Int. j. psychol res, Vol. 10 (2) 34-45, 2017
DOI 10.21500/20112084.2760

International Journal of PSYCHOLOGICAL RESEARCH

Group cognitive intervention targeted to the strengthening of executive functions in children at social risk

Intervención cognitiva grupal destinada a fortalecer funciones ejecutivas en niños en riesgo social

Celina Korzeniowski[1 2] *, Mirta Susana Ison[1 2] and Hilda Difabio[3]

Abstract
The present study set out to evaluate the effectiveness of a group cognitive intervention aimed at promoting executive functions in children at social risk. The quasi-experimental, pretest-posttest design included a control group. The sample was made up of 178 children (52% boys), aged 6-10. The children were evaluated by means of a battery of neuropsychological EF tests and a teacher-rated behavioral EF scale. The intervention program included 30 group cognitive stimulation sessions that increased in difficulty and were embedded into school currícula. Trained children performed better in terms of cognitive flexibility, planning, metacognition and inhibitory control, as compared to their baseline values and to children in the control group. This study provides new evidence of the effectiveness of cognitive interventions for children and of children's capability to transfer cognitive improvements to daily school activities.

Resumen
El presente trabajo se propuso evaluar la efectividad de una intervención cognitiva grupal destinada a promover las funciones ejecutivas en niños en riesgo social. Se utilizó un diseño cuasi-experimental pretest–postest con grupo control. La muestra estuvo compuesta por 178 niños argentinos (52% varones) de 6 a 10 años de edad. Se empleó una batería de tests neuropsicológicos y una escala de funcionamiento ejecutivo versión docente. La intervención incluyó 30 sesiones grupales, de dificultad creciente y se insertó dentro de la curr'icula escolar. Los niños entrenados evidenciaron un mejor desempeño en flexibilidad cognitiva, planificación, metacognición y control inhibitorio en comparación con su desempeño basal y sus controles. Estos resultados aportan nueva evidencia sobre la efectividad de las intervenciones cognitivas infantiles y su capacidad para transferir las mejoras cognitivas a las actividades cotidianas de los niños en el ámbito escolar.

Keywords
Cognitive intervention; executive functions; children; poverty.
Palabras Clave
Intervención cognitiva; funciones ejecutivas; niños; pobreza.

[1] *Institute of Human, Social and Environmental Sciences (INCIHUSA-CONICET), National Scientific and Technical Research Council (CONICET), Argentina.*
[2] *Psychology College, Aconcagua University, Mendoza.*
[3] *Cuyo Research Center (CIC-CONICET), Mendoza, Argentina.*
***Corresponding author**: ckorzeniowski@mendoza-conicet.gob.ar
Manuscript received 29-11-2016; revised 15-06-2017; accepted 05-07-2017.

1. Introduction

Executive functions (EF) are cognitive control processes that regulate thoughts, emotions and actions to support behavior while targeting a goal (Barker et al., 2014). There is general agreement that there are three core EFs: inhibition (behavioral inhibition and interference control), working memory and cognitive flexibility (Diamond, 2013; Huizinga, Dolan, & van der Molen, 2006; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Based on these, more complex EFs are built, such as planning, reasoning and problem solving (Diamond, 2013). The cognitive control process involves a set of interconnected neural networks that operate in a coordinated way across an integration zone located in prefrontal areas (Koechlin & Summerfield, 2007).

EF development is long, multi-stage and sequential; it is more intense during childhood, slows at the beginning of adolescence and continues up to adulthood. Each cognitive control process has a specific pattern of evolutionary development; however, the literature agrees that there is a common growth peak from 6 to 10 years of age (Hughes, 2011). EFs progress from a stage of stronger undifferentiation to a stage of higher differentiation, with an add-on and systematic effect that leads to greater selectivity and hierarchical control of cognitive processes (Davidson, Amsoa, Anderson, & Diamond, 2006). Therefore, the progressive development of EFs will favor the appearance of a greater capacity to create mental schemes, increased mental flexibility, a higher use and complexity of memory strategies and a better organization and planning of cognitive and behavioral activity (Flores-Lázaro, Castillo-Preciado, & Jiménez-Miramonte, 2014). These achievements will have a strong impact on the children's school, social and emotional environment.

EFs predict school performance (Best, Miller, & Naglieri, 2011; Canet-Juric, Urquijo, Richard's, & Burin, 2009; Fuhs, Nesbitt, & Dong, 2014; García-Madruga, Vila, Gómez-Veiga, Duque, & Elosúa, 2014; Rosselli, Matute, & Ardila, 2006; Welsh, Nix, Blair, Bierman, & Nelson, 2010) and help children be successful at school inasmuch as they, boost positive social behavior and decrease disruptive actions in the classroom (Blair & Raver, 2014; Diamond, 2012). In addition, self-regulated behavior during childhood is associated with better health, a higher quality of life, greater academic success, better employment status and a lower incidence of criminal conduct in adulthood (Diamond, 2012; Moffitt et al., 2011).

On the basis of these reports, interest in the design and implementation of intervention programs oriented to the stimulation of EFs in populations of children with and without disorders has grown in the past 15 years (Blair & Raver, 2014; Diamond & Ling, 2016). In this regard, one line of development proposes the promotion of these cognitive abilities in children from disadvantaged socioeconomic contexts based on reports that attest to the negative impact of poverty in childhood development under these conditions (Hackman, Farah, & Meaney, 2010).

Children at social risk have poorer cognitive control performance and slower developmental pathways (Hackman et al., 2010; Ison, Greco, Korzeniowski, & Morelato, 2015; Lipina et al., 2011). In addition, specific mediators of the effects of childhood poverty have been identified, including low parental education levels, little cognitive stimulation at home, limited language interactions from parents to children, overcrowding, poor housing conditions, pre and post-natal stress and anxiety or depression on the part of parents (Noble & Farah, 2013; Segretin et al., 2014).

The literature shows encouraging results demonstrating that EFs can become stronger with practice. It has specifically been reported that at-risk children who participate in cognitive stimulation programs or activities improve attention tasks, inhibitory control, working memory, planning, cognitive flexibility, problem resolution, and verbal and graphic fluency (Blair & Raver, 2014; Diamond, Barnett, Thomas, & Munro, 2007; Goldin et al., 2014; Ison, 2009, 2011; Röthlisberger, Neuenschwander, Cimeli, Michel, & Roebers, 2012). Review studies suggest that children with poorer EF performance benefit the most from these interventions, especially in terms of the most demanding cognitive tasks (Diamond, 2012; Diamond & Ling, 2016).

Different intervention modalities were used, including school curricular adjustments ("Tools of the Mind" Diamond et al., 2007), which have already proven their effectiveness in transferring children's cognitive gains to school and socioemotional competencies. In spite of these far-reaching benefits, special curricula have only been tested in small children (3 to 6 years old), while their application in middle childhood has been limited or null (Diamond, 2012).

