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The Influence of the Parents' Educational Level on the Development of Executive Functions

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Information about the influence of educational variables on the development of executive functions is limited. The aim of this study was to analyze the relation of the parents' educational level and the type of school the child attended (private or public school) to children's executive functioning test performance. Six hundred twenty-two participants, ages 5 to 14 years (276 boys, 346 girls) were selected from Colombia and Mexico and grouped according to three variables: age (5–6, 7–8, 9–10, 11–12, and 13–14 years), gender (boys and girls), and school type (private and public). Eight executive functioning tests taken from the *Evaluación Neuropsicológica Infantil;* Matute, Rosselli, Ardila, & Ostrosky, in press) were individually administered: Semantic Verbal Fluency, Phonemic Verbal Fluency, Semantic Graphic Fluency, Nonsemantic Graphic Fluency, Matrices, Similarities, Card Sorting, and the Mexican Pyramid. There was a significant effect of age on all the test scores and a significant effect of type of school attended on all but Semantic Verbal Fluency and Nonsemantic Graphic Fluency tests. Most children's test scores, particularly verbal test scores, significantly correlated with parents' ed-

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ucational level. Our results suggest that the differences in test scores between the public and private school children depended on some conditions existing outside the school, such as the parents' level of education. Implications of these findings for the understanding of the influence of environmental factors on the development of executive functions are presented.

The term *executive function* is a relatively new term in the neurosciences. The observation that the frontal lobes were involved in behaviors such as problem solving, planning, inhibiting responses, strategy development with implementation, and working memory resulted in the comprehensive term "executive function" (Lezak, 1983). These skills improve as the brain matures during childhood and adolescence (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001). The incomplete development of the frontal lobes in childhood implies that a limited ability to apply effective executive skills may be present (Anderson, Lajoie, & Bell, 1996). Although age (as an index of maturational status) seems to account for most of the executive function test-performance variability in children, very little has been studied regarding the influence of environmental factors. This study focused on the effect of two environmental variables on executive function test performance: the influence of the level of education of the children's parents and the type of school that the child attends (public or private).

Few studies have approached the development of executive functions in children (e.g., Anderson, 2001; Espy, Kaufmann, & Glisky, 2001; Levin et al., 1991; Soprano, 2003; Welsh & Pennington, 1988). Generally, a progressive improvement in test score with maturing age has been observed. However, the increase in scores depends on the test and is not steady across the different age ranges (Senn, Espy, & Kaufmann, 2004). Recently, Klenberg, Korkman, and Lahti-Nuuttila (2001) studied the development of executive functions in four hundred 3- through 12-year-old Finnish children. Data from 10 subtests measuring impulse control and inhibition of irrelevant responses, auditory and visual attention, visual search, planning, and verbal and visual fluency were included. The development proceeded sequentially, from motor inhibition and impulse control to functions of selective and sustained attention, and finally to fluency. Significant relations between gender and development and between parent education and development were found for several subtests. The authors concluded that development of basic inhibitory functions precedes the development of more complex functions of selective attention, and executive functions continue to develop into adolescence.

Anderson et al. (2001) used a sample of 138 children ages 11.0 to 17.11 years. Socioeconomic status (SES) was controlled across age groups. They found a relatively flat development trajectory for executive functions during late childhood and early adolescence. Progress, however, tended to be faster during early and middle childhood and to slow during late childhood and adolescence in this sample.

Developmental studies have provided evidence that the development of executive functions is a multistage process in which different components develop at different times (Klenberg et al., 2001). Environmental variables have an unclear influence on this development, although performance on neuropsychological tests is very sensitive to educational and cultural variables (Ardila, 1995; Fletcher-Janzen, Strickland, & Reynolds, 2000; Lezak, 2004; Rosselli & Ardila, 2003). Links have been suggested between cognitive development and SES in different countries (Kohen, Gunn, Leventhal, & Hertzman, 2002). For example, spoken language skills of children reared in poverty are depressed in comparison with the general population, and in comparison with their general cognitive abilities. Hoff (2003b) found that children whose families belong to high SES demonstrated larger productive vocabulary than the children from mid-SES families. The influence of environmental factors has also been shown for the development of other cognitive abilities (e.g., Ardila & Rosselli, 1994). Turkheimer, Haley, Waldron, D'Onofrio, and Gottesman (2003) suggested that the proportions of IQ variance attributable to familial background and environment vary nonlinearly with SES.

One very important environmental influence in the child's cognitive development is the parents' level of education. Parents with a higher education create a more intellectually stimulating environment for their children (Hoff, 2003a, 2003b). It has been demonstrated that highly educated parents (professionals) have a different way of interaction with their children particularly in respect to their language used (Hoff, Laursen, & Tardif, 2002). College-educated mothers talk more, use a richer vocabulary, and read more to their children than those mothers limited to a high school education (Hoff-Ginsberg, 1991). Parents's educational level has also been related to children's school attendance and general cognitive development (e.g., Ganzach, 2000; Teachman, 1987; White, 1982). Children from parents with higher education tend to have a larger vocabulary, more rapid language development, better performance in cognitive tests, and higher school attendance. Portes, Cuentas, and Zady (2000) assessed the relation of parent–child interaction to children's intellectual achievement. The results demonstrated that although interaction characteristics are related to children's intellectual achievement, that relation is moderated by context factors that may vary in each culture. Some differences in educational systems among different countries have to be considered. Further, the association between parents' education and private versus public schools may vary across countries.

SES is a compound variable that includes family income, parental education, occupational status, and place of residence. A significant association between SES and test scores has been frequently reported (e.g., Bradley & Corwyn, 2002; Lichtenstein & Pedersen, 1997; Petrill & Deater-Deckard, 2004; Turkheimer et al., 2003). Research shows that SES is associated with a wide array of health, cognitive, and socioemotional outcomes in children, with effects beginning prior to birth and continuing into adulthood. A variety of mechanisms linking SES to child well-being have been proposed, with most involving differences in access to material and social resources or reactions to stress-inducing conditions by both the children themselves and their parents (Bradley & Corwyn, 2002). This SES effect on test scores has been documented in diverse cultures. For example, Sigman, Neumann, Jansen, and Bwibo (1989) observed in children growing up in rural Kenya that cognitive scores were best predicted by a combination of factors, including duration of schooling, food intake, physical stature, and SES. In this article we are dealing only with parents' educational level, but we are aware of the close association between parents' education and SES. As a matter of fact, parent education is a major component of the SES variable.

The purpose of this research was to analyze the relation of the parent's educational level and the type of school (private or public school) on children' s executive functioning test performance. We predict a significant correlation between the parents' education and children's performance on executive functioning measures Likewise, it was anticipated that children from private schools would perform better than children from public schools. Attendance at private or public school may be linked with differences in the level of education of the parents, their interests, and their income. Most likely, the level of education and the income of children's parents who attended private school are higher that those children whose parents attended public school. We anticipated that the effect of type of education would be independent of the age of the child. In other words, children from private schools would have higher test scores than children from public school across age groups. It was also expected based on previous research (e.g., Anderson et al., 2001; Klenberg et al., 2001; Rosselli, Ardila, Bateman, & Guzman, 2001) that test scores would improve with age.

METHOD

Participants

Six hundred twenty-two 5- to 14-year-old children (276 boys, 346 girls) were selected from private and public schools in Colombia (city of Manizales, population about 500,000 inhabitants) and Mexico (city of Guadalajara, population about 3,300,000 inhabitants; and city of Tijuana, population about 1,100,000 inhabitants). The mean educational levels of the public school children's fathers and mothers were 11.26 (*SD* = 4.23) and 10.82 years (*SD* = 3.99), respectively; the mean educational levels of the private school children's fathers and mothers were 15.65 (*SD* = 3.10) and 15.55 (*SD* = 2.72) years, respectively. The sample included 579 right-handers and 43 left-handers. Table 1 presents the gender, age, and type of school distribution of the sample.

All participants were screened to identify any history of neurological or psychiatric problems, mental retardation, and learning disabilities, using a struc-

TABLE 1
General Characteristics of the Sample

	Boys			*Girls*			
Age Group	*Public School*	*Private School*	*Total*	*Public School*	*Private School*	*Total*	*Total*
5–6	23	25	48	29	30	59	107
7–8	26	25	51	30	36	66	117
9–10	38	23	61	42	37	79	140
11–12	40	23	73	49	29	78	141
13–14	29	24	53	37	27	64	117
Total	156	120	276	187	159	346	622

tured interview for parents included in the *Evaluación Neuropsicológica Infantil* (ENI; Matute et al., in press). Although no formal testing was done to rule out intellectual or learning disabilities, we screened for grade retention, ascertained that no chronological age–grade level disparity was present, and that the children's reading and math performance agreed with their chronological grade levels according to the school records. Handedness was assessed using the handedness test included in the ENI.

Instruments

The scores of eight executive function subtests from the ENI (Matute et al., in press) were analyzed. The ENI is a new neuropsychological test battery developed in the Spanish language, targeting different cognitive domains (Matute, Montiel, Rosselli, & Ardila, 2003; Matute, Rosselli, Ardila, & Morales, 2004; Rosselli, Matute, Ardila, & Montiel, 2003).

The following are the executive functioning tests that were used.

1. Semantic Verbal Fluency: Children were instructed to name all animals they could in 1 min. The score was the total number of animals named correctly.

2. Phonemic Verbal Fluency: Children were instructed to say as many words starting with *M* as they could in 1 min, omitting all proper nouns (names of people, places, etc.) as well as morphological variations of the same word. The score was the total number of correct words.

These two verbal tests assess concept formation as well as an ability to simultaneously remember to think in an abstract manner and to shift responses when required (Anderson et al., 2001; Matute et al., 2004).

3. Semantic Graphic Fluency (meaningful figures): Children were instructed to draw as fast as possible (within 3 min) all the different meaningful figures they

could on a page featuring 35 contiguous 1-in. squares in a 5 × 7 array (Matute et al., 2004). The examiner instructed the child to make each drawing as simple as possible. One point was given for drawing of a shape that represented something definite. The points were added to obtain the total score.

4. Nonsemantic Graphic Fluency (geometric designs): Children were instructed to draw, as fast as possible, linear geometric figures connecting five points with four lines within a square presented on a sheet of paper containing a 7 × 5 array of 35 dot matrices (adapted from Regard, Strauss, & Knapp, 1982), but only 3 min were allowed as in Lee, Loring, Newell, and McCloskey (1994) and Spreen and Strauss (1998). All 35 dot matrices were identical and contained five symmetrically arranged dots; four of them were black, and each one of them was located in a different corner. The fifth point was white and was located at the center of the square. All lines must connect dots and at least one has to touch the white dot. Those figures that were not formed by four lines or those in which the white dot was not connected were scored as intrusions, whereas those that the child had made previously were scored as perseverations. One point was given to each correct drawing.

