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The role of L1 reading ability, L2 proficiency and non-verbal intelligence in L2 reading comprehension

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(Received 05/01/15; final version received 31/03/15)

Abstract

This correlational study investigated the relative contribution of first language (L1) reading ability, non-native language (L2) proficiency and non-verbal intelligence to non-native (L2) reading comprehension among 64 Hungarian high-school students learning English as a foreign language in Slovakia. Using standardized measurements for all variables, the study concluded that for L1 reading ability to be transferred to L2 reading comprehension, one has to have sufficiently high L2 language proficiency. The correlation between non-verbal intelligence and L2 reading comprehension was significant, albeit not a particularly strong one. The study is consistent with other previous findings, and lends further support to both the linguistic threshold and linguistic interdependence hypotheses.

Keywords: non-verbal intelligence; L2 proficiency; L1/L2 reading comprehension.

Resumen

Este estudio correlacional investiga la contribución relativa de la habilidad de lectura en la primera lengua (L1), el dominio de la lengua no-nativa (L2) y la inteligencia no-verbal hacia la comprensión de lectura de la lengua no-nativa (L2) entre 64 estudiantes húngaros de nivel bachillerato aprendiendo inglés como idioma extranjero en Eslovaquia. Utilizando medidas estandarizadas en todas las variables, el estudio concluye que para que la habilidad de lectura de L1 se transfiera a la comprensión de lectura en L2, uno debe tener un dominio suficientemente alto de L2. La correlación entre la inteligencia no-verbal y la comprensión de lectura en L2 fue significativa, aunque no particularmente fuerte. El estudio es consistente con los resultados previos en otras investigaciones y además apoya las hipótesis del umbral de lingüística y de la interdependencia lingüística.

Palabras clave: inteligencia no-verbal; dominio de L2; comprensión de lectura en L1/L2.

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WHAT CONTRIBUTES TO effective non-native language (hereafter L2) reading comprehension has been at the center of researchers' attention for many years. Despite the existence of numerous studies on L2 reading comprehension, (e.g., Bernhardt & Kamil, 1995; Carrell & Eisterhold, 1983; Jiang, 2011; Koda, 2007, Nassaji, 2003) the precise factors involved in L2 reading have not been researched to the extent one would expect. This might be due to the fact that much of L2 reading research has been a replication of native language (hereafter L1) reading studies. Also, researchers in L2 routinely adopted L1 conceptual frameworks for conducting research in L2 (e.g., Clarke, 1979; Cziko, 1978; McLeod & McLaughlin, 1986, among others).

Clearly the field needs studies that investigate distinct skills that contribute to L2 reading comprehension. The gap in L2 reading research is obvious when it comes to investigating adults whose L1 reading skills are high, and who are relatively proficient in their L2 as well, for most substantial research has focused on L2 learners who are either children or adults with special needs or whose L1 literacy skills are low (e.g., August, 2001; August, Calderón & Carlo 2002). Relatively little study has been undertaken concerning the processes involved when skilled L1 readers attempt to become fluent L2 readers.

The current study examined the necessary skills for fluent L2 reading in learners of English as a foreign language, whose native language is Hungarian, and who study English in a classroom setting as opposed to a natural second language environment. The study is a correlational one; therefore, it establishes various relationships between L1 reading skills, L2 proficiency and non-verbal IQ; it does not, however, establish a causal relationship between them.

The Relationship between L1 and L2 Reading

Koda (1994) identified three conditions that distinguish L2 reading from L1 reading: 1) the influence of prior literacy; 2) limited linguistic knowledge, and 3) cross-linguistic effects of lower level processes. In this study, the first two factors will be examined in light of Alderson's (1984) widely quoted question of whether difficulty in L2 reading is a reading problem or a language problem.

Alderson's question–whether native language literacy level or L2 proficiency would be a better predictor of L2 reading performance–is related to Koda's first two differences between L1 and L2 reading: the influence of prior literacy and the language learner's L2 proficiency. In other words, the questions are: How much L1 literacy does a reader need in order to read successfully in the L2, and, how much L2 proficiency does one need in order to transfer L1 literacy skills and read successfully in the L2? Two hypotheses were formulated regarding this issue, both by Cummins (1978, 1979 a&b, 1981, 1984). The issue of the relationship between L1 and L2 reading has been framed in two hypotheses:

The Linguistic Threshold Hypothesis and the Linguistic Interdependence Hypothesis. Relevant to these theories is Clarke's (1980) "short circuit hypothesis" (also referred to as "linguistic ceiling hypothesis") that argues that "limited control over the language 'short circuits' the good readers' system, causing him/her to revert to known reading strategies when confronted with a difficult or confusing task in the second language" (p. 206). What he meant by this is that being an efficient reader in L2 is largely a function of linguistic proficiency in that language.