Some factors enhance cognitive enrichment. Early, intensive and systematic interventions sustained over time bring about stronger benefits. Interventions using different sensory channels, training different EFs, articulating with the children's daily activities and training the adults who are significant in the child's environment in the application of techniques and strategies bring about results with a stronger ecological validity (Diamond & Ling, 2016). The current challenge is to put together intervention proposals that can enrich the children's day-to-day activities with a true potential to generalize the results to other untrained cognitive and socioemotional abilities. Intervention programs can thus become valuable tools to narrow the persistent academic and sociocultural gap associated with poverty.

Based on this conceptual framework, the purpose of this research was to assess the effectiveness of a group cognitive intervention designed to promote EFs in Argentine children at social risk. Our specific objectives were: (1) analyze executive functioning (specifically, attention, inhibitory control, planning, cognitive flexibility and metacognition) in 6 to 10 year olds on the basis of age, gender and poverty gradient; (2) evaluate the effectiveness of group cognitive interventions and rate their effects on the EFs of participating children; and (3) assess the post-intervention report drawn up by the teachers on the executive functioning of children in the classroom and examine the differences, if any, between children who participated in this cognitive intervention and the control group.

2. Method

2.1 Desing and participants

This practical research study was planned on the basis of a quasi-experimental, pretest-posttest, control group design. The non-probabilistic intentional sample included 178 Argen-

Figure 1. Cognitive Flexibility task. Look at the geometric shapes in the box. Form two groups according to their characteristics and give a name to each group. Then, figure out a different way to match the shapes and create new groups according to this newly found characteristic.

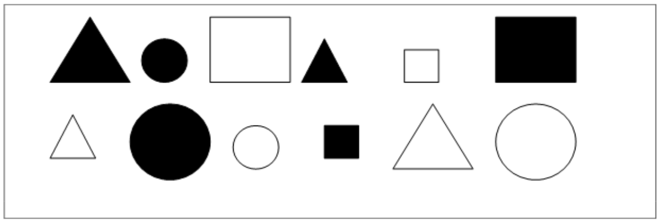
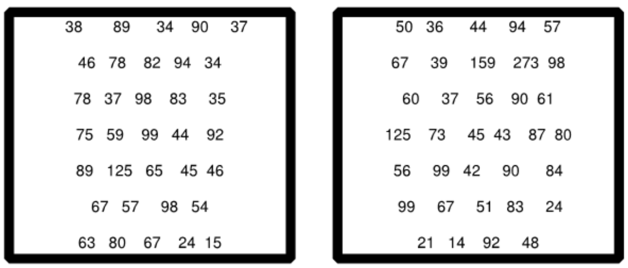


Figure 2. Divided Attention task. Cross out the duplicate numbers in both boxes.



tine 6 to 10 year old school boys and girls ($M = 7.24; SD = 1.17$) from 1st to 3rd primary school grades in two marginal public urban marginal schools in Mendoza. These children were from a low socioeconomic status (middle-low: 7%; higher low: 32%; lower low: 40.5%; marginal: 20.5%). Parents had to give written consent for their children to participate in the study. Children who a) presented neurological, psychological or psychiatric disorders; b) had learning disorders; or c) were two or more years older than the regular age for the school grade were excluded from the study.

The total number of participants was divided into two groups: the intervention group and the control group (see Table 1). The intervention group (IG) was composed of 94 pupils aged 6 to 10 years old, whose mean age was 7.09 years old (SD = 1.08); 49% of this group were girls. The control group (CG) was formed by 84 pupils aged 6 to 10 years old, whose mean age was 7.40 years old (SD = 1.25); 47% of this group were girls. The sociodemographic composition of both groups was comparable in terms of age ($t_{176} = -1.82$, $p = .07$), gender ($\chi^2{}_{(178,1)} = 0.112$ $p = .738$), socioeconomic status ($\chi^2{}_{(178,3)} = 3.42$, $p = .331$ and school grade ($\chi^2{}_{(178,2)} = 5.41$, $p = .07$.

2.2 Materials and instruments

2.2.1 Executive function tasks

Executive functioning scale for children (EFS, Korzeniowski, 2015). This instrument is an adaptation of the Behavioral Observation Guide (Ison & Fachinelli, 1993), which was taken as a basis for the development of an instrument to rate the perception of parents or teachers of a child's executive functioning. The EFS is composed of 21 items distributed in five dimensions: attentional control (4 items), inhibitory control (6 items), metacognition (4 items), organization (4 items) and planning (3 items). Each subscale score is obtained by simple summation. The factorial structure of the scale was satisfactory ($GFI = .83$; $CFI = .94$; $RMSEA = .08$) and the internal consistency of subscales ranged from .84 to .94.

Porteus Maze Test (PMT, Porteus, 2006). This task measures planning abilities and inhibitory control. The test consists of ten labyrinths of increasing difficulty that the participant is asked to solve. Once the participant has entered the labyrinth, she/he cannot lift the pencil, cross lines, go into blind alleys or move backward. This test has two scores to assess EFs: a quantitative one, evaluating planning skills, and a qualitative one, measuring inhibitory control (Porteus, 2006). Marino, Fernández, and Alderete (2001) reviewed the quantitative scoring originally developed by Porteus, which used the obsolete criterion of mental ages to assess planning skills, and designed a new scoring system to cover errors and hits in labyrinth solving in a single index, the Porteus Quality Index. Our research study used the Porteus Quality Index (Marino et al., 2001) to rate planning abilities and the adaptation of Q scores (Korzeniowski, 2015) to rate the inhibitory control function. The PMT has a moderately high internal consistency ($\alpha = 0.80$ Krikorian & Bartok, 1998). In this sample, the internal consistency indices for the planning scores ($\alpha = 0.81$) were satisfactory. Similarly, the inter-examiner reliability for the nine items that make up the Q score was acceptable (the Intraclass Matching Ratio [IMR] ranged between .79 to .99).

Concept Formation of the Woodcock-Muñoz Tests of Cognitive Ability (Woodcock, Muñoz-Sandoval, Ruef, & Alvaado, 2005). This task measures the ability to reason abstractly, think flexibly, form concepts, draw inferences, understand implications and solve problems using novel information. In our research study, this instrument was used to evaluate cognitive flexibility. It is administered to individual subjects, who have to perform a controlled learning task where a rule needs to be identified from among a set of presented visual stimuli. The median test-retest reliability of this instrument is $rho = .94$ (Woodcock et al., 2005). The reliability obtained with the study sample was satisfactory ($rho = .80$).

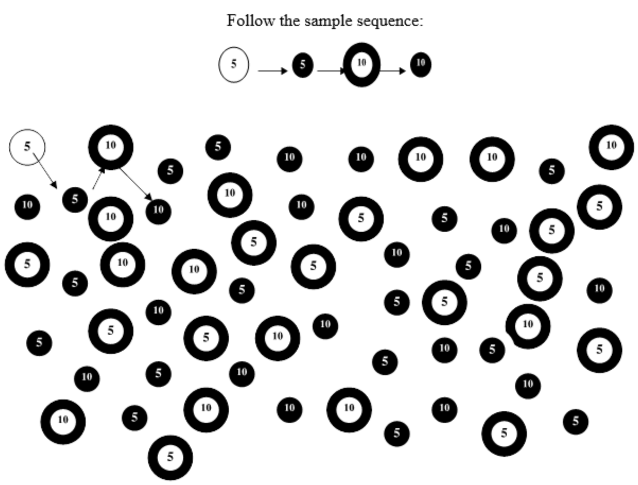
Escala Magallanes de Atención Visual (EMAV, for its initials in Spanish, García-Pérez & Magaz-Lago, 2000). This test evaluates the ability to sustain focused attention. The participants have to cross out figures that match the target stimuli from a pool of distractors. For a sample of Argentine school children, the test-retest reliability index was high ($rho = .89$, Carrada, 2011). The test-retest reliability index for the sample under study was satisfactory ($rho = .87$). This test was used to evaluate focused and sustained attention in children.

A metacognitive interview for children Lucangeli and Cornoldi (1997). This semi-structured interview assesses the child's metastrategic knowledge relative to a categorization task. It consists of 8 questions, 4 of which are open, while the

Table 1. Descriptive statistics of the sample.

Variable		Intervention Group ($n = 94$)		Control Group ($n = 84$)	
		n	$f\%$	n	$f\%$
Age	6 years old	31	33%	27	32,1%
	7 years old	32	34%	17	20,2%
	8 years old	23	24,5%	25	29,8%
	9 years old	5	5.3%	10	11,9%
	10 years old	3	3,2%	5	6%
Gender	Girls	48	49%	45	47%
	Boys	46	51%	39	53%
Grade	1^{st} grade	33	35,1%	33	39,3%
	2^{nd} grade	37	39,4%	20	23,8%
	3^{rd} grade	24	25,5%	31	36,9%
SES	Lower Middle	9	9,6%	4	4,8%
	Upper Low	30	31,9%	27	32,1%
	Lower Low	40	42,6%	32	38,1%
	Marginal	15	16%	21	25%

Figure 3. Planning and Cognitive Flexibility tasks.

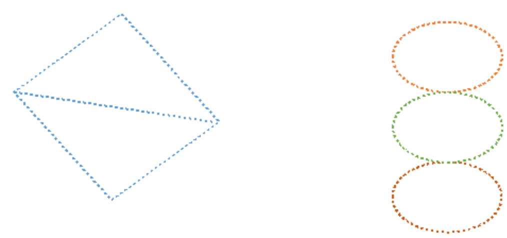


other 4 have a Likert format. The interview is divided into two parts. The first part rates prediction and planning abilities, so it is administered before the subject carries out the proposed task. The second part of the interview measures monitoring and evaluation abilities and is administered immediately after the task is completed. For the open questions, the level of agreement among examiners was estimated (IMR from .86 to .95), while for the four Likert items, internal consistency was estimated ($\alpha = 0.52$). The interview provides a total score attained by simple summation. This score was used in this study to evaluate the children's metacognitive ability (Lucangeli & Cornoldi, 1997).

2.2.2 Socioeconomic Index

Socioeconomic status (SES) (Comisión de Enlace Institucional, 2006). This index rates the socioeconomic status of a household through indirect variables, excluding income level.

Figure 4. Planning task. Draw each shape without lifting the pencil and without going over the same place twice.



It has two main variables: the main household provider's employment and education levels.

2.2.3 Intervention program

Cognitive intervention program (Korzeniowski, 2015). The cognitive training program was divided into 30 sessions, each with group activities and games designed to stimulate different cognitive control functions synergistically in the same session (see Table 2). These activities included crossing out numbers or letters, finding differences, listening attentively, playing games with rules, putting cartoon sequences into the correct order, solving problems, playing cognitive interference games and completing sequences, classification tasks, divided attention exercises, performance self-evaluation tasks (see Figures 1 to 5). This program was embedded into school curricula to be delivered twice a week, and was implemented in the classroom for the full set of pupils over four months.

This intervention program was designed so that each training session would concurrently stimulate multiple executive functions. Each session used a combination of increasingly difficult activities to favor inhibitory control, attention, planning, cognitive flexibility and metacognition capabilities. Therefore, various executive functions that were of interest for the study were trained during each single session. In addition,

Table 2. Description of stimulating activities in one training session.

Activity	Description	Stimulated EFs
Interference group game	Children are shown three geometric shapes: a red triangle, a green circle and a yellow square. In the first 15 tasks, children have to name the geometric shape and its color as they perceive them. Then, in the 15 subsequent tasks, children have to say “green triangle” when they see the red triangle, “red circle” when they see the green circle “and yellow” square when they see the yellow square.	Focused attention Cognitive flexibility Inhibitory control
Grouping geometric shapes	Children are given a group of geometric shapes of different sizes and colors. They are asked to form three groups according to common characteristics of the figures. Then, they are asked to sort the shapes in a different way, forming three new groups (see Figure 1).	Categorization Cognitive flexibility
Finding numbers	On a number grid, children have to circle a number and cross out another one.	Focused attention Sustained attention Inhibitory control Cognitive flexibility
Drawing geometric shapes	Children are shown a dotted-contour shape and must draw the lines without lifting the pencil or going over the same place twice (see Figure 4).	Planning Organization
Crossing out repeated numbers	Children are shown two boxes with numbers and have to cross out the duplicate numbers in each box (see Figure 2).	Focused attention Divided attention Sustained attention Working memory
Self-evaluation	Children have to identify the tasks that were the easiest and most difficult. Identify their mistakes. Rate their performance. Say whether it was hard for them to sustain their attention while performing this task.	Monitoring Metacognition

activities were designed in close collaboration with participant teachers and included the contents of monthly school planning. For example, some designed activities dealt with two or three-digit numbers, in line with school contents already taught by the teachers to their pupils.

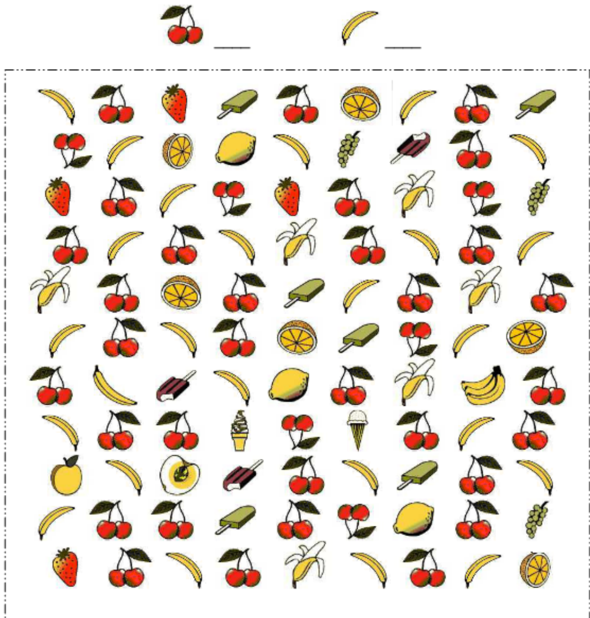
2.3 Procedure

Researchers obtained a written authorization from the principal of each participating school. Parents or legal guardians were asked to sign an informed consent form for their children’s participation in the study. The children who were authorized were explained the characteristics of the tasks that would be conducted, were invited to participate of their own free will and were informed of their rights as study subjects.

Before the cognitive intervention was initiated, children were evaluated by the main author of this paper in four 30-minute sessions. In the first session, the EMAV was administered to the whole group. Over the three remaining sessions, the EF tests were administered individually. Then, the intervention group received 30 sessions of cognitive training in the classroom while they stayed with their full group of schoolmates in the presence of the school grade teacher. During post-intervention, pupils were evaluated with the same battery of neuropsychological tests. Teachers completed the Executive Functioning Scale for Children to supplement the information obtained from the activity. It is important to highlight that a pre-test Executive Functioning Scale for Children was not included as the first and third grade teachers in the intervention group did not complete their pupils’ questionnaires.

In order to be aligned with the ethical principles for psychological research issued by the American Psychological Association in 2002, children in the control group received cognitive training in the classroom in the presence of the

Figure 5. Focused and sustained attention tasks. Circle the cherries and the bananas that are identical to the sample.



responsible teacher after the post-test period. In addition, psychoeducational workshops were delivered to parents and teachers, where research results and guidelines for the promotion of cognitive development in children were discussed.

2.4 Data analysis

A series of statistical process methods were used to meet study objectives. First, data was developed by evaluating missing value patterns with the SPSS 19 missing value analysis routine and identifying univariate atypical cases by applying a standard score calculation to each variable. Cases with a z score higher than 3.29 (two-tailed test, $p < .001$) were considered atypical. The assumptions of normality for the study sample were corroborated by an analysis of asymmetry and kurtosis of each variable. Second, a descriptive study of the variables of interest was conducted, and the baseline performance of the control and intervention groups was compared using a multivariate analysis of variance (MANOVA). Control/intervention group, gender, age and SES were included as independent variables in the MANOVA procedure, while attention, inhibitory control, planning, cognitive flexibility and metacognition were the dependent variables. Finally, a post-intervention comparative study was carried out to weigh cognitive stimulation program effectiveness. An intergroup comparison (t-test for independent samples) and an intragroup comparison (t-test for paired samples) were performed. The effect size of recorded differences was estimated using Cohen's *d* (Cohen, 1992). Comparisons complementary to these analyses were performed between the groups, segmented by age, gender and socioeconomic status, with the purpose of controlling the effects of these variables on the efficacy of the intervention.

3. Results

3.1 Preintervention comparative study

Descriptive statistical data for cognitive variables was calculated for the full group of pupils during the preintervention stage (see Table 3).

The results of the multivariate analysis (MANOVA) showed that the CG and the IG's baseline performance were similar for 4 of the 5 study variables (Wilks' Lambda = 1.50, $p = .195$)(see Table 2). Both groups showed significant differences in inhibitory control ($F_{(1,178)} = 6.37$, $p = .013$, $\eta^2 = .05$), while IG participants were less impulsive ($M = 7.37, SD = 4.11$) as compared with CG members ($M = 8.85$, $SD = 3.94$).

Second, cognitive performance varied according to the children's sociodemographic characteristics *(age:* Wilks' Lambda $= 3.35$ $p < .001$; *gender:* Wilks' Lambda $= 3,41$, $p = .007$). The age variable was associated with differences in attention ($F_{(1,178)} = 9.90$), $p < .000$, $\eta^2 = .25$), planning ($F_{(1,178)} = 7.94$, $p =< .000$, $\eta^2 = .21$), inhibitory control ($F_{(1,178)} = 4.37$, $p = .002$, $\eta^2 = .13$), and cognitive flexibility ($F_{(1,178)} = 3.10$, $p = .018$, $\eta^2 = .09$). In all cases, the older the children in the sample, the better their cognitive control functions. As to gender, girls marginally outperformed boys in cognitive flexibility ($F_{(1,178)} = 3.85$, $p = .052$, $\eta^2 = .03$). Finally, children from with higher socioeconomic statuses (SES: Wilks' Lambda $= 1,38$, $p = .154$) showed an increase in flexible thinking capacity ($F_{(1,178)} = 3.73$, $p = .013$, $\eta^2 = .09$) and planning abilities ($F_{(1,178)} = 3.03$, $p = .032$, $\eta^2 = .07$).

Finally, the analysis of interaction between factors revealed significant effects for Age x SES (Wilks' Lambda = 1.31, $p = .081$) in planning ($F_{(1,178)} = 2.14$, $p = .027$, $\eta^2 = .15$), Gender x SES (Wilks' Lambda = 1.73, $p = .044$) in metacognition ($F_{(1,178)} = 2.95$, $p = .036$, $\eta^2 = .07$) in favor of girls, and Group x Age x SES (Wilks' Lambda = 0.87, $p = .661$) in attention ($F_{(3,178)} = 2.34$, $p = .036$, $\eta^2 = .11$).

3.2 Intragroup comparative study

When results from the IG were compared before and after delivery of the training sessions, differences in executive functioning were found. The post-test showed better performance in attention ($t_{(86)} = -11.13$, $p < .001$, $d = -1.19$), cognitive flexibility ($t_{(86)} = -13.78$, $p < .001$, $d = -1.48$), planning ($t_{(86)} = -9.51$, $p < .001$, $d = -1.01$) and inhibitory control ($t_{(86)} = 2.27$, $p = .026$, $d = 0.24$) as compared to the pre-test performance. No pre- and post-test differences were observed in metacognition ($t_{(86)} = -1.06$, $p = .292$, $d = -0.14$). Similar results were derived from the control group. Children performed better in attention ($t_{(72)} = -12.60$, $p < .001$, $d = -1.47$), cognitive flexibility ($t_{(72)} = -5.64$, $p < .001$, $d = -0.66$), planning ($t_{(72)} = -5.19$, $p < .001$, $d = -0.60$) and inhibitory control ($t_{(72)} = 2.82$, $p = .006$, $d = 0.33$) in the second evaluation as compared with baseline data. Contrary to this data, pupils in this group showed decreased metacognition ($t_{(72)} = 2.56$, $p < .012$, $d = 0.39$) when the first and

Table 3. Statistical data describing cognitive variables in the full sample of children, pre-intervention stage.

