PEL Pensamiento Educativo. Revista de Investigación Educacional Latinoamericana
2018, 55(2), 1-16

Pontificia Universidad Católica de Chile
Facultad de Educación

Relationships Between Oral Comprehension and Executive Functions in Pre-School Children. Impact of an Integrated Development Program.

Relaciones entre comprensión oral y funciones ejecutivas en niños de nivel pre-escolar. Impacto de un programa de desarrollo integral.

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Abstract

The present study aims to observe the impact of the implementation of an Integrated Development Program to improve comprehension skills and executive functions in 5 years old children. In order to develop a pilot intervention, preliminary versions of 15 didactic sequences that make up the book Klofky and his friends explore the world 1 (Program We Want to Learn) were applied within differents classrooms. Participants were 47 children from two Kindergartens in La Plata, Argentina, who were part of an experimental group (EG) and a control group (CG). The intervention in the EG consisted of 56 sessions of one hour (3 per week) in which the activities focused on different skills: language (phonological awareness, oral language development, vocabulary, reading and writing of words), cognitive (executive functions) and socio-emotional. Children in both groups were evaluated at the beginning and at the end of the intervention. In the case of oral comprehension and executive functions, the focus of this work, the results showed that the intervention helped to develop these skills and the relationships between the variables in the EG. Significant differences were observed between groups with low, medium and high effect sizes in all variables.

Keywords: intervention, preschool, oral comprehension, executive functions, educational policies

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***This research was funded by the Comisión de Investigaciones Científicas de la provincia de Buenos Aires, Argentina, in the years 2015-2016 and a subsidy of the Universidad Nacional de La Plata through an extension project.**

ISSN:0719-0409 DDI:203.262, Santiago, Chile
doi: 10.7764/PEL.55.2.2018.8

Resumen

El presente estudio se propone observar el impacto de la aplicación de un programa de desarrollo integral en el desarrollo de las habilidades de comprensión oral y las funciones ejecutivas de niños de 5 años. Para ello, se aplicó en un estudio piloto una versión preliminar de las 15 secuencias didácticas que componen el libro "*Klofky y sus amigos exploran el mundo 1*" (Programa Queremos Aprender). Participaron 47 niños de dos jardines infantiles de la ciudad de La Plata, Argentina, que formaron parte de un grupo experimental (GE) y un grupo control (GC). La intervención en el GE consistió en 56 sesiones de una hora (tres horas semanales). En las sesiones, se focalizó en el desarrollo de habilidades lingüísticas (conciencia fonológica, desarrollo del lenguaje oral, vocabulario, lectura y escritura de palabras), cognitivas (funciones ejecutivas) y socio-emocionales. Los niños de ambos grupos fueron evaluados al inicio y al finalizar la intervención. En el caso de la comprensión oral y las funciones ejecutivas, foco de este trabajo, los resultados mostraron que la intervención potenció el desarrollo de estas habilidades y las relaciones entre las variables en el GE. Se observaron diferencias significativas entre los grupos y tamaños del efecto bajos, medios y altos en todas las variables.

Palabras clave: intervención, preescolar, comprensión oral, funciones ejecutivas, políticas educativas

In the last few years, research has focused on the cognitive and linguistic development of pre-school children, as it has been observed that the knowledge and skills which are developed early have an impact on the learning process in future stages (Shanahan & Lonigan, 2013; Stanovich, 1986). In relation to literacy, different precursor skills have been identified, which predict the learning of reading and writing (Guardia, 2011; Whitehurst & Lonigan, 1998). Among these skills, it is possible to find phonological awareness, knowledge about letters, writing isolated words (e.g. our own name), phonological memory, knowledge about writing and style of the written language, oral comprehension, vocabulary and visual processing (National Reading Panel, 2000).

Results from previous research also show that early intervention through adequate programs can decrease the gap between children from different sociocultural contexts (Suggate, 2016). Therefore, it is currently postulated that it is important to elaborate and implement programs that cater to children's comprehensive development and preparation for their future education – *School Readiness* (Blair, 2002; García Fernández, Chávez Valenzuela, Chávez, Delgado, Velázquez Saucedo, & González, 2018; High, 2017). These should be done considering not only children's cognitive and linguistic aspects, but also their social-emotional and physical-motor development.

In the case of Argentina, although many early intervention proposals have been implemented (e.g., Aran Filipetti & Richaud, 2008, 2001; Borzone, 2005; Colombo & Lipina, 2005; Marder, 2011), these consist of specific programs focusing on one singular aspect. Therefore, these have not been generalized to the whole educational system. The lack of public policies that attend to the implementation of systematic, evidence-based programs is seen in recent results from national (APRENDER, 2017) and international (PIRLS, 2017) testing instances. These have shown that children from different regions of the country face difficulties when reading and writing simple texts, even at the end of their primary and secondary years at school.

To counter this, a comprehensive program for pre-school children has been elaborated (Queremos Aprender). This program presents activities for the different dimensions of child development (Borzone & De Mier, 2017). This paper evaluates its impact on the development of skills for oral comprehension of texts and executive functions (EF) in a pilot implementation in two pre-school classrooms in the city of La Plata, Argentina.