More recently, Grabe (2009) identified several differences between L1 and L2 reading, and he categorized them into linguistic and processing; developmental and educational; and finally, sociocultural and institutional differences.

The Linguistic Threshold Hypothesis

The Linguistic Threshold Hypothesis initially was also called the "short circuit" hypothesis, meaning that a lack of L2 linguistic knowledge ultimately "short-circuits" L1 reading knowledge. Therefore, a certain level of L2 linguistic ability must be obtained before L1 reading skills can be effectively transferred and aid L2 reading comprehension.

Within this hypothesis is the assumption that language is the key factor in reading/ literacy activities. In other words, one has to know enough of the language in order to read it. To extend this hypothesis more broadly, it also assumes that

> those aspects of bilingualism that might positively influence cognitive growth are unlikely to come into effect until children have attained a certain minimum or threshold level of proficiency in the second language. Similarly, if bilingual children attain only a very low level of proficiency in one or both of their languages, their interaction with their environment through these languages both in terms of input and output, is likely to be impoverished (Cummins, 1981, p. 38.).

This suggests that there are at least two benefits from a sufficient level of L2 knowledge; the first as it relates to reading in particular and the second, more broadly, in regard to cognitive advantages. The latter interpretation, in fact, has become more generally associated with the Linguistic Threshold Hypothesis, while the Linguistic Interdependence Hypothesis has become more closely linked to reading skills.

The Linguistic Interdependence Hypothesis

L2 readers have access to their L1 as they read, and they can use their L1 as a strategy to help comprehend a text. It was Cummins (1979) who first claimed that academic

skills, such as reading, can easily be transferred from one language to another, and he makes a strong case for the transfer of literacy skills across languages. He states that an underlying cognitive/academic proficiency exists common to all written languages. Differently put, reading is a skill that can be developed in any language, and that a universal pattern of skill development exists. Once readers have acquired such skills in their L1, they just have to transfer them to similar tasks in L2. Therefore, the transfer of such skills must result in a very positive correlation between L1 and L2 reading. Studies that demonstrate cross-linguistic effects of skills between L1 and L2 (e.g., Geva, Wade-Woolley & Shany, 1997, Koda, 1990; Wade-Woolley, 1999), serve as evidence that particular aspects of reading, or the sub-skills underlying the reading process, have the potential of carrying over from one language to a subsequent one. Grabe (2009) refers to it as the Developmental Interdependence Hypothesis, or Common Underlying Proficiency Hypothesis. He also claims that there is "strong evidence that underlying cognitive processes supporting L1 and L2 reading are basically the same" (p. 141).

Nevertheless, unique features characterize L2 reading comprehension. These specific features have to do with the interaction of L1 literacy and L2 proficiency, among other factors including lexical and syntactic skills in the L2 especially (Jeon, 2011; Sparks, Patton, Ganshow & Humbach, 2011; Zhang, 2012).

Most researchers hypothesize a stronger relationship between L2 proficiency and L2 reading than between L1 reading and L2 reading. For example, Bernhardt and Kamil (1995) found after examining several studies that L1 reading accounts for between 10% and 16% of the variances in L2 reading, whereas L2 proficiency accounts for between 30% and 38%. In some studies L2 proficiency accounts for as much as 55% (e.g., Hacquebord, 1989) of L2 reading ability. Overall, more evidence supports the conclusion that the problem of L2 reading is more attributable to weakness in L2 proficiency than to L1 reading ability. An important finding that helps sort out the issue is that the relationship between L1 and L2 reading ability becomes stronger when the learners' L2 proficiency becomes higher. Lower-level L2 readers are either not able to transfer their L1 reading skills, or even if they do, the degree of transfer is smaller in comparison to higher-level learners (Brisbois, 1995; Lee & Shalleart, 1997). According to Bernhardt (2005), L2 language-specific factors, such as, vocabulary and syntactic skills as well as comprehension strategies operate "synchronically, interactively and synergistically" (p. 140) during the L2 reading process. Bernhardt's (2005) suggestion is to design studies that look into the question whether reading strategies can compensate for weaknesses in syntax and vocabulary.

