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أثر الذاكرة العاملة، والذكاء اللغوي كجانب إدراكي للفروق الفردية في تعلم اللغات الأجنبية

The Effects of Working Memory and Linguistic Intelligence as a Cognitive Aspect of Individual Differences on Foreign Language Learning

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Abstract:

Individual differences are quite apparent in a language instruction. Some learners find it rather easy to acquire very complex foreign language rules (with regard to grammar, vocabulary and phonetics), others struggle with even the simplest rules. Individual differences (ID) research is thoroughly dealt with in the field of second language acquisition. A number of aspects are believed to affect the acquisition of a second/foreign language.

These factors are: cognitive, affective, social, to name but a few. This paper purports to scrutinize the influence of the cognitive aspect of individual differences on foreign language learning. Two cognitive abilities were highlighted, viz. working memory and linguistic intelligence, and their relationship with foreign language achievement was investigated. A measure of each of these abilities was administered to a sample of sixty first year freshman students learning English as a Foreign Language at the department of Letters and English, University of Frères Mentouri Constantine 1.

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Working memory measure contained four subtest that assess working memory capacity in the foreign language; while linguistic intelligence test comprised five subtests that assess both inductive and deductive reasoning skills. Correlations were made between the obtained scores in these measures and the students' language learning achievement. The results revealed significant associations between this latter and the two cognitive abilities: working memory and foreign language learning achievement (.29) and linguistic intelligence and foreign language learning achievement (.28). The study cognition adds evidence to the importance of cognition in foreign language learning and would recommend the implementation of a cognitive linguistic test as a basis for selection for Baccalaureate holders who opt to learn English as a foreign language at university to ensure success.

Keywords: cognitive abilities- individual differences- language learning achievement- linguistic intelligence- working memory

الملخص:

تعد الفروق الفردية واضحة تمامًا في تعليم اللغة، حيث يجد بعض طلبة اللغات الأجنبية أنه من السهل تعلم قواعد هذه اللغات بالرغم من مدى تعقيدها بينما يتصارع آخرون حتى مع أبسط القواعد. ويعد مجال البحث في الفروق الفردية مهما جدا في مجال اكتساب اللغة الأجنبية، حيث يعتقد علماء هذا المجال أن هناك عددًا من الجوانب التي تؤثر على اكتساب أي لغة أجنبية، وأهم هذه العوامل العامل المعرفي، والعامل العاطفي، والعامل الاجتماعي.

ويسعى هذا المقال إلى تسليط الضوء على بعض الجوانب المعرفية للفروق الفردية التي تؤثر على تعلم اللغة الأجنبية حيث تم تسليط الضوء على اثنين من القدرات المعرفية (الذاكرة العملية والذكاء اللغوي) وعلاقتهما بالنجاح في اكتساب اللغة الانجليزية كلغة أجنبية، وعلى هذا الأساس قمنا بإجراء اختبارين فكريين للقذرتين السابقتين الذكر لعينة تتكون من 60 فرد ا من طلبة السنة الأولى في قسم الآداب و اللغة الانجليزية- جامعة الإخوة منتوري قسنطينة1.

أما بالنسبة لاختبار الذاكرة فقد احتوى على أربعة اختبارات فرعية تقيّم مدى قدرة الذاكرة العاملة في اللغة الأجنبية، بينما يتكون اختبار الذكاء اللغوي من خمسة اختبارات فرعية تقيّم مهارات التفكير الاستقرائي والاستنتاجي، و بعدها تم قياس الترابط بين النتائج المتحصل عليها في هذين الاختبارين وبين تحصيل الطلاب السنوي في تعلم اللغة، حيث كشفت النتائج عن وجود ارتباط معتبر

بين هذا الأخير والقدرات المعرفية، على سبيل المثال مدى الترابط بين الذاكرة العاملة و التحصيل السنوي في تعلم اللغة الأجنبية (.29)، والذكاء اللغوي و التحصيل السنوي في تعلم اللغة الأجنبية (.28)، و أضافت الدراسة دليلًا على أهمية الإدراك في تعلم اللغة الأجنبية و من أهم التوصيات يجب تطبيق اختبار لغوي إدراكي كأساس لاختيار حاملي شهادة البكالوريا الذين يختارون تعلم اللغة الإنجليزية كلغة أجنبية في الجامعة لزيادة فرص النجاح.