Discourse Comprehension

Previous longitudinal studies on the development of oral comprehension skills of preschool to primary school students have shown that oral discourse comprehension and decoding skills are strongly interrelated when children learn to read fluently. Nevertheless, this relationship later weakens (Kendeou, van den Broek, White, & Lynch, 2009). As children automatize their decoding skills, oral comprehension independently predicts their reading comprehension performance (Storch & Whitehurst, 2002).

In the case of oral retellings, it is noted that from an early age, children can process inferences, identify relationships among events and establish coherence (e.g., Bustos & Crespo Allende, 2014; Rosemberg, 1994; van den Broek, 1997). Likewise, the retrieval of events from a story, in 4 to 6-year-old children, is related to other factors such as the characteristics of the story and general cognitive skills. Van Den Broek, Lorch y Thurlow (1996) showed that, in their own retellings, children tend to better retrieve events with a higher amount of causal links than those less causally connected. Additionally, pre-school children (4 to 5-year-olds) present lower sensibility to the causal structure between episodes from a single story and can only retrieve causal relationships within a single episode. At the same time, they emphasize the relationships between concrete events, that is, at the factual level of narration, disregarding the intention and objectives of the characters (van den Broek, 1997).

The development of comprehension and story retelling skills has been attributed to 1) the different experiences of children in situations where they are guided by adults to construct a mental model and 2) the increase of the EF. Particularly, the development of the capacity and efficiency of the working memory (Strasser & del Rio, 2013). This is why it is important to consider both factors, the intervention during oral reading in the classroom and the development of the EF, in the school curricula.

Executive functions and language development

The EF are cognitive skills that involve controlling attention and behavior (Blair & Ursache, 2011, Diamond, 2013, 2016). Therefore, they have a direct effect on school success, and are fundamental for programs of comprehensive development (Blair, 2002; Fuhs, Nesbitt, Farran, & Dong, 2014; McClelland et al., 2007). Its main components are Inhibitory Control, Verbal and Visuospatial working memory and Cognitive Flexibility (Diamond, 2013). In his model, Diamond (2013) regards Planning (PL) as a higher order component in need of the main components to develop. Inhibitory Control allows to maintain the attention and prevents automatic responses not related to the task being performed. For its part, both Verbal and Visuospatial working memory is an ability of limited capacity which allows to perform operations of mental representations. Cognitive Flexibility is the ability to shift perspectives and choose strategies suitable to the demands and external changes. Lastly, Planning allows to establish consecutive steps to perform a goal-oriented action. In this sense, Planning is crucial both during the text comprehension process and mathematical problem solving. At pre-school level, EF behave like a construct that predicts the academic performance of children (Rosas, Espinoza, Garolera, & San-Martín, 2017). What is more, further scholars sustain that EF are critical to school performance and that they are even more important than the IQ value for school readiness, both for literacy and math (Blair, 2002; Blair & Razza, 2007, Diamond, 2016).

In fact, existent evidence suggests that early development of EF improves academic performance. The Chicago School Readiness Project (CSRP) found out that children's EF (inhibitory control of attention and action) improved significantly more in pre-school classes where Head Start teachers had been trained in CSRP than those in other classes analyzed for comparison (Raver et al., 2011). Also, children significantly improved more in vocabulary, letter naming and math than those in the control group. The improvement of academic skills through the CSRP was largely mediated through the improvement of the EF. EF from the mid pre-school ages predicted success 3 years later in math and literacy. Furthermore, disadvantaged children who had been randomly assigned to a CSRP school tended to perform better at school 3 years later, mediated mainly through their EF (Li Grining, Raver, & Pess, 2011). (Diamond, 2016, pp. 21-22).

On another note, verbal fluency tasks (semantics and phonology) are also regarded of great use in cognitive and linguistic assessment because they are easy and quick to administer and are one of the most analyzed variables to measure executive functioning (Arán Filipetti, 2011; Matute, Rosselli, Ardila & Ostrosky, 2013). This skill implies linguistics aspects of search, expressive processing and phonological and semantics awareness processing. Yet, it also requires from the individual to exert executive control, since the child must retrieve from memory the lexical items adequate for the task, inhibit those that do not belong to the category and allow flexibility to change his answer under new demands.

Although different studies have focused on the relationship between the EF and language development, little is known about the interrelationship between these variables in light of a systematic intervention that attends to all the precursor skills for literacy and the different dimensions of child development (Korzeniowski, 2011). Among the studies on the role of memory in oral narration, Florit, Roch, Altoe y Levorato (2009) analyzed the relationship between text comprehension and pre-school children's memory so as to corroborate whether memory contributed to oral comprehension. Results showed that short-term memory and working memory predicted comprehension independently.

Daneri y Blair (2017) recently conducted a longitudinal analysis on the interrelationship between the EF and the language from pre-school to first grade students. The participants, 5 and 6-year-old children, completed a series of tasks of expressive vocabulary and EF in three stages. Results showed that both skills are related; therefore, the researchers suggest that intervention in both these aspects is key to promote school readiness and early school success.

Intervention to development oral comprehension skills

Numerous studies have shown the importance of intervention in the development of comprehension skills. All of these have observed the impact of the explicit teaching of strategies such as activation of previous knowledge, self-monitoring, summarizing, identification of text structure and formulating questions (e. g., Gersten, Fuchs, Williams, & Baker, 2001; Faggella-Luby & Deshler, 2008).

