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ORIGINAL PAPER

The Influence of Parental Skills on Children Executive Performance in the Chilean Context

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Abstract

The relationship between parenting styles and executive functioning in children has been well established. However, few studies have evaluated the effect of specific parental skills on children's executive functions. The main goal of our study was to investigate the existence of association and/or the effect of specific dimensions of parental skills on children's global and domain-specific executive functions. A non-experimental ex post facto design was implemented, which included a sample of ninety-six parent/child dyads. Parents completed a positive parenting scale, whereas primary schoolchildren were assessed in six executive domains. Pearson's correlation, regression models, and one-way ANOVA analyses were performed. Results showed significant associations between most parental skills dimensions and children's EFs specific domains. Regression analyses showed good predictive capacity of protective skills when predicting children's planning and problem-solving, global executive and semantic fluency. ANOVA analyses showed significant effects of protective and formative skills on children's executive performance. However, we did not observe any significant effects of parental skills on children's phonological fluency, cognitive flexibility and inhibitory control. Our results identify which dimensions of parental skills could contribute to the development of executive functions in children. We highlight the influence of protective skills on children's executive performance. In light of our findings, we suggest potential areas of future research, such as the effectiveness of positive parenting training and its benefits on children's executive development. Our findings also provide evidence to develop programs for parents that promote the acquisition and/or strengthening of positive parenting, which favor the cognitive development of children.

Keywords Parenting · Executive functions · Children · Cognitive development · Scaffolding

Highlights

- Parents' protective skills best predict children's executive performance.
- Children's planning and problem-solving skills are best predicted by protective skills.
- Parents' reflective skills did not predict children's executive performance.
- Children's attentional performance is best predicted by formative skills.
- Parental skills do not predict cognitive flexibility nor inhibitory control.

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Executive functions (EFs) are multidimensional higher cognitive processes, which include several abilities, such as planning, inhibition, working memory, flexibility, problem-solving, and sequencing skills (Burgess et al. 2000; McCloskey and Perkins 2012; Pennington and Ozonoff 1996). The mentioned abilities become essential for planning, guiding, and controlling goal-oriented behavior (Isquith et al. 2004). The development of EFs has been strongly associated with the maturation of prefrontal cortex structures (Diamond 2013; Diamond and Lee 2011), and its early stimulation becomes especially important because it

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supports and limits the individual capacities to learn and prosper during one's lifetime (Bernal-Ruiz et al. 2018). From Luria's genetic-cultural perspective (1976) and Vygotsky's historical-cultural paradigm (1978), cognitive development does not occur as a mere consequence of brain structure maturation, but it is significantly mediated by learning and adult-child communication processes (Luria 1976). In this regard, children's early stimulation is closely related to the concept of "scaffolding"—coined by Wood et al. (1976)—and is based on the idea that the human mind originates in social relations (Mead 1934; Vygotsky 1978; Rogoff 2003). Vygotsky (1978) postulated that the development of higher psychological functions is subordinated to social interaction between individuals, which are later internalized so that children can perform them on their own. Next, scaffolding implies that an adult provides the social structure necessary for the child to perform a task, providing only the appropriate level of support that the child needs (Wood et al. 1976).

As conceptualized in attachment theory, sensitive and responsive caregiving characterized by affection, warmth and absence of hostility is assumed to promote the internalization of regulatory strategies (Bernier et al. 2012). Today, it is widely accepted that early relational experiences and a secure attachment style exert an enormous influence on the development of children's cognitive, motor and socio-emotional abilities as they stimulate synapses between neurons in different brain regions (Barudy and Dantagnan 2010). Thus, sensitive care and affection received early in the family context would play an active role in brain configuration and functioning (Vargas-Rubilar and Arán-Filippetti 2014), and EFs can be seen as self-regulated and environment-dependent higher cognitive processes. Therefore, a better understanding of the EFs development proves critical for both monitoring and stimulating them, especially when the outgrowth of any of its components shows some delay or alteration (Hendry et al. 2016; Johnson 2012). Several studies (Bernier et al. 2012; Downer and Pianta 2006; Kopp 1991) emphasize the role of the family structure and the caregiving environment in EFs development. For instance, there is evidence suggesting the association of emotional and family variables to the development of some EFs dimensions in children at different developmental stages. A longitudinal study conducted by Landry et al. (2002), encompassing 253 children and their female primary caregivers, reported the influence of early maternal scaffolding on the development of planning, problem-solving, and flexibility abilities in children from three to six years old. Related studies support Landry et al.'s (2002) findings, linking the emergence and development of problem-solving and planning abilities to maternal scaffolding (Hughes and Ensor 2009), to the attachment styles between parents and their children (Musso 2010), and to the mother's emotional self-regulation skills (Meuwissen and Englund 2016).

The literature on children's cognitive development offers a plethora of definitions associated with parenting and its related constructs (e.g., "parenting skills", Darling and Steinberg 1993; "parenting quality", Mahrer et al. 2018; "parenting competence", Vance and Brandon 2017; "parenting practices", Tramonte et al. 2015). In 1993, Darling and Steinberg defined "parenting skills" as specific content and goal-directed behaviