

Learning potential assessment in the elderly: mediation influence in a memory assessment test

Evaluación del potencial de aprendizaje en adultos mayores: influencia de la mediación en una prueba de memoria

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Abstract: The “learning potential” version of the Auditory Verbal Learning Test (AVLT-LP) assesses memory performance after an active intervention (mediation). The AVLT-LP allows to quantify a learning curve by means of a gain score. Previous studies showed that if the gain score is equal- to or greater than 3, it would be evidence of learning potential. Objectives. To analyze performance in healthy old adults assessed with AVLT-PA with mediation (MG) and without mediation (NoMG). Method. A neuropsychological battery was applied to 2 groups (MG and NoMG) of 35 cognitively-healthy older adults aged between 60 and 85 years old. The performance between both groups was compared. Results. The MG obtained higher scores than the NoMG in AVLT-LP’s last trial, post-test and gain score. Conclusions. In both groups, the subjects started the AVLT-LP by remembering a similar number of words. However, the MG subjects retained more words than the NoMG showing the enhancement in memory applying the AVLT-PA to assess learning potential.

Keywords: learning potential, memory, dynamic assessment, neuropsychology, aging

Resumen: Introducción. La versión “potencial de aprendizaje” de la Auditory Verbal Learning Test (AVLT-PA) evalúa el rendimiento luego de una mediación activa por parte del evaluador. La AVLT-PA permite cuantificar una curva de aprendizaje mediante un puntaje de ganancia. Estudios previos demostraron que un puntaje de ganancia igual o mayor a 3 evidenciaría presencia de potencial de aprendizaje. Objetivos. Analizar diferencias en el rendimiento en la AVLT-PA en sujetos evaluados con mediación y sin mediación. Metodología. Se aplicó una batería neuropsicológica y la AVLT-PA a dos grupos de 35 adultos mayores cognitivamente sanos: un grupo recibió la mediación y el otro grupo no. Se comparó el rendimiento entre ambos grupos. Resultados. Se observaron diferencias en el último intento de la AVLT-PA, post-test y puntaje de ganancia en el grupo que recibió la mediación. Conclusiones. En ambos grupos, los sujetos inician la AVLT-PA recordando una cantidad de palabras similar. Sin embargo, los sujetos que recibieron la mediación del evaluador finalizan la prueba recordando más palabras que el grupo que no la recibió, evidenciando y validando la utilidad de la aplicación de esta versión de la prueba para la evaluación de potencial de aprendizaje.

Palabras clave: potencial de aprendizaje, memoria, evaluación dinámica, neuropsicología, envejecimiento

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Introduction

The learning potential is defined as the distance between the current level of cognitive development of an individual (its execution in a given task) and the result obtained after applying a mediation (Cabras, 2012; García, 2004). This definition is closely linked to the concept of cognitive plasticity. The cognitive plasticity demonstrates the ability of subjects to improve their performance under optimal training conditions (Calero & Navarro Gonzalez, 2006; Leon & Roldan, 2016). Assessment carried out from this perspective is known as “dynamic assessment” and it opposes to traditional assessment, considered “static assessment”. There are three main differences between these two approaches (Sternberg & Grigorenko, 2003). First of all, while the static assessment observes the current performance of a subject, the dynamic assessment also observes whether this actual performance improves the potential abilities involved in learning under training conditions through the intervention or mediation (lead by an expert evaluator). Secondly, static and dynamic assessments differ from one another, by the given feedback in dynamic assessment (mediation) during the test. Finally, the static and the dynamic tests are distinguished by the evaluator’s active interventions: while in the static assessment the evaluator tries to be neutral, in the dynamic assessment the evaluator seeks to link and intervene in the subject’s response process (Sternberg & Grigorenko, 2003).

The origin of the learning potential construct goes back to the concept of Vygotsky’s zone of proximal development, which defined learning potential as the difference between an individual’s ability to independently solve a problem and the level of potential development that occurs when solving that problem with the collaboration of an expert (Vygotsky & Cole, 1979). While the current execution alludes to the observed abilities of a subject, the learning potential refers to their latent capacities (Malbrán & Villar, 2002).

Neurocognitive tests that assess learning potential in the elderly are, in general, standard tests whose original instructions have been modified for that purpose (called extended instructions or mediation). The Learning Potential Assessment Battery for Dementia (in Spanish, *Batería de Evaluación del Potencial de Aprendizaje en Demencias -BEPAD-*) (Fernandez Ballesteros, Za-

marrón, Tárraga, Moya & Iñiguez, 2003) includes four classic neuropsychological tests: Rey’s Auditory Verbal Learning Test, Hanoi Tower, Positions Test and Verbal Fluency. The original instructions were modified to introduce the mediation and to assess the learning potential of a subject (Calero, 2000; Calero-García, 2004). This type of tests seeks to operationalize the concept of learning by evaluating the initial level of performance and the resulting execution after mediation by the evaluator. Through these extended instructions, the evaluator provides the subject with help to solve a task (Cabras, 2012; Calero & Navarro Gonzalez, 2006; Calero-García, 2004). The difference between current (prior to mediation) and potential (after mediation) performance is called a *gain score* and it is considered a measure of learning potential. Through the administration of this kind of tests, the learning potential assessment would consider, in a clinical way, the presence of cognitive plasticity in the elderly (Calero & Navarro Gonzalez, 2006).

Considering that mnesic changes during aging have played a noticeable role in different older adult’s studies, the current study entitled the learning potential version of the Rey’s (1964) Auditory Verbal Learning Test (AVLT-LP) to assess episodic memory. Neurocognitive assessment and research on aging have focused on the early detection of cognitive deficits, especially to identify markers that may be predictors of possible deterioration. Among them we can find the alteration of episodic memory as a possible predictor of evolution towards an Alzheimer type dementia (García Herranz, 2013).

In its original version (Rey, 1964) the AVLT consists in a list of 15 simple words (list A) that the evaluator reads aloud asking the evaluated to repeat them. List A is read 5 times (trials A1 to A5), and the evaluator records the number of words the subject remembered in each trial. The Auditory Verbal Learning Test – Learning Potential version (AVLT-LP) is the adaptation of the traditional AVLT to assess learning potential (Wiedl, Wienobost, & Schöttke, 1999, Spanish version of Calero, 2000). In the AVLT-LP the evaluator presents list A for 6 times (trials A1 to A6) and, in the intermediate trials (A3 and A4) the evaluator introduces the mediation or training. The mediation consists of a given feedback, monitoring and reinforcement of the words recalled by the subject. In the AVLT-LP, the average between the first trial (A1 and A2) is called pre-test (or baseline/current

performance), and the average between the last trials (A5 and A6) is called post-test (or potential performance). The difference between post-test and pre-test allows the evaluator to estimate the gain score which evidence cognitive plasticity. Unlike the AVLT that requires certain neutrality on behalf of the evaluator, the AVLT-LP requires the evaluator to be actively involved. The behavior developed by the evaluator is adapted to the performance of the subject, in order to stimulate the learning of the words. In this way, an interaction relationship between both builds an atmosphere of teaching and personalized help (Cabras, 2012). The administration procedure in the AVLT-LP is summarized in table 1.

Previous studies in Spain conclude that a gain score equal-to or greater-than 3 points, would refer to a “winning subject” as a valid evidence of learning potential and cognitive plasticity (Calero & Navarro González, 2006; Calero-García, 2004). In these cases, it is stated that the winning subjects are those who have been able to benefit from mediation. Nevertheless, it should be mentioned that these studies have worked with a low educated older adults’ sample. In this sense, the 3-point gaining score may be not valid for other population, suggesting the necessity to obtain local data to confirm the best gain score cut-off in regional samples. Therefore, the present study states a local contribution for older adults’ learning potential assessment in Latin American.

Calero and Navarro Gonzalez (2006) observed that older adults who were in the initial stages of a cognitive decline process had no evidence of learning potential (low gain score), while cognitively healthy older adults learned

significantly more words in these tests (high gain score). Several studies have replicated this type of study in healthy older adults with Mild Cognitive Impairment (MCI) and in different stages of dementia (Boosman, Boven d’Eerd, Visser-Meily, Nijboer, & Heugten, 2016; Cassinello, Mestre, & Fernández-Ballesteros, 2008; Fernández-Ballesteros, Zamarrón & Tárraga, 2005; Fernández-Ballesteros et al., 2003; Zamarrón, Mestre, & Fernandez Ballesteros, 2009). Thus, the AVLT-LP would be especially useful for the differential diagnosis of MCI identifying neuropsychological markers that may potentially predict cognitive decline in prior stages to dementia, resulting of valuable interest for research (García Herranz, 2013; Miranda et al., 2015; Russo et al., 2013).

