Phonological Memory and L2 Pronunciation Skills

Akiko Kondo
Nara National College of Technology

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The purpose of this study is to examine the influence of phonological memory on L2 pronunciation skills. The distinctive features of this study are first investigating two different types of phonological memories, verbal and non-verbal, and second, investigating causal effects between phonological memory and L2 pronunciation skills. The results indicate the positive influence of both phonological memories on L2 pronunciation skills.

本研究は、音韻的短期記憶の第二言語発音スキルへの影響の大きさを調査することを目的とし実施された。本研究の特色は第一に、今まで扱われたことない非言語的情報の音韻記憶と言語的情報の音韻記憶の2つの異なる記憶力のそれぞれの影響の大きさを調べたことと、記憶力と言語スキルの相関関係ではなく記憶力がどの程度言語スキルに影響を与えているかを回帰分析によって調査した点である。実験結果により、それぞれ2つの異なる記憶力は第2言語の発音スキルに影響を与えていることが示唆された。

Research has indicated that language learning aptitudes influence second or foreign language acquisition. Some students are able to relatively easily acquire foreign language skills, while others need a great amount of effort to master a foreign language. For example, the rate of acquisition of L2 vocabulary varies depending on the individual. Moreover, based on my teaching and learning experience of English, acquisition of L2 pronunciation skills are affected by individual aptitude. Some learners are able to produce L2 sounds that do not exist in their L1 with less effort, while others need more effort to produce the same L2 sounds. Numerous studies have been conducted to explain these individual differences (Federmeier, Kutas, & Schul, 2010; Jakoby, Goldstein, & Faust, 2011; Payne & Lynn, 2011; Weissheimer & Mota, 2009). Various factors including motivation, age, personality, and memory have been investigated, reporting those factors can contribute to second or foreign language acquisition success (Dörnyei, 2005; Golestani & Zatorre, 2009). Among various individual factors claimed to influence learning of a second or foreign language, the role of phonological memory has gained attention as a contributing factor to learning. Phonological memory is one of the subsystems of working memory, which refers to, according to Baddeley (2010), "the system or systems that are assumed to be necessary in order to keep things in mind while performing complex tasks such as reasoning, comprehension and learning" (p. 136). The subsystem is also called phonological loop, phonological short-term memory or phonological

memory, and is responsible for the temporal maintenance of acoustic, or speech-based, material.

Among the working memory subsystems, phonological loop, or phonological memory, is the most examined subsystem (Hummel & French, 2010). Phonological memory has been researched in the field of not only L1 acquisition (Baddeley 1986), but also in the field of L2 acquisition (French, 2004; Dufva & Voeten, 1999; Masoura & Gathercole, 1999). Although several studies failed to indicate the direct link between phonological memory and L2 acquisition (Harrington & Sawyer, 1992; Hummel, 2002; Mizera, 2006), research findings of most studies, overall, are generally positive, indicating a specific role for phonological memory in L2 acquisition with both children and adults across various levels of L2 proficiency (Fortkamp, 1999; Furuhata, 2007; Hong, 2004; Van den Noort, Bosch & Hugdahl, 2006; Tokimoto, 2008). The relationships between phonological memory and specific second/foreign language skills, such as vocabulary (Atkins & Baddeley, 1998; French, 2006 ; Giovanna, Nick & Tracey, 2004; Masoura & Gathercole, 1999; Service, 1992; Service & Kohonen, 1995), speaking (O'Brien, 2006), reading (Harrington & Sawyer, 1992), listening (Kormos & Safar, 2008; Tsuchihira, 2007), and grammar (Miyake & Friedman, 1998) have also been investigated.

While a number of studies have investigated the relationship between phonological memory and L2 skills, there is no study that examines the relationship with L2 pronunciation skills. Second, most studies dealt with phonological verbal memory, but not with nonverbal, or musical memory. In addition, most studies examined correlation between phonological memory and L2 skills, but do not investigate the causal relationship. Therefore, this study investigates how two different types of phonological memories affect L2 skills through regression analysis. The study I report in this article is part of a pilot study and focuses on examining the following two research questions: 1) How much does phonological memory affect L2 pronunciation skills? 2) How much do verbal and non-verbal (musical) phonological memory affect L2 pronunciation skills?