	M	*SD*	Range	*AS*	*KS*	Min.	Max.
Attention	0.25	0.14	−1–1	−0.02	0.00	−0.19	0.62
Cognitive flexibility	13.11	4.82	0–40	0.22	−0.10	2.00	26.00
Planning	4.26	1.93	0–10	0.23	−0.57	0.00	8.50
Inhibitory control	8.07	4.09	− − −	0.89	0.29	0.80	21.00
Metacognition	6.80	2.63	0–18	0.07	−0.24	0.00	13.00

Note: $n = 178$. Attention: EMAV's raw score; Cognitive flexibility: Concept Formation of the Woodcock-Muñoz Tests of Cognitive Ability's raw score; Planning: Porteus Maze Test's Porteus Quality Index; Inhibitory control: Porteus Maze Test's Q score; Metacognition: Metacognitive interview for children's global raw score..

second evaluations were compared.

3.3 Post-intervention intergroup comparisons

Cognitive performance was compared between the control and intervention groups at post-test (see Table 5). Results show that children who participated in the cognitive stimulation program had higher scores in cognitive flexibility ($t_{(158)} = 4.66$, $p < .001$, $d = 0.74$), metacognition ($t_{(158)} = 3.84$, $p < .001$, $d = 0.61$), planning ($t_{(158)} = 2.83$, $p < .005$, $d = 0.45$) and inhibitory control ($t_{(158)} = -2.78$, $p = .006$, $d = -0.45$) than children who did not receive training. In terms of the last variable, trained pupils manifested an increase in their ability to control impulses as compared with the control group (pre-intervention: $\eta^2 = .05$, post-intervention: $d = .45$). In the attention domain, no differences were observed between the groups ($t_{(158)} = 0.35$, $p = .730$, $d = 0.05$).

The teachers' report confirmed the better cognitive and school performance by IG children. Teachers suggested that these children had increased planning capacity ($t_{(157.54)} = 2.04$, $p = .043$, $d = 0.32$), inhibitory control ($t_{(158)} = -2.14$, $p = .034$, $d = -0.34$) and metacognition ($t_{(158)} = 2.55$, $p = .012$, $d = 0.41$) as compared with children in the control group. Teachers perceived no differences in regard to the prevalence of inattention conduct ($t_(158) = -1.56$, $p = .121$, $d = -0.25$) and organization difficulties ($t_{(158)} = -0.75$, $p = .456$, $d = -0.12$) between the groups.

Finally, intergroup analyses were broken down by age, gender and socioeconomic status to assess whether the children's sociodemographic variables could act as a mediator for the differences observed between the IG and the CG.

In the group of 7-year olds, IG children outperformed CG children in cognitive flexibility ($t_{(47)} = 2.91$, $p = .005$, $d = 0.83$); in the group of 8-year old children, performance in the areas of metacognition ($t_{(45)} = 3.37$, $p = .002$, $d = 0.66$) was better in trained children. In the group of 9-year olds, IG pupils performed better in cognitive flexibility ($t_{(42)} = 3.07$, $p = .004$, $d = 0.93$), planning (TLP: $t_{(42)} = 2.12$, $p = .04$, $d = 0.63$; EFS: $t_{(42)} = 2.95$, $p < .005$, $d = 0.90$), metacognition (EFS: $t_{(42)} = 3.37$, $p = .002$, $d = 0.66$), organization (EFS: $t_{(42)} = -2.65$, $p < .011$, $d = -0.79$) and impulsivity (EFS: $t_{(45)} = -4.13$, $p < .000$, $d = -1.23$), and manifested less frequent inattention conduct (EFS: $t_{(45)} = -2.42$, $p = .020$, $d = 0.73$) as compared to controls. In the older group (10-11 years old), results showed the opposite pattern. CG children performed better in areas of attention (EMAV: $t_{(18)} = -3.84$, $p < .001$, $d = -1.76$; EFS: $t_{(18)} = 3.17$, $p < .005$, $d = 1.54$) and organization (EFS: $t_{(18)} = 2.58$, $p = .019$, $d = 1.21$) as compared to trained children.

IG boys outperformed CG boys in cognitive flexibility ($t_{(78)} = 3.10$, $p < .003$, $d = 0.70$) and metacognition (Metacognitive interview: $t_{(78)} = 3.94$, $p < .000$, $d = 0.89$; EFS: $t_{(78)} = 1.94$, $p = .056$, $d = 0.44$); conversely, IG girls outperformed CG girls in cognitive flexibility ($t_{(65)} = 3.48$, $p < .001$, $d = 0.86$), planning (TLP: $t_{(78)} = 2.67$, $p = .009$, $d = 0.60$; EFS: $t_{(45)} = 1.94$, $p = .056$, $d = 0.44$) and inhibitory control ($t_{(78)} = -2.57$, $p = .012$, $d = -0.57$).

In students with lower low SES, IG children outperformed controls in cognitive flexibility ($t_{(45)} = 3.48$, $p < .000$, $d = 0.81$) and metacognition ($t_{(65)} = 2.61$, $p = .011$, $d = 0.64$). In the group with upper low SES, differences were observed in cognitive flexibility ($t_{(52)} = 2.95$, $p = .004$, $d = 0.81$), planning ($t_{(52)} = 2.18$, $p = .033$, $d = 0.59$), inhibitory control ($t_{(40.4)} = -3.27$, $p = .002$, $d = -0.90$) and metacognition ($t_{(52)} = 2.67$, $p = .010$, $d = 0.59$) favoring trained children. The marginal and middle-low SES achieved comparable results.

4. Discussion

This work strengthens and expands previous findings by reporting that the systematic and synergistic training of executive functions embedded in school curricula helped attain cognitive improvements in children. These improvements, in turn, were passed on to their everyday school activities. Contrary to earlier research, this work explored cognitive mediators in children before actual program implementation in order to find out whether mediators could affect the gains to be derived from cognitive training. Overall, results replicated what had been reported in the literature, indicating that the children's age (Flores-Lázaro et al., 2014; Fuhs et al., 2014; Hughes, 2011), gender (Matthews, Marulis, & Williford, 2014; Matute, Sanz, Gumá, Roselli, & Ardila, 2009) and

Table 4. Significant cognitive functioning differences in children, per control /intervention group, gender, age and socioeconomic status, at pretest.