Although in different studies the ability of older adults to benefit from training and the assistance of a mediator has been observed (Calero & Navarro Gonzalez, 2006; French, Barandiarán, Marcellán, & Moreno, 2003; Calero-García, 2001; Navarro Gonzalez & Calero, 2011), the results of these studies are not enough to demonstrate whether this gain is related to the aids provided by the evaluator (mediation), or whether it is due to the activation of skills already present in the elderly (Baltes, 1987; Navarro González & Calero, 2011; Staudinger, Marsiske, & Baltes, 1995).

Therefore, the purpose of the present study is to observe the mediation’s influence on a verbal episodic memory test performance assessed by the AVLT-LP. Likewise, an approximation of the AVLT-LP with local South American population is proposed, given that studies with this type of techniques at a regional level is very limited.

Table 1
Administration procedure in the AVLT-LP (Calero y Navarro Gonzalez, 2006)

List A	Instruction	stage	
A1	Standard instuction	Mean A1 and A2 = Pre-test	Post-test – Pre-test = Gain Score
A2	Standard instuction		
A3	Extended instruction	Training / mediation	
A4	Extended instruction		
A5	Standard instuction	Mean A5 and A6 = Post-test	
A6	Standard instuction		

Method

Participants

The study included 70 Argentinean healthy older adults, between 60 and 85 years old ($X = 72.94$; $SD = 6.82$) of both genders (67% of women) with an average of 12.75 ($SD = 3.96$) years of formal education. All subjects were informed of the study's objectives and voluntarily signed an informed consent.

Instruments

The subjects were assessed by two professional experts in neuropsychological assessment in a session of approximately 1 hour and a half. During the session, a neuropsychological battery was administered that included the following tests:

- *Mini Mental State Examination (MMSE)* (Allegri et al., 1999; Butman et al., 2001; Folstein, Folstein, & McHugh, 1975; Lobo et al., 1999): used for the initial screening of cognitive impairment that assesses cognitive decline in a quick and standardized way. In the present study the MMSE was administered according to the guidelines published by the Clinical Neuropsychology Working Group of the Argentine Neurological Society (Allegri et al., 1999; 2011).

- *Frontal Assessment Battery - FAB* (Dubois, Slachevsky, Litvan, & Pillon, 2000; Rodríguez del Álamo, Catalán-Alonso, & Carrasco-Marín, 2003): screening tool for executive functions exploration. The FAB quickly and briefly assesses different cognitive abilities considered within the executive functions, such as conceptualization capacity, mental flexibility, motor programming, sensibility to interference, inhibitory capacity and environmental autonomy.

- *Boston Naming Test-short version* (Kaplan, Goodglass, & Weintraub, 1983; Serrano et al., 2001): naming test of drawings used as an instrument to detect language alterations (anomies) and semantic memory decline associated with cognitive impairment in Alzheimer's disease.

- *Verbal Fluency Tasks* (Carnero-Pardo & Lendínez-González, 1999; Labos, Trojanowski, del Rio, Zabala, & Renato, 2013): categorical evocation test where the subject is asked to name all the words he can within 60 seconds within a

semantic category (animals) and a phonological category (words that start with the letter P). It is a sensitive test to observe the presence of cognitive alterations.

- *Clock Drawing Test* (Cacho, García-García, Arcaya, Vicente, & Lantada, 1999; López, Allegri, & Soto-Añari, 2014; Sunderland, Hill, Mellow, Lawlor, Gundersheimer, Newhouse, & Grafman, 1989): this quick and simple test is sensitive for the detection of cognitive decline. In this study, the subject was asked to draw a clock and its numbers, and that the needles should mark 11:10.

- *AVLT-LP* (Calero & Navarro-González, 2006): modified version of the AVLT to assess learning potential. In this version, the evaluator introduces the mediation in the intermediate items of the list (A3 y A4), and a gain score is obtained after calculating the difference between the averages of the last trials (A5 y A6) and the first two trials (A1 y A2). The procedure for the administration of the AVLT-LP was previously detailed in table 1.

Procedure

The 70 participants were randomly divided into two groups of 35 subjects each: one group received mediation (MG) in A3 and A4 trial of the AVLT-LP, and the other group didn't receive mediation or training in those trials (NoMG). The differences in the application procedure of the AVLT-LP according to the groups are described in table 2. As mentioned above, the standard instructions applied to the NoMG, consisted of the neutral reading of the words in the list and the recording of the words remembered by the subject, i.e. without interventions by the evaluator. On the other hand, the MG received the extended instructions (provided by Calero & Navarro-González, 2006) consisting in reading the words on the list together with an active intervention by the evaluator (mediation), providing, in trials 3 and 4, feedback on their performance and a reinforcement in the reading of the words that the subject has not yet learned, recording the words recalled in each trial.