Methodology

Participants

The participants in this study are 36 university students majoring in English, 12 male and 24 female students. All are Japanese and their native language is Japanese. Their ages range from 18 to 19. They had learned English for six or seven years previous to this research and their English level is intermediate.

Instruments

In order to measure the participants' memory spans and L2 language skills, the following three instruments were designed.

Non-Verbal Phonological Memory Test

This test examined student capacity for memorizing non-verbal (tonal sound) information. In this test, students first listened to a sequence of melodies played on the piano and choose the same melody from two recorded options. If neither recorded option matched, this was also an answer option. This test consisted of 10 items of increasing difficulty, with melody length increasing toward the end of the test.

Verbal Phonological Memory Test

This subtest examined student informational memory span in their L1. The test format is the same as the non-verbal phonological memory test. In this test, students listened to a set of Japanese names of colors, and were asked to choose the correct order of the colors from two recorded options. Again, if neither

recorded option matched, this was also an answer option. This test also consisted of 10 items of increasing difficulty, with color sequence length increasing toward the end of the test.

Both phonological memory tests were conducted using PowerPoint with slides automatically transitioning, with equal time for each. For scoring, 1 point was given for a correct answer, 0 points for an incorrect answer. Partial credit was not given.

Pronunciation Test

This test is designed to examine students' English pronunciation ability, and consists of two sections. The first section is word reproduction. In this section, students repeat English words after they listen to the recording of model pronunciation spoken by native speakers. The test included 15 English words. Target English words from three to seven syllables were chosen. The students' responses were recorded by a computer and rated by the researcher, who is the instructor of the pronunciation course. Their pronunciation was rated based on the place of the primary stress and the number of syllables, which are easy to recognize and judge than focusing segmental features, such as /l/ and /r/ sounds. The other section is English sentence reproduction. In this test, students are asked to reproduce English sentences after they listen to the recording of model pronunciation spoken by native-speakers of English. The test includes five English sentences. The section consists of five sentences which include seven to 16 words. For rating, the rater focused on intonation and the number of words reproduced by the students. Zero to 5 points were given depending on the students' performance.

Procedures

Two class sessions were used for data collection. The first session tested non-verbal phonological memory and verbal phonological memory. In the second session, an L2 pronunciation test (word reproduction and sentence reproduction test) was given. Both sessions were administered in a computer room where each student had access to a computer.

Data was analyzed using SPSS 19 using multiple regression analysis to examine the correlation between phonological memory and L2 skills. I also chose the stepwise method in order to examine the relationship of each independent variable, non-verbal and verbal L1 memory, on the dependent variable, L2 pronunciation. Figure 2 presents the research design for this study.

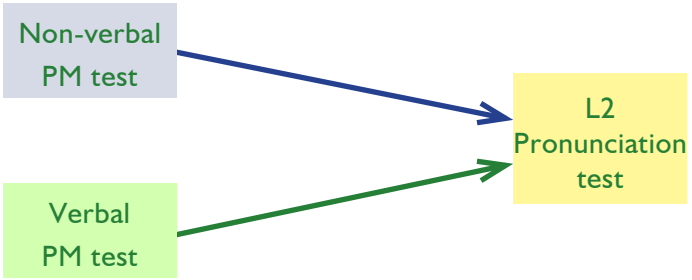

Figure 1. Research Design of this Study

Results

Table 1 shows the model fit statistics. In Model 1, in which the independent variable is only verbal memory, R square is .19, which is statistically significant. This means that 19% of the variance in L2 pronunciation scores can be predicted from verbal phonological memory scores. In Model 2, verbal and non-verbal phonological memories were the independent variables. In this model, R square is .32, again statistically significant. Thus, it shows that 32% of the variance in L2 pronunciation scores can be predicted from the two variables, verbal and non-verbal phonological memory.