الكلمات المفاتيحية : القدرات المعرفية - الفروق الفردية - النجاح في اكتساب اللغة الاجنبية - الذكاء اللغوي - الذاكرة العاملة.

Introduction:

Starting from a good basis is our major concern. The primary aim of the present investigation is to put emphasis on some cognitive abilities that are believed to affect success in foreign language learning. Working memory and intelligence are some examples of individual differences that receive extensive attention in this study. We will examine the influence of these constructs on learning English as a foreign language (EFL). If a significant relationship is observed, then a practical test of these abilities would be recommended and implemented as an entry test for students opting to learn EFL in university to enhance success.

1- Review of the literature

1.1- Working memory

The term working memory (WM) refers to "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). It was introduced in 1974 as a reaction to Atkinson and Shiffrin model of information processing (Atkinson & Shiffrin, 1968) which centred the simple process of storage. Baddeley and Hitch model of WM (Baddeley & Hitch, 1974) divided this ability into three main subcomponents:

phonological loop, visuo-spatial sketchpad, and central executive. An additional subcomponent, that is the episodic buffer, was added to the model approximately three decades later (Baddeley, 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. While Miller (1956) argued that individual's memory capacity is $7(\pm 2)$ chunks, Cowan (2000) speculated that this capacity is unitary and cannot hold more than $4(\pm 1)$ 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. performing something that interrupts recall like reading in RSPAN or judging the accuracy of sentences or mental operations in OSPAN.

The active process of working memory plays an important role in learning in general and language learning in particular. Since the beginning of WM research, this capacity has been argued to be quite focused on mainly when learning a foreign language. An example of the influence of this capacity on foreign language learning is non-word repetition tasks (Gathercole & Baddeley, 1990). Other research evidence (Miyake & Shah, 1999) proved that attention that is an important aspect of the central executive is highly controlled notably in beginning levels. In advanced levels, however, individuals depend less on this ability in that information processing becomes automatic.

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

1.2- Linguistic intelligence

As early as the beginning of the 20th century, debates have raged back and forth for the correct definition and the accurate measurement of intelligence. psychometricians agreed that intelligence is what intelligence tests measure; however, they disagree on the nature of this capacity. While some (e.g. Spearman, 1904) believed that it is a single capacity, some others (e.g. Thurstone, 1938) speculated that it is composed of a set of mental abilities, and again other (e.g. Vernon, 1961) assembled between the two views. Recent theories of intelligence have gone beyond the psychometric testing of human cognitive abilities and shift attention to the link between this capacity and the accomplishment of real-life goals. Gardner (1983) identified nine distinct types of intelligence that are not only related to school but also extend to real-life situations. These abilities are: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal, and natural intelligence. Similarly, Sternberg (1985) is another modern researcher who distinguished between three types of intelligence: analytical, that is related to IQ testing; practical, that includes real-life competence; and creative, that involves novelty.

Although confirmed by all researchers to be a crucial aspect of intelligence, the term linguistic intelligence was not explicitly deployed until the emergence of Gardner's MI theory.

However, all intelligence measures (e.g. Wechsler intelligence scales and Binet's tests of intelligence) (Urbina, 2004) did assess this capacity. All the six subscales in Binet's test measure linguistic ability (e.g. verbal absurdities, verbal analogies, vocabulary, understanding complex statements of spatial orientations, and memory for sentences). Similarly, Wechsler test contains a whole scale for the assessment of linguistic intelligence that is referred to as verbal scale. This latter includes a variety of language tasks: Vocabulary, Similarities, Arithmetic, Digit Span, Information, and Comprehension.

