Is There an Association of L2 Proficiency with Social and Physical Abilities?
Effects of Various Types of Abilities on English Proficiency

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Key words: L2 proficiency, social ability, physical ability, Japanese learners, reading rate, vocabulary size, TOEIC score

1. Introduction

Second language acquisition is a complex construct, involving a variety of factors. Individual learner variables in literature include cognitive factors, personality, sex, memory, age, aptitude, motivation, attitude, hemisphere specialization, language learning strategies, general intelligence, sociological preference, interest, previous experiences, and birth order (Altman 1980, Skehan 1989, Larsen-Freeman and Long 1991). Among these factors, extensive research has investigated cognitive factors from the viewpoints of working memory and empathy (Taylor, Guiora, Catford and Lane 1969, Guiora, Beit-Hallahmi, Brannon, Dull and Scovel 1972, Kim et al. 2002, Perani 2005, Van den Brink et al. 2010, Gorman 2012, Hu et al. 2013). Spatial cognition and memory play a crucial role in social communication (Wheatley, Millellie and Martin 2007, Hari and Kujala 2009, Kourtis, Sebancz and Knoblch 2010). The usefulness of working memory, which is a major component of social communication, has been reported in various fields. Although working memory has been considered as a language learning device, an association between phonological working memory and language learning abilities was found to decline in advanced learners (Gathercole 2006). Hu et al. (2013) reported an association in advanced language learners between L2 acquisition and the cognitive factor, empathy, but not working memory.

Studies have dealt with the relationships between language proficiency and physical abilities (Beilock, Lyons, Mattarella-Micke, Nusbaum and Small 2008, Fargier et al. 2011), reporting that physical experiences change the processing of action language. Several studies have explored the relationships between physical activities and academic performance, reporting that
physical activities influence brain health and cognition which leads to enhanced academic performance (Coe, Pivarnik, Womack, Reeves and Malina 2006, Castelli, Hillman, Buck and Erwin 2007, Chomitz et al. 2009, Kwak et al. 2009, Hillman, Kamiyo and Scudder 2011). In those studies, among other factors, reading ability in L1 and math were employed as indices of academic performance.

We have carried out a series of studies on the relationships among L2 proficiency, physical abilities and brain activities. Sudo, Mochizuki, Itoh and Kirino (2010) investigated interrelationships among these factors, especially from the viewpoint of social cognition. Furthermore, we attempted a preliminary system analysis of associations between spatial cognitive memory and performances of social communication as well as physical exercises (Itoh, Sudo, Mochizuki and Kirino 2011, Itoh, Sudo, Mochizuki and Kirino 2012). Sudo, Mochizuki, Itoh and Kirino (2011) examined the interrelationships between L2 proficiency and social cognition from the viewpoint of brain activation. Physical abilities and social functioning have been of interest with respect to their interrelationship in connection with common higher brain activities (Hillman, Erickson and Kramer 2008, Zentgraf, Munzert, Bischoff and Newman-Norlund 2011, Singer 2012). Mochizuki and Kirino (2008) examined the effects of coordination exercises on brain activation measured by fMRI. The results of the study indicated that coordination exercises contribute to not only the improvement of motor activities but also cognitive control. Mochizuki, Sudo, Kirino and Itoh (2014) investigated the brain activation associated with coordination exercises done by one person and those by two persons, and examined the interrelationships between the brain activation and social abilities. Mochizuki, Sudo, Itoh and Kirino (2013) suggested that there are significant sex differences in the relationships between some of the physical abilities and social cognitive abilities. A series of our studies indicated a strong possibility of the different types of human abilities being closely interrelated. In language acquisition, spatial cognitive memory and performances are crucial factors. Working memory plays an important role in language acquisition, image training, rehabilitation of language, and cognitive impairment. These factors also have an effect on physical abilities. L2 learning attainment can be considered as an index of academic and learning performance. We hypothesized that the different types of abilities—social abilities and physical abilities—have an influence on L2 learning attainment.

The purpose of the present study was to investigate the association between L2 proficiency and two other different types of abilities—social and physical abilities. We attempted to quantify the relationships among these three types of abilities. The analysis of individual learner factors will contribute to more efficient L2 learning.

2. Methods

2.1 Subjects

Forty-five college students (24 males and 21 females, 21.2 ± 1.4 years old) served as subjects. They were all Japanese undergraduate and graduate students who belonged to a School of Health and Sports Science. The study protocol, which is in accordance with the Declaration of Helsinki, was approved by the Juntendo University Research Ethics Committee and Teikyo Heisei University Research Ethics Committee. After a complete description of the study was given to all subjects, they gave informed consent for the protocol.

2.2 Procedures

There were three sessions in this study: language session, social ability session, and physical ability measurement session. We held the two sessions, social ability session and language session, on the same day for each subject. The physical ability measurement session was held within the range of one week to six weeks before/after the other sessions. To evaluate the associations among L2 proficiency, social abilities, and physical abilities following a normality test, correlation analysis was conducted for language parameters, social parameters, and physical parameters.