A study from van den Broek, Kendeou, Lousberg y Visser (2011) focused on the effects of question types and the moment in which these are asked (during or post reading) in the construction of a coherent mental model of textual information in pre-school children (3-year-olds) and 3rd grade primary school children. The intervention consisted of reading texts that were adequate to the children's age, answering questions (during or post reading, depending on the group) and retelling the text. Results showed that for both pre-school and primary school readers, the strategy of asking questions during reading proved to be more effective than asking question in the post reading stage. This study also included measuring of the working memory, and so it was observed that in both groups the higher capacity of working memory was associated to a higher level of comprehension.

Likewise, research has shown the impact of dialogic reading to favor the development of comprehension skills, vocabulary and knowledge of writing styles (Arnold, Lonigan, Whitehurst, & Epstein, 1994; Pullen & Justice, 2003; Whitehurst, Arnold, Epstein, Angell, Smith, & Fischel, 1994). Dialogic reading occurs when the adult reads the text aloud. In these instances, there are specific strategies at play such as text reformulation, repetitions, explanation of unfamiliar vocabulary and open-ended question formulation so that the child can make inferences (Borzone & Manrique, 2010). Recently, Ortega, Vega y Poncelis (2016) evaluated the impact of dialogic reading to promote comprehension and oral expression skills in pre-school children. They implemented a 13-session intervention, from which the results obtained showed that the exchange between the teacher and the students during reading stories allowed children to 1) elaborate inferences and arguments 2) develop knowledge about the style of written language and 3) reconstruct the stories.

To the best of our knowledge, oral comprehension in interaction with other variables under a framework of comprehensive literacy programs as proposed in this paper, has been poorly researched, though research has focused on the impact of specific EF programs in learning and comprehension (e.g., Rojas-Barahona, Förster, Moreno-Ríos, & McClelland, 2015). Empirical studies have had and continue to have theoretical and practical implications for educational intervention and evaluation. However, in the case of Spanish and specifically in Argentina, the number of programs that articulate these skills in their educational proposals is scarce. The development of comprehension skills is one of the axis of the pre-school curriculum in Argentina, but systematic programs that include interaction with other key factors such as the EF are not applied. This signals the importance of evaluating the relationships among these variables under the framework of a systematic intervention proposal.

This paper presents a pilot study on the impact of the intervention with materials from the 'Queremos Aprender' program. Specifically, there is a comparison of the results from the experimental and control groups obtained after the program application, and an analysis of the relationships between the EF and comprehension (assessed through the oral retelling of a story). It is expected that the participant children from this pilot experience obtain higher scores than those in the control group, in the post-test evaluation. In the case of comprehension skills, it is expected to observe an increase in both groups, but particularly in the children from the experimental group. Finally, in relation to the relationships among variables, it is possible to think that the correlations among the EF and the comprehension skills will show a higher value in the experimental group, which would give an account of the effect of the intervention.

Methodology

Research Design

This study follows a comparative quasi-experimental design of two groups (experimental and active control group), with repeated measures of pre and post-intervention tests (Hernandez Sampieri, Fernandez Collado, & Baptista Lucio, 2010).

Participants

The participants were 47 children (22 girls and 25 boys) aged 5, from two public kindergartens of the urban area of La Plata city (Buenos Aires, Argentina). Every child's parents consented and authorized them to participate. The sampling procedure was non-randomized, intentional, with the support of the authorities from the Educational Provincial Directorate of the General Directionate of Culture and Education of the Buenos Aires Province and the Municipal area of Education of the city of La Plata, and the judgements of the provincial education authorities.

The total sampling population was divided in two groups: experimental group (EG) and control group (CG). The EG consisted of 27 boys and girls who worked with the 'Queremos Aprender' program, meanwhile the CG consisted of 20 boys and girls, whose teacher applied the current curricular design. Children from both groups showed similar characteristics in terms of age, gender, educational level of their families and general intelligence (IQ), both in the pre-test and post-test evaluations. The mean for the CG is 63.60 months (SD = 3.05), whereas for the EG is 64.78 months (SD = 2.68) [$t_{(45)} = 1.41$, $S_e = 0.84$, $p = .17$] for the pre-test. Both kindergartens are also equal in relation to the educational level of their families: most are located within the secondary level education, complete or incomplete. Concerning gender, no significant differences were observed. The GC presented a 55% of girls (11 participants), meanwhile the EG presented a 52% (14 participants) [$\chi^2(1) = .00$, $p = 1.00$]. Both groups were not different in terms of the participants' IQ levels, obtained after the general intelligence scale K-Bit, with a mean of 101.85 ($SD = 12.35$) for the IQ level of the participants in the CG, whereas those in the EG presented a mean of 100.22 ($SD = 12.63$) [$t(45) = 0.44$, $S_e = 3.69$, $p = .66$].