These two graphic fluency tests were designed to measure the individual's ability to generate a series of novel designs (Regard et al., 1982) and have been used as a measure of executive functions in children (Matute et al., 2004).

5. Similarities: The child was requested to find commonalities between pairs of words. This type of task assesses verbal concept formation (Lezak, 2004), and has been associated with left temporal and frontal functioning. Eight pairs of words were presented, one at a time. The word pairs ranged in level of difficulty from the simplest (*dog* and *cat*), to the most difficult (*liberty* and *justice*). Abstract generalizations or categorizations (i.e., "A dog and a cat are animals") were scored with 2 points; specific and descriptive answers (i.e., "A dog and the cat have four legs") were scored with 1 point, and incorrect answers received a zero. Maximum score was 16.

6. Matrices: This multiple-choice subtest consisted of a series of visual pattern-matching and analogy problems pictured in nonrepresentational designs. It requires the child to conceptualize spatial and design relations such as in Raven's Progressive Matrices (Raven, Court, & Raven, 1976). This test consists of eight items ranging from simple and concrete to complex and abstract. One point is given to each option correctly selected by the child. The maximum score is 8.

7. Card Sorting: This is a sorting subtest that requires the child to shift concepts of color, shape, and number. The format of this subtest is similar to the Wisconsin Card Sorting Test (WCST; Heaton, 1981) and taps attention, concept formation, cognitive flexibility, and working memory. The child is given 54 cards on which are printed one to three symbols—a circle, square, or rhombus, in pink, yellow, and blue. The child's task is to place the cards one by one under three stimulus

cards—one pink square, two yellow rhombuses, and three blue circles—according to a principle (color, shape, or number) that the child must deduce from the pattern of the examiner responses (correct or incorrect) to the child's placement of the cards. The test begins with color as the basis for sorting, followed by form, and ending with number. The test continues until the child has made three runs of 10 correct placements, or if the child has placed all 54 cards. The score corresponds to the number of successful runs (categories). Maximum score is 3.

8. Pyramid of Mexico: This test requires identification and organization of steps to achieve a goal. The goal is to arrange, with the fewest moves, three blocks with different colors (green, white, and red) and sizes (large, medium, and small), according to a desired construction model. Eight different desired constructions are presented one by one on color cards. The child has to construct the design with the minimum number of moves. The score corresponds to the number of items constructed with the minimum number of moves. The maximum score of successes is 11. This test is similar in principle to the Tower of London test (Shallice, 1982), and its purpose is to measure problem-solving ability.

For validity purposes, the Spanish *Escala de Inteligencia Wechsler Para Niños –Revisada* (WISC–R; Wechsler, 1974) was also administered to 30 of the participants to calculate the validity of the ENI subtests, Matrices and Similarities. Correlations were obtained between these tests and two subtests (Block Design and Similarities) from the WISC–R. The Pearson correlation (two-tailed) of ENI Similarities with WISC–R Similarities subtest was 0.67 ($p = .0001$). The scores of the ENI Matrices were correlated, using Pearson correlation, to the WISC–R Block Design subtest ($r = .52$; $p = .001$). The Block Design was used because it is one of the best predictors of abstract spatial abilities.

Procedure

The purpose of this research was initially explained to the school principals. After accepting to participate, the teachers from the different grades were approached. Teachers were informed in detail about the different points of the testing, such as purpose, confidentiality, parents' consent, time to complete the testing, and so forth. Class lists were reviewed with the teachers. Children were randomly selected from several classrooms, using these lists provided by the schoolteachers. Their parents were contacted and interviewed. Children with no history of school failure and no history of neurological or psychiatric disorders were chosen and individually tested at their schools or homes in two sessions of about 90 min each. The whole battery ENI was administered to each child, but only the executive function tests were analyzed in this article. Each child received a small gift (e.g., a box of crayons, candy) for participation in the study.

Statistical Analyses

A multivariate analysis of variance (MANOVA) was performed using age (5–6-, 7–8-, 9–10-, 11–12-, and 13–14-year-old groups), sex (boys, girls), and school type (public, private) as independent variables and executive function test scores as dependent variables. The parents' educational level was used as a covariate. Main effects and interactions were analyzed. The overall MANOVA (Hotelling T^2) was calculated and univariate analyses were obtained for each of the eight dependent measures. Partial eta squares ($\eta^{2)}$ were used to estimate the effect sizes measure for the multivariate and univariate *F*s. Post hoc analysis was done using Tukey honestly significant difference test to compare mean differences within groups. Pearson correlation coefficients were obtained to determine the associations between the parents' level of education and the different executive test scores. In addition, to further evaluate the influence of environmental factors on those tests that significantly correlated with the parental education, a hierarchical regression analysis was used, entering school and parental education as predictors for each test and controlling for age.