Language session. In the language session, we used three tests to measure the English proficiency of the subjects. They took the official TOEIC (Test of English for International Communication) for the measurement of English listening and reading proficiencies. The scores of the Listening Section and the Reading Section, as well as the total score, were employed to measure the L2 proficiency of the Japanese subjects. They also took the standardized tests, the “Rate Level Test” (Carver 1987a) and the “Accuracy Level Test” (Carver 1987b). The “Rate Level Test” was used to measure their reading rate in English. In the test, the subjects read English sentences for two minutes. The raw score was calculated from the number of words and the reading rate was interpreted by the conversion table. Two points were subtracted in cases of an incorrect answer.
This reading rate was shown in terms of the number of words that one could read within one minute. We applied the “Rauding Theory” (Carver 1984)—which claims that the same comprehension processes underlie both reading and listening—to L2 acquisition and tested the hypothesis that the processing time for reading had an effect on that for listening. The “Accuracy Level Test” was used to measure vocabulary abilities. The subjects answered 100 vocabulary questions within ten minutes. The raw score was calculated from the number of correct answers. 0.5 points were subtracted in cases of an incorrect answer. The vocabulary ability was interpreted by the conversion table. In sum, we employed TOEIC scores (total, listening, and reading scores) together with reading rate and vocabulary size which reflect learning and performance abilities of English as a second language.

Social ability session. We examined social abilities in terms of two specific components: empathizing and memory span. Empathizing—the ability to recognize other’s emotions and mental states—was measured by self-reports on the Systemizing, Empathy, and Autism Spectrum Quotients (SQ, EQ, and AQ). The SQ was used for individual differences in trying to analyze, understand, predict, control, and construct rule-based systems. The EQ, which has been proved largely independent of SQ, was used for individual differences such as specific essential components of social cognition, especially interpersonal reactivity. The AQ was used for individual differences in autistic traits; however, this score may be predicted from EQ and SQ (Wheelwright et al. 2006). The questionnaire consisted of 150 questions, and the response was on a scale of 1 to 4. Regarding memory span, the Japanese version of the reading span test (RST) was employed to measure memory span as one of the quantified indices of working memory. The total number of the sentences in a set ranged from two to five sentences. The sets in the test consisted of 20 sets.

Physical ability measurement session. In the physical ability measurement session, we used five tests to measure physical abilities of the subjects. We employed a side-step test for the measurement of quickness, a vertical jump test for that of power, a grip test for that of strength, a sitting-and-bending-forward test for that of flexibility, and a 12-minute run test for that of endurance. In the side-step test, we used three lines with a width of one meter, and counted the number of steps within 20 seconds. In the vertical jump, we employed a digital meter installed on the wall, and in the grip test, a digital meter was used. In the 12-minute run test, we used an outdoor athletic track. The subjects were tested individually, except for a 12-minute run test in which the men and women ran in separate groups.

3. Results
To evaluate the associations among L2 proficiency, social abilities, and physical abilities, correlation analysis was conducted for TOEIC scores (total, listening, and reading scores) together with reading rate and vocabulary size, social parameters (RST, SQ, EQ, and AQ) and physical parameters (quickness, power, strength, flexibility, and endurance). The parameters, except for the RST group, passed normative tests. Therefore, Spearman’s and Pearson’s correlation coefficients were calculated for non-normative parameters and others, respectively. Table 1 shows means and standard deviations as well as statistically significant (p < .05) correlation coefficients for the above-mentioned parameters, and strong correlations (|r| > 0.7) are indicated in bold-faced type but moderate (0.4 < |r| ≤ 0.7) and weak (|r| < 0.4) ones in normal type. The correlation coefficients for all the subjects, males and females together, showed that TOEIC total scores showed a strong correlation with reading rate (r = 0.77, p < .0001) and moderate correlation with vocabulary (r = 0.64, p < .0001). It is worth noting that reading rate showed a stronger correlation with the TOEIC listening score (r = 0.75, p < .0001) rather than the TOEIC reading score (r = 0.69, p < .0001) (Figure 1). However, vocabulary ability showed a moderate but higher correlation with the TOEIC reading score (r = 0.68, p < .0001) than listening score (r = 0.50, p < .0001). English parameters had no significant correlations with the RST parameters. Vocabulary ability showed a negative weak correlation with EQ (r = −0.30, p < .05).

Reading rate showed a weak positive correlation with endurance (r = 0.39, p < .01), and also with power (r = 0.30, p < .05). In addition, the physical parameters, endurance, correlated with TOEIC total scores (r = 0.40, p < .05) as well as listening (r = 0.35, p < .05) and reading scores (r = 0.39, p < .05). This physical parameter,
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(--: p > 0.05)
Is There an Association of L2 Proficiency with Social and Physical Abilities?

![Figure 1 Scatter plot of reading rate and TOEIC listening score (male and female subjects)](image1.png)

![Figure 2 Scatter plot of vocabulary ability and EQ of male (■: \( r = -0.519, \ p = 0.009 \), solid regression line) and female (○: \( r = 0.083, \ p = 0.721 \), dashed regression line) subjects](image2.png)

endurance, negatively correlated with EQ (\( r = -0.30, \ p < .05 \)). Another physical parameter, strength, positively correlated with SQ (\( r = 0.32, \ p < .05 \)).

