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Investigating the Influence of Working Memory,Language Aptitude, and Verbal Reasoning as Aspects of Linguistic Intelligence on Foreign Language Learning

L'impact de la mémoire de travail, l'aptitude inguistique et le raisonnement verbal comme facteurs de 'intelligence linguistique sur l'apprentissage d'une langue étrangère

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Abstract

This paper addresses some cognitive aspects of individual differences that influence foreign language learning. The study explores the relationship between one type of intelligence that is referred to as linguistic intelligence and language learning achievement. Three cognitive abilities were hypothesized to be factors of this capacity: working memory, language aptitude, and verbal reasoning. In testing this hypothesis, a measure of each of the three aforementioned abilities was administered to sixty first year freshman students majoring in English as a Foreign Language in University of Constantine 1. Correlations were made between the obtained scores in the three measures, and factor analysis was conducted to determine the final factors of linguistic intelligence. Another correlational study was carried out between the overall linguistic intelligence as with its final factors and language learning achievement. The results revealed a significant relationship between linguistic intelligence total score and language learning achievement as well as between this latter and two factors of the former ability: verbal reasoning, and grammatical ability, yet a low correlation between the third factor (working memory) and language learning achievement.

Key words: *Linguistic Intelligence, Working Memory, Language Aptitude, Verbal Reasoning, Language Learning Achievement.*

Résumé

Cet article traite certains aspects cognitifs des différences individuelles qui influencent l'apprentissage des langues étrangères. L'étude explore la relation entre un type d'intelligence qui s'appel « l'intelligence linguistique » et la réalisation de la langue étrangère. Cette capacité cognitive elle-même a été supposé d'inclure trois autres capacités: mémoire de travail, aptitude linguistique, et raisonnement verbal. De ce fait, trois tests de ces capacités cognitives ont été remis à un échantillon de 60 étudiants de première année, apprenant l'Anglais comme langue étrangère à l'université de Constantine 1. Des corrélations ont été établies entre les scores obtenus dans les trois tests. Ensuite, une analyse factorielle a été menée afin de déterminer les facteurs finals de cette intelligence linguistique. Une autre étude de corrélation a été réalisée entre le score global de la matière étudiée avec ces facteurs finals ainsi que le score de la réalisation linguistique. Les résultats montrent des relations significatives entre ces deux variables aussi bien que deux facteurs finals de cette intelligence: raisonnement verbal et capacité grammaticale avec une corrélation faible concernant le dernier facteur: mémoire de travail.

Mots clés : *Intelligence linguistique, Mémoire de Travail, Aptitude Linguistique, Raisonnement Verbal, Réalisation Linguistique.*

Introduction

Individual Differences (ID) research addresses a variety of issues that influence learning in general and language learning in particular. A variety of factors have been highlighted in this sphere: aptitude, personality, motivation, learning styles, learning strategies, to include but a few. Working memory, language aptitude, and verbal reasoning have thoroughly been examined in the realm of ID. Intelligence is another construct that has received the lion's share of attention in the same area of research. In this paper we are focusing on one important aspect of the broad concept of intelligence, which is linguistic intelligence and its three main hypothesized components, namely language aptitude, working memory and verbal reasoning. We will also examine the role of this general cognitive ability in foreign language learning.

1-Review of the Literature

1-1 Language aptitude

Language aptitude refers to the ability to learn a foreign language (Carroll & Sapon, 1959). Researchers disagree on the nature of this cognitive capacity. While some scientists (e.g. Dörnyei, 2005) asserted that aptitude is a general ability, others (e.g. Carroll & Sapon, 1959; Skehan, 1998) emphasized its componential nature.

Aptitude measures flourished mainly between the 1950s and 1960s. Consequently, two major tests emerged: the Modern Language Aptitude Test (MLAT) (Carroll & Sapon, 1959), and the Pimsleur Language Aptitude Battery (PLAB) (Pimsleur, 1966). The MLAT test comprises five subtests, namely number learning, phonetic script, spelling clues, words in sentences, and paired associates, while the PLAB measure contains not only linguistic aspects but also motivational factors. The PLAB's components are: grade point average, interest in foreign language learning, vocabulary, language analysis, sound discrimination, and sound-symbol association.