Intervention Program

During the intervention with the experimental group, part of a program of comprehensive development was applied with children aged 4 to 5 (for a revision, see Borzone & De Mier, 2017). This corresponds to a proposal that considers the development of linguistic, socio-emotional and cognitive skills. The material used for this intervention was a preliminary version of the students' textbook of "Klofky and his friends explore the world 1" (Borzone & De Mier, 2017) as well as the teacher's version (Benítez, Plana, & Marder, 2017). During the implementation, 14 didactic sequences of the program were implemented. Each sequence contained a main text for oral comprehension and retelling development, and around 20 activities were used to develop vocabulary, phonological awareness, knowledge of the correspondences and reading of words, as well as tasks to develop the EF. The program also incorporated games and songs. The main texts of the didactic sequences were narrative texts selected for the teacher to read in dialogic reading (see Figure 1 in Annex). The activities took place 3 times per week, and each one involved working with a particular skill for 15 or 20 minutes. The beginning of the session coincided with the reading and oral retelling of a personal experience, and then this was alternated with a game, a physical activity or a song (10 minutes). The intervention, in the case of reading, implied the activation of previous knowledge and vocabulary, reading aloud (stressing intonation and making pauses to reformulate) and questions on comprehension tasks about the content of the text.

Procedure

The program was implemented in the EG classroom from May to mid-November, with a weekly frequency of three sessions (1 hour each), totaling 56 sessions. For this implementation, teachers and administrators were trained in weekly meetings of 1 hour each during the first part of the year (12 hours). Then, meetings were held to supervise the implementation until the end of the academic year. Likewise, researchers accompanied teachers in the classroom for the implementation of tasks and to ensure the integration of the program in the teachers' planning. Every child was evaluated in April and once again in December (pre and post intervention, respectively). The evaluations were conducted in a classroom inside their schools, and the tests were distributed in two 30-minute sessions each.

In the CG, the activities planned for the area of language practice of the curricular design of the Buenos Aires province (General Dir. of Culture and Education of the Province of Buenos Aires, 2008) whose theoretical foundations adhere to the Psychogenesis of written language with practical proposes based on the *whole language* paradigm (Goodman, 1986). In this group, the researchers made observations and registered situations from the reading text instances. The activities done in the classroom implied anticipating the content of the reading from the title and book cover, working with books holders, free writing, reading stories without interruptions, writing their own name. The children were evaluated with the same tests, by the same examiners and during the same time frame of the children in the EG.

Instruments

Intelligence. To evaluate the IQ of the children, subtests from the Test KBIT (Kaufman & Kaufman, 2000) were considered: (1) expressive vocabulary (part A) and (2) tests of matrixes to evaluate the capacity to establish relationships among different stimuli (fluid intelligence). The internal consistency analyze with the method of the two halves is .98 and the ratio of test-retest stability is .94 (Kaufman & Kaufman, 2000).

Executive functions. To evaluate the development of visual attention, verbal and visuospatial working memory, inhibitory control, cognitive flexibility, planning and verbal fluency, the following tests were considered:

- Test for the neuropsychological assessment of the child ENI II (Matute, Roselli, Ardilla & Ostrosky, 2013). Four subtests were selected: (1) *Digits in progression.* This measures verbal memory and attention. The child must repeat series of up to 8 numbers. The score represents the number of digits repeated correctly. The maximum score is 8. The test-retest ratio of stability for this test is .42 (2) *Digits in regression*. This measures the working memory (span). The child must repeat a series of numbers in inverse order. The score represents the number of digits repeated correctly. The maximum score 7. The test-retest ratio of stability for this test is .57 (3) *Cancellation of pictures*. This test measures sustained and focalized attention. The test presents pictures of 44 rabbits, big and small, in one page. The child must cross out the big rabbits within a 1-minute time limit. One point is given for each rabbit correctly crossed out and one point is taken for each small rabbit. The maximum score is 44. The test-retest ratio of stability for this test is .77 (4) *Test of Semantic Verbal (fruits and animals) and Phonological (letter M) Fluency.* The child must speak all the possible words that belong to a determined category or that start with a specified letter within a 60-second period. The amount of words for each task is considered. The test-retest ratio of stability for this test is .77.
- Memory of designs of NEPSY II (Korkman, Kirk, & Kemp, 2007), Spanish adaptation by Pearson (2014). This test evaluates visual-spatial working memory. The child must retain visual information to identify a correct design among cards that are progressively incorporated. The maximum score is 120. The internal consistency is .71 and the test-retest stability is .71.
- Test of Mazes from the Wechsler Preschool and Primary Scale of Intelligence, WPPSI (Wechsler, 1967). This test measures the capacity for planning and prevision, as well as eye-hand coordination. The task is to find the exit from 9 mazes of progressive difficulty. The maximum score is 28. The test-rests ratio of stability for this test is .62.
- Test Hit and Touch from NEPSY (Korkman, Kirk, & Kemp, 1998). This test assesses inhibitory control and behavioral flexibility. The child must inhibit one motor action to produce a motor answer. The maximum score is 30. The test-retest reliability ranges between .60 to .90.

Comprehension. To measure the comprehension of oral texts, one oral retelling task was considered, designed ad hoc for this study (De Mier & Marder, 2017). For the pre-test, one fable was adapted ("The Lion and the Rat", La Fontaine), and for the post-test, one story was written ("The giant and the dwarf"). Both stories presented a structure of two episodes (Stein & Glenn, 1979) and equivalent length (see Figure 2 in Annex). The stories were presented to children in audiovisual format (static pictures and recorded voice). For the task administration, children were instructed to listen and look closely at the story, as they would later need to retell it to a friend or relative. The retellings of the children were audio recorded for post analysis. To evaluate discourse comprehension, the number of elements within the categories of the story that children retrieved in their oral retelling was considered. Two points were given when children incorporated elements in a free fashion and one point if the retrieval was guided (through questions asked by the researcher to favor the establishment of causal relationships among events and scaffold the retelling). The score was obtained through a process of analysis by inter-raters. The maximum score is 36. The internal consistency is .749.

