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The Association between Dynamic Assessment of Grammar and Fluid Intelligence: A Case of Undergraduate EFL Students

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A The Association between Dynamic Assessment of Grammar and Fluid Intelligence: A Case of Undergraduate EFL Students

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Abstract

The present study examined the association between static assessment, dynamic assessment and fluid intelligence. A pool of 109 students majoring in English Language Teaching and Translation Studies took part in the study. Two major instruments of the study included Computerized Dynamic Grammar Test and Raven's Advanced Progressive Matrices. The results of the study confirmed that the relation between static assessment of grammar and fluid intelligence as well as the relation between dynamic assessment of grammar and fluid intelligence were statistically significant. However, the relation between dynamic assessment of grammar and fluid intelligence was large. Finally, the results from the interviews revealed that ZPD and IQ are complementary and not contradictory. A practical implication for the students is that practicing fluid intelligence can improve their logical thinking by focusing on metacognitive strategies. Likewise, C-DA is a helpful source to develop effective learning strategies like directed attention, self-evaluation, and self-discovery strategies.

Keywords: dynamic assessment, grammar, fluid intelligence, static assessment



La Asociación entre la Evaluación Dinámica de la Gramática y la Inteligencia Fluida: El Caso del Alumnado del Grado de EFL

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Resumen

Este estudio examina la asociación entre la evaluación estática, la evaluación dinámica y la inteligencia fluida. Una muestra de 109 estudiantes cursando el grado de English Language Teaching and Translation Studies participó de este estudio. Se utilizaron dos grandes instrumentos de investigación el Test Computerizado de Gramática Dinámica y las Matrices Progresivas Avanzadas de Raven. Los resultados del estudio confirmaron que la relación entre la evaluación estática de la gramática y de la inteligencia fluida así como la relación entre la evaluación dinámica de la gramática y la inteligencia fluida fueron estadísticamente significativas. Sin embargo, la relación entre la evaluación dinámica de la gramática y la inteligencia fluida fue grande. Finalmente, los resultados de las entrevistas revelaron que el ZPD y el IQ son complementarios, no contradictorios. Una implicación práctica para los estudiantes es que practicar la inteligencia fluida puede mejorar su pensamiento lógico al centrarse en estrategias metacognitivas. E igualmente, C-DA es un recurso útil para desarrollar estrategias de aprendizaje efectivas como atención dirigida, auto-evaluación, y estrategias de auto-descubrimiento.

Palabras clave: evaluación dinámica, gramática, inteligencia fluida, evaluación estática



Vygotsky's (1978, 1986) writings on Sociocultural Theory (SCT) of mind led to the emergence of Dynamic Assessment (abbreviated as, DA) which has been employed as a theoretical framework for research undertaken in second language acquisition. The concept of DA was not coined by Vygotsky, himself, though. SCT is a system of ideas on the development of the mind (Vygotsky, 1978). Based on this theory, learning is a social phenomenon fixed in the cultural context. In Vygotsky's approaches, an optimal scenario for development is the Zone of Proximal Development (ZPD). To reiterate the well-known definition of the ZPD, it is the difference between what an individual can do autonomously and what he or she can do with assistance or mediation (Lantolf & Poehner, 2004). As remarked by Lantolf and Poehner (2004), fundamental in the ZPD, is the role of mediation, and DA incorporates assessment and instruction into a unified activity through appropriate forms of mediation. DA enables learners to perform beyond their current level of functioning, thereby providing insights into emerging capabilities (Poehner & Lantolf, 2013).

According to Poehner (2008), two significant strands of research that will set a chief place for DA in the L2 area are C-DA and group-based DA. The former signifies an attractive method to large-scale assessment contexts that mandate standardization while the latter is particularly relevant to classroom settings where teachers may be concerned with the feasibility of dialogically mediating twenty or more learners (Poehner, 2008). Poehner (2008) declares that Computerized Dynamic Assessment (henceforth, C-DA) mostly follows an interventionist model with mediation offered from a menu of predetermined clues, hints, and leading questions selected in a lock-step fashion (moving from most implicit to most explicit) by the computer. Theoretically, while computer-based assessments typically only indicate the correctness of a response, C-DA tracks learners' errors as well as the precise forms of mediation that prove beneficial (Poehner, 2008). Indeed, development occurs in a present-to-future model. The present study tries to find the relationship between computerized dynamic assessment of grammar and fluid intelligence.

Meanwhile, in psychology, cognitive abilities can be defined in several ways. Cattell (1971) proposed two major types of cognitive abilities: fluid intelligence (Gf) and crystallized intelligence (Gc). Gf includes deductive

and inductive reasoning, and Gc comprises abilities that reflect the influence of culture and education on verbal knowledge (Flanagan, McGrew & Ortiz, 2000). As Cattell (1971) explains, crystallized intelligence is the ability to use skills, knowledge, and experience. It does not equate to memory, but it does rely on accessing information from long-term memory. Crystallized intelligence is one's intellectual achievement, as demonstrated largely through one's vocabulary and general knowledge. This improves somewhat with age, as experiences tend to expand one's knowledge. To him, crystallized intelligence is associated with learned or acculturated knowledge. That is, Gc is a result of learning and knowledge acquired over one's lifetime. According to Gf-Gc theory, fluid intelligence causes crystallized intelligence (Cattell, 1987).

So far, nobody attempted to find out the relationship between dynamic assessment of grammar and aspects of intelligence. Although to Vygotsky (1986), ZPD is against IQ since IQ measures the knowledge of the individuals from the past to the present and it is fixed, ZPD measures the potential knowledge of the individuals from the present to the future. Nevertheless, Feuerstein, Feuerstein, and Falik (2010) resembles the potential development to fluid intelligence, although no experimental study has been carried out in this regard. The present study contributes to the field of English language teaching and learning since for the first time the relationship between dynamic assessment and intelligence type is examined and the study could shed the light to the neglected aspect of Vygotsky's (1986) ZPD, which is the influence of fluid intelligence. The major significance of the present study is that it is hypothesized that investigating traditionally valued psychological factors, mingled with the contemporary theories of language learning, may yield a more realistic image of the second language learning mechanism. Hence, in the current study, the researcher proposes to adopt a pair of complementary viewpoints.

Therefore, the main contribution of the present study to the field of SLA is that the study sets out to find out the relation between Gf (abstract reasoning) and structural proficiency through mediation, highlighting the association between one's structural proficiency, as demonstrated largely through one's grammatical knowledge and one's cognitive ability while working on language tasks. Both dynamic assessment and fluid intelligence

are related to becoming issues not being issues, that is, to dynamic nature and not static nature. Moreover, the present study focused on the computerized dynamic assessment of grammar which is related to logical intelligence (Pishghadam & Moafian, 2008), and the present study was an attempt to find out another aspect of intelligence which is fluid intelligence.

Literature Review

Static Assessment vs. Dynamic Assessment

The central difference between DA and static assessment derives from Vygotsky's theorizing in the ZPD that is based on a fundamentally different understanding of the future. In static assessment, actual development is sought rather than potential development. That is to say, static assessment is based on the past-to-present model of assessment, while DA is based on the present-to-future model of assessment (Valsiner, 2001). Extensive research within DA has been carried out in the Netherlands, Germany, the United States, Canada, Belgium, Europe in general, the United Kingdom and South Africa (Murphy, 2011). The new trends within psychological assessment suggest DA methods as complementary to mainstream assessment (Stiggins, 2005). Based on the Vygotsky's ZPD, Lantolf and Poehner (2004) made a clear distinction between the two general approaches to DA: *Interactionist* DA and *Interventionist* DA. *Interactionist* DA finds its origins in Vygotsky's qualitative, interpretation of the ZPD, which encourages us not to measure but to focus on students' development, and this can only be accomplished through interaction and cooperation. Thus, mediation in the interactionist model emerges from the interaction between the teacher as the mediator and the learner, accordingly responding to the learner's ZPD. *Interventionist* DA is rooted in Vygotsky's quantitative interpretation of the ZPD as a difference score. It is currently utilized in either of two formats: 1) A pretest-treatment-post-test experimental approach and 2) item-by-item assistance selected from a prefabricated menu of hints during the administration of a test (Poehner, 2008).

Fluid and Crystallized Intelligence

As part of a long-standing program examining cognitive ability, Cattell (1943) proposed that intelligence is not a unitary construct (such as Spearman's *g*), rather it assumes two broad but distinct types, fluid intelligence and crystallized intelligence. According to the theory, fluid intelligence represents novel or abstract problem solving capability and is believed to have a physiological basis. According to Cattell (1987, p. 97), the label "reflects the construct's —fluid quality of being directable to almost any problem". *Gf* is typically assessed with items of a nonverbal or graphical format using tests such as Raven's Progressive Matrices. However, verbal items (such as analogies) can also be used to assess *Gf* if the word pairs contain simple words that are familiar to the population of test takers (Cattell, 1987). Crystallized Intelligence is associated with learned or acculturated knowledge. That is, *Gc* is a result of learning and knowledge acquired over one's lifetime.

Dynamic Assessment and English Grammar

There is ample evidence for the usefulness of the theoretical construct of DA in grammar instruction (Aljaafreh & Lantolf, 1994; Antón, 2003; Nassaji & Swain, 2000). Aljaafreh and Lantolf (1994) studied the use of high frequency features of English (tense morphology, articles, modal verbs, and prepositions) in the written performance of three ESL learners and reported that a shift from explicit mediation to a more implicit mediation contributed to students' development. Nassaji and Swain (2000), in a case study of two learners, provided feedback within the learners' ZPD to complement Aljaafreh and Lantolf's (1994) findings. Their study showed that help provided within the ZPD was more effective than help offered randomly. According to Lantolf and Aljaafreh (1995), as learners displayed greater independence from the tutor's guidance and improved accuracy in their use of the relevant forms, development through the ZPD was observed over time. However, they argued that learner development was not a smooth linear process; instead, it followed the type of irregular trajectory covered by Vygotsky's description of development as a revolutionary process.

Theoretical Framework of the Study

The study followed two theoretical framework to conduct the study. The first theoretical framework followed by the researchers refers to Fluid Intelligence developed by Feuerstein, Feuerstein, and Falik (2010) who expanded on the notion arguing that an individual is not born with a certain intelligence remaining fixed throughout life. Rather, they have the potential to change and if provided with an appropriately mediated learning environment, they are modifiable. In static assessment, the task of the assessor is to look for what is fixed, permanent, and unchanging in the learner. Static assessment is constructed in a way that no learning will take place since it measures the knowledge already gained by the learner, that is, it measures a learner's crystallized intelligence which does not allow the transfer of the learned principles to new situations rather than "treats one's intelligence as *fluid* which can be shaped" (Feuerstein, Feuerstein & Falik, 2010, p. 90). The second theoretical framework refers to Computerized Dynamic Assessment (C-DA) proposed by Poehner and Lantolf (2013). To the authors, C-DA following an interventionist model entail mediation offered from a menu of predetermined clues, hints, and leading questions selected in a lock-step fashion (moving from most implicit to most explicit) by means of computers.

The following research questions were posed by the researchers to be investigated:

- 1. Is there any significant relationship between static assessment of grammar and fluid intelligence for undergraduate EFL intermediate students?*
- 2. Is there any significant relationship between dynamic assessment of grammar and fluid intelligence for undergraduate EFL intermediate students?*
- 3. Does gender of the participants moderate the relationship between dynamic assessment of grammar and fluid intelligence for undergraduate EFL intermediate students?*
- 4. What do the EFL students think of the association between fluid intelligence and dynamic assessment of grammar?*

The Study

Participants

A pool of 112 students majoring in English Language Teaching and Translation Studies took part in the study. The participants were at BA level, and they were selected based on convenient sampling from different Universities including Islamic Azad University of Quchan, Ferdowsi University of Mashhad, University of Bojnord, University of Tehran, Islamic Azad University of Mashhad, University of Babol, and Islamic Azad University of Gorgan. Students participated in this study had already passed their English Grammar Courses (including eight credits). In order to make our sampling fairly homogenous in terms of their level of proficiency, the researchers just included those students whose scores obtained from non-dynamic assessment on CDGT used in this study fell one standard deviation below and above the mean. Three students did not complete the computerized dynamic grammar test because there was no final report of their performance. Therefore, the final number of scores analyzed was 109. Moreover, 10 EFL students were interviewed in the study who have been learning English Grammar courses at university level to explore the relation between dynamic assessment and fluid intelligence. They were selected based on convenient sampling.