Another useful notion to further our understanding of the relationship between L2 proficiency, L2 reading and L1 reading ability is that of compensation. In fact, Alderson (1984) raised some questions related to compensatory mechanisms that might play a role

in L2 reading: "Is it conceivable that good first-language readers will require a lower threshold before being in a position to utilize their good reading strategies? Will the attainment of a higher-level of competence compensate a good first-language reader?" (p. 21). What Alderson means is that it might be possible to compensate for somewhat deficient L2 proficiency by high L1 reading ability and vice versa.

In addition to L2 vocabulary knowledge and L2 syntactic awareness, Guo and Roehrig (2011) investigated the role of metacognitive awareness in L2 reading comprehension. In a well-designed and well-executed study, they attempted to answer whether the three above-mentioned factors were three separate psychological constructs, and if so, how they related to reading comprehension. In their findings, they concluded that two major factors are responsible for differences in L2 reading comprehension (when L1 proficiency or verbal intelligence is controlled for). These two factors were L2 vocabulary or syntax, and metacognitive knowledge of reading strategies. In their study, vocabulary knowledge was so highly correlated with syntactic awareness that neither of them could be distinguished as separate factors explaining reading comprehension. This finding, however contradicts other findings from previous studies suggesting that vocabulary knowledge and syntactic awareness are separate psychological constructs (Shiotsu & Weir, 2007). As far as the relationship between L2 reading comprehension and metacognitive awareness is concerned, in contrast to L2 language (syntax and vocabulary) metacognitive awareness did not make a unique contribution to predicting L2 reading comprehension. These results together actually support the linguistic threshold hypothesis which was discussed previously. Namely, "reading is primarily a linguistic skill" (Guo & Roehrig, 2011, p. 59).

Yamashita (2002) attempted to investigate whether high L1 reading ability compensates for low L2 proficiency (measured by grammar and vocabulary) and vice versa, i.e., whether high L2 proficiency compensates for low L1 reading ability. In her experiment with 241 Japanese learners of English she found that the answers to both of these questions were positive, but as has been repeatedly shown, the compensatory facilitation of L1 reading ability was much smaller than that of L2 proficiency. Yamashita confirmed that L2 proficiency is primarily responsible for high levels of L2 reading comprehension, suggesting that, as the linguistic threshold hypothesis proposes, without a firm basis of L2 proficiency, achieving high levels of L2 reading is difficult. Nevertheless, her results also indicated that readers with high L1 reading ability benefited from their L1 reading skills at least to some extent even if their L2 proficiency was low. This suggests that the transfer of L1 reading ability happens in spite of low L2 proficiency, thus supporting the linguistic interdependence hypothesis, but disputing the threshold hypothesis as it is usually formulated. In fact, Yamashita proposes a new model of the linguistic threshold. She hypothesizes that there are three levels of the

linguistic threshold: the fundamental level, the minimum level, and the maximum level. Before readers reach the fundamental level, L2 proficiency is so low that it cannot contribute to explaining any of the variance of L2 reading. The contribution of L2 proficiency increases when readers' L2 proficiency becomes higher and approaches the minimum threshold. Consequently, when L2 proficiency reaches a very high level, the maximum threshold is reached and the contribution of L1 reading ability will increase in its contribution.

Reading and Non-Verbal IQ

Cognitive assessment is well grounded in psychometric theory (Flanagan, Ortiz, Alfonso & Mascolo, 2006; Flanagan, Alfonso, Ortiz & Dynda, 2010), and intelligence tests might offer useful information to reading teachers as well as L2 instructors. While originally IQ was conceptualized as a single "g" factor that represented global intelligence, the most recent IQ tests developed in the last 15 years have been centered on theoretical perspectives that emphasize multi-dimensional cognitive factors. One of the most empirically supported and widely accepted theories of intelligence is the Cattell-Horn-Carroll (CHC) theory, which is the basis for many modern psychometric measures. The CHC theory is a fusion of the two most prominent theoretical models of intelligence, the Cattell-Horn fluid-crystallized (Gf-Gc) theory and Carroll's three-stratum theory of cognitive abilities (Flanagan, Ortiz, Alfonso, & Mascolo, 2006; McGrew, 2005).

The Cattell-Horn theory proposes that general intelligence is actually an accumulation of numerous abilities working together in various ways to bring out different intelligences. Gf-Gc theory separates these abilities broadly into two different sets of abilities: fluid intelligence, which Cattell describes as the ability to reason and solve novel problems, and crystallized intelligence, which is the ability to reason with previously learned information and develops largely as a function of education, experience, and language development (Kamphaus, Winsor, Rowe, & Kim, 2005).