Table 3 summarizes the sociodemographic characteristics of the groups (MG and NoMG) which are homogeneous in terms of gender, age and educational level.

Table 2
Application procedure of the AVLT-LP among the groups with and without mediation

Mediation group (N=35)			
	Instruction		Scores
Trial 1	Standard	Number of recalled words	Pre-test score: mean between recalled words in trials 1 and 2
Trial 2	Standard	Number of recalled words	
Trial 3	Extended	Number of recalled words	(The evaluator does the mediation)
Trial 4	Extended	Number of recalled words	
Trial 5	Standard	Number of recalled words	Post-test score: mean between recalled words in trials 5 and 6
Trial 6	Standard	Number of recalled words	

Without Mediation Group (N=35)			
	Instruction		Scores
Trial 1	Standard	Number of recalled words	Pre-test score: mean between recalled words in trials 1 and 2
Trial 2	Standard	Number of recalled words	
Trial 3	Standard	Number of recalled words	(The evaluator does not do the mediation)
Trial 4	Standard	Number of recalled words	
Trial 5	Standard	Number of recalled words	Post-test score: mean between recalled words in trials 5 and 6
Trial 6	Standard	Number of recalled words	

Table 3
Sample's sociodemographic characteristics

	Total sample N=70		Mediation group N=35		Without mediation group N=35		<i>t</i>	<i>p</i>
	<i>X</i>	<i>SD</i>	<i>X</i>	<i>SD</i>	<i>X</i>	<i>SD</i>		
Gender	67% women		69% women		66% women		N/A	.87
Age	72.94	6.82	73.74	6.42	72.01	7.25	.31	.31
Educational level	12.75	3.96	12.49	3.83	13.07	4.15	.56	.56

Values are shown in mean (*X*) and standard deviation (*SD*). Educational level is shown in years of formal education.

Data analysis

The analysis consisted in the comparison of the performance between the MG and the NoMG, assuming the hypothesis that the subjects of the MG would recall more words than the NoMG. The statistical tool used to compare the MG and NoMG's means was Student's *t* test for independent samples. Cohen's *d* effect size was estimated when significant differences were found. The SPSS v21.0 statistical package was used to carry on the analysis.

Results

The performance in the neuropsychological tests between both groups was compared (see table 4). The performance in classical neuropsychological tests, such as the MMSE ($p = .13$), Clock

Drawing Test ($p = .33$), Phonological Verbal Fluency ($p = .67$), Semantic Verbal Fluency ($p = .83$), abbreviated Boston Naming Test ($p = .19$) and FAB ($p = .77$), did not present statistically significant differences between the groups. In terms of the AVLT-LP, both groups started remembering a similar number of words ($p > .05$), but the MG ended up remembering significantly more words than the NoMG in trial 6. The MG recalled more words after the mediation was done in trials 3 and 4, ending with statistically significant differences in trial 6 ($t_{(68)} = 2.22$; $p = .03$). A significant effect size of moderate magnitude was observed for the differences between the groups in trial 6 ($d = .55$). The comparison of the pre-test score (average between trials 1 and 2) resulted in similar scores between the two groups ($p = .47$), but the post-test score (average between trials 5 and 6) evidenced higher scores in the MG ($t_{(68)} = 2.35$; $p = .02$), in-

Tabla 4
Resultados obtenidos en las pruebas neuropsicológicas

	Mediation group N = 35		Without mediation group N=35		t test		Effect size
	X	dt	X	dt	t	p	d
Minimental	28.71	1.1	29.10	.92	-1.52	.13	N/A
Clock drawing test	9.29	1.26	9.25	1.34	-.98	.33	N/A
Phonemic fluency	16.09	4.44	15.6	4.61	.43	.67	N/A
Semantic fluency	19.11	3.84	18.90	3.99	.22	.83	N/A
Boston naming test	11.4	.74	11.63	.67	-1.33	.19	N/A
FAB	17.23	.88	17.17	.79	-.29	.77	N/A
AVLT-LP Trial 1	4.49	1.72	4.73	1.48	-.62	.54	N/A
AVLT-LP Trial 2	7.14	1.99	7.5	1.86	-.75	.46	N/A
AVLT-LP Trial 3	9.37	2.16	8.63	2.14	1.38	.17	N/A
AVLT-LP Trial 4	10.46	2.31	9.93	2.12	.95	.35	N/A
AVLT-LP Trial 5	11.29	2.37	10.23	2.78	1.65	.1	N/A
AVLT-LP Trial 6	12.17	2.36	10.8	2.62	2.22	.03	.55
AVLT-LP Pre-test	5.81	1.63	6.1	1.52	-.73	.47	N/A
AVLT-LP Post-test	11.73	2.24	10.25	2.84	2.35	.02	.58
AVLT-LP gain score	5.91	1.78	4.65	2.09	2.63	.01	.65

Values are shown in mean (X) and standard deviation (SD).

dicating that those subjects who were exposed to mediation from trial 3 and 4, finished the test with a better performance than those who did not. In this case, a significant effect size of moderate magnitude was also observed for the differences between the groups in the post-test score ($d = .58$).