Instrumentations

The first instrument utilized by the researchers was CDGT, designed and validated by Modarresi and Alavi (2014), to assess the grammatical knowledge of the learners based on the principles of DA. The test consisted of 40 items and each item included five hints. Since the scope of structural patterns cannot be captured in a single test battery, the test was an attempt to cover the most important and frequently-used patterns. In so doing, the authors categorized the structural patterns into 10 major categories including 40 subcategories. The reliability and validity of the test were already determined by the researchers, as .71 and .83, respectively. The scoring procedure is calculated out of 200.

The second instrument used in this study was Raven's Progressive Matrices, which is used in many countries for decades as a measure of problem-solving and reasoning ability (Raven, Raven & Court, 1998). In this study, for measuring fluid intelligence (abstract thinking and reasoning), APM was employed. APM has been standardized in Iran by Rahmani (2008) in Azad University of Khorasgan. The reliability and validity reported for the test are at acceptable level (.91 and .73 respectively). APM is the advanced form of matrices contains 36 items. The scoring procedure is calculated out of 36.

The last instrument utilized by the study was semi-structured questions, asking the participants regarding the EFL students' thought about the association between fluid intelligence and dynamic assessment of grammar. The content validity of the questions were checked by two experts in the field of English Language Teaching who had been teaching English at Ferdowsi University of Mashhad and Islamic Azad University of Quchan (Appendix C). After receiving the feedback from the experts, the researchers revised the questions in terms of their validity.

Procedure

The researchers gathered the relevant data in three major sessions. First, they asked the participants to answer the test battery of computerized dynamic assessment of grammar known as CDGT in the Cafe net or the English laboratory of the University. The test battery consisted of 40 items and the researchers prepared 5 hints for each item. The hints matched the structural patterns covered in the test battery. Students were allowed to answer each item within 4 minutes. Regarding the hints, since the grammatical patterns are labeled by abstract names such as connectors, present continuous, or adverbs of indefinite frequency, the researchers used examples together with the labels to help students understand them. The C-DA program allowed the students to take the test in 2 hours and 40 minutes. If they failed to answer an item within 4 minutes, they would lose that item automatically. The original test was in multiple-choice format, which was not appropriate to be used here since the researchers offered hints to the students to find the answer. If a multiple-choice format was used, as soon as a student was given

a hint, he or she would know that the answer was wrong and they would be left with three alternatives, and by receiving the second hint, they would have only two alternatives, and so on. Thus, they could guess the correct answer from the remaining choices. The researchers decided to design the communicative test of grammar as an appropriate test format.

Therefore, the application of discourse-based grammar has two major merits. First, since new perspectives on grammar consider the discourse in emergentist and sociolinguistic terms, the current study is an early attempt to assess grammar at the discourse level in C-DA. Second, the learners could identify the errors while giving hints to learners would not help them guess the right answer. The following test is an example of a discourse-based grammar test designed by the researchers to assess knowledge of relative clauses. After the items were prepared, five hints were prepared for each item. In DA, the quality of hints is very important as different learners may have different ZPDs for the same incorrect forms, meaning learners require different levels of assistance. The first hint was the most implicit and the last hint was the most explicit. The assistance was given on a progressive scale varying from implicit to specific answers. Indeed, each time a learner answered a question incorrectly, computerized mediation was provided with increasing explicitness.

Test item and its hints:

Instructions: You have 4 minutes to answer each question. If you can answer an item correctly in your first attempt, a score of 5 is awarded for that item. This is your non-mediated score. If you answer the item in your second attempt, a score of 4 is awarded and so on until the correct answer is revealed in the fifth hint and a score of 0 is earned for the item. This is your mediated score.

Several people were injured this morning when a lorry, which was carrying pipes, overturned in the center of town and hit two cars. Ambulances called to the scene took a long time to get through the rush hour traffic. People who saw the accident say the lorry hit the cars after it swerved to avoid a pile of stones leaving in the road.

Hint 1 → That's not the right answer, try again.

Hint 2 → Look at the relative clauses in the test. They are defining relative clauses used to include essential information.

Hint 3 → There are four relative clauses here. Sometimes we can leave the *relative pronoun + auxiliary verb* out of the clause. For example, *The man who is watering the garden is my uncle* can be reduced to *The man watering the garden is my uncle*.