The nature of the relationship between reading ability and performance on IQ tests has been controversial, and their correlation has been variously estimated to lie between 0.05 and 0.80 (Cotton & Crewther, 2009). The diversity in correlations may be due to the measures of intelligence and reading adopted by individual researchers.

Most of the studies investigating this relationship (e.g., Jensen, 1980, 1986, 1998; Naglieri & Das, 1997; Siegel, 1988; Stanovich, Cunningham & Feeman, 1984) have been carried out with children, and the results are usually related to one's beginning stages of reading and predictions of future reading comprehension ability. Some researchers claim: "When elementary school children of the same age are matched on decoding skill, their rank on a test of reading comprehension is practically the same as on IQ" (Jensen, 1980, p.325). However, most researchers would caution that the explanation of

reading ability by a global trait rather than a sub-skill or a group of skills is untenable, for it fails to reflect the complexity of the reading process.

Measured intelligence also plays a role in diagnosing children with dyslexia. Stanovich (1991) criticizes the fact that measured intelligence was adopted as a foundational construct for the definition of dyslexia. His point is than an IQ test score is not properly interpreted as a measure of a person's potential. Thus, to the extent that IQ scores were viewed as measures of potential, "the practice of diagnosing dyslexia by measuring discrepancies from IQ scores was misconceived from the beginning" (p. 10).

In one of the earlier studies on the relationship between IQ (both verbal and non-verbal), Hage and Stroud (1959) claim that the results correlating 800 ninth graders' scores on The Lorge-Thorndike Intelligence Test and the Pressey Reading Rate and Comprehension test revealed that non-verbal intelligence correlated with both their reading comprehension and to some extent to their reading rate. This relationship suggests that the abilities measured by reading rate and comprehension tests are also among the abilities measured by the nonverbal test. They also drew attention to the fact that the nonverbal IQ of the Wechsler Intelligence Scale for Children has been found to correlate with reading achievement about as highly as the verbal IQ, and that two of the nonverbal tests correlated with reading more highly than any of the verbal tests.

Stanovich et al. (1984) examined the relationship between the Raven's Standard Progressive Matrices Test (SPM), the Gates-MacGinitie Reading Tests, and the Reading Survey of the Metropolitan Achievement test. Correlations ranged from 0.30 in elementary grades to a high of 0.70 in grades 9 and above. Age-related changes in the association between reading and intelligence have been reported in a number of studies (Naglieri, 1996; Vellutino, 2001; Vellutino, Scanlon, & Lyon, 2000). With increasing age, this correlation value increases. Therefore, with adults, the relationship between reading comprehension and IQ is a stronger one.

These studies, however, measured the relationship between L1 reading and non-verbal IQ; the relationship between L2 reading and non-verbal IQ has not been investigated, to the best of our knowledge.

The Study

Objectives of the Study

The main purpose of the study is to investigate the relative contribution of first language reading ability, L2 proficiency, and non-verbal intelligence to L2 reading comprehension, and inform classroom instructors about the pedagogical implications of the results. Relative contribution is a procedure by which subsets of variables can be selected and their relative importance assessed, which, typically, is done in a stepwise fashion.

Hypotheses

The hypothesis for the research question comes from research that claims that reading skills in two languages are transferrable (Frost, Katz, & Bentin, 1987; Haynes & Carr, 1990; Koda, 1992, Shiotsu, 2009). It considers the relative contribution of L1 reading ability to L2 reading comprehension. Given that this study's participants were highly skilled readers in their L1, it is posited that their reading comprehension difficulties in L2 will not originate from L1 literacy deficiencies, but rather from inadequate L2 knowledge, whether vocabulary or syntax. It is hypothesized that L1 reading comprehension will contribute significantly to L2 reading comprehension among skilled L1 readers. While a non-verbal IQ test was given to our participants to screen and exclude those with below average non-verbal IQ, no correlation between non-verbal IQ and reading comprehension is hypothesized for the obvious reason that reading is a highly verbal skill, referring to the extent to which a person can approach words, sentences and written texts.

Participants

Participants were 65 twelfth graders attending a high school in Galanta, Slovakia. Their ages ranged from 17 to 19, with a mean age of 18.3 years (SD .71). Participants were administered a non-verbal IQ test to ensure that each had normal intelligence. One participant was eliminated due to lower than average non-verbal IQ score and uncooperative behavior. Thus, analyses were conducted on 64 students (26 males, and 38 females). They were recruited via the help of the school principal and local English teachers. The language of instruction in the school is Hungarian, which is the L1 of all the participants. Participants' background information was collected via a written questionnaire in Hungarian. In addition, all participants were foreign language learners of English, all of whom have been learning the language in a classroom setting since the approximate age of 11, ensuring relative equality among participants in their language learning experiences. The average number of years the participants had studied English was 8. All participants were literate in Slovak, but did not speak it at home.