Results

Impact of the Intervention Program

To analyze the impact of the intervention program in the different skills, the measures from the two groups' pre and post-test were compared though a T test for independent samples. The confidence intervals were estimated at 95% ($CI_{95\%}$) for the post-hoc analyses.

In the pre-test, both groups showed similar results and no statistically significant differences were found, except in the visuospatial memory in which children from the CG obtained higher results in the pre-test. In the planning test, children from the EG obtained higher results than those in the CG. Table 1 shows the means and standard deviations obtained by both groups in the two instances of evaluation (pre-post).

Table 1.

Descriptive statistics and T score from the measures analyzed in pre and post-test conditions for the EG and CG (N = 47).

Medidas	Pre-test							Post-test						
	GE		GC					GE		GC				
	M	DE	M	DE	T	*gl*	*Sig*	M	DE	M	DE	T	*gl*	*Sig*
Inteligencia: Matrices	15.68	3.81	15.4	3.39	-.359	45	.721	18.84	4.93	17.25	3.17	-1.299	45	.201
Atención Visual	8.11	6.17	10.28	3.75	1.390	45	.171	14.48	6.22	12.12	3.78	-1.504	45	.140
Memoria verbal: Dig prog	3.22	0.85	2.67	1.21	-1.848	45	.071	3.78	0.89	3.17	1.27	-1.942	45	,058*
Memoria de trabajo: D reg.	0.85	1.06	0.78	1.15	-.227	45	.821	1.28	1.19	0.89	1.25	-1.088	45	.283
Memoria VE: Diseño	20.41	14.38	30.17	12.17	2.452	45	,018*	45.44	18.54	41.56	18.15	-.716	45	.478
Planificación: Laberintos	15.40	6.58	12.71	3.85	-1.966	45	,055*	20.92	5.18	15.35	5.44	-3.765	45	,000**
Control inh y flex	19.89	7.345	20.95	5.365	.546	45	.587	25.32	4.513	22	5.351	-2.304	45	,026*
Fluidez semántica	10.73	3.31	10.8	2.54	.151	45	.880	13.58	3.65	12.85	3.21	-.704	44	.485
Fluidez fonémica	0.15	0.61	0.15	0.48	.011	45	.991	1.96	2.45	1.10	1.74	-1.330	44	.190
Comprensión oral de texto	15.33	6.88	13.15	5.65	-1.157	45	.253	20.19	5.26	17.3	4.70	-1.934	44	,059*

Note: * $p < .05$., ** $p < .001$.

In the post-intervention test, children from the EG showed a significant improvement in their performance in the different skills than those in the CG (Table 1). In the case of the EF, children from the EG increased their scores in the test that measured planning and organization of a complex task (mazes), inhibitory control and flexibility (hit and touch). Also, significant differences were observed, in favor of the EG, in those tasks of information storage in verbal memory (digits in progression). On another note, although all children improved their comprehension skills, the EG showed significant differences in their performance compared to the CG. This would account for the impact of the intervention, because in the pre-test the differences between the groups were not significant.

That said, although no significant differences were observes in the other variables, it is important to consider the differences among the pre and post-test values of each group in order to weigh the impact of the intervention. In fact, table 2 shows a higher increase of the EG in all the measures obtained.

Table 2
Means of the variables in the pre-post test and score of improvement of children from the EG-CG (N= 47) and effect size (d Cohen).

	GE			GC			
	Pre	Post		Pre	Post		*d*
Variables	M	M	mejora	M	M	mejora	
Inteligencia: Matrices- K bit	15.68	18.84	3.16	15.4	17.25	1.85	0.38
Atención Visual	8.11	14.48	6.37	10.28	12.12	1.84	0.46
Memoria verbal: D Prog	3.22	3.78	0.56	2.67	3.17	0.50	0.56
Memoria de trabajo V: D Reg	0.85	1.28	0.43	0.78	0.89	0.11	0.32
Memoria VE: diseños	20.41	45.44	25.03	30.17	41.56	11.39	0.21
Planificación: Laberintos	15.4	20.92	5.52	12.71	15.35	2.64	1.05
Control Inhibitorio y flexibilidad	19.89	25.32	5.43	20.95	22.0	1.05	0.67
Fluidez semántica	10.73	13.58	2.85	10.8	12.85	2.05	0.21
Fluidez fonémica	0.15	1.96	1.81	0.15	1.10	0.95	0.40
Comprensión oral de texto	15.33	20.19	4.86	13.15	17.30	4.15	0.58

Note: *d* Cohen (effect size); < 0.80 efecto fuerte; < 0.50 efecto moderado; < de 0.20 efecto bajo; 0.00 no hay efecto.