RESULTS

MANOVAs were initially used to analyze the main effects and interactions of the three independent variables over all dependent measures (test scores) using parent level of education as a covariate. The main effects of age, sex, and type of school were statistically significant, $F(4, 601) = 22.25$, $p < .0001$, $\eta^2 = 0.44$; $F(1, 601) = 3.31$, $p < .001$, $\eta^2 = 0.10$, and $F(1, 601) = 3.08$, $p < .01$, $\eta^2 = 0.10$, respectively. These main effects were found when all the dependent variables were analyzed together in the multivariate model. Also, the parents' level of education was a significant covariate, $F(1, 601) = 4.31$, $p < .0001$, $\eta^2 = 0.13$. A significant interaction was found between age group and type of school, $F(4, 601) = 2.17$, $p = .001$, $\eta^2 = 0.07$. The interactions between sex and age, $F(4, 601) = 0.68$, $p = .926$, $\eta^2 = 0.02$, and sex and type of school, $F(1, 601) = 1.26$, $p = .262$, $\eta^2 = 0.04$ were not significant. For all the subtests, performance increased with age and was higher in private than in public school children. The most important variable was age, but type of school was also a significant variable for all the tests. No differences were observed between boys and girls. That is, type of school remained a significant factor, independent of age or gender of the child, and after controlling for parent education.

Univariate ANOVAs were used to analyze the age, gender, and type of school effects on each of the dependent measures. Table 2 presents the between-subject effects for the different executive function tests. Age had a significant main effect on all the dependent variables, and type of school had a significant main effect on all measures except Card Sorting. Significant interactions between age and type of

TABLE 2
Analysis of Variance for Each Executive Function Test

	Age		*Gender*		*School*		*Age × Gender*		*Gender × School*		*Age × School*	
Test	*F*	η^2	*F*	η^2	*F*	η^2	*F*	η^2	*F*	η^2	*F*	η^2
Verbal fluency												
Semantic	50.4**	.42	4.4*	.01	44.3**	.14	.43	.00	1.13	0.0	2.8*	.04
Phonologic	168.0**	.53	1.7	.00	28.7**	.05	.97	.00	1.0	.00	1.34	.00
Graphic fluency												
Semantic	101.7**	.40	30.3**	.05	55.6**	.09	.91	.00	3.8*	.01	.83	.00
Nonsemantic	91.5**	.39	.3	.00	20.0**	.03	1.1	.00	1.13	.00	2.6*	.01
Similarities	118.9**	.44	.1	.00	29.5**	.05	.6	.00	.14	.00	1.7	.01
Matrices	64.3**	.34	.2	.00	6.87**	.00	.5	.00	.15	.00	1.7	.01
Card Sorting	27.1**	.15	1.5	.00	0.09	.00	1.2	.00	.76	.00	3.2*	.02
Mexican Pyramid	17.63**	.11	2.6	.00	26.96**	.04	1.3	.01	.17	.00	3.5*	.03

*$p < .05$. **$p < .01$.

school were found for Semantic Verbal Fluency, Nonsemantic Graphic Fluency, Card Sorting, and Mexican Pyramid tests. Differences between private and public school were highest in the youngest group for Semantic Verbal Fluency and Mexican Pyramid (see Figures 1–4). The scores in the Semantic Verbal Fluency test of the youngest group of children from private schools was about 50% higher than the scores for the youngest public school children $F(1, 106) = 11.96$, $p = .001$. In the oldest group, this difference was only about 10%, $F(1, 116) = 0.40$; $p = .52$. The direction of the interaction was similar for the Mexican Pyramid. In this test, the youngest group from private school scored significantly higher than the same age group from the public school, $F(1, 106) = 10.46$, $p = .002$, whereas in the oldest group this difference disappeared, $F(1, 116) = 0.07$, $p = .78$. The direction of the interaction for the Nonsemantic Graphic Fluency test scores was in the opposite direction; the difference in this test between the youngest public and private school children is small, $F(1, 106) = 0.82$, $p = .36$, but it is large between the public and private school groups in the oldest sample, $F(1, 116) = 7.31$, $p = .008$.

The main effect of gender was observed in Semantic Verbal Fluency and Semantic Graphic Fluency tests. In the former variable, boys outperformed girls; the opposite pattern was found in the latter variable (see Table 2). A significant interaction between gender and school type for Semantic Graphic Fluency was found. Girls' superiority was observed mainly in the private school group. Interactions between age, gender, and type of school were not significant for any of the dependent measures.

Considering that type of school (public or private) is significantly associated with the parents' educational level, we decided to look at the correlations between the children's tests scores and their parents' years of education. We calculated the correlations between parents' educational level and children's test scores. Only the youngest and oldest children were select in this analysis to minimize and maximize the potential school effect (zero years of school vs. 7 years of school; Table 3). Six significant correlations were found between the parents' education and test scores. The highest correlations in the younger group were found with Verbal Fluency. The highest correlations in the oldest group were found with Matrices and Similarities.

The hierarchical regression analysis showed in Table 4 corroborates the predictive value of parental education and the type of school on the fluency tests and similarities. After 38% of the variance attributable to the child's age was removed, the parents' education and type of school accounted for an additional 12% of the Semantic Verbal Fluency score variance. The variance associated to the parents' education after controlling for age on Phonemic Verbal Fluency, Semantic Graphic Fluency, and Nonsemantic Graphic Fluency was 3%, 7%, 3%, and 5 %, respectively. The parents' education better predicts Semantic Verbal and Graphic Fluency, Nonsemantic Graphic Fluency, and Similarities test scores than the type of school.

