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WORKING MEMORY AND READING COMPRENHENSION IN YOUNG PEOPLE WITH INTELLECTUAL DISABILITIES

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Abstract

The difficulties of people with intellectual disabilities to construct meanings from texts, makes it necessary to study their performance at different levels of execution. This article shows the results of the research carried out on the relationship between measures of working memory, spelling and reading comprehension, of a group of 25 young people with mild and moderate intellectual disabilities. The comprehension of sentences, simple narrative text, expository text and the comprenhension of complex text was analyzed. The results showed that people with intellectual disabilities do not perform these tests uniformly. It was also noted that there is a significant correlation between the measurements of *working memory, fluid intelligence* and *spelling.* The relationship between *reading comprehension* scores and the rest of the variables was not as expected. The tests used in this research have been proven to be adequate to assess people with mild to moderate intellectual disabilities who have acquired literacy skills.

Keywords: Working memory, reading comprehension, fluid intelligence, cognitive disabilities.

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1. Introduction

Numerous authors have studied the strong relationship between intelligence and memory. There are several memory tasks within the intelligence test; consequently there is an interdependence between intelligent tests and sub-tests of memory. There is a correlation between working memory (WM) and complex cognitive processes, because WM is fundamental for cognition.

After analysing the sub-tests in the tests battery, Gathercole and Alloway (2008) confirmed that intelligence measures are strongly influenced by those of WM, since they measure a relatively wide range of capacities. This produces a summation effect. However, WM´s tests evaluate the capacity of the components of a particular system. Intellectual quotient (IQ) scores are associated with children's learning, particularly in school subjects such as reading, mathematics, and their previous experience. However, the measure of WM is "relatively pure." It is evident that there is a direct correspondence between the WM measures and the IQ. Many children with a poor WM have a low IQ and vice versa. In addition, difficulties in WM produce serious limitations in children's ability to learn. This relationship has not yet been studied in depth in people with intellectual disabilities (ID). It seems clear that the deficits in the intelligence scores will correlate with WM deficits, but there are still many aspects that should continue to be studied. Some of these are the functioning of the WM in people with intellectual disabilities, the role of the IQ and its implications in the WM, and the differences in cognitive function in relation to the IQ.

2. Problem Statement

Miller, Galanter, and Pribram (1960) proposed, for the first time, the concept of *Working Memory* (WM), as it is currently conceived. From the work of Atkinson and Shiffrin (1968, 1971) and their "multi-store model", the WM became the object of study of cognitive psychology. This model meant the overcoming of the traditional, purely structuralist vision of the human memory system. Despite the general consensus on the importance of WM in cognition, there are numerous theoretical models that try to explain its structure and function. One of the aspects in which these models differ is in the consideration of a multicomponent nature as opposed to a unitary one. Among the first highlights the one proposed by Baddeley and Hitch (1974) and their subsequent reformulations (Baddeley, 2007).

The WM capacity of children grows as age increases. This occurs similarly in all its components (Gathercole, Pickering, Ambridge, & Wearing, 2004). However, not all children of the same age have the same WM capacity. In fact, the differences can be very pronounced. Numerous studies have confirmed that the evolutionary differences in the WM are mainly of a functional nature, and are due to the better use of the specific resources and processes involved in the different tasks (Gutiérrez-Calvo, 2003). This approach has favored the development of procedures for the measurement of WM, allowing to establish and explain individual differences in complex cognitive tasks.

Although studies on the functioning of WM in people with ID have increased in recent decades, most have focused on specific groups with known etiologies, such as Down Syndrome, Williams Syndrome and X-Fragile Syndrome (Di Blasi, Buono, Città, Costanzo, & Zoccolotti, 2018). These studies have provided different data on the specific profile of each group, which sometimes differ significantly from one another.

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There is little research that has explored the functioning of the WM in borderline and mild ID of unknown etiology and, even less, with moderate ID. Frequent investigations that focus on what the role of IQ and its implications for the WM in this population are also excluded. Children with ID present difficulties of a global nature that have an impact on their capacity for attention, concentration, listening and understanding, amongst others. These are going to pose important repercussions on the results of the report. What is clear is that children and adults with moderate or severe ID have WM deficits (Gathercole & Alloway, 2006).