Even though there are differences in all variables, effect sizes vary. The results of the analysis show a medium rate of impact in verbal memory (d = .56), inhibitory control and flexibility (d = .67) and oral comprehension of texts (d= .58). As for the rest of the variables, an impact was also observed, although this was low (with values ranging from d = .21 to d = .46), such as fluid intelligence, visual attention, verbal and visuospatial working memory and phonemic and semantic fluency.

Interrelationships among the variables

To deepen the analysis of the intervention impact, a complementary study of bivariate correlation was conducted with the variables in the post test. Both groups were considered in insolation and the educational level of the mother was added to the analysis as a variable linked to socioeconomic aspects. This was done because it is a factor that directly or indirectly comes into play in the skills and cognitive processes of children, modulating their development (Arán Filippetti & Rhichaud, 2011; Ardila, Roselli, Matute, & Guajardo, 2005; Lipina et al, 2012). As seen in Table 3, there is a higher number of positive correlations statistically significant (p<0,05) in the EG compared to the CG. The fluid intelligence presents a high relationship in the EG with the verbal working memory, planning, oral comprehension and phonemic fluency. Meanwhile, in the CG, fluid intelligence correlates only with working memory and fluency, but above all with the educational level of the mother. Another relevant fact is that visual attention is related to three of the EF (visuospatial memory, planning and inhibitory control) in the EG, but this does not happen in the CG. Lastly, only in the EG oral comprehension of text correlated with fluid intelligence and planning.

Table 3.
Bivariate correlations among all the measures from the study post intervention and educational level of the mothers in EG and CG (n = 47).

	1	2	3	4	5	6	7	8	9	10	11
1.Inteligencia: K bit-Matrices		.220	.102	,593*	.399	.419	.186	.160	,575**	.061	,496*
2.Atención visual	-.008		.117	.261	-.014	-.117	-.308	-.085	.312	-.037	.279
3. Memoria V. D.Progres.	-.101	.096		.343	-.018	,548*	.070	-.069	.198	-.080	.411
4.Memoria de trabajo. D. Regresión	,676**	-.131	.097		.436	,486*	.385	-.040	,685**	.137	.283
5.Planificación	,465*	,422*	-.143	.295		.096	,543*	.058	.419	.301	-.043
6.Memoria visoespacial	.316	,539**	-.224	.226	0,454*		.189	.264	.327	.175	.288
7.Control Inh y flex	-.066	,419*	,438*	-.102	.215	.042		-.073	.192	.217	.252
8.Comprensión oral	,642**	-.054	-.281	.277	,563**	.206	-.101		.060	.264	.140
9.Fluidez fonémica	,535**	-.126	-.076	,544**	.185	.139	.074	.331		-.166	.142
10.Fluidez semántica	.164	.278	.243	.335	.277	.222	.160	-.131	.029		.095
11. Nivel Escolaridad Madre	.206	-.081	.018	.025	.219	.142	.053	.216	.135	.054	

Note: * $p < .05$.,
** $p < .01$

The development of comprehension skills under the program framework

To deepen the development of comprehension, grammatical elements from the stories were considered. A descriptive analysis was conducted of the different items, which were grouped according to the grammar in each of the test episodes. On another note, to observe which items presented significant differences that could be attributed to the intervention, an analysis of variance was conducted which showed statistically significant differences between the groups in each of the units of information (grammatical items of the stories).

The analysis (Table 4) shows differences that, although are not statistically significant, are relevant when comparing the performances between the groups considering the total of narrative categories retrieved in the retellings by children. Likewise, the EG performed better in the retrieval of the main character, and the reaction to the character from episode 1. In the rest of the items from that episode and from episode 2, the performance of children from the EG is superior to those in the CG, although this does not constitute statistically significant differences between these groups.

Table 4.

Items present in the post-test retellings by the children according to the text grammar for the EG and CG and T test for independent samples.

Unidades de informacion		M	DE	T	gl	Sig.
Total renarración (máx 36)	E	20.19	5.26	1.934	44	.060
	C	17.3	4.70			
Escena (máx 8)	E	3.92	1.64	1.053	44	.298
	C	3.40	1.69			
Ep1: Evento inicial (max 4)	E	2.92	1.09	-0.084	44	.933
	C	2.95	1.05			
Ep1: Respuesta interna e intento (max 6)	E	2.92	1.70	1.707	44	.955
	C	2.10	1.52			
Ep1: Consecuencia y reacción (max 4)	E	2.04	1.28	2.153	44	.037*
	C	1.25	1.16			
Ep2: Evento inicial (max 2)	E	1.62	0.70	0.588	44	.56
	C	1.50	0.61			
Ep2: Respuesta intena e Intento (max 2)	E	1.31	0.88	1.091	44	.281
	C	1.00	1.03			
Ep2: Consecuencia 1,2º Intento, consecuencia y reacción (max 10)	E	5.46	1.86	0.625	44	.535
	C	5.10	2.05			

$^{*}p < .05$. $^{**}p < .01$.

Discussion

The purpose of this study was to determine the impact of the application of a comprehensive development program for comprehension skills and the EF of pre-school students who participated in a pilot intervention. Likewise, the relationship among the variables and the effect of the intervention on the information retrieval for the retellings was explored, attending to the grammar of the narrations.