It is noteworthy that gender-segregated analysis suggested that sex differences could affect the overall relationships among English-related parameters, social parameters, and physical parameters. The correlation coefficients for the above-mentioned parameters show significant sex-related differences in the interrelationships among these parameters. The correlation between vocabulary ability and EQ was negative and significant (\( r = -0.52, \ p < .01 \)) in the male group, but not in the female group as shown in Figure 2. In addition, vocabulary ability showed a correlation with RST rate in the female group (\( r = 0.50, \ p < .05 \)) as shown in Figure 3, but not in the male group. Regarding physical parameters, quickness showed a negative correlation with AQ in the male group (\( r = -0.45, \ p < .05 \)), but not in the female group. Flexibility showed a negative correlation with SQ in the male group (\( r = -0.43, \ p < .05 \)), but positive in the female group (\( r = 0.54, \ p < .05 \)).

4. Discussion

The results of the English parameters showed that reading rate had a significant effect not only on reading ability but also on listening ability for the Japanese learners of English, indicating the validity of the hypothesis in L2 that the processing time for reading had an effect on that for listening. Thus, the results of this study support the “Rauding Theory” (Carver 1984), which claims that the same comprehension processes
underlie both reading and listening, thus showing the validity of the “Rauding Theory” in not only L1 but also L2. It is noteworthy that reading rate has a stronger effect on listening ability than vocabulary ability does.

We carried out a quantitative analysis of L2 proficiency as well as social and physical abilities for the purpose of analyzing individual learner factors and finding out the factors contributing to effective L2 acquisition. A conspicuous effect of physical ability on English ability was observed for endurance among five physical abilities—quickness, power, strength, flexibility, and endurance. Some association was also observed between English and power, which is an integrated index of speed and energy output. The results regarding L2 proficiency and these physical abilities, endurance and power, are in concordance with the studies by Castelli et al. (2007) and Hillman et al. (2011) that reported a positive correlation between academic abilities and physical abilities. This finding suggested that learners need persistence and energy in L2 acquisition. Regarding social abilities, EQ was observed to be negatively correlated with vocabulary ability. This result can be interpreted as suggesting that a learner with high vocabulary ability tends to be less sensitive to interpersonal reactivity. This might reflect the learning strategy of learners for vocabulary, which is memorization by themselves.

The present study showed that there are sex-related differences in the relationships between language proficiency and the other two abilities, physical and social abilities. Some sex differences have been reported in each field of language proficiency and social abilities (Takeuchi, Griffiths and Coyle 2007, Kaiser 2009, Krach et al. 2009, Wallentin 2009, Pavlova, Guerreschi, Lutzenberger, Sokolov and Krägeloh-Mann 2010, Payne and Lynn 2011, Wright and Skagerberg 2012). The present study revealed that there are male-female differences in the relationships between L2 proficiency and the other two abilities. In the case of males, vocabulary ability was found to be negatively correlated with EQ, but not in females. In the case of females, vocabulary ability had a positive correlation with RST. Male learners with high vocabulary ability tended to be low in interpersonal reactivity, while female learners with high vocabulary tended to have a high ability of working memory. Males with a high ability of vocabulary were found to be low in ability to empathize. This result might be interpreted as suggesting that a man with high vocabulary ability becomes absorbed in what he does, without paying attention to other people’s states, which is in concordance with the results of several studies (Hayes, Bickerstaff and Baker 2010, Longman, Stock and Wells 2011, Van Honk et al. 2011). The above-mentioned sex differences might be interpreted as suggesting that there is an influence of sex hormones on the hemispheric differences of mental activities (Hayes et al. 2010).

We also carried out preliminary analysis by grouping the learners according to the TOEIC total scores. The group of proficient English learners, that is persons with high TOEIC scores, was shown to be low in SQ, while the group of non-proficient learners with low TOEIC scores was high in AQ. This suggests that the personality trait of being extraverted might contribute to successful L2 acquisition. This result is in accordance with the literature on L2 acquisition (Strong 1983, Ehrman...
and Oxford 1989, Verhoeven and Vermeer 2002, Ellis 2010) which has reported that different personality types such as types of extroversion vs. introversion are among the factors that affect success in L2 acquisition.

5. Conclusion

This study attempted to find out the factors related to L2 acquisition attainment. The social and physical abilities of language learners were shown to have different effects on the attainment of L2 acquisition. The present study suggests that efficient language learning needs to take into account a range of personal abilities, including sex differences. We were able to provide information on the significant factors related to individual learners. Despite the noteworthy findings in this study and its contribution to understanding the relationships of social and physical factors to L2 proficiency, the present research has some limitations. In particular, taking into account the fact that L2 learning involves a wide range of variables, individuality still has an effect on the results of this type of study. Further research, with a larger number of subjects, is needed especially to analyze proficient learner- and non-proficient learner-group related factors.

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References


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