Hint 4 → Pay attention to the last sentence. We can form clauses with a present participle (e.g., *watering*) in active sentences and a past participle (e.g., *watered*) in passive sentences.

Hint 5 → The right answer is **left** NOT leaving.

After completing the test, a file was created on the computers containing demographic and their scores information. Having finished the test, the following information were stored for each test taker:

1. Test takers' non-mediated scores. This score is calculated according to the students' scores obtained from their non-dynamic performance or their first try. In fact, this score is exactly the same as that obtained in traditional tests. To make it comparable with score based on DA of the test, the researchers calculates this score on a scale of 0 to 200 points; five points for each item.

2. Test takers' mediated scores. This score is calculated according to the students' scores obtained from their dynamic performance or their use of the hints. However, it should be noted that the same hints are given to all test takers in the same order and indeed, what makes a difference between test takers in terms of ultimate score is whether they have used more the explicit or the implicit ones on average. The number of hints used by each test taker is subtracted from the total number of hints, which is 200. The number that is obtained by this subtraction is the score based on DA. For instance, imagine that a student uses two hints for the first twenty items of the test; that is, two hints for each of these items. This student's score is 160 which is calculated by subtracting the number of hints used by him (here 40 hints) from 200. The non-mediated score of the same student would be 100

because this student has given wrong answer to the first 20 items of the test, and only after receiving hints, he is able to get to the right answers.

3. The number of hints used in each item. The software subtracts the number of hints used by each test taker from the total number of hints. It means that for each hint that is used, one point is deducted from the total score that is 200.

Following this step, the researchers administered the fluid intelligence test to the students and they were informed about the way they should have answered the test and about the given time. The test was the advanced form of matrices and consisted of 36 items. Items were presented in black ink on a white background, and became increasingly difficult as progress is made through each set. These items were appropriate for adults and adolescents of above average intelligence. The time needed for this test was 45 minutes.

Finally, the data were gathered from ten students in the by means of face-to-face interview sessions held by the researchers. Different students from different universities were selected by them. The interview sessions took 20 minutes and the students were free to speak in either English or Persian language.

Results

Static Assessment of Grammar and Fluid Intelligence

The first research question of the study dealt with the significant relationship between static assessment of grammar and fluid intelligence for undergraduate EFL intermediate students. The participants' non-mediated scores were calculated according to the students' scores obtained from their non-dynamic performance or their first try. In fact, this score was exactly the same as that obtained in traditional tests. The test included 40 items and the scores were calculated on a scale of 0 to 200 points; five points for each item. Moreover, Advanced Progressive Matrices (APM) was employed to measure fluid intelligence (abstract thinking and reasoning). The test included 36 items, and the scoring procedure was out of 36.

Table 1.
Descriptive statistics for non-mediated score and fluid intelligence

	N	Min.	Max.	Mean	Std. Dev.	Skewness		Kurtosis	
	Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	Std. Error	Stat.	Std. Error
Non-mediated score	109	5.00	170.00	64.31	40.42	.55	.23	-.34	.45
Fluid Intelligence	109	13.00	25.00	19.23	2.81	-.30	.23	-.68	.45
Valid N (listwise)	109								

The researchers performed the preliminary analysis to ensure no violation of the assumptions of normality (i.e., skewness and kurtosis, which were between +2 and -2 for the variable). Table 1 shows the means and standard deviations of the non-mediated performance of the students (M= 64.31; SD=40.42) and fluid intelligence (M= 19.23, SD=2.81).

Table 2.
Correlations between non-mediated score and fluid intelligence

		Non-mediated score	Fluid Intelligence
Non-mediated score	Pearson Correlation	1	.359**
	Sig. (2-tailed)		.020
	N	109	109
Fluid Intelligence	Pearson Correlation	.359**	1
	Sig. (2-tailed)	.020	
	N	109	109

** . Correlation is significant at the 0.01 level (2-tailed).

After performing the preliminary analysis to ensure no violation of the assumptions of normality, the results obtained from Pearson product-moment correlation coefficient showed the relationship between scores of

non-mediated performance and scores of fluid intelligence (See Table 2). There was a medium, positive correlation between the two variables [$r=.35$, $n=109$, $p<.05$], with higher scores on non-mediated performance is associated with higher scores on fluid intelligence, based on the guideline proposed by Cohen (1992):