Predictors	Dependent variable	*SS*	*df*	*MS*	*F*	*p*	η^2
Intercept	Attention	4.96	1	4.96	296.35	< .001	0.71
	Cognitive flexibility	12438.57	1	12438.57	654.60	< .001	0.85
	Planning	1398.09	1	1398.09	444.94	< .001	0.79
	Inhibitory control	3892.27	1	3892.27	254.75	< .001	0.68
	Metacognition	3020.81	1	3020.81	439.73	< .001	0.79
C/I Group	Inhibitory control	97.34	1	97.34	6.37	.013	0.05
	Age Attention	0.66	4	.17	9.90	< .001	0.25
	Cognitive flexibility	235.72	4	58.93	3.10	.018	0.09
	Planning	99.79	4	24.95	7.94	< .001	0.21
	Inhibitory control	267.07	4	66.77	4.37	.002	0.13
SES	Cognitive flexibility	212.58	3	70.86	3.73	.013	0.09
	Planning	28.55	3	9.52	3.03	.032	0.07
Gender	Cognitive flexibility	73.14	1	73.14	3.85	.052	0.03
Gender*SES	Metacognition	60.75	3	20.25	2.95	.036	0.07
Age**SES	Planning	67.16	3	6.72	2.14	.027	0.15
C/I Group* age* SES	Attention	0.23	6	0.04	2.34	.036	0.11

Note: $n = 178$, *SS* = Sum of squares, *MS* = Mean square. C/I Group = Control Group vs. Intervention Group. Attention: EMAV's raw score; Cognitive flexibility: Concept Formation of the Woodcock-Muñoz Tests of Cognitive Ability's raw score; Planning: Porteus Maze Test's Porteus Quality Index; Inhibitory control: Porteus Maze Test's Q score; Metacognition: Metacognitive interview for children's global raw score.

socioeconomic status (Hackman et al., 2010; Noble & Farah, 2013) are associated to differences in EF. In this particular study, age was the most significant predictor.

Interesting data for the future design of new experiences can be drawn from the implementation of this cognitive stimulation program. First of all, a comparison between the first and second evaluations showed that children actually improved EFs regardless of whether they had participated in cognitive training. In line with earlier studies, this data indicates that the accelerated development of EF, consistently documented for 6 to 10-year olds (Davidson et al., 2006; Flores-Lázaro et al., 2014; Hughes, 2011) played a key role in children's cognitive gains. These results raise the question as to the actual contribution of the cognitive stimulation program. Children who participated in this experience outperformed their controls in cognitive flexibility, inhibitory control, planning and metacognition during the post-test stage. Based on an in-depth analysis of enriched cognitive functions, it is clear that complex EFs were reinforced the most, especially cognitive flexibility ($d = .74$). On the contrary, the training program did not stimulate better performance in attentional activities. These findings match prior research revealing that improvements associated to EF training are reflected in the most demanding cognitive tasks such as rule changing (Diamond, 2012; Diamond & Ling, 2016; Goldin et al., 2014). Regarding attentional capacity, our findings conflict with those from prior research (Checa & Rueda, 2011; Ison, 2011). This may be due to the study intervention group design. The improvement of attentional abilities associated with formats based on individual training (Ison, 2009, 2011) or training in small groups (Lipina et al., 2011; Röthlisberger et al., 2012), has been documented by several studies, but there are few reports describing a full class training format to stimulate attention (Diamond et al., 2007).

The teachers' report was consistent with the results obtained from the neuropsychological evaluation of the children. Educators perceived that compared to control children, trained children had stronger abilities to plan their school tasks and activities, self-monitor and assess their learning processes, correct their mistakes, control their impulses and self-regulate their behavior in the classroom. This finding, which is rare in the literature (Anderson, Anderson, Northam, Jacobs, & O, 2002; Gioia & Isquith, 2004), provides the reported results with ecological validity as it reveals a generalization of cognitive achievements to daily school activities performed by the participant children.

Finally, thanks to the gender, age and socioeconomic status segmentation, different patterns could be identified in terms of the cognitive enrichment of school children, which can give rise to future research. Two very interesting results were observed when looking at age comparisons. From a high-level perspective, the analysis segmented by age showed that cognitive training was effective in 7 to 9-year olds, but not in 10 to 11-year olds. In the older age group, control children had a better attentional performance than trained children. A possible explanation may be that each group had very few participants and there was an imbalance in the number of group members between the control group (n = 12) and

Table 5. Post-intervention means of executive functioning and differences between the control group and the intervention group.

	IG ($n = 87$)		CG ($n = 73$)						
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*	95% CI	*d*
Attention	0.49	0.19	0.48	0.18	0.35	158	.730	−0.05 – 0.07	0.05
Flexibility	**19.97**	5.33	**16.24**	4.69	4.66	158	< **.001**	2.15 – 5.32	**0.74**
Planning	**6.24**	1.65	**5.46**	1.82	2.83	158	**.005**	0.23 – 1.32	**0.45**
Inhibitory control	**5.94**	2.64	**7.32**	3.48	−2.78	132.60	**.006**	−2.34 – −0.42	**−0.45**
Metacognition	**7.14**	2.28	**5.78**	2.20	3.84	158	< **.001**	0.66 – 2.07	**0.61**
EFS-Inattention	3.54	2.87	4.20	2.49	−1.56	157.83	.121	−1.51 – 0.19	−0.25
EFS-Metacognition	**5.41**	2.85	**4.30**	2.60	2.55	158	**.012**	0.43 – 0.25	**0.41**
EFS-Impulsivity	**2.55**	3.47	**3.75**	3.57	−2.14	158	**.034**	0.56 – −2.30	**−0.34**
EFS-Organization	2.97	2.73	3.29	2.60	−0.75	158	.456	0.42 – −1.15	−0.12
EFS-Planning	**3.87**	1.93	**3.31**	1.53	2.04	157.54	**.043**	0.28 – 0.01	**0.32**

EFS = Executive functioning scale. Attention: EMAV's raw score; Cognitive flexibility: Concept Formation of the Woodcock-Muñoz Tests of Cognitive Ability's raw score; Planning: Porteus Maze Test's Porteus Quality Index; Inhibitory control: Porteus Maze Test's Q score; Metacognition: Metacognitive interview for children's global raw score.

the intervention group (n = 8). In addition, most IG children were one year older than the regular school age, which is a complex issue involving multiple cognitive, affective and sociocontextual variables (Ison et al., 2015) that could have contributed to attenuating the benefits from the training program. Therefore, these results reflect the need to implement individual, intensive, early-start interventions with children who are older than the regular school age along with other approaches intended to tackle several aspects of this problem.

From a more detailed perspective, the analysis by age group revealed that children earned differential gains in regard to their EFs. Benefits differed according to age: cognitive flexibility for the 7-year olds, planning for the 8-year olds, and metacognition for the 8 and 9-year olds. This pattern could be associated with a sensitive time window to develop these cognitive functions: *cognitive flexibility*, 6 to 7-year olds (Davidson et al., 2006); *planning,* 7 to 10-year olds (Anderson et al., 2002; Matute et al., 2008) and *metacognition,* from 8 years old onwards (Georghiades, 2004; Roebers, Cimeli, Röthlisberger, & Neuenschwander, 2012). In summary, higher permeability in this experience associated with sensitive time windows could explain why training favored the EFs that were undergoing an intensive development stage.