The interest in applying the conclusions of the studies on WM to the field of education, has increased the number of researches focused on specific aspects of learning, such as reading comprehension, reasoning or calculation. Research has increased in this field analysing the role that WM plays in learning disorders and the difficulties that children with a poor WM find in school (Gathercole & Alloway, 2008; Vicari, Costanzo, & Menghini, 2016). Regarding ID, it seems that the relationship between cognitive ability and WM is greater than in the population without disabilities, being an important predictor of results (Vicari, Costanzo, & Menghini, 2016). Van Tilborg, Segers, Van Balkom, and Verhoeven (2018), compared 53 children aged 5 and 6.5 years with different etiologies, with other children without ID, and observed that the phonological working memory capacity in children with ID was significantly reduced. This influenced the learning of letters and new words.

3. Research Questions

After reviewing previous study and set out the research problem, the main research questions asked were:

- As in the population without intellectual disability, people with mild and moderate intellectual disabilities are expected to present a relationship between intelligence and working memory.
- As in the population without intellectual disability, the scores of young people with light and moderate disabilities in operational memory will correlate with the performance of tasks of understanding sentences, simple texts and complex texts.

Finally, operational memory measures will also correlate, as in the population without intellectual disabilities, with the spelling skills of people with light and moderate disabilities.

4. Purpose of the Study

The main objective of the study has been to analyze the relationship between measures of WM, spelling and reading comprehension of a group of young people with mild and moderate intellectual disabilities.

In addition to this objective, we have tried to confirm the effectiveness of reading comprehension measures, *Evaluación diagnóstica de la comprensión lectora* (EDICOLE) (García Madruga et al., 2010) and *Evaluación de los Procesos Lectores de los Niños de Educación Primaria Education* (PROLEC) (Cuetos, Rodríguez, & Ruano, 1996) and WM, *Reading amplitude test for children-Primary* (PAL-P) (Orjales, García-Madruga, & Elosúa, 2010), in the population with ID.

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5. Research Methods

5.1. Sample

The study involved 27 young people with intellectual disabilities, enrolled in a special education college. One of them could not perform the tests because he did not understand the instructions. After conducting the tests, another subject was excluded by always giving the same answer to all questions, in a persevering way. The group was made up of 25 young people with an age range between 13 and 21 years (average 17.11 years). 15 were girls and 10 boys.

The majority of participants had moderate intellectual disability and 4 of them had mild intellectual disability. The average IQ was 50.04, varying between 40 and 65.

5.2. Test

The tests applied in the data collection were:

- Fluid Intelligence. *Matrices Subtest of the Kaufman Brief Intelligence Test* (K-BIT; Kaufman & Kaufman, 2000).
- Working Memory. *Prueba de amplitud Lectora para niños-Primaria* (PAL-P). Orjales, García-Madruga, & Elosúa, 2010), for primary students of the Reading Amplitude Test of Elosúa, Gutiérrez, García Madruga, Luque, and Gárate (1996). This is the Spanish version of the *Reading Span Test* (RST) (Daneman & Carpenter, 1980). After completing the test, it was found that due to the difficulties of the participants, the scores were not sufficiently discriminatory. Therefore, the correction criterion was adapted so that the comparison of the data was more discriminative. The test items and all the correct answers given were taken into account, even if the test was not completed.
- Orthography. *Test de reglas de ortografía de la Batería de Evaluación de la Lectura* (BEL) (López-Higes, Mayoral, & Villoria, 2002).
- Reading comprehension:
  - *EDICOLE* (García-Madruga et al., 2010, Spanish version of *Diagnostic Assessment of Reading Comprehension* (DARC) (August, Francis, Hsu, & Snow, 2006; Francis et al., 2006).
  - Subtest Comprehension of Sentences and subtest Understanding the Texts of the Battery for *Evaluación de los Procesos Lectores de los Niños de Educación Primaria* (PROLEC) (Cuetos, Rodríguez, & Ruano, 1996).

5.3. Design

The design was intrasubjects. All the participants completed all of the tasks. The administration of the tests was individual. Although several of the tests can be administered as a group, this ensured their correct understanding and performance. The presentation of the PAL-P test phrases was made on the computer.

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6. Findings

Table 1 shows the means, standard deviations and maximum and minimum scores of the results of the tests applied, and the correlations between the analyzed variables.