Table 1. Model Fit Statistics for Predicting L2 Pronunciation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.43	.19	.16	6.08	.19	7.77	.009**
2	.57	.32	.28	5.63	.14	6.65	.015*

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

Table 2 shows the examination of whether non-verbal and verbal L1 memory predict L2 pronunciation. As in Table 1, Model 1 includes verbal phonological memory as the independent variable, while Model 2 includes both verbal and non-verbal phonological memory as independent variables. For both models the significance level was less than .01, which indicates verbal memory and non-verbal memory predict L2 pronunciation skills.

Table 2. How Non-Verbal and Verbal L1 Memory Predict L2 Pronunciation

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	286.91	1	286.91	7.77	.009**
	Residual	1255.64	34	36.93		
	Total	1542.56	35			
2	Regression	497.39	2	248.70	7.85	.002**
	Residual	1045.16	33	31.67		
	Total	1542.56	35			

** p<.01

Table 3 shows coefficient data for each model. VPM refers to L1 verbal phonological memory and NVPM is non-verbal phonological memory. As this table shows, in Model 2 the standardized coefficient for VPM is .52, which is statistically significant. This means that for every unit increase in VPM, we expect a .52 increase in the pronunciation score. The coefficient for NVPM is 38, which is also statistically significant. For every unit increase in NVPM we expect a .38 increase in the pronunciation score. From this data, we can see VPM influences pronunciation more than NVM. In addition, as the coliniality statistics show, this model has no coliniality problem.

Table 3. Predictability of Non-Verbal and Verbal L1 Memory for L2 Pronunciation

Model B		Unstandardized Coefficients		Standardized Coefficients	T	Sig. Tolerance	Collinearity Statistics	
		Std. Error	Beta				VIF	
1	(Constant)	33.26	2.75		12.10	.000		
	VPM	1.94	.70	.43	2.79	.009**	1.000	1.000
2	(Constant)	25.92	3.82		6.78	.000		
	VPM	2.33	.66	.52	3.52	.001*	.95	1.05
	NVPM	1.52	.59	.38	2.58	.015*	.95	1.05

p<.05, ** p<.01

Discussion and Limitations

As the results showed, phonological memory positively correlates with L2 pronunciation. Examining the sub-variables of phonological memory, verbal memory has a greater positive relationship with L2 pronunciation skills, which makes intuitive sense because L2 pronunciation deals with language. The

remarkable point is that non-verbal or musical memory also had a significant positive relationship with L2 pronunciation skills, which reinforces the findings of the few studies that imply a relationship between L2 pronunciation and musical ability. For example, Milovanov, Pietilä, Tervaniemi & Esquef (2010) investigated the interaction between musical aptitude and foreign language pronunciation skills and concluded music and foreign language seem to share a similar structure. Furthermore, including non-verbal aspects of phonological memory gave the model more power to predict proficiency. Therefore, when measuring phonological memory, it might be better to include verbal and non-verbal aspects of phonological memory.

Although the results showed a positive correlation between phonological memory and L2 pronunciation, there are several limitations to this study. First, the number of participants is relatively small for regression analysis, so the next study will include more than two hundred students to make the results more generalizable.

The second problem regards the rating of the pronunciation test. The researcher, a non-native speaker of English, evaluated student pronunciation as a single rater, focusing on supra-segmental pronunciation features, such as the number of syllables and words, stress and intonation, all relatively easy for non-native speakers to judge relative to segmental features. However, for better reliability, in future research multiple raters who are trained native speakers of English should judge pronunciation.

The third problem is that student ability was measured using only one instrument. For examining pronunciation skills, a word and sentence reproduction test was used. Future research should add another type of pronunciation test, in which students read words and sentences aloud without any model to measure pronunciation skills more comprehensively.

Conclusion

This study investigates the relationship between phonological memory (both verbal and non-verbal) and L2 pronunciation skills. Although there are several limitations, the results indicate the possibility of the positive influence of verbal and non-verbal phonological memory on L2 pronunciation skills. In the future, the research design should be redesigned to take into account the limitations of this study to obtain more generalizable results.

Bio Data

Akiko Kondo is Associate Professor at Nara National College of Technology. She also studies at Temple University as a doctoral student. Her current interests include teaching L2 pronunciation, working memory and teacher education. She can be contacted at <akiko913@gmail.com>.

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