The gender-based analysis revealed that girls outperformed their controls in terms of inhibitory control, planning and cognitive flexibility, while boys showed the same result in cognitive flexibility and metacognition. This data may suggest that, as opposed to boys and their controls, trained girls selectively improved the cognitive abilities in which they showed baseline strength, reflecting that both a cumulative effect—the well-known Matthew effect (Stanovich, 1986) and an enrichment effect can be associated with the cognitive stimulation program used in this study.

The analysis of the different SESs covered by the work showed that enrichment was higher for boys from a low socioeconomic status than for those from the marginal (20.5%) and medium-low layers of the population (7%). Although final conclusions cannot be drawn due to the small number of participants in the marginal and medium-low SES groups, they do seem to mark a trend: when cognitive improvements are compared according to poverty gradients, children from the lowest SESs are the least favored. Even though this appears to conflict with earlier research conclusions stating that children from disadvantaged settings benefit the most from cognitive interventions (Blair & Raver, 2014), this data actually expands on these findings by showing that, when training gains are analyzed by poverty gradients, the importance of adjusting intervention modalities to the specific requirements and situations of the poorest children stands out.

To sum up, the results presented suggest that training enhanced the children's evolutionary development of cognitive control functions and that this strengthening was actually generalized to improve self-regulated behavior in class. These gains may have been favored by the following characteristics of the implemented intervention: a prolonged duration (30 sessions), its implementation in a natural context, its incorporation into the children's daily activities, the implementation of cognitive and affective support to school children so that they could direct their attention and effort to task performance and its use of games, tasks arranged by increasing difficulty, activities that stimulated several EFs synergistically in each session, and words of praise and positive reinforcement.

Before we conclude, we find it necessary to point out some limitations of this study that can be overcome in the future. First of all, groups were not randomized and the long-term effects of the intervention were not measured. Second, it would have been valuable to go deeper into socio-contextual factors that could have mediated EF gains: cognitive stimulation at home, the richness and complexity of language interactions from parents to children, and so on. Third, as a core component of EFs, working memory contributes to the performance of other, more complex ones, such as cognitive flexibility and planning. It would have been interesting to measure and control for working memory gains. Finally, to the present study didn't identify the specific characteristics of the proposed activities that were associated to EF promotion: namely, individual tasks or group games, structured or slightly structured activities, and frequency and amount of practice. Future research could consider all of these aspects.

Keeping in mind the limitations of this study, we still conclude that this experience has produced new evidence about the effectiveness of cognitive interventions oriented to strengthening cognitive control functions in children from socially vulnerable contexts. Three aspects can be highlighted as the main contributions of this work: a school curriculum designed to boost executive functions in 6 to 10-year olds, a group design in line with the natural group composition and a generalization of cognitive gains to daily school activities. Children who participated in cognitive training strengthened their self-regulation capabilities and were able to subsequently transfer these achievements to their daily school activities.

It is very important for both science and society to move forward toward designing new intervention programs designed to counteract or at least offsett the negative effects that poverty has on cognitive performance. Future interventions should combine cognitive and socioemotional stimulation strategies to develop innovative practices and experiences that can enrich the daily activities of children and strengthen family and school resources towards the end of supporting integral child development.

References

Anderson, V., Anderson, P., Northam, E., Jacobs, R., & O, M. (2002). Relationship between cognitive and behavioral measures of executive function in children with brain disease. *Child Neuropsychology*, *8*(4), 231-240. doi: 10.1076/chin.8.4.231.13509

Barker, J. E., Semenov, A. D., Michaelson, L., Provan, L. S., Snyder, H. R., & Munakata, Y. (2014). Less-structured time in children's daily lives predicts self-directed executive functioning. *Frontiers in Psychology*, *5*, 1-16. doi: 10.3389/fpsyg.2014.00593

Best, J., Miller, P., & Naglieri, J. (2011). Relations between executive function and academic achievement from ages 5 to 17 in a large, representative national sample. *Learn Individ Differ*, *21*(4), 327-336. doi: 10.1016/j.lindif.2011.01.007

Blair, C., & Raver, C. (2014). Closing the achievement gap through modification of neurocognitive and neuroendocrine function: results from a cluster randomized controlled trial of an innovative approach to the education of children in kindergarten. *PLoS ONE*, *9*(11), e112393. doi: 10.1371/journal.pone.0112393

Canet-Juric, L., Urquijo, S., Richard's, M. M., & Burin, D. I. (2009). Predictores cognitivos de niveles de comprensión lectora mediante análisis discriminante. *International Journal of Psychological Research*, *2*(2), 99-111. doi: 10.21500/20112084.865

Carrada, M. (2011). *El mecanismo atencional en niños escolarizados: Baremación de instrumentos para su medición* (Unpublished doctoral dissertation). Universidad Nacional de San Luis.

Checa, P., & Rueda, M. R. (2011). Behavioral and brain measures of executive attention and school competence in late childhood. *Developmental Neuropsychology*, *36*(8), 1018-1032. doi: 10.1080/87565641.2011.591857

Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science*, *1*, 98-101. doi: 10.1111/1467-8721.ep10768783

Comisión de Enlace Institucional. (2006). *Nse 2006 informe final.* Retrieved from https://es.scribd.com/doc/64283742/Nivel-Socio-Economico-2006-de-Argentina-23-11-2006-Informe-Final-SAIMO-AAM-CEIM

Davidson, M., Amsoa, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*(11), 2037-2078. doi: 10.1016/j.neuropsychologia.2006.02.006

Diamond, A. (2012). Activities and programs that improve children's executive functions. *Current Directions in Psychological Science*, *21*(5), 335-341. doi: 10.1177/0963721412453722

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*(1). doi: 10.1146/annurev-psych-113011-143750

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, *318*(5855). doi: 10.1126/science.1151148

Diamond, A., & Ling, D. S. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience*, *18*, 34-48. doi: 10.1016/j.dcn.2015.11.005

Flores-Lázaro, J. C., Castillo-Preciado, R. E., & Jiménez-Miramonte, N. A. (2014). Desarrollo de funciones ejecutivas de la niñez a la juventud. *Anales de psicología*, *30*(2), 463-473. doi: 10.6018/analesps.30.2.155471

Fuhs, M. W., Nesbitt, K. T., & Dong, D. C. F. N. (2014). Longitudinal associations between executive functioning and academic skills across content areas. *Developmental Psychology*, *50*(6). doi: 10.1037/a0036633

García-Madruga, J. A., Vila, J. O., Gómez-Veiga, I., Duque, G., & Elosúa, M. R. (2014). Executive processes, reading comprehension and academic achievement in 3th grade primary students. *Learning and Individual Differences*, *35*, 41-48. doi: 10.1016/j.lindif.2014.07.013

García-Pérez, M., & Magaz-Lago, A. (2000). *Escala magal-*

lanes de atención visual. Madrid: Albor-cohs.