- $r=.10$ to $.29$ or $r=-.10$ to $.29$ small
- $r=.30$ to $.49$ or $r=-.30$ to $.49$ medium
- $r=.50$ to 1.0 or $r=-.50$ to 1.0 large

Dynamic Assessment of Grammar and Fluid Intelligence

The second research question of the study investigated the significant relationship between dynamic assessment of grammar and fluid intelligence for undergraduate EFL intermediate students. Students’ scores on dynamic test was calculated according to the students’ scores obtained from their dynamic performance or their use of the hints. The number of hints used by each test taker was subtracted from the total number of hints, which was 200. The number that was obtained by this subtraction was the score based on DA.

Table 3.
Descriptive statistics for mediated score and fluid intelligence

	N	Min.	Max.	Mean	Std. Deviation	Skewness		Kurtosis	
	Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	Std. Error	Stat.	Std. Error
Mediated score	109	14.00	196.00	117.90	39.85	-.21	.23	-.44	.45
Fluid Intelligence	109	13.00	25.00	19.23	2.81	-.30	.23	-.68	.45
Valid N (listwise)	N 109								

Moreover, the researchers performed the preliminary analysis to ensure no violation of the assumptions of normality (i.e., skewness and kurtosis,

which were between +2 and -2 for the variable). Table 3 shows the means and standard deviations of the mediated performance of the students (M= 117.90; SD=39.85) and fluid intelligence (M= 19.23, SD=2.81).

Table 4.
Correlations between mediated score and fluid intelligence

		Mediated score	Fluid Intelligence
Mediated score	Pearson Correlation	1	.680**
	Sig. (2-tailed)		.000
	N	109	109
Fluid Intelligence	Pearson Correlation	.680**	1
	Sig. (2-tailed)	.000	
	N	109	109

** . Correlation is significant at the 0.01 level (2-tailed).

After performing the preliminary analysis to ensure no violation of the assumptions of normality, the results obtained from Pearson product-moment correlation coefficient showed the relationship between scores of mediated performance and scores of fluid intelligence (See Table 4). There was a large, positive correlation between the two variables [$r=.68$, $n=109$, $p<.05$], with higher scores on mediated performance was associated with higher scores on fluid intelligence.

Gender, Dynamic Assessment of Grammar and Fluid Intelligence

As for the third research hypothesis concerned with whether the gender of the participants could moderate the relationship between dynamic assessment of grammar and fluid intelligence for undergraduate EFL intermediate students, the researchers divided the participants into two groups based on their gender. They were divided into the male group (N=45) and the female group (N=64). To see if gender of the participants could moderate the relationship between dynamic assessment of grammar and

fluid intelligence, the researchers performed one-way MANOVA and the results are reported as follows:

Before running MANOVA, the prerequisite assumptions were met. To test for multivariate normality, the researchers calculated Mahalanobis distances using the Regression menu. The maximum value obtained from the output was 13.52 and since this value was not larger than the critical value 13.82, there was no ‘multivariate outliers’ (Tabachnick & Fidell, 2001, p. 68). Moreover, MANOVA works best when the dependent variables are only moderately correlated. As displayed in Table 2 and 4, the correlations between the variables were .35 and .68, therefore, there was no violation with regard to multicollinearity.

Table 5.

Box's test of equality of covariance matrices^a

Box's M	7.10
F	2.31
df1	3
df2	650277.99
Sig.	.07

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + gn

Moreover, the assumption of homogeneity of variance covariance matrices was checked. If the Sig. value is larger than .001, then there is no violation. In this study, as Table 5 showed, the Box's M significance value was .07, which was larger than .001; therefore, there was no violation.

The results indicated that there was statistically no significant difference between the groups on a linear combination of the dependent variables. Since the sample size in this study was assumed to be normal, the researchers opted for Wilks' Lambda, which is recommended for general use (Tabachnick & Fidell, 2001) in the *second* section of the Multivariate Tests table 6, labeled Gender. The value was .71 and the significant level was .49. Since the significance level was more than .05, it was concluded that there was a difference between the male and female.