Materials

In the study, four standardized proficiency tests measures were used. All of the tests were group-administered, and except for the Gate-MacGinitie Reading Test that required 60 minutes to complete, each test took 30 minutes.

   Michigan Listening Comprehension Test. The University of Michigan English Language Institute Listening Comprehension Test is a standardized proficiency measure designed to assess knowledge of English grammar through listening and writing responses to 45 multiple-choice questions. This measurement was used to determine

the proficiency levels of participants in order to answer what relationship, if any, can be found between L2 language proficiency and L2 reading comprehension. The test questions were pre-recorded by a native English speaker and were administered via a laptop computer. The participants listened to either a one-sentence question as in (1), or to a one-sentence statement as in (2), and then checked the appropriate response from a three-choice written list (A., B., C.) on an answer sheet. The questions and the answers were not accessible in written form.

1. Do you know if Grandfather is coming for dinner on Thursday?
   a) Yes, we are.
   b) Yes, he is.
   c) Yes, they are.

2. I've never seen snow here.
   a) There has been no snow in the past.
   b) There has been less snow in the past.
   c) There has been more snow in the past.

Gates-MacGinitie Reading Test (GMRT) Level 6. This standardized reading test is designed to provide a general assessment of reading achievement of native English speakers in grade 6. While it is designed for native speakers in the 6th grade, an earlier pilot study with 11th graders revealed that Level 4 was much too easy for them. Therefore, we speculated that Level 5 would be an adequate match for 11th graders, and Level 6 for 12th graders, the population in the research. The test consists of a Vocabulary and a Comprehension section, with 45 and 48 items respectively.

The vocabulary test measures reading vocabulary; the words are presented in a brief context intended to suggest which part of speech the word belongs to, but not to provide clues to meaning. Participants are expected to select the word or phrase out of five possible choices that is closest in meaning to the test word, which is underlined. An example is shown in (3), where choice a) would be the correct response:

3. *-a big garage*
   a) place for cars
   b) machine
   c) sidewalk
   d) covered porch
   e) cloth sack

The comprehension section measures readers' abilities to read and understand different types of prose. Example (4) illustrates a literal question from a non-fiction context:

4.   *Sometimes – not very often – we get two full moons in one month. That second full moon is called a "blue moon". No one knows why. Now we say "once in a blue moon" to mean "once in a long time".*

To be a "blue moon," the moon must be…..
a) dark
b) long
c) blue
d) full

Hungarian National Reading Competency Measure (OKM). The reason for administering a native language reading test was to ensure that no participant had reading disabilities, i.e. that each scores within the "normal" range. The Hungarian Reading Competency Measure was selected as it is the standardized reading test of the Hungarian Ministry of Education that is administered every year to each 4th, 6th, and 10th grader. This standardized test is used for the Europe-wide PISA-project. This test measures only comprehension of different styles of prose, some of which are extensive in length. The participants select their answers on a multiple-choice questionnaire. While in English, reading tests always contain a separate vocabulary section, the Hungarian test almost exclusively concentrates on inference making, tone of prose and other aspects of comprehension.

Naglieri Nonverbal Ability Test (NNAT). The NNAT is a 38-item test of non-verbal reasoning, such as reasoning by analogy, serial reasoning, and spatial visualization, which are said to be independent of language proficiency or educational background. The test also claims that its scores are predictive of academic success, and has a variety of educational applications. It has separate test levels from Kindergarten through Grade 12. Level G is designed for grades 10-12, and thus was used in our study. Test questions include items that ask for reasoning by analogy, serial reasoning and spatial visualization. Reasoning-by-analogy items require the students to recognize the logical relationship between several geometric shapes. Serial reasoning items require students to recognize a sequence of shapes and changes in the sequence. Spatial visualization items are among the most difficult ones, for they require students to recognize rotations or shapes that intersect. It is widely used in several school districts to identify gifted and talented children. Its results may also be used to screen students for general ability who

may not perform well because their school performance is hindered by limited English proficiency.

Results

Descriptive Statistics

Table 1 shows the mean correct scores for all participants in each test taken. The five measurements that were used yielded the following means, standard deviations (SD) and raw numbers for minimum, maximum and item totals.