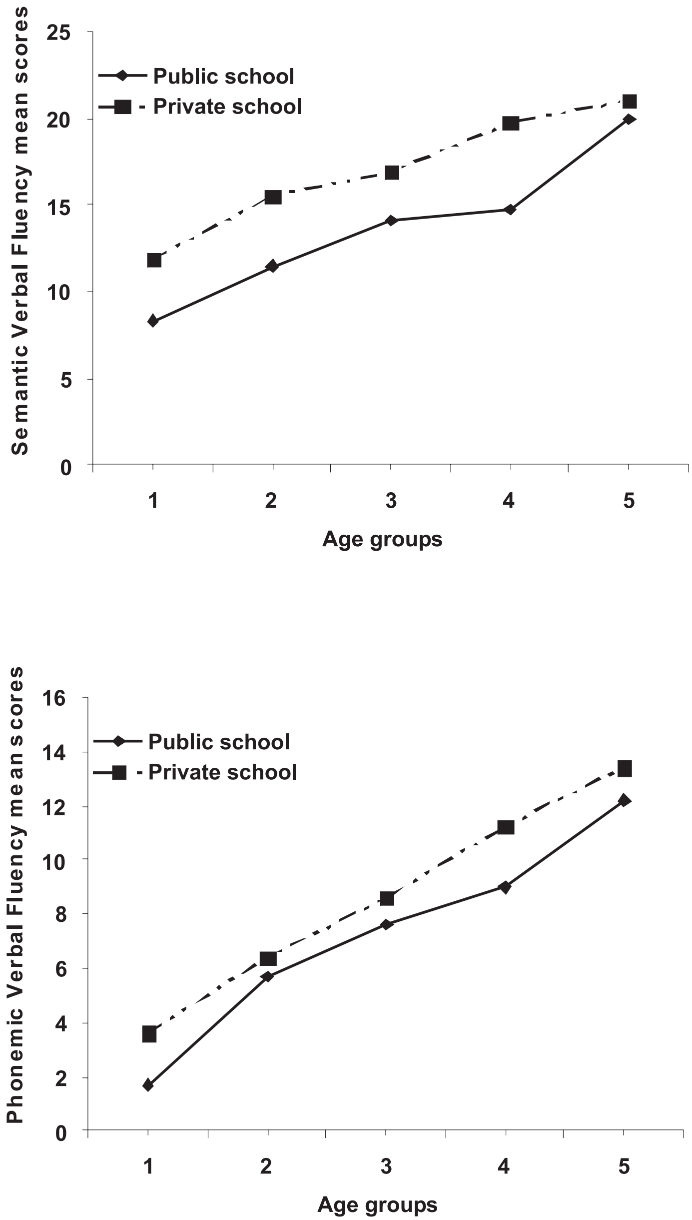


FIGURE 1 Test scores of children from public and private schools in different age groups. *Note.* 1 = 5–6 years; 2 = 7–8 years; 3 = 9–10 years; 4 = 11–12 years; 5 = 13–14 years.

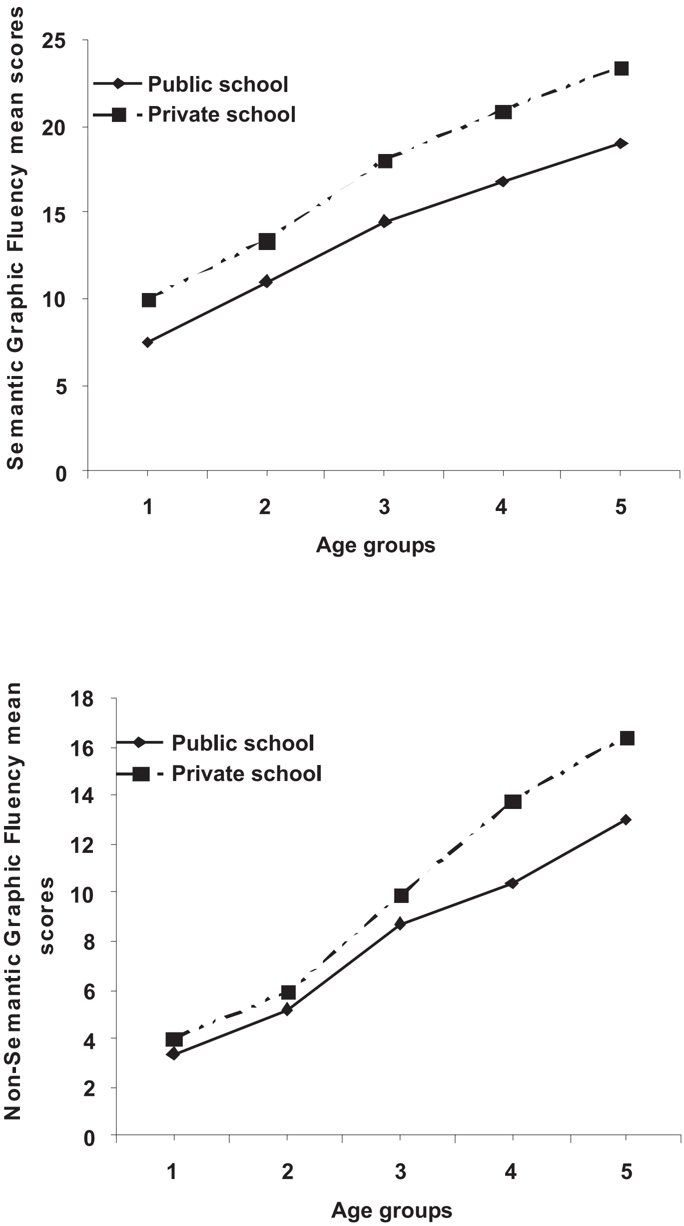
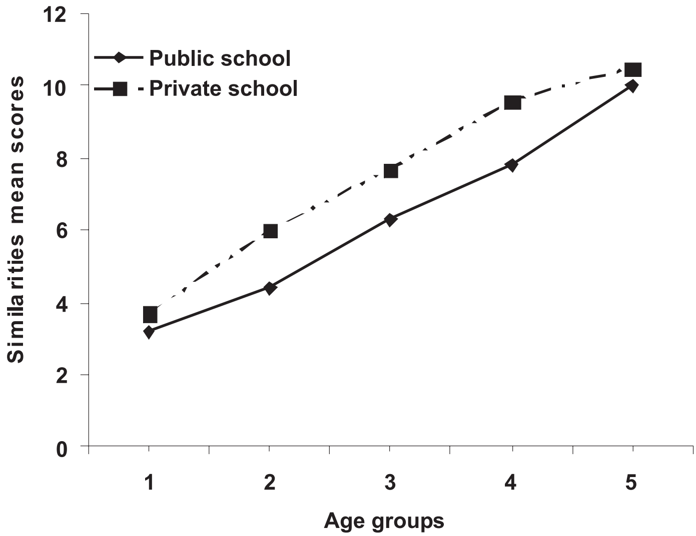