The influence of language aptitude on foreign language learning has long been an intriguing issue in SLA research. Disagreement was between whether this ability has an impact on learning an L2 or not. Some researchers (e.g. Ehrman, 1998; Bowden, Sanz & Stafford, 2005; Sáfár & Kormos, 2008) claimed that aptitude tests are only associated with traditional methods of language teaching, i.e. audiolingual method, and that they have no influence in communicative language teaching classrooms. Other experts, on the other hand, proved that language aptitude plays an important role in the acquisition of different aspects of the foreign language (Skehan, 1998; Ellis, 2003) and in different learning contexts (Krashen, 1981; Robinson, 2005).

One further area in SLA research is the relationship between aptitude and other cognitive abilities. There were a variety of findings with regard to the relationship between aptitude and intelligence as well as aptitude and working memory. The correlations between aptitude and intelligence varied from weak (Skehan, 1998) to strong (Dörnyei, 2005). Concerning the link between aptitude and working memory, most research studies revealed a close relationship (Carroll, 1993; Wen & Skehan, 2011).

1-2 Working memory

The term working memory (WM) is defined as "a limited capacity system allowing the temporary storage and manipulation of information necessary for such complex tasks as comprehension, learning and reasoning" (Baddeley & Hitch, 2000, p. 418). It was introduced in 1974 as a reaction to Atkinson and Shiffrin model of information processing (1968) which centered the simple process of storage. Baddeley and Hitch model of WM (1974) divided this ability into three main subcomponents referring to them as the phonological loop, the visuo-spatial sketchpad, and the central executive. A further subcomponent, that is the episodic buffer, was recently added to the model in 2000.

As far as working memory capacity is concerned, although there was agreement that the construct

of WM is a limited-capacity-system, researchers disagreed on the number of items that can be stored or processed in it. Some (e.g. Miller, 1956) argued that individual's memory capacity is 7(±2) chunks; others (e.g. Cowan, 2000) speculated that this capacity is unitary and cannot hold more than 4(±1) items.

Measures of working memory vary; however, two major tasks have been proved reliable: Reading Span Tasks (RSPAN) (Daneman & Carpenter, 1980), and Operation Span Tasks (OSPAN) (Turner & Engle, 1989). In these tasks, two main processes of memory are assessed: recall-process, i.e. recalling unrelated items, and manipulation of information process, i.e. doing something that interrupts recall like reading in RSPAN or judging the accuracy of sentences or mathematical operations in OSPAN.

The active process of working memory plays an important role in learning in general and language learning in particular. As for language learning, Miyake and Shah (1999) speculated that this capacity is quite focused on notably in beginning levels where there is a control of attention; however, in advanced levels, individuals depend less on this ability in that information processing becomes automatic.

Similar to its relationship with language aptitude, working memory has long been asserted to relate with intelligence. Thorough research findings were concerned with the link between WM and Cattell's types of intelligence: fluid intelligence (Gf) and crystallized intelligence (Gc). While some studies (e.g. Conway et al., 2002; Engle, 2002) revealed a close relationship between WM and fluid intelligence, others (e.g. Alloway & Alloway, 2009) proved the association between this ability and crystallized intelligence, and again other evidence (e.g. Dang et al., 2012) showed the link between this construct and both types.