Variable	Number of participants	Mean correct	SD	Minimum	Maximum	Total number of items
English (L2) reading comprehension	64	19.85/44%	11.27	0	44	45
English (L2) vocabulary	64	21.29/52%	6.05	8	35	40
English (L2) proficiency	64	31.10/69%	6.61	17	44	45
Hungarian (L1) reading comprehension	64	16.90/77%	3.08	10	22	22
Non-verbal IQ	64	28.88/76%	4.84	15	37	38

Table 1. Descriptive results of the variables.

The widest range (with SD of 11.27) was found with the English reading comprehension test, where the participants scored anywhere between 0 minimum and 44 maximum out of the possible 45. The English vocabulary and the English proficiency tests also produced a relatively wide range of scores, most participants scoring in the mid-range. Hungarian reading comprehension and the non-verbal IQ resulted in almost the same percent correct (77 and 76 respectively), with relatively small SDs. These results indicate our participants' high non-verbal intelligence and relatively high first language literacy level in addition to their relatively high L2 proficiency.

Relationships between L2 Reading Comprehension and the Independent Variables

The data were analyzed using STATA 10.0 software. In order to find out how the various factors relate to L2 reading comprehension and to each other, a correlational analysis was performed which is shown in Table 2.

	English (L2) reading comprehension	English (L2) vocabulary	Hungarian (L1) reading comprehension	English (L2) proficiency	Non-verbal IQ
English (L2) reading comprehension	1.000				
English (L2) vocabulary	.543**	1.000			
Hungarian (L1) reading comprehension	.376**	.396**	1.000		
English (L2) proficiency	.399**	.518**	.245	1.000	
Non-verbal IQ	.282*	.490**	.31*	.252*	1.000

*p≤ .05, **p≤ .01

Table 2. Correlations between all the variables in the study.

If we look at the correlations among the independent variables, we can note that English vocabulary knowledge most highly correlates with English proficiency (.518), while non-verbal IQ and Hungarian reading comprehension are also quite high, with correlation coefficients measuring .490 and .397 respectively. Both results are somewhat puzzling given that the Hungarian lexicon is not related in any way to that of English, and also that the non-verbal IQ test presumably taps into different abilities from the vocabulary test.

The inter-correlation of variables is usually a problem for research, for it suggests that the variables are not totally independent from each other. The highly complex task of reading comprehension—and the measurement of it—involves skills that overlap: word knowledge, syntactic comprehension, and inferencing. From Table 2, we can note that L1 reading comprehension and non-verbal IQ significantly correlated with L2 reading comprehension. First, we will take a closer look at L1 reading comprehension for it maintained its significance even at the .01 level. Cummins' Interdependence Hypothesis (1980) posits that there is underlying academic language proficiency such that L1 reading skills will support L2 cognitive skills, thus possibly explaining the correlations we found. To further test this hypothesis, we regressed L1 reading comprehension with L2 reading comprehension with participants in the top and the bottom halves of the Michigan English proficiency test. This was also to examine whether there is a "threshold" such as that suggested by the early Threshold Hypothesis (Cummins, 1980, 1984), whereby a certain level of L2 linguistic ability must be obtained before L1 cognitive skills (e.g. reading) can be effectively transferred to L2 reading.

In order to answer this question, we tested our participants on the Michigan test, which is a standardized proficiency test used for placement purposes in many colleges.

The part we utilized was the listening comprehension section that tests aural grammar comprehension by multiple choice responses to one sentence—either a question or a statement—prompts. We divided our participants' scores on the Michigan into two medians enabling us to have more robust numbers in each broad group. Thus, we had a bottom and a top proficiency group with 32 participants in each group. It is by chance that the median is also equal to half of our participants. In order to ensure that the two groups are in fact different, we performed a t-test. The group statistics are given in Table 3.

English (L2) Proficiency	Number of participants	Mean score	Standard deviation
Low	32	.5681	.0925
High	32	.8139	.0660

Table 3. Descriptive statistics for the low and high proficiency groups.

After a paired-samples t-test, we conclude that the two groups are statistically different t (31)= -12.32, p<0.001, clearly representing two distinct proficiency levels.

In Table 4 we used the previously determined two English proficiency (measured by the Michigan test) groups' Hungarian reading scores to calculate the contribution of L1 reading comprehension to L2 reading comprehension.