FIGURE 2 Test scores of children from public and private schools in different age groups. *Note.* 1 = 5–6 years; 2 = 7–8 years; 3 = 9–10 years; 4 = 11–12 years; 5 = 13–14 years.



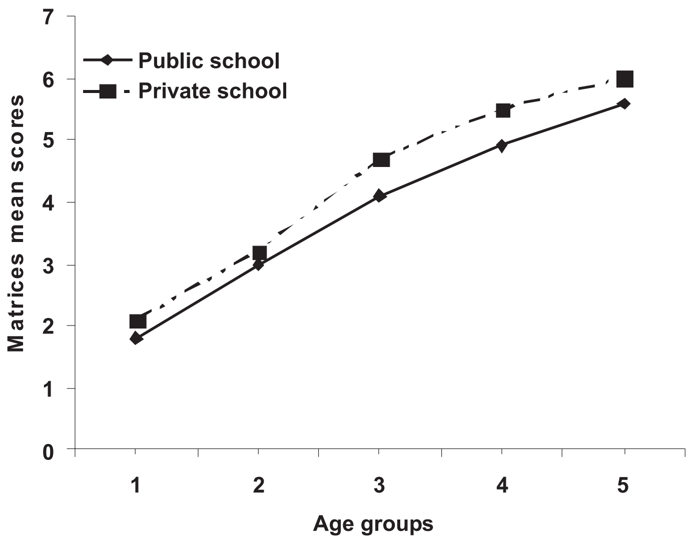
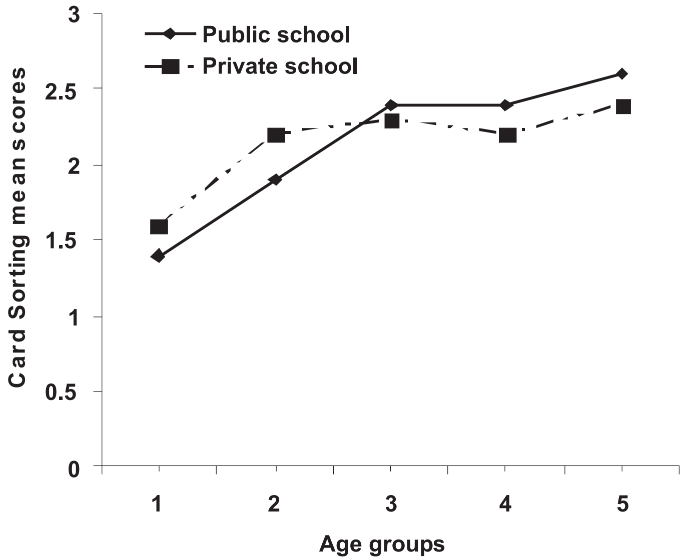


FIGURE 3 Test scores of children from public and private schools in different age groups. *Note.* 1 = 5–6 years; 2 = 7–8 years; 3 = 9–10 years; 4 = 11–12 years; 5 = 13–14 years.



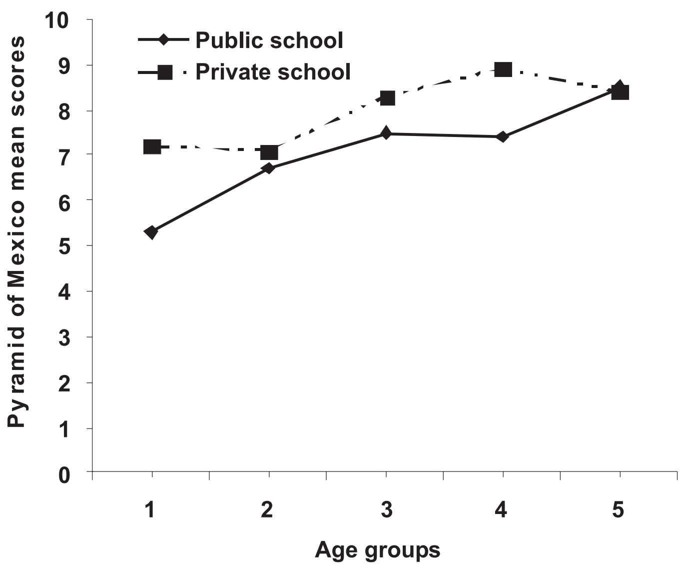


FIGURE 4 Test scores of children from public and private schools in different age groups.
Note. 1 = 5–6 years; 2 = 7–8 years; 3 = 9–10 years; 4 = 11–12 years; 5 = 13–14 years.