The results of the tests carried out found that young people with ID obtained worse results than the population without disabilities in the different measures. In the spelling test, the subjects obtained an average of 12.12, with a range of scores between 5 and 20. The average of the students of 3rd grade of 8 years, in that same test, is higher, 15, 18, although the range of response is similar, 7-19. In the EDICOLE reading comprehension test, young people with ID obtained an average of 22.68 with a response range of 12-23, while subjects of 2nd grade of primary school, 7 years old, obtained an average of 25.8 and a response range of 14-37 (García-Madruga et al., 2013). The results of the PROLEC sentence comprehension test, 9.52, are also below the average of the results of the students of 1st grade (M = 10), but, in the comprehension of texts are found by above the scores of children in the 2nd grade, 9.72 versus 8.

As can be seen when analyzing the correlations, the results were disparate in relation to the hypotheses raised. As expected, the analysis of the data obtained showed a significant correlation of r=0.76 ($p<0.01$) between the measurement of *operational memory* and that of *fluid intelligence*, confirming our first hypothesis. It is also found that the correlation, r=0.52 ($p<0.01$), between the measurement of *operational memory* and *spelling* is, as we assumed, significant, and between the latter and *fluid intelligence*, r=0.47 ($p<0.01$). However, the relationship between *reading comprehension* scores and the rest of the variables was not as expected and allowed us to confirm our second hypothesis only partially.

Table 01. Descriptive statistics (Mean, Standard Deviation) and correlation coefficient (Pearson) between the different measures of working memory, fluid intelligence , spelling and reading

	1	2	3	4	5	6	7
1. PAL-P	1	.76**	.52**	.47*	.18	-.04	.32†
2. K-BIT Matrices		1	.47**	. 50*	-.02	-.16	.14
3. Spelling			1	. 50*	. 29	.03	.02
4. PROLEC. Sentences				1	.24	-.32	.05
5. PROLEC Texts					1	.22	-.02
6. EDICOLE Total						1	.03
7. EDICOLE Total - NO							1
Mean	6.56	18.92	12.12	9.52	9.52	22.68	4.36
Standard Deviation	6.02	5.48	4.19	1.73	3.32	6.49	2.56
Range	0 - 24	11 - 35	5 - 20	5 - 12	2-15	12 – 33	0 - 10

**p< 0,01; *p<0,05; †p<0,06

7. Conclusion

The objective of this work has been to further study the cognitive functioning of persons with ID and the role of WM in relation to reading comprehension and spelling tasks.

We can see that persons with ID do not perform these tests uniformly. The intellectual deficit does not affect the execution of the different tasks unilaterally. In many investigations conducted with persons with ID, we see that the group of subjects with disabilities are matched with another of the same mental age. In this way its operation is compared in the different measures investigated. We believe that, although

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this pairing provides significant information, the cognitive functioning of a person with intellectual disability is not equal to that of a child of the same mental age. In tasks of similar content, such as those that concern us, we have verified that this occurs. Presumably, these differences will be accentuated by comparing tasks in which different cognitive processes are involved.

The tests in which the subjects of our study obtained better results compared to the population without disabilities, were the spelling and the text comprehension test of the PROLEC. This would be in line with the conclusions of Henry and Winfield (2010), that children with ID benefited from a more elaborate representation of long-term memory, due to greater experience in life, which makes them obtain better results in these tasks than in the others.

The highest correlation was obtained between fluid intelligence and WM. As in subjects without ID, the measurement of operational memory is a strong predictor of general fluid intelligence. The operative memory-intelligence relationship is not only significant in people with limited levels of intelligence, but for those with moderate ID.

One of the main difficulties in conducting research with persons with ID is to have tests that allow us to perform the desired measurements. In this study we have been able to verify that the tests used allow us to adequately assess the subjects with light and moderate ID. The tests used certain requirements that allow them to be performed, in this case it was reading, which many of these subjects did not have. To carry out our research we had to select young people with moderate disabilities and sufficient reading level to read the test text phrases. Not having measures adjusted to the real level of subjects with ID makes it difficult to carry out research that allows us to provide data on their cognitive development and functioning, and with them, improvements in educational intervention and their quality of life.

Research on intellectual disability is scarce and sometimes lacks the rigor applied to other issues. The difficulty in interacting, communicating and obtaining data from people whose cognitive deficits are significant, hinders the task of any researcher. However, understanding the development and learning difficulties of these people, not only benefits the intervention we can carry out with them. In the field of education, it provides us with information to develop strategies and programs from which the rest of the groups can benefit. Therefore, although the difficulties cause progress to be slow, studies should be designed to provide information and allow us to broaden our knowledge about the cognitive functioning of persons with ID.