English (L2) reading comprehension	Coef.	Std. Error	t	P > |t|	R-squared	Adj. R-squared
Hungarian (L1) reading Top half of English (L2) proficiency N=32	1.7315	.7137	2.43	.021	.1640	.1361
Hungarian (L1) reading Bottom half of English (L2) proficiency N=32	.6287	.4785	1.31	.199	.054	.022

Table 4. The relative contribution of L1 reading comprehension to L2 reading comprehension according to L2 language proficiency.

We can note that L1 reading comprehension ability only contributes significantly to L2 reading comprehension at the higher proficiency level; at the lower proficiency level it does not. This suggests that in order for L1 skills to be helpful, one needs to attain a certain threshold level of L2 proficiency in order for Linguistic Interdependence to take effect.

Discussion

Let us begin with reiterating some of the characteristics of our participants and their results on the various tests. Given our participants' mean age (18.3) and the fact that at the time of testing they had been studying English as a foreign language for 7-8 years on average, our findings indicate that we experimented with a relatively highly skilled cohort that possessed good L1 reading skills as well as relatively high L2 proficiency. Furthermore, their performance on the non-verbal IQ and L1 reading comprehension was close to 80%, and their L2 proficiency was almost 70%. L2 reading comprehension and L2 vocabulary performance, however, were in the lower range of 44 and 52% respectively.

One might legitimately ask the question why choose such high level learners. The rationale for selecting young adults with high level skills lies in Cummins's hypothesis (1984) according to which transfer of L1 reading (or other academic skills) to L2 will only occur if students have achieved a considerably high level of L1 skills. Furthermore, Clarke's (1980) Linguistic Ceiling Hypothesis also presupposes a certain level of L2 proficiency in order for students to benefit from high level L1 reading skills. In addition, high levels of L2 proficiency were important if we want to contribute to the growing literature on potential threshold effects in L2 reading, i.e. that L1 skills will only transfer to L2 reading if learners have reached relatively high levels of proficiency in the non-native language.

The research question investigated the interaction of L1 reading abilities and L2 language proficiency as well as the extent of contribution of non-verbal IQ. The prediction was that L1 reading comprehension would significantly contribute to L2 reading comprehension, while non-verbal IQ will not. Let us begin with the second part of the hypothesis.

While the sole purpose of administering the Naglieri non-verbal IQ test was to ensure that the participants' intelligence fell within the normal range, it is important to notice that the IQ measure significantly correlated with L2 reading comprehension, and almost all the other variables as well.

The researcher predicted a non-correlation between reading, which is a verbal skill, and non-verbal IQ. This hypothesis was based on Vellutino et al. (2000) and Rutter and Yule (1975) who questioned the validity of using IQ scores to estimate expected reading achievement. These researchers contend that measures of language and language-based skills are better predictors of reading ability than are IQ scores.

In this study, however, a strictly nonverbal IQ still moderately correlated (at the .05 level) with both L1 and L2 reading comprehension. In response to Vellutino et al. (2000), Naglieri (2001) demonstrates that evidence from large-scale investigations (e.g., Carver, 1990; Naglieri & Das, 1997; Naglieri & Ronning, 2000) indicates that both group- and

individually administered tests of nonverbal ability are significantly and substantially correlated with reading achievement, suggesting that there is ongoing controversy about the relationship between non-verbal IQ and reading. The results of the current research lend themselves to the debate—this time involving L2 reading—supporting Naglieri's claim of a positive (albeit not particularly strong) relationship with non-verbal IQ. It is also conceivable that reading in a non-native language is more dependent on IQ than L1 reading is. Furthermore, it is possible that non-verbal IQ contributes to L2 aptitude. In other words, those, whose IQ is higher, will achieve a higher level L2 proficiency, which in turn, will translate to higher L2 reading comprehension. This speculation is not impossible given that researchers have found strong correlations between working memory and language learning success (Harley & Hart, 2002; Miyake & Friedman, 1998; Robinson, 2002). Reading in L2 does require highly analytical skills, so it only makes sense that non-verbal IQ would significantly correlate with reading.

Let us finally turn our attention to L1 reading comprehension and its role in L2 reading. We can claim that limited L2 proficiency prevents the transfer of higher-level skills in L1 to L2 reading.