TABLE 3
Correlations Between Parents' Years of Education and Scores in the Different Executive Functioning Tests in the 5- to 6-Year-Old Children Group and in the 13- to 14-Year-Old Group

Test	*5- to 6-Year-Olds' Parents*	*13- to 14-Year-Olds' Parents*
Semantic Verbal Fluency	0.46*	0.30*
Phonemic Verbal Fluency	0.33*	0.18*
Semantic Graphic Fluency	0.30*	0.30*
Nonsemantic Graphic Fluency	0.31*	0.30*
Similarities	0.27*	0.34*
Matrices	0.11	0.30*
Card Sorting	0.20*	0.03
Mexican Pyramid	0.13	0.16

*$p < .05$ (2-tailed).

DISCUSSION

In accordance with our predictions based on previous research there was a significant association between age and performance on executive function tests for both boys and girls. The most important finding in this study, however, was the robust difference observed between children in private and public schools on executive function test scores. This effect showed a significant interaction with age for most measures. Differences between public and private school children were robust for younger children but decreased with age and schooling for some tests (e.g., Verbal Fluency tests). Hence, the score difference between the public and the private school in these measures represented indeed not a school, but a previous-to-school effect. For the Nonsemantic Graphic Fluency, the differences between children from public and private school increased with age. This finding suggests a more school-dependent effect for graphic nonverbal measures than for verbal fluency measures. The differences between the public and private school children in Phonemic Verbal Fluency, Semantic Graphic Fluency, and Matrices tests scores observed in the younger group remained similar across age groups.

This study found a significant correlation of the parents' education level with most of the measures of children's functioning. Moreover, the school-type variable covaried with the parents' education, and in many cases parental education better predicts the executive function test performance than the type of school. These results suggest that the differences in test scores between the public and private school children depended on some conditions existing outside the school, such the parents' level of education. Researchers (see Hoff et al., 2002; Hoff, 2003a for a review) have shown a strong association between the parents' SES, types of language used, and ways of interactions, such as more reading behavior. In addition, a

TABLE 4
Hierarchical Regression Analysis Predicting the Variance in a Child's Executive Test Scores Attributable to Parental Education and Type of School, Removing the Effects of Age

Test	*B*	*SE B*	*β*	*p*	R^2	R^2 *Change*
Semantic Verbal Fluency						
Step 1					.38	
Age	2.39	.18	.62	.001		
Step 2					.50	.12
Age	2.46	.16	.64	.001		
Parents' education	.33	.07	.24	.001		
Type of school	1.56	.59	.13	.01		
Phonemic Verbal Fluency						
Step 1					.50	
Age	2.34	.09	.70	.001		
Step 2					.53	.03
Age	2.38	.09	.72	.001		
Parents' education	.09	.04	.08	.05		
Type of school	1.03	.32	.11	.01		
Semantic Graphic Fluency						
Step 1					.36	
Age	3.02	.17	.59	.001		
Step 2					.42	.07
Age	3.12	.16	.61	.001		
Parents' education	.20	.07	.11	.01		
Type of school	2.62	.55	.19	.001		
Nonsemantic Graphic Fluency						
Step 1					.36	
Age	2.74	.15	.60	.001		
Step 2					.39	.03
Age	2.82	.15	.62	.001		
Parents' education	.22	.07	.14	.001		
Type of school	0.81	.51	.06	*ns*		
Similarities						
Step 1					.43	
Age	1.68	.08	.66	.001		
Step 2					.49	.06
Age	1.72	.07	.68	.001		
Parents' education	.18	.03	.19	.001		
Type of school	1.46	.26	.06	*ns*		

whole array of complex and uncontrolled environmental conditions is associated with attending a private or public school (Aldana, Amézquita, & Becerra, 1983; Reimers, 2002). Attending a private or public school may have different associations in Mexico, in the United States, or in any other country. Parents may select a private school because they suppose it is either academically stronger, there are social class considerations, or simply because of family traditions or distance from home. Children in private school do not receive any scholarships.

The parents' educational level is not an isolated variable. It reflects many associated living conditions (Baydar, Brooks-Gunn, & Furstenberg, 1993). In this study there was a significant association between the parent education and all fluency tests. The fact that this effect was found, suggests that the influence of the parents' educational level is a strong factor contributing to the differences observed between the private and public school in children's test performance. The influence of the mother's educational level over the child's literacy at an early age was described by Baydar et al. (1993).

Parents' education was significantly different between the two school groups. The mean educational level of the public school children's parents was about 11.04 (*SD* = 4.11), roughly corresponding to a high school level (in Mexico and Colombia the equivalent to the U.S. high school is completed after 11 years of education). In the private school group the children's parents' educational level was 15.60 (*SD* = 2.91), roughly corresponding to a college level of education.[1] Dispersions within groups were not particularly high (standard deviations were about 3 years), and hence both groups were relatively homogenous. However, a few parents from public schools had a college level of education.

We cannot assume that the lower education (public school) group was a "socially deprived group," or that it was a group presenting nutritional or serious health problems. The public school parents were not living in significant poverty or social marginality, but were lower middle-class individuals. The average education of our children's parents in the public school sample was above the average education for the Mexican adult population, *M* = 7.6 years of schooling (Instituto Nacional de Estadística Geograía e Informáticia, 2000). We also cannot conclude that the quality of education offered by private or public schools accounted for the differences.