1-3 Intelligence and reasoning

Definitions of intelligence vary for the nature of this complex ability. One common definition is "(the) ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, [and] to overcome obstacles by taking thought" (Neisser et al., 1996, p. 01). As early as the beginning of the 20th century, debates have raged back and forth for providing an accurate measurement to this ability. Psychometricians concurred that intelligence is what intelligence (IQ) tests measure. However, they disagreed on the nature of this capacity. Some of them (e.g. Spearman, 1904) perceived it as a general ability, while others (e.g. Thurstone, 1938) claimed that it is a set of mental abilities, and again others (e.g.Vernon, 1961) assembled between the two views. Modern theories have recently emerged, as a reaction to psychometric views that put focus on the measurement of intelligence in its explanation, to relate this capacity with other different abilities. One contemporary researcher, Gardner (1983) highlighted eight distinct types of intelligence that are not only related to school but extend to daily life requirements. These intelligences are: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal, and natural intelligence. Sternberg (1985) is another modern researcher who distinguished between three types of intelligence: analytical, practical, and creative.

Regarding the measurement of human intelligence, two major tests have been introduced to become rather popular: Binet's measures and Wechsler's measures. Binet's first intelligence test developed in the early years of the 20th century in France and was adapted for the first time in 1916 in the U.S.A. This test includes a number of subtests: vocabulary, understanding, differentiation between objects, items completion, and drawings. Wechsler tests started to develop in the thirties to become widely used for several decades. Like the previous test, this test also measures a set of abilities like verbal comprehension, spatial reasoning, working memory and perceptual speed.

The ability to reason has been intensively focused on in the study of intelligence since the beginning of intelligence research. Reasoning appears either as

the basic component or as a very important aspect of intelligence. The term reasoning refers to "an aspect of thinking that is involved not only in drawing inferences but in making decisions and solving problems as well" (Leighton & Sternberg, 2004). There are two main types of reasoning: deductive reasoning and inductive reasoning. The former refers to a process of the mind that moves from general to specific (from rule to instance), while the latter functions in an opposite manner. Examples of the first type are syllogisms, and those of the second type are analogies and series completion.

The literature review of the three aforementioned cognitive abilities provides knowledge on their crucial role in foreign language learning. Although research in psychology and SLA has thoroughly addressed the impact of these abilities (i.e. language aptitude, WM, and verbal reasoning) on learning EFL, there has been no previous attempt to assemble them in a single study. The present work comes as a result to deal with the three capacities altogether under the umbrella term 'linguistic intelligence' and accordingly examines the relationship between this latter and foreign language learning. In so doing, we hypothesize, first that language aptitude, working memory and verbal reasoning would correlate and compose three factors of linguistic intelligence, and second, that this latter might be significantly associated with language learning achievement.

2-The study

2-1 Method

2-1-1Subjects

The sample comprised sixty participants (50 girls and 10 boys). The subjects were selected randomly from a population of 300 freshman students at the University of Constantine 1, Faculty of Letters and Languages, Department of English. The age ranged between 19 and 20 with the mean (M=19.61).

2-1-2 Measures and procedures

1. The language aptitude test

Language aptitude measure was a paper-and-pencil measure that included three subtests assessing phonemic ability, grammatical sensitivity and inductive language learning ability, respectively. This test was taken from the MLAT measure (Stanfield, 2013) with some adaptations.

a- Phonemic ability subtest

In this subtest, the participants were provided with five tasks to solve. The five tasks measured sensitivity to different sounds of the foreign language. In the first task, the participants were asked to check from a list of words the differently-pronounced word. In the second task, they were instructed to select the correct spelling of the given words. In the third task, a number of phonetic transcriptions were given and the subjects were instructed to write corresponding words. In the fourth task, they were told to write transcriptions for given pseudowords (i.e. English-like words). In the fifth task, the testees were instructed to recognize the disguised word from the spelling presented and to select one from the four words that is closest in meaning to it.

b- Grammatical sensitivity subtest

This subtest was a multiple choice task that measured the individuals' sensitivity to foreign language structures. The participants were asked to select the correct grammatical function of the given words. Here a variety of grammatical functions were presented: subject, verb, object, conjunctions (coordinating and subordinating), simple past tense, interrogatives, perfect tenses, conditional, Prep+ noun, Not+ infinitive, and discrimination between "wh" questions and between relative pronouns, etc. .

c- Inductive language learning subtest

This subtest assessed the subjects' sensitivity to foreign language structures as well as their inductive reasoning skills. A set of words and sentences were given in the foreign language (an invented language), and the subjects were told to infer their corresponding counterparts in English or do the opposite task.

