .001 Adjusted R^2 = .40) yielded two predictor variables: L2 vocabulary breadth and L2 syntactic knowledge. The results of the analysis are presented in Table 7. The standard partial regression coefficients show that L2 vocabulary breadth (β = .44, p < .05) made the greatest independent contribution to L2 listening comprehension for the higher-level group, which was followed by L2 syntactic knowledge (β = .33, p < .05).

As with the case of the higher-level listeners, a statistically significant regression model emerged for the lower-level listeners (F = 23.17, p < .001 Adjusted R^2 = .50). As shown in Table 8, the results of the analysis presented two predictor variables. In the case of lower-level group, L2 phonological modification knowledge (β = .53, p < .001) was the greatest contributor to L2 listening comprehension. This was followed by L1 working memory capacity (β = .32, p < .05). It is a noteworthy result that L1 working memory capacity would contribute to L2 listening comprehension in the lower-level group after removing variance common to L2 linguistic variables.

Table 7
Higher-group: Summary of Multiple Regression for Variables Predicting TOEIC Listening Test Score (n = 45)

Variables	β	t	*Adjusted* R^2
L2 vocabulary breadth	.436	3.360**	.399
L2 syntactic knowledge	.332	2.555*	

Note. *p< .05, **p < .01

Table 8
Lower-group: Summary of Multiple Regression for Variables Predicting TOEIC Listening Test Score (n = 45)

Variables	β	t	*Adjusted* R^2
L2 phonological modification knowledge	.525	4.426***	.502
L1 RST	.319	2.688*	

Note. *p < .05, ***p < .001

6. Discussion

The present study attempted to investigate the significance of L2 lower-level components as predictors of L2 listening comprehension through correlation and multiple regression analysis. The study also hypothesized that the role of such lower-level sub-skills would differ across L2 proficiency levels.

With regard to RQ 1, the results showed that lower-level processing sub-skills, L2 phonological modification knowledge and L2 syntactic knowledge, accounted for 65 % of the variance in the Japanese learner's L2 listening comprehension. L2 listening processing possibly involves the complex interaction of L2 syntactic and L2 phonological modification knowledge skills. Knowledge of these sub-skills was found to contribute to recognizing the words in the connected speech at the perceptual stage, and converting them into a mental representation of the message during parsing.

With regard to RQ 2, the results provided an insight into how listeners at different proficiency levels process the language. In the multiple regression analysis, L2 phonological modification knowledge and L1 working memory capacity emerged as the significant predictors of the lower-level listeners' L2 listening comprehension. Because of the limited L2 linguistic knowledge and skills, the lower-level listeners may depend more on decoding skills to catch the information to the surface of the discourse than higher-level skills to integrate the information and understand the discourse. Working memory is also thought to be related to controlled attention (Engle, 2002), and the efficiency of information processing (Osaka, 2000). The ability to direct attention to important information and avoid distraction effectively may play a greater role in the lower-level listeners' L2 listening performance. On the other hand, L2 vocabulary breadth and L2 syntactic knowledge emerged as the significant contributors to L2 listening performance for the higher-level group. The ability to form a mental representation of the input may contribute to the higher-level listeners' L2 listening performance.

An interesting finding in the study was that the relationship between working memory capacity and L2 listening comprehension was stronger in the lower-level group than the higher-level group. It is assumed that limited capacity of working memory could affect L2 listening comprehension when L2 linguistic knowledge and processing skills are not efficient enough. The lower-level listeners need to devote more cognitive resources to process what they hear in each phase of listening than the advanced-level listeners. Therefore, working memory capacity related to the listeners' processing efficiency might affect the L2 listening performance of the lower-level listeners more than the higher-level listeners.

7. Limitations and Implications

The results of the present study should be taken as suggestive rather than conclusive, and some limitations have to be acknowledged. Firstly, 35 % of the variance remained unaccounted

for. Secondly, future research might as well use more robust statistical techniques such as confirmatory factor analysis, and structural equation model with larger population.

Despite such limitations, the findings of the study suggest that the skilled and the less-skilled listeners process the language in different ways. The skilled listeners rely less on the lower-level sub-skill components of L2 phonological modification knowledge, and working memory, whereas the less-skilled listeners rely heavily on the lower-level components. Vandergrift (2004) supposes that listeners with more automatic processing have more room in working memory to retain information and revise the prior information as they listen. Developing such lower-level sub-skills as word recognition skills seems to contribute to saving limited capacity of working memory to be devoted to higher-level processing.