The data analysis confirmed the stated hypotheses and the results coincided with previous research. In fact, a relationship between the development of EF and comprehension was observed, as well as a higher increase in the EG than the CG, with significant differences in favor of the EG. Overall, the results allow to presuppose that the values in the EG increased because of the intervention, going beyond the educational level of their mothers, which can be determinant for a child's development.

The studies conducted which compared the scores obtained by both groups, pre and post intervention, allowed to observe that children performed similarly pre-test, with the exception of the visuospatial memory in which the CG children obtained higher scores. The reverse is true for the planning test, where the EG children obtained better results than those in the CG. Nevertheless, in the post-test, the EG outperformed the CG. Both groups progressed in their skills development, although the group who participated in the intervention through the comprehensive development program surpasses the CG, with high and medium effect sizes in variables that measure central abilities such as planning, verbal memory, inhibitory control, flexibility and comprehension. Systematic intervention then seems to have an effect on the development of these skills and favor information processing and the construction of a mental model of a text so that it can be retrieved in oral retellings.

It is important to consider that this study is one of the few in our country in which an intervention program is applied to pre-school children, which simultaneously works with a varied set of processes in a systematic fashion, leaving an installed capacity in the school. It must be noted that among the activities performed by the EG children, dialogic reading was incorporated to develop comprehension strategies, as well as different activities which brought the EF into play: activities in which children had to memorize pictures and then remember them from a series of increasing stimuli, following progressively complex verbal instructions, games in which they had to make contrary gestures, crossing out repeated pictures in a short amount of time, mazes, etc. In the case of comprehension, the results are congruent with those of previous

research in which the impact of dialogic reading on the development of comprehension strategies was evaluated (Ortega, Vega, & Poncelis, 2016; van den Broek et al., 2011). It is worth noting that during the intervention and the evaluation, the same strategy for question formulation was used for the during and post reading stages.

In terms of the relationship among variables, the analysis of correlations in the post-test showed that the EF do relate to one another in the EG but this does not happen in the CG, in which only correlations among the variables were observed (IC, MO and fluency). It is possible to think that, in the comprehensive development program, the skills are enhanced due to the systematic intervention in different aspects; therefore, it is expected that there will be more correlations among these skills. To determine the relationships among the skills, the educational level of the parents was incorporated into the study of correlations among variables. Nonetheless, in the case of the EG, this variable was not related to any other variable. This would give an account of how progress made by the children is related to the type of intervention and the strategies that were promoted during the program application. Particularly, in the case of comprehension, a significantly high correlation with the performance in the planning test was observed. This relationship coincides with observations from previous studies about the incidence of this EF in language development, but above all in comprehension and oral retelling tasks. In fact, the retelling activity implies, on the one hand, the construction of a mental model of a text and, on the other hand, planning and using the necessary strategies to orally organize a text. This is what the EG children did during the "Lo contamos Otra vez" tasks in the didactic sequences (See Figure 1 in Annex).

Numerous empirical studies provide evidence portance of adult-child verbal interaction to develop the sense of temporality (Hudson, 2002) and planning capacity (Gauvain, 2001; Radziszewska & Rogoff, 1988). These results can give an account of the cultural and social construction of the ability for planning (Baker-Sennet, Matussov & Rogoff, 1992, 1993; Gauvain, 2001). Therefore, the environment and interactions would condition the development of this function. (Arán Filippetti y Rhicheaud de Minzi, 2011, pp 342).

The same authors report similar results to our own study in relation to the importance of the development of planning in early childhood. In that case, 110 6-year-old Argentinian children were divided in different groups, only one receiving an intervention program (PECE, 2008; Arán Filippetti & Rhicheaud de Minzi, 2011). Results show a high impact value on the planning of the group that was intervened, presenting values almost identical to the differences pre-post-test that were obtained in our study. The differences lie in that children from our study (5-year-olds) reached the same average score in the maze test than those in the cited study, who were 6-year-old children.

The importance of this type of research on early age interventions lies on the concept of plasticity. We know that the brain changes through life thanks to its genetic programming, but that it also changes as a result of learning, making new connections and adjusting itself depending on the problems that the environment poses. Nonetheless, this plasticity decreases in tie differently according to the brain areas (Koizumi, 2003; OECD, 2002). Due to this, early age interventions tend to be more effective and cost-effective than those at later stages, because promoting brain development costs less than compensating it.

On a different note, this study also analyzed the performance of children when retrieving the story in the post-test. It was expected to observe significant differences between the groups, in favor of EG. A general incidence was observed regarding the number of elements and information units of the story that were incorporated into the retellings. However, if these are considered at the category of analysis level in particular, the only significant differences found between the groups were in the case of consequence and reaction to the first episode of the narration. This fact seems interesting in light of previous studies (Bustos & Crespo Allende, 2014; Rosemberg, 1994; Trabasso et al., 1984; van den Broek, 1997) as these are events causally related that incorporate relevant information from both a factual and psychological viewpoint of the story (See Figure 2 in Annex).

The fact that no significant differences were observed in all categories can be explained due to the characteristics of the story, as this could have been lengthy for the children, generating processing overload. This becomes evident, particularly in the low scores observed in both groups on the grammatical elements related to consequence, intent and reaction to the characters from episode 2, which shows most children's incapability to establish causal links between both episodes to give an account of the resolution of conflict in the text (van den Broek, 1997).