Finally, the most significant finding was the analysis of the gain scores between the groups. The MG ended with a higher average gain score of 5.91 words recalled ($SD = 2.24$), while the NoMG ended with an average gain score of 4.65 words ($SD = 2.09$). These differences were statistically significant ($t_{(68)} = 2.63$; $p = .01$). The effect size observed for these differences was moderate to strong ($d = .65$). It is important to highlight that both groups obtained a high gain score, but when the subjects were exposed to mediation by the evaluator, the profit goes up even more.

Discussion

The results in the present study suggest, as observed in different previous studies (Baltes & Kliegl, 1992; Calero & Navarro González, 2006), that by performing a dynamic assessment (with the use of mediation) older adults can improve their cognitive performance and benefit from the interventions and aids from an expert evaluator.

In the present study, the interventions used were highly significant and were able to differentiate the subjects who received it from those who did not.

All the subjects included in the present study were categorized as cognitively healthy, and their performance in all tests was considered normal. However, the group who received mediation in the AVLT-LP presented an even better performance in this test than the group who did not receive it. Given the demanding analysis carried out to corroborate the homogeneity of the groups in terms of sociodemographic variables and cognitive performance, the differences in the AVLT-LP cannot be explained by any other phenomenon than the intervention of the evaluator in the mediation stage. This would indicate that, in conditions of optimal stimulation, older adults show a greater cognitive performance.

The sample was composed of homogeneous subjects in terms of gender, age, educational level and cognitive performance, and it is interesting that the only differences occur precisely in the items where the evaluator's mediation effect was observed. Thus, it can be deduced that the inclusion of the mediation by the extended instructions proposed by the dynamic assessment, enhances significantly the verbal episodic memory performance. The results suggest that mediation was

effective to improving learning, since the values showed differences in the number of words remembered after the mediation (post-test) but not before it (pre-test). This is of particular interest given that, until now, the specific influence of mediation on this memory test in healthy elderly adults has not been analysed separately (Calero & Navarro González, 2006).

Conclusion

The main purpose of dynamic assessment is to study, not only the observed or current performance, but also the potential performance that a subject could reach when exposed to an enriching and stimulating environment. Authors who rely on this line (Calero & Navarro Gonzalez, 2006; Malbrán & Villar, 2002; Calero-García, 2004, Cabras, 2012; Vygotsky & Cole, 1979) consider the intelligence as the ability to learn, seeking to approach the understanding of a subject's performance considering not only their current but also their potential performance. In this way, the neurocognitive tests that are sustained in this theoretical framework look for measures of learning potential and cognitive plasticity. The purpose of this methodology is to operationalize the concept of the learning curve by interpreting a gain score.

It is interesting to note that the interventions carried out in the mediation stage of the AVLT-LP were aimed at simply stimulating the subject to create new learning strategies, but the subject is not explicitly told which strategy to use. It could be hypothesized (research studies are yet to be carried out) that, if the strategies were greater and more explicit, the subjects would improve even more, especially in cognitively impaired patients.

This study established a relevant antecedent in the investigation of the dynamic neuropsychological assessment field. It is known that the contribution of this type of approaches is valuable for the differential diagnostic between a performance within normal parameters and a performance below it (Boosman et al., 2016; Calero-García 2004). The aim of our research is to continue studying the AVLT-LP in healthy and cognitively impaired older adults.

The dynamic neuropsychological assessment, and the current and potential performance observation of the older adult performance, proves to be an important contribution to the description of cognitive status, and could collaborate with

a more accurate early diagnosis of an incipient cognitive decline. The present work sought to provide evidence of the usefulness of the evaluation of learning potential and its differences with traditional static assessment. In order to study the diagnostic and prognostic capacity of this test, new studies are designed to study the gain score cut-off and the variability of cognitive plasticity along the different trajectories of normal aging, MCI and mild Alzheimer's disease

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