Table 6.
Multivariate tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept t	Pillai's Trace	.98	2716.13 ^b	2.00	106.0	.000	.98
	Wilks' Lambda	.01	2716.13 ^b	2.00	106.00	.000	.98
	Hotelling's Trace	51.24	2716.13 ^b	2.00	106.00	.000	.98
	Roy's Largest Root	51.24	2716.13 ^b	2.00	106.00	.000	.98
gender	Pillai's Trace	.013	.71 ^b	2.00	106.00	.492	.01
	Wilks' Lambda	.987	.71 ^b	2.00	106.00	.492	.01
	Hotelling's Trace	.013	.71 ^b	2.00	106.00	.492	.01
	Roy's Largest Root	.013	.71 ^b	2.00	106.00	.492	.01

a. Design: Intercept + gn

b. Exact statistic

Results Obtained from the Interviews

The last research question of the study explores the EFL students' thought of the association between fluid intelligence and dynamic assessment of grammar. The researchers wrote four questions included: 1) Have you already worked on computerized dynamic assessment? 2) Were you familiar with the concept of fluid intelligence? 3) What do think of the relation between dynamic assessment and fluid intelligence? and 4) How do you assess the relation between dynamic assessment of grammar and fluid intelligence? The researchers used theme-based categorization (Dornyie, 2007) to categorize the commonalities emerged from the responses gathered from 10 participants who were selected based on criterion sampling. In so doing, the qualitative data that came from the open-ended questions and interviews were analyzed following the general qualitative analysis techniques and specific interview analysis techniques. First, the data that came from open-ended questions were prepared through the theme-based

categorization by structuring and classifying. Structuring of complex data was done by transcription. Then, the transcript was classified by eliminating repetitions and digressions.

They were interviewed to gain a deeper understanding of the effectiveness of dynamic nature of assessment and its association with fluid intelligence. Initially, the researchers asked the participants to introduce themselves. Then, they asked some questions about their majors, academic experience, and their universities. The main themes extracted from the interviews are reported below. One of the interviewees, majoring in TEFL, mentioned that he was satisfied with his mediated score. His comments included:

[The test was stimulating...I was pleased more with the mediated scores...the students really progresses from non-mediated to mediated scores. At first, the students may have some stress for time but after answering two or three tests, they would have no problem with time. I think this [type of] test[s] is very helpful... hints are teaching grammar... the fluid intelligence is also an interesting but ignored topic and it deals with problem-solving and reasoning which is related to logic and reason and dynamic assessment also aims at problem-solving through hints and prompts].

For most of the participants, the test was challenging for students studying English language. To them, the idea for the relation between dynamic assessment of grammar and fluid intelligence was creative and new; however, to the students, she believed the fluid intelligence test was hard. The dynamic test was more facilitative since it provides the students with hints, unlike the intelligence test that measures the ability of the students rather than their potentiality.

In sum, the students who were interviewed asserted that dynamic assessment is not a matter of pass or fail since one's performance is not compared to a pre-defined set of criteria or a standard and one's performance is not compared with that of other examinees what is common in norm-referenced assessment. The point is that DA is development-referenced type of assessment that focuses on promoting learners' development through appropriate forms of mediation. Also, it seems that lack of familiarity with

computer-based testing in our context is a major reason for the students' stress. They believed that students' knowledge of grammar can be really enhanced by means of dynamic assessment and fluid intelligence also could help students improve their problem-solving and analytic strategies. The interviews believed that the discoursed-based test of grammar helps students to promote higher learning processes like application and synthesis and not just focus on knowledge and understanding. An important point is that unfortunately, some of the students think that their intelligence is low and they have no talent. However, in dynamic assessment if one progresses from non-mediated score to mediated score, this shows that he or she has the potentiality to learn and should not think that his or her intelligence is a fixed attribute.

Discussion and Conclusion

The current study mainly focused on the association between dynamic assessment of grammar and fluid intelligence, and the results showed that the relationship between the two variable was statistically significant. Indeed, there was a medium positive relationship between static assessment and fluid intelligence with respect to grammar. The results also confirmed that there was a large positive relationship between dynamic assessment of grammar and fluid intelligence. The results also revealed that the gender of the participants did not contribute to the relationship between dynamic assessment of grammar and fluid intelligence. It was concluded that there was no difference between the male students the female students between the two variables with respect to grammar.