From these observations, it is possible to note some limitations in this work. In fact, it was possible to observe improvements in the comprehension skills of children, it is possible to think that in order to obtain the expected results, the intervention must possess certain characteristics: small-sized groups of children (not 30 as in this case), higher intervention frequency (daily) and highly trained teachers. Moreover, it is important to note that the retelling task, although it is widely used to assess comprehension in small children, implies planning skills and oral production of the story, which can render the task even more complex. As for teachers, although in this pilot study this variable was not controlled for, both educators come from the same educational institute in the city of La Plata, Argentina, and share similar teacher training formation. Also, they were selected due to participate in this intervention due to their remarkable performance, as noted by the school administrators.

It may be important for future studies to analyze the results from the comprehension task by distinguishing between production and comprehension measures, as done in other studies (Bustos & Crespo Allende, 2014). The comparison of the improvement made by children in both aspects of the task can produce important data to evaluate the impact of the program, as different sections of the program focus on the development of oral expression skills (see Figure 1).

Finally, in order to deepen the impact of the program, other elements should be included, such as the analysis of the improvement done in other precursor skills of literacy like vocabulary and reading and writing words. Also, a longitudinal follow-up of the sample population of children should be conducted so as to evaluate the impact in the medium term of schooling. This data could strengthen the importance of applying systematic programs that attend to the different dimension of child development and promote long-term impact public policies.

The original article was received on January 29th, 2018
The revised article was received on October 31st, 2018
The article was accepted on October 31st, 2018

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Annex

Figure 1

Apartados y procesos cognitivos que se desarrollan en las secuencias didácticas del programa de intervención

APARTADOS	ACTIVIDADES Y PROCESOS COGNITIVO-LINGUISTICOS
Compartimos	Comprensión y producción oral de relatos de experiencias personales
Mostrar y decir.	Comprensión y producción oral de descripciones
Diario mural	Producción de textos escritos a partir de los relatos de los niños. Primero por la maestra (dictado al docente) y luego progresivamente en forma independiente por los niños.
A pintar, dibujar y crear	Dibujo de objetos en forma gradual con andamiaje y actividades de reciclado y desarrollo de la creatividad con elementos variados.
Leemos y comprendemos	Activación de conocimiento previo y lectura de textos narrativos y expositivos.
Después de leer	Comprensión del texto leído por el docente focalizando en las relaciones causales y temporales entre eventos.
Lo contamos otra vez	Reconstrucción oral del texto leído a partir de imágenes.
Nuevas palabras- nuevos mundos	Ampliación del vocabulario de los niños en ambas dimensiones, amplitud y profundidad (palabras nuevas, sinónimos, antónimos, hiperónimos, etc.).
A cantar, adivinar y recitar	Trabajo con canciones, adivinanzas que promueven el desarrollo de la educación musical.
Sonidos y letras marchando	Desarrollo de la conciencia fonológica en forma lúdica a partir de fragmentos de las canciones del apartado anterior o del texto de otros apartados. Se complementa con el libro *Sonidos y letras en acción.*
A jugar	Realización de actividades que promueven el juego dramático, simbólico y motor.
Leemos en eco	Desarrollo de la prosodia a través de poesías, recetas y noticias para cuando empezamos a leer.
Historias para contar	Desarrollo discursivo oral y el aprendizaje de estrategias inferenciales.
Pensamos	Desarrollo de la atención, la memoria de trabajo, el control inhibitorio, la flexibilidad cognitiva y la planificación
¿Qué aprendimos?	Toma de conciencia de los aprendizajes realizados.

Figure 2
Episodios del texto "El león y el ratón" (pres test) y "El gigante y el enanito" (post test)
Escena: Un ratón y un león vivían en la selva
Episodio 1
Evento inicial: El león atrapa al ratón
Respuesta interna 1: El ratón siente miedo
Intento: El ratón le pide que lo suelte y le dice que algún día lo va a ayudar
Consecuencia: El león siente lástima y lo suelta
Reacción: El ratón le da las gracias y le dice que lo puede ayudar. Se va.
Episodio 2
Evento inicial: El león queda atrapado en una red
Respuesta interna: El león está triste
Intento 1: El león ruge y llora
Consecuencia 1: El ratón lo escucha y acude a salvarlo
Intento 2: El ratón roe la red
Consecuencia 2: El ratón libera al león
Reacción: El ratón y el león se van caminando como buenos amigos

Escena: Un gigante y un enanito viven en el bosque
Episodio 1
Evento inicial: El enanito se choca con el gigante y el gigante atrapa al enanito
Respuesta interna: El enano siente miedo porque el gigante le iba a pegar
Intento: El enanito le pide que lo suelte porque es gigante, y que algún día lo va a ayudar
Consecuencia: El gigante siente pena y lo suelta
Reacción: El enano agradece y se va feliz
Episodio 2
Evento inicial: El gigante queda atrapado en una jaula
Respuesta interna: El gigante está desesperado
Intento 1: El gigante grita furioso
Consecuencia: El enano lo escucha y acude a salvarlo,
Intento 2: El enano le roba la llave al señor malo y lo libera
Consecuencia 2: El gigante le agradece al enanito.
Reacción: El enano y el gigante se van caminando como buenos amigos