A crucial question is obvious: Why did an additional five or more years of education in the children's parents make a significant contribution to the children's executive function test performance? Noteworthy, this educational difference corresponds to whether or not university was attended. The decision of continuing university studies depends on a whole array of variables, including financial resources, system of values (what is and what is not important in life), personal interests, previous academic performance, family tradition, intellectual level, and "ability to delay the reward" (i.e., those children beginning to work immediately

[1]In the Mexican educational system, as well as in other Latin American systems derived from the Spanish educational system, there is no difference between college and university. After high school, students go to university. Usually, after some five university years they obtain a professional degree (e.g., psychologist).

after high school will receive money sooner than those attending college; Ayala Rubio, 2001).

It may be conjectured that, once finishing high school, students divide into two major groups: those more academically oriented (pursuing a higher educational level) and those less academically oriented (not pursuing a higher educational level). These two groups, of course, are the extremes of a continuum. Those individuals pursuing college education likely have different values and attitudes (i.e., different *cosmovision*) than those who are excluded from university education. This difference may be reflected in the environment parents' provide to their children, the types of activities they perform with the child, and the values they transmit to their offspring. Furthermore, the parents of public and private school children, who either attended college or not, may be different in their value systems, their personal interests, and in their intellectual ability.

Based on previous research we could expect that those children attending private schools (generally, offspring of parents with a college education) had a more school-oriented home environment and more intellectual environmental conditions long before entering school. Teachman (1987) found that parents use resources to create a home environment conductive to higher attainment in education.

In this study, differences in vocabulary, measured with the Semantic Verbal Fluency test, were evident when beginning school; children entering private schools scored about 50% higher than those children entering public schools. This extended vocabulary most likely came mainly, but not only, from the parents. Children entering private schools also had a richer awareness of verbal issues. For instance, scores in the Phonemic Verbal Fluency test—a test requiring phonological awareness—was about three times higher in children when starting in a private than in a public school. Very likely, children entering a private school already had some prereading training, and some of them had early reading ability. The parents and their previous living conditions likely provided this prereading ability.

We were surprised to find how alike the educational level of the mothers and fathers was for both groups. The mean difference in the educational level between fathers and mothers was less than 1 year of education. We may, in consequence assume a "home effect," not a "father" or "mother" effect in the differences that were found.

Another point deserves consideration. The parents' educational level was associated especially with the scores in verbal tests. For some nonverbal tests (e.g., Matrices and Card Sorting) no significant association was found. Interestingly, Matrices has been regarded as a nonverbal abstracting ability test (e.g., Anastasi, 1988). The Card Sorting represents a simpler version of the WCST. The WCST is a widely used test in neuropsychology to assess abstract behavior and executive disorders (Lezak, 2004). This study suggests a stronger parents' educational effect for verbal executive function tests than for nonverbal executive function tests.

In summary, this study revealed differences in executive function test performance between private and public school children. The results suggest that these differences are not due to the school characteristics, per se, but to some conditions potentially associated with attending a private or public school, such as the parents' educational level. The parents' educational level may be associated with home environmental circumstances that establish early skills when solving problems or performing executive function tasks. We suggest that parents who attend college may have a different value system (cosmovision) than those who never received a college education. This different value system may be correlated with a more intellectually stimulating environment for their children that ultimately will result in their higher performance in some executive functioning tests. It is likely that the influence of the parents' level of education is also reflected in other neuropsychological tests, particularly verbal tasks. More research is needed to analyze the influence of home environmental conditions on different cognitive tests.

The value of this study may be twofold. First, there is a very little research on the influence of environmental variables on the development of executive functions. This study may help to understand variables that contribute to the variability found in executive functioning test scores among children of different ages. Second, most of the studies on the development of executive functions have focused on children younger than 6 years of age (e.g., Anderson et al., 2001). Current study analyzed the development of executive functions from ages 5 to 14. Results may provide important developmental information within a broader age range.

Some limitations to this study should be noted. First, only three different samples were taken (two from Mexico and one from Colombia), limiting generalizability of current results. We did not deal with SES, but simply "educational level." We assume, however, that educational level may be as informative about intellectual functioning as the SES. Furthermore, it may be easier to operationalize. SES, in addition to school attendance, also includes other elements, such as income, that are not directly related to intellectual functioning. The family income does not necessarily correlate with level of education.

Other limitations to the generalization of the results of this study are related to the validity of the executive function tests. Some of these tests (e.g., Mexican Pyramid) are unpublished and have not been validated. In this study, however, we addressed this limitation by establishing validity coefficients with well-known measures for three of the executive function tests. Furthermore, the question, "Do current results apply to executive functions in particular, or to neuropsychological functioning in general?" remains unanswered. We used just a few tests supposedly measuring executive functioning. But, of course, they are not simply evaluating executive functioning, but are also evaluating other domains, such as vocabulary, visuoconstructive abilities, and so forth. Further research in obviously required.

Finally, it could be argued that not all the administered tests are completely evaluating executive functions. As a matter of fact, it is difficult to separate intellectual functions in general from executive functions. Executive functions include self-regulating, stimulus control, and purposeful rational thought, thus affecting test performance. Many of the "executive tasks" attempt to tap into the individual's ability to formulate strategies, to separate essential from nonessential, and adapt to conditions that become novel. It has been emphasized that there is no one single measure of executive functioning, but rather different tests represent different executive components, and as such, more than one measure should be used in a comprehensive assessment (Bamdad, Ryan, & Warden, 2003).

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