Time allocation for this test was 60 minutes.

Concerning the scoring procedure, the score 100 was given as the score of perfection and was distributed on the three subtests. Phonemic ability subtest received the highest score (i.e. 50) as it contained more tasks. The second subtest was scored out of 30 and the third out of 20.

2- The working memory test

WM test was displayed on a data show. It contained four subtests that measured working memory capacity (WMC): Reading Span task (RSPAN), Operation Span task (OSPAN), Anagrams, and Listening Span Task (LSPAN).

a- RSPAN subtest

This subtest assessed two main abilities: reading ability and recall ability. In this subtest, the participants were asked to read an increasing number of sentences (2 to 8) with an element at the end of each sentence to recall. This element might be a letter, a number, or a word. To mention, the sentences were taken from Daneman and Carpenter RSPAN (1980) and were adapted to fit the Algerian socio-cultural context. This means that the words that seemed unfamiliar to our participants' culture were omitted and replaced by more familiar words to ensure the results.

b- OSPAN subtest

The second subtest measured the students' mathematical ability and recall capacity. In this part, the participants were given simple arithmetic equations to judge or solve with a letter, number or word to recall. Eleven tasks were presented with an increasing number of items to recall (2 to 7). This subtest was taken from Turner and Engle OSPAN (1989).

c- Anagrams subtest

In this subtest, the participants were exposed to lists of jumbled letters for a short time (5 seconds for each series), and then they were asked to remember the letters and make meaningful words out of them. The task was taken from Carter's book of intelligence tests (2005). This task was included under working memory test as it measured two abilities as well: recall ability (remembering the jumbled letters), and process ability (making meaningful words).

d- LSPAN subtest

In the fourth subtest, the participants were asked to listen to an increasing number of sentences (1 to 7) and judge whether or not they were meaningful, then they were told to recall the last word in each span. This task was also adapted from Daneman & Carpenter WM tasks (1980).

Time allocation for this test was 60 minutes. Concerning the scoring procedure, the score 100 was also given as the score of perfection. Although the participants used two processes, i.e. attention process (reading, counting, or judging) and recall-process, the scores were devoted to recall-process. RSPAN was given the highest score (40), OSPAN and LSPAN were given equal scores (25), and anagrams was given the lowest score (10).

3- The verbal reasoning test

Verbal reasoning test was another pencil-and-paper measure containing five subtests that assessed both inductive and deductive reasoning abilities. The five subtests were: analogies, similarity, knowledge, understanding relations, and syllogisms. These subtests were found to be the major components of verbal intelligence measures. The questions were taken from WAIS (online test) with making some adaptations to fit the Algerian socio-cultural context, and the participants' cognitive abilities, i.e. the findings of the pilot study aided us in the choice of challenging questions.

In the first subtest, the participants were given a list of jumbled letters to make a meaningful word, and were asked to infer what the obtained word represented. In the second subtest, they were provided with a list of words sharing a similar relationship with the addition of an odd word and were instructed to deduce the odd one out. In the third subtest, they were presented with statements (premises) to read and were told to infer the right conclusion from these premises. In the fourth

task, they were instructed to understand the relation between people or their arrangement, and then they were asked to deduce the right position. In the fifth subtest, the participants were given a pair (two items) to understand the relationship and were asked to induce the same relationship to the second pair.

The time allocated for this test was 45 minutes. As for the scoring procedure, the same score of perfection was given to this measure (i.e. 100). This score was distributed on the five items. Analogies subtest received the highest score (30) as it contained more tasks. Similarity subtest, knowledge subtest, and understanding relations subtest were equally scored (20). Syllogisms subtest was given the lowest score (10) as it contained fewer items. For the challenging nature of intelligence tests, and because reasoning is considered an aspect, the questions in this test were ordered in increasing difficulty with a gradual increase in scoring.