References

Atkinson, R. C., & Shiffrin, R. M. (1968). Human Memory: A Proposed System and its Control Processes. *Psychology of Learning and Motivation,* 89-195.

Atkinson, R. C., & Shiffrin, R. M. (1971). The control of Short-Term Memory. *Scientific American*, 225 (2), 82-91.

August, D., Francis, D. J., Hsu, H.-Y. A., & Snow, C. E. (2006). Assessing Reading Comprehension in Bilinguals. *The Elementary School Journal, 107*(2), 221–238

Baddeley, A. (2007). *Working memory, thought, and action*. Oxford: Oxford, University Press.

Baddeley, A. D., & Hitch, G. (1974). Working memory. *Psychology of Learning and Motivation*, *8*, 47-90.

Cuetos, F., Rodríguez, B., & Ruano, E. (1996). *PROLEC-R: Batería de evaluación de los procesos lectores*. Madrid: TEA Ediciones.

Daneman, M., & Carpenter, P. A. (1980). Individual Differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19,* 450-466.

Di Blasi, F., Buono, S., Città, S., Costanzo, A., & Zoccolotti, P. (2018). Reading Deficits in Intellectual Disability Are still an Open Question: A Narrative Review. *Brain Sciences, 8*(8), 146.

Elosúa, M. R., Gutiérrez, F., García Madruga, J. A., Luque, J. L., & Gárate, M. (1996). Adaptación española del "Reading Span Test" de Daneman y Carpenter. *Psicothema*, *8*(2), 383-395.

Francis, D. J., Snow, C. E., August, D., Carlson, C. D., Miller, J., & Iglesias, A. (2006). Measures of Reading Comprehension: A Latent Variable Analysis of the Diagnostic Assessment of Reading Comprehension. *Scientific Studies of Reading, 10*(3), 301–322.

García Madruga, J. A., Pérez, E., Gómez-Veiga, I., Orjales, I., Gil, L., Elosúa, R., & López Escribano, C. (2010). Prueba de comprensión lectora para enseñanza primaria: EDICOLE (evaluación diagnóstica de la comprensión lectora). Unpublished work.

García-Madruga, J. A., Elosúa, M. R., Gil, L., Gómez-Veiga, I., Vila, J. Ó., Orjales, I., & Duque, G. (2013). Reading Comprehension and Working Memory's Executive Processes: An Intervention Study in Primary School Students. *Reading Research Quarterly*, *48*(2), 155-174.

Gathercole, S. E., & Alloway, T. P. (2006). Short-term and working memory impairments in neurodevelopmental disorders: Diagnosis and remedial support. *Journal of Child Psychology & Psychiatry*, *47*, 4-15.

Gathercole, S. E., & Alloway, T. P. (2008). *Working Memory and Learning.* London: SAGE Publications.

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology, 40*, 177–190.

Gutiérrez-Calvo, M. (2003). Memoria operativa e inferencias en la comprensión del discurso. In J.A. León (Coord.), *Conocimiento y discurso*. Madrid: Pirámide.

Henry, L., & Winfield, J. (2010). Working memory and educational achievement in children with intellectual disabilities. *Journal of Intellectual Disability Research, 54*(4), 354–365.

Kaufman, A. S., & Kaufman, N. L. (2000). *K-BIT, Test breve de inteligencia de Kaufman.* Madrid: Pearson.

López-Higes, R., Mayoral, J. A., & Villoria, C. (2002). *Batería de evaluación de la lectura (BEL)*. Madrid: Psymtec.

Miller, G. A., Galanter, E., & Pribram, K. H. (1960). *Plans and the structure of behavior*. New York, NY: Henry Holt and Co.

Orjales, I., García-Madruga, J. A., & Elosúa, M. R. (2010). Prueba de amplitud lectora para primaria, PAL-P. Unpublished manuscript.

Van Tilborg, A., Segers, E., van Balkom, H., & Verhoeven, L. (2018). Modeling individual variation in early literacy skills in kindergarten children with intellectual disabilities. *Research in Developmental Disabilities, 72*, 1–12.

Vicari, S., Costanzo, F., & Menghini, D. (2016). Memory and Learning in Intellectual Disability. *International Review of Research in Developmental Disabilities*, 119-148.