As has been viewed, despite the fact that linguistic intelligence has been tackled by all psychometricians in the assessment of human cognitive abilities, the name was not utilized, nor was it defined. For this reason, we use the term linguistic intelligence in this study to refer to the ability to reason deductively and inductively with the use of language (Leighton & Sternberg, 2004).

Similar to working memory, the effects of intelligence on learning in general and mainly on language learning has long been an intriguing issue in Psychological research. All intelligence experts (e.g. psychometricians, developmental psychologists, e.g. Piaget, 1950, and modern researchers) associate this construct with the ability to learn. As for language learning, the term language aptitude appeared to replace linguistic intelligence (Dörnyei, 2005) in SLA research and has been proved to have an influence. The correlation between this ability and foreign language learning ranged from moderate (.34; .52) (Carroll & Sapon, 1959) to strong (.67) (Ehrman, 1998).

The literature review of the two aforementioned cognitive capacities centres their crucial role in learning in general and language learning in particular. Therefore, the present study comes as a result to investigate the impact of these capacities, i.e. working memory and

linguistic intelligence, in learning English as a foreign language. Following past research evidence, we hypothesize that the two abilities have a significant relationship with foreign language learning achievement.

2- The study

2.1- Method

2.1.1- Subjects

The sample comprised 60 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

2.1.2.1 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, i.e. remembering the jumbled letters; and process ability, i.e. 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 and Carpenter WM tasks (1980).

Time allocation for WM 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: 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 the lowest score (10).

2.1.2.2 Linguistic intelligence test

Linguistic intelligence was measured through a set of verbal reasoning activities. Five tasks were given to assess both inductive and deductive reasoning abilities: 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 adult Wechsler intelligence scale test, 2013) with 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 they 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 asked to deduce the odd one out. In the third subtest, they were presented with statements (premises) to read and then to infer the right conclusion from these premises. In the fourth task, they were instructed to understand the relation given 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. Concerning the scoring procedure, the same score of perfection was given to this measure (i.e. 100). This score was distributed on the five subtests. 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.

2.1.2.3 foreign language learning success (achievement)

Success in foreign language learning was assessed through taking the students' 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 abilities 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

In order to measure the degree of linear relationship between working memory and foreign language learning achievement and intelligence and foreign language learning achievement, the technique of the Pearson Product Moment Correlation Coefficient was

used with the formula: $r=\frac{\sum xy}{\sqrt{(\sum x^2)(\sum y^2)}}$. The results of these correlations are displayed in the following table:

TableN°1. The correlation between working memory, linguistic intelligence and foreign language learning

	Working memory	**Linguistic intelligence**
Foreign language learning	.29	.28

Discussion

The critical value of r for one-tailed test (directional hypothesis, i.e. predicting in the direction of our hypothesis) at 0.05 level of significance and with 59 degrees of freedom is 0.25. Since the obtained (r) for the relationship between working memory and foreign language learning and between linguistic intelligence and language learning is higher than the critical value (.29; .28>.25), we would conclude that the results are significant. These results offer that the two cognitive abilities, i.e. working memory and linguistic intelligence, do have an influence on foreign language learning. The study, hence, adds evidence to past research on the impact of cognition on SLA.

3- CONCLUSION

The present article provides theoretical and empirical evidence on the link between working memory and foreign language learning as well as between linguistic intelligence and foreign language learning. The results confirmed that these two cognitive abilities do have an influence. These results would, hence, draw teachers' attention on the important role cognition plays in foreign language learning. On the basis of these findings, the study would recommend the implementation of a cognitive linguistic test as a basis for selection

for Baccalaureate holders who opt to learn English as a foreign language at university to ensure success.

The current article might give suggestions for future research to explore other relationships between additional cognitive abilities and foreign language learning to expand the components of this test.

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