4- Language learning achievement

The subjects' language learning achievement was assessed through taking their average in the modules they were taught during a whole year in learning English as a foreign language. The overall average gave insights about general linguistic and communicative skills of the students at specific levels of proficiency. This means that the students were assessed according to the standards and objectives of learning. The students overall achievement was the sum of the obtained average in both semesters of learning EFL. As far as scoring is concerned, similar to the previous variables, the highest average point (20) was converted into the value 100 and the individuals scores were also converted and explained according to this value.

2-2 Results and interpretations

2-2-1 The correlation between language aptitude, working memory and verbal reasoning

The technique of the Pearson Product Moment Correlation Coefficient was used to calculate the strength of relationship between the three administered tests. Having used the formula

$$r = \frac{\sum xy}{\sqrt{((\sum x^2)(\sum y^2)}}$$

the results are summarized in the following table:

	Language aptitude	Working memory	Verbal reasoning
Language aptitude	1		
Working memory	.53	1	
Verbal reasoning	.58	.38	1

Table 1. The correlation between the administered measures

The critical value of r for one-tailed test at (0.05) level of significance and with (59) degrees of freedom is (.25). As the obtained value for the correlation between language aptitude and working memory is (.53), between language aptitude and verbal reasoning is (.58), and between working and verbal reasoning is (.38), we would say that the results are indeed significant. This means that the three variables do correlate with each other. So, we can assume that the three abilities represent the different factors of linguistic intelligence. Factor analysis will subsequently be used to determine the final factors of this general ability.

2-2-2 Factor analysis findings

In determining the final factors of linguistic intelligence, Exploratory Factor Analysis (EFA) was used. The first step we went through in our analysis is the examination of intercorrelations between all the items used in the three tests. Table 2 displays the degree of association between these items.

The findings of table 2 reveal that two variables do not

Table 2. Correlation matrix between all the tests items scores

	PCA	GS	ILL	KN	SIM	SYL	UR	ANL	RS	OS	ANG	LS
PCA	1											
GS	0.54	1										
ILL	0.52	0.32	1									
KN	0.53	0.38	0.44	1								
SIM	0.20	0.18	0.19	0.23	1							
SYL	-0.12	-0.09	-0.19	-0.03	-0.13	1						
UR	0.35	0.08	0.30	0.41	0.17	-0.02	1					
ANL	0.52	0.25	0.39	0.61	0.13	0.009	0.34	1				
RS	0.19	0.26	0.20	0.18	0.05	-0.17	0.27	0.11	1			
OS	0.55	0.28	0.36	0.29	0.08	-0.02	0.40	0.28	0.49	1		
ANG	0.46	0.40	0.37	0.42	0.003	-0.23	0.38	0.19	0.27	0.53	1	
LS	0.35	0.29	0.24	0.45	-0.02	-0.08	0.14	0.35	0.36	0.24	0.21	1

PCA* phonetic coding ability **GS*** grammatical sensitivity **ILL*** inductive language learning ability
KN* knowledge **SIM*** similarity **SYL***syllogisms **UR*** understanding relations
ANL* analogies **RS*** RSPAN **OS***OSPAN **ANG***analogies **LS*** LSPAN

show significant correlations with the other variables. Syllogism shows a negative correlation with almost all the subtests (e.g. -0.05, -0.03, 0.07), and similarity shows a very weak association (e.g. 0.20, 0.18, 0.02). For this reason, we decide to omit these two items as they may cause problems in our factor analysis as recommended by Field (2005); hence, we are left with 10 variables for factor analysis. Then, we predict that the variables that show significant correlations with each other would represent factors of the same underlying dimension that is referred to as linguistic intelligence.

Therefore, the question is: How many factors does the overall linguistic intelligence include?

After measuring the correlation between the ten variables, it is required from us to extract factors from these variables. Since our aim is to determine the number of factors of linguistic intelligence, the technique used is Principle Component Analysis. SPSS findings identify 10 eigenvalues, i.e., the same number of variables. Table 3 displays the results of factor extraction.