The results of the current study differ from those of Yamashita, but are consistent with other previous findings, though in those studies (e.g., Bossers, 1992; Brisbois, 1995) language proficiency was always measured by grammar and vocabulary as opposed to an independent measure in this study. The results indicate that the degrees of correlation of L1 reading and L2 language proficiency to L2 reading comprehension are virtually equivalent (.376 and .399 respectively). Moreover, the percentage of L1's contribution to L2 reading shows an interesting and important distribution across L2 language proficiency. While the contribution in the top L2 proficiency group is significant, it is not the case with the lower level group. In other words, this indicates that students in our study at least need to attain a threshold level of L2 proficiency before their L1 reading skills can aid in their L2 reading comprehension. This is in line with Alderson's (1984) prediction that reading ability in an L2 is more likely to be influenced by proficiency in the L2 itself than by L1 reading ability alone. The current study revealed a significant correlation between L1 and L2 reading measures, providing further support that literacy skills transfer across languages within the same orthography (Bernhardt &Kamil, 1995; Bossers, 1991; Brisbois, 1995; Lee & Schallert, 1997; Perkins, Brutten & Pohlmann, 1989; Pichette, Segalowitz, & Connors, 2003; 1979; Taillefer, 1996; Yamashita, 1999, 2002), and giving credibility to the Linguistic Interdependence Hypothesis.

It seems then that being a good reader in L1 only helps in L2 reading comprehension if one also has a high enough proficiency in L2. This is an important finding that demonstrates empirically the interdependence of L1 literacy skills and L2 linguistic skills in L2 reading comprehension, and more specifically, a relatively high threshold

for the transfer of L1 reading skills. Further research is needed to help illuminate the conditions under which a high threshold (as in our study) vs. a lower threshold (as in Yamashita's 2002 study) is required for this transfer to occur.

Limitations of the Study

As a cross-sectional, correlational study, it can only suggest relationships, while its predictive power is limited. Furthermore, the fact that the independent variables inter-correlate makes it very difficult to determine the exact amount of each measurement's contribution.

There are also ways our test materials could be improved. For example, the Hungarian reading measure was intended for 10th graders in Hungary, not 12th graders. Unfortunately, there was no available standardized reading measure for this grade, and so we were constrained to use this lower level version. The fact that the Hungarian reading test used substantially longer passages (in some occasions more than a page long), means that it is not quite comparable with the English reading comprehension measure.

A recurring problem for studies that attempt to investigate the contribution of L2 proficiency to L2 reading is the fact that there is no consensus among researchers as to the construct of L2 proficiency. In other words, L2 proficiency has been operationalized and measured differently by the various researchers, and there has been no agreement as to how represent the constructs associated with knowledge of the language (Lee & Schallert, 1997).

The study might also have benefited from the more current Structural Equation Modeling (SEM) statistical analysis, which more effectively deals with data where independent variables inter-correlate. Cronbach and Meehl (1955) pose two questions relevant to convergent and discriminant evidence as they relate to the evaluation of construct-validity: the first is whether the measures correlate with other measures they theoretically should correlate with. The second question is whether the measures that are supposed to be theoretically distinct correlate with each other. A well-designed study investigating the construct validity of measures of varieties of L2 reading comprehension should therefore include measures that are theoretically distinguishable as well as measures that are theoretically related. Our theoretically unrelated measure was only the non-verbal IQ, while all the other measures were theoretically related to L2 reading comprehension.

Conclusions

To recapitulate the findings of this study, we can claim that there is a significant correlation between non-verbal IQ and L2 reading comprehension, albeit not a particularly strong

one. However, L1 reading comprehension makes a very significant contribution, but only when L2 language proficiency is in the upper range. Therefore, Alderson's question whether L2 reading difficulties represent a reading problem or a language problem cannot be answered straightforwardly, for it looks like L1 reading skills in proficient readers can only be transferred after one achieves a relatively high threshold level of linguistic proficiency in L2. Thus both L1 reading skills and L2 proficiency interact in interesting ways as they contribute to L2 reading.

Since one of the objectives of the study was to shed light on what to prioritize in both curriculum and pedagogy at a particular stage of L2 learning, some (if not specific) pedagogical strategies based on the findings of this study are due so that difficulties of less proficient L2 readers could be appropriately addressed. Participants in this study had relatively high level of L1 reading comprehension skills, but that was only helpful when their L2 proficiency was also relatively high. The obvious recommendation would be to concentrate on improving their L2 proficiency. However, since reading is part of language proficiency, the author of this study believes that focusing on language proficiency by systematic reading for meaning while concentrating on vocabulary and sentence structure may produce positive outcomes. Also, the often-neglected skill of listening should be systematically practiced (mainly vocabulary and listening skills) by struggling L2 readers. Finally, reading is an extremely complex activity not only in L2, but also in L1, and thus, will always be a bit elusive.

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