Georghiades, P. (2004). From the general to the situated: three decades of metacognition. *INT. J. SCI. EDUC*, *23*(3), 365-383. doi: 10.1080/0950069032000119401

Gioia, G. A., & Isquith, P. K. (2004). Ecological assessment of executive function in traumatic brain injury. *Developmental Neuropsychology*, *25*(1), 135-158. doi: 10.1080/87565641.2004.9651925

Goldin, A. P., Hermida, M. J., Elías-Costa, M., López-Rosenfeld, M., Shalom, D. E., Segretin, M. S., ... Sigman, M. (2014). Far transfer to language and math scores of a short software-based gaming intervention. *Proceedings of the National Academy of Sciences (PNAS)*, *111*(17). doi: 10.1073/pnas.1320217111

Hackman, D. A., Farah, M. J., & Meaney, M. J. (2010). Socioeconomic status and the brain: mechanistic insights from human and animal research. *Neuroscience*, *11*. doi: 10.1038/nrn2897

Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant and Child Development*, *20*, 251-271. doi: 10 .1002/icd.736

Huizinga, M., Dolan, C., & van der Molen, M. (2006). Age-related change in executive function: Developmental trends and a latent variable analysis. *Neuropsychologia*, *44*, 2017-2036.

Ison, M. S. (2009). Abordaje psicoeductivo para estimular la atención y las habilidades interpresonales en escolares argentinos. *Revista de la Facultad de Psicología – Universidad de Lima*, *12*, 29-51.

Ison, M. S. (2011). Programa de intervención para mejorar las capacidades atencionales en escolares argentinos. *International Journal of Psychological Research*, *4*(2), 72-79. doi: 10.21500/20112084.783

Ison, M. S., & Fachinelli, C. C. (1993). Guía de observación comportamental para niños. *Interdisciplinaria*, *12*(1), 11-21.

Ison, M. S., Greco, C., Korzeniowski, C., & Morelato, G. (2015). Attentional efficiency: a comparative study on argentine students attending schools from different socio-cultural contexts. *Electronic Journal of Research in Educational Psychology*, *13*(2). doi: 10.14204/ejrep .36.14092

Koechlin, E., & Summerfield, C. (2007). An information theoretical aprroach to prefrontal executive fuction. *Trends in Cognitive Sciences*, *11*(6), 229-235. doi: 10.106/j.tics.2007.04.005

Korzeniowski, C. (2015). *Programa de estimulación de las funciones ejecutivas y su incidencia en el rendimiento escolar en alumnos mendocinos de escuelas primarias de zonas urbano-marginadas* (Unpublished doctoral dissertation). Universidad Nacional de San Luis, Argentina.

Krikorian, R., & Bartok, J. A. (1998). Developmental data for Porteus Maze Test. *The Clinical Neuropshycologist*, *12*(3), 305-310. doi: 10.1076/clin.12.3.305.1984

Lehto, J., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology*, *21*, 59-80.

Lipina, S. J., Hermida, M. J., Segretin, M. S., Prats, L., Fracchia, C., & Colombo, J. A. (2011). La pizarra de babel. puentes entre neurociencia, psicología y educación. In S. J. Lipina & M. Sigman (Eds.), (p. 243-264). Buenos Aires, Argentina: Libros Del Zorzal.

Lucangeli, D., & Cornoldi, C. (1997). Mathematics and metacognition: What is the nature of the relationship? *Mathematical cognition*, *3*(2), 121-139. doi: 10.1080/135467997387443

Marino, J. C., Fernández, A. L., & Alderete, A. M. (2001). Valores normativos y validez conceptual del test laberintos de porteus en una muestra de adultos argentinos. *Revista de Neurología Argentina*, *26*, 102-107.

Matthews, J. S., Marulis, L. M., & Williford, A. P. (2014). Gender processes in school functioning and the mediating role of cognitive self-regulation. *Journal of Applied Developmental Psychology*, *35*, 128-137. doi: 10.1016/j.appdev.2014.02.003

Matute, E., Chamorro, Y., Inozemtseva, O., Barrios, O., Rosselli, M., & Ardila, A. (2008). Efecto de la edad en una tarea de planificación y organización ("pirámide de méxico") en escolares. *Revista de Neurología*, *47*(2), 61-70.

Matute, E., Sanz, A., Gumá, E., Roselli, M., & Ardila, A. (2009). Influencia del nivel educativo de los padres, el tipo de escuela y el sexo en el desarrollo de la atención y la memoria. *Revista Latinoamericana de Psicología*, *41*(2), 257-273. doi: 1434/rlp.v41i2.380

Miyake, A., Friedman, N., Emerson, M., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*. doi: 10.1006/cogp.1999.0734

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences (PNAS)*, *108*, 2693-2698. doi: 10.1073/pnas.1010076108.

Noble, K. G., & Farah, M. J. (2013). Neurocognitive consequences of socioeconomic disparities: the intersection of cognitive neuroscience and public health. *Developmental Science*, *16*(5). doi: 10.1111/desc.12076.

Porteus, S. D. (2006). *Laberintos de Porteus (4^a ed.)*. Madrid: TEA Ediciones.

Roebers, C., Cimeli, P., Röthlisberger, M., & Neuenschwander, R. (2012). Executive functioning, metacognition, and self-perceived competence in elementary school children: an explorative study on their interrelations and their role for school achievement. *Metacognition Learn-*

ing, *7*, 151-173. doi: 10.1007/s11409-012-9089-9

Rosselli, M., Matute, E., & Ardila, A. (2006). Predictores neuropsicológicos de la lectura en español. *Revista de Neurología*, *42*(4), 202-210.

Röthlisberger, M., Neuenschwander, R., Cimeli, P., Michel, E., & Roebers, C. (2012). Improving executive functions in 5- and 6-year-olds: Evaluation of a small group intervention in prekindergarten and kindergarten children. *Infant and Child Development*, *21*, 411-429. doi: 10.1002/icd.752

Segretin, M. S., Lipina, S. J., Hermida, M. J., Sheffield, T., Nelson, J. M., Espy, K. A., & Colombo, J. A. (2014). Predictors of cognitive enhancement after training in two samples of argentinean preschoolers from diverse socioeconomic backgrounds. *Frontiers in Psychology*, *5*. doi: 10.3389/fpsyg.2014.00205

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, *21*, 360-407.

Welsh, J. A., Nix, R. L., Blair, C., Bierman, L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology*, *102*(1). doi: 10.1037/a0016738

Woodcock, R. W., Muñoz-Sandoval, A. F., Ruef, M. L., & Alvaado, C. G. (2005). *Bateria III Woodcock-Muñoz: pruebas de habilidades cognitivas*. Riverside Publishing Company.