Table 3. Factor extraction and total variance explained

Componants	**Initial eigenvalues**			**Extraction Sums of squared loadings**			**Rotation sums of squared loadings**		
	Total	%of variance	% cumulative	Total	% variance	% cumulative	Total	% variance	% cumulative
1	4,21	42,15	42,15	4,21	42,15	42,15	2,57	25,78	25,78
2	1,20	11,99	54,15	1,20	11,99	54,15	2,24	22,40	48,18
3	1,01	10,11	64,26	1,01	10,11	64,26	1,60	16,08	64,26
4	0,94	9,40	73,67						
5	0,630	6,39	80,06						
6	0,56	5,67	85,73						
7	0,51	5,13	90,87						
8	0,41	4,13	95,00						
9	0,28	2,82	97,83						
10	0,21	2,16	100						

Table 3 demonstrates that the first three variables represent a large amount of variance, while the seven remaining variables represent small amounts of variance. Three factors greater than 1 are thus extracted as eigenvalues. These eigenvalues are displayed again and the percentage of variance is explained (in the column of Extraction: Sums of squared loadings). We observe that in the columns of factor extraction and factor rotation only three factors are kept and the others are discarded. We would, thus, confirm the existence of three factors for linguistic intelligence. However, as a related question, we would ask if the obtained factors are identical to the hypothesized ones. More explicitly, do language aptitude, WM, and verbal reasoning represent the final factors of linguistic intelligence?

Having extracted the factors, the ten chosen variables will be loaded onto them. Table 4 and table 5 exhibit the results of factor loading and their rotation. Table 4 represents the component matrix, and table 5 represents the components after rotation.

Table 4. Component matrix

	components		
	1	2	3
PCA	0,810	-0,140	
KN	0,752	-0,387	
OS	0,691	0,482	-0,147
ANG	0,671	0,298	-0,165
ILL	0,661	-0,139	-0,137
ANL	0,645	-0,523	0,445
GS	0,596		
RS	0,481	0,621	0,306
UR	0,568	0,132	-0,579
LS	0,552	-0,111	0,555

Table 5.Rotated component matrix

	components		
	1	2	3
ANL	0,820		0,156
KN	0,782	0,176	0,269
PCA	0,650	0,384	0,325
ILL	0,580	0,340	0,150
OS	0,661	0,811	0,205
ANG	0,645	0,672	0,165
UR	0,596	0,636	-0,265
RS	0,481	0,628	0,533
LS	0,568	0,183	0,728
GS	0,552		0,656

The observation of table 4 and table 5 indicates that in the first matrix most variables are loaded highly onto the first factor, while the second and the third factors are not considered. However, after rotation, the loading of factors becomes more organized. In other words, four variables load onto the first factor- the criterion value is recommended by Field (2005) to be .40: Analogies (.82), Knowledge (.78), Phonemic ability (.65), and Inductive language learning ability (.58). Four other variables load onto the second factor: OSPAN (.81), Anagrams (.67), Understanding relations (.63), and RSPAN (.62). Two variables are loaded onto the third factor: LSPAN (.72), and Grammatical sensitivity (.65).

Although the results confirmed the existence of three factors, the final factors seem different from those we hypothesized. This means that the variables used in measuring a specific factor tend to be measures of a different factor, e.g. grammatical sensitivity that was used in assessing language aptitude became a measure of another factor which we will name later.

In order to name the obtained factors, one needs to examine the content of the loaded variables. The variables loaded onto the first factor share a common theme, which we call 'verbal reasoning'. For example, in analogies subtest, the subjects were given a set of pairs and were asked to induce the pair that showed a similar relationship; in knowledge subtest, they induced what the given words represented; the majority of phonemic ability subtest questions required the

subjects to induce words with similar sounds or meanings; and in inductive language learning subtest, they induced similar syntactic structures. In addition to measuring inductive reasoning skills, these tasks require knowledge of the vocabulary of the foreign language as well.