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第２言語リスニングの構成要素としての ワーキングメモリーと言語知識の影響

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要約

本論文は、第２言語リスニングの構成要素に関する予備的な研究結果の報告である。90人の日本人英語学習者に対して、文法、語彙、音声変化知識、メタ認知知識などの言語テストとワーキングメモリー容量を測定するタスクを実施し、TOEICのリスニングテストを指標とした第２言語のリスニング能力に対して言語知識とワーキングメモリーが及ぼす影響について検証を行った。重回帰分析の結果、音声変化知識と文法知識が第２言語リスニングを構成する有意な構成要素であることがわかった。さらにリスニング能力の上位群と下位群で比較を行ったところ、上位群においては、語彙と文法知識が有意な構成要素である一方で、下位群においては、音声変化知識とワーキングメモリーが有意な構成要素となった。これらの結果より、上位群と下位群では、第２言語リスニングの際の処理のプロセスが異なる可能性が示唆された。

Appendices

Appendix A: A Passage Used for Phonological Modification Knowledge Test

Examples of dictation sheet

I'll come and pick you up in a couple of hours.
How would you like to have dinner with me tonight ? (p.276)

Appendix B: Sentences Used for RST

Examples of Japanese version of RST

2-sentence condition
2-1 電車に乗り遅れたので、母に車で送ってもらった。
2-2 彼はぶっきらぼうだが、根はいいやつだと思う。
Target words: 母、ぶっきらぼう

Examples of ESL version of RST

2-sentence condition
2-1 We can easily make plastic from oil.
2-2 The parents and their children are happy.
Target words: oil, happy

Appendix C: L2 Syntactic Knowledge Test Paper

Examples of test items

This is the grammar section. I will either ask a question or make a statement. I will either ask a question or make a statement. To show that you have understood what was said, you are to select the ONE answer choice you think is correct, and mark that choice on the bubble card. Here is an example of the question type of problem. Listen carefully to the question, then choose one of the answers given below.

Example A
a. I am.
b. Tomorrow.
c. At home.
d. Football.

The correct answer is b. Tomorrow.

Here is an example of the statement type of problem.

Example B
a. The camera is expensive.
b. The desk is expensive.
c. The camera and the desk are expensive.
d. Neither the camera or the desk are expensive.

The correct answer is a. The camera is expensive.

Appendix D: L2 Vocabulary Breadth Test Paper

Examples of the test items

1	A	折る	b	さえぎる	c	囲む	d	そらす	e	はぐ
2	A	心配	b	電球	c	製造業者	d	範囲	e	畜牛
3	A	痛み	b	考慮	c	設備	d	優先	e	幹部社員
4	A	教育	b	度	c	ねじ	d	声明	e	供給
5	A	証拠	b	棚	c	資格	d	封筒	e	葬儀

Appendix E: L2 Sentence Stress Awareness - Test Paper

Examples of the test items

Q1.	There's nothing to do in this town. (a) (b) (c) (d) (e)
Q2.	All the students in our class passed the exam. (a) (b) (c) (d) (e)
Q3.	There aren't enough chairs for everyone to sit down. (a) (b) (c) (d) (e)

Appendix F: Listening Strategies Usage-Questionnaire

これは、今日のＴＯＥＩＣのリスニングテストであなたがどのようにリスニングをしたかについてのアンケートです。各々の質問で、あなたに当てはまっていると思うものを選び、その記号を○でかこんでください。

学科＿＿＿＿＿＿＿＿＿＿＿＿氏名＿＿＿＿＿＿＿＿＿＿＿＿

	非常にそう思う	そう思う	どちらでもない	そう思わない	全くそう思わない
1) （トピックが分かっていれば）聞き始める前にその話について何か知っていることはないかと考える。	A	B	C	D	E
2) 話し手の声の調子やその他の聞こえてくる音を言葉の意味の推測に役立てている。	A	B	C	D	E
3) 聞きながら次に何が起こるかを予測する。	A	B	C	D	E
4) 聞きながら、既に分かっている語を分からない語の意味を推測するのに利用する。	A	B	C	D	E
5) 理解するのが難しい時には、聞くことをやめてしまう。	A	B	C	D	E
6) 全体的な意味をとるようにして聞く。	A	B	C	D	E
7) 理解しにくい時でも、なんとか理解しようと自分に言い聞かせる。	A	B	C	D	E
8) 聞きながら、すでに理解していることと、聞いていることとを関連付ける。	A	B	C	D	E
9) 質問の英文の中の情報を、わからないことを予測するのに使う。	A	B	C	D	E
10) 聞きながら、答えのかぎとなる単語に集中する。	A	B	C	D	E
11) 理解するのが大変でも、さらに注意を払い、より聞くことに集中する。	A	B	C	D	E
12) 理解するのが大変でも、もっと後になれば理解できることを期待して、聞き続ける。	A	B	C	D	E
13) 分からない単語の意味を正確に理解しようとすることが多い。	A	B	C	D	E
14)ぼんやりしてしまった時でも、たいていの場合すぐに集中力を取り戻す。	A	B	C	D	E
15) 何回か聞くことができれば、どこにもっと注意を払うべきかたいていの場合分かる。	A	B	C	D	E
16) 頭の中で訳すことなしに理解している。	A	B	C	D	E
17) 聞きながら、自分が理解している時と理解していない時が分かる。	A	B	C	D	E