The results of the study are in agreement with the research project conducted by Yi-an (2010) who investigated the role of analytical intelligence in foreign language behavior and performance. Participants of the study were 2,545 Taiwanese college students who were given an English Proficiency Test of Listening and Reading, and filled out a questionnaire related to analytical. Results of analyses showed that intelligence plays a significant role in foreign language learning including students' learning behavior and English performance. Yi-an (2010) also concluded that musical, interpersonal, and intrapersonal intelligences make significant

contribution to predicting students' learning behavior and musical, verbal, and visual intelligences are predictors of English performance.

In the Iranian context, the study carried out by Davoudi and Sadeghi (2015), align with the results of the current study. They concluded that there was a positive relationship between crystallized intelligence as well as fluid intelligence and foreign language grammar. Of course, they used the students' scores on their grammar courses (Modern 1 & Modern 2) to measure students' grammatical knowledge, and the number of participants was 85 students. However, the present study examined the dynamic assessment of grammar and fluid intelligence, that is, the current study followed assessment for learning not assessment of learning. The number of students participated in this study was more than the previous one conducted by Davoudi and Sadeghi (2015). The results obtained from the study are in line with the previous research proving that mediation in the forms of hints and leading questions improves the learners' language skills ability and their potentiality for learning (Alavi, Kaivanpanah & Shabani, 2011). In the present study, the performance of the students increased significantly from non-mediated test to mediated test on a test battery of grammar. Moreover, the results of the study are similar to those of Pishghadam and Barabadi (2012) and Poehner and Lantolf (2013) who carried out their C-DA research on reading comprehension skills and concluded that students' scores were progressed from static test to dynamic test.

The researchers believe that present-day research on second language acquisition should concentrate on both second language skills and sub-skills as well as on interdisciplinary and transdisciplinary research whereby the causal relationship between language skills and learners' psychological and sociocultural factors are examined. Taking metacognitive abilities into account could facilitate the process of learning and in the Iranian context; regrettably, the real focus is on the cognitive abilities and particularly on repetition and memorization. Nevertheless, fluid intelligence is pertinent to abstract thinking, and abstract thinking is a matter of meta-cognition or thinking about one's thought. When learners have the ability to think abstractly, they can manage the process of learning and can gain mastery over the content and materials they are learning.

Dynamic assessment is also focusing on the process of learning and focuses on potentiality and the point is that ZPD and IQ are complementary and not contradictory. Indeed, learning a second language is a taxing task and the use of both dynamic assessment and fluid intelligence could pay the way for the learners to put aside the barriers because fluid intelligence is the ability to solve problem and when students are engaged in problem-solving activities in learning language skills, they can recall and apply what they learn in new situations. Structural proficiency is related to the students' awareness of the application of grammatical rules and patterns in new situations, and this can be done by focusing on problem-solving activities. Indeed, like dynamic assessment, fluid intelligence can help learners to become autonomous learners when they see themselves involved in the process of recognition of correct forms and the application of those forms and structures in different situations. The researchers concluded that most of the students are familiar with spoon-feeding education, allowing the teachers to teach from A to Z and then, the students have to memorize the structural patterns in contrived situations. The attention to fluid intelligence and making students familiar and aware of such capacities would help them reinforce their fluid intelligence by concentrating on not only logical thinking but abstract thinking in learning the grammatical patterns.

The researchers offer potentially helpful implications for language learners, and teachers in this regard. Regarding second language learners, they are suggested to practice aspects of intelligence including fluid intelligence and improve their abstract thinking by focusing on metacognitive strategies and putting what they have learned into practice since memorization and understanding do not suffice to gain mastery over structural patterns in language use. As highlighted by Hunt (1995), intelligence-related skills are related to learners' success and autonomy in learning. Likewise, C-DA is an informative and helpful source for the learner to evaluate their knowledge of language proficiency and add to their language knowledge, serving them develop effective learning strategies like directed attention, self-evaluation, and self-discovery strategies. As for second language teachers, they can explain for the learners that fluid intelligence can be improved through practice and perseverance and they can provide for the learners diverse grammatical activities including mechanical

tasks and communicative tasks, training the students to move from mechanical tasks to communicative tasks through involving in challenging tasks. Teachers are also recommended to practice writing creative hints to teach learners using hint-based education or “development-oriented pedagogy” (Poehner & Lantolf, 2013, p. 15) as opposed to spoon-feeding education or teaching from A to Z.

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