In the second factor, most variables share a common theme, which we refer to as 'working memory'. This name was adopted as all the factors measure two main abilities: recall ability, on the one hand, and process ability (e.g. calculating, reading, making words and arranging stimuli), on the other hand.

In the third factor, two variables share a common topic, which we label 'grammatical ability'. This name was given as the two components measure the individuals' judgment of foreign language structures.

2-2-3 The correlation between linguistic intelligence and language learning achievement

The third step in this investigation is to examine the degree of association between the overall linguistic intelligence and language learning achievement. Since we did not have a ready-made test for this ability, and as we assembled a battery of tests in its measurement, it is required from us to give it a score. The procedure used to score this ability is to set the value 100 as the score of perfection and to divide this score on the number of the variables that composed the factors. As there were ten variables, each one was given the score 10. The participants' obtained scores in each variable were then converted and explained in comparison to this value. Concerning the score of language learning achievement, we have previously mentioned that the participants mean average was converted into percentages.

In measuring the correlation between linguistic intelligence and language learning achievement, the same technique that was adopted previously was also used. The Pearson Correlation results reveal a correlation of (.40 >.25). Consequently, we would confirm that the two constructs share a significant relationship.

Regarding the measurement of correlation between linguistic intelligence final factors and language learning achievement, we need to score each factor. The first factor that was called verbal reasoning was given the score 40 as it contained four variables, WM 40, and grammatical ability 20. After that, we converted these scores into percentages and explained the participants' final scores in comparison to the value 100. After the use of Pearson correlation, the results are exhibited in the following table:

Table 6. The correlation between linguistic intelligence factors and language learning achievement

Language learning achievement	Verbal reasoning	Working memory	Grammatical ability
	.36	19	.45

As the critical value for one tailed test and with 59 degrees of freedom is (.25), we would state that two factors of linguistic intelligence share significant relationships with language learning achievement, while one factor does not. Verbal reasoning and grammatical ability show a moderate correlation (.36, .45), whereas working memory demonstrates a weak association (.19). One should note that the non-significant correlation that was found between WM and language learning achievement would be attributed either to some imperfections of WM test or to inaccuracy in converting the subjects WM raw scores into produced scores (i.e. when more subtests were added to the same measure after factor analysis) especially that most, if not all, SLA studies assert the active role of this dynamic capacity.

Conclusion

The current article has provided theoretical as well empirical evidence on the relationship between three cognitive linguistic capacities, namely language

aptitude, working memory and verbal reasoning. In the light of this relationship, a common underlying factor has been predicted and labeled as 'linguistic intelligence'. The significant correlations that were found between the hypothesized cognitive abilities led to the use of factor analysis. The findings of this latter confirmed the existence of three factors with a precision in the designation of the hypothesized ones. Language aptitude turned to be addressed as grammatical ability; whereas, the concepts of working memory and verbal reasoning remained intact.

The paper has also presented an empirical investigation on the impact of the overall capacity 'linguistic intelligence' as with its hypothesized factors on foreign language learning achievement. Regarding the influence of the former, the Pearson Correlation result was proved significant (linguistic intelligence and achievement: .40). However, not all the factors of this ability were significantly associated with language learning achievement, i.e. only two factors showed significant associations (verbal reasoning: 36 and grammatical ability: 45), yet the third factor (working memory) revealed low relationship (.19).

The current investigation would then add evidence to the role of cognition in second language acquisition. Teachers should, hence, pay attention to individual differences in these cognitive capacities, i.e. language aptitude, working memory and verbal reasoning, when teaching. For example, they would put students in equal ability levels and design corresponding lessons for better instruction. In placing learners with equal ability levels, the study would recommend the implementation of a linguistic intelligence test as an entry test for those who engage in learning EFL to ensure success. The test might not only aid in placing learners according to their abilities, but would also identify those with a language disability. In addition, the article might provide suggestions for future research to expand this linguistic intelligence test through an integration of additional components that are related to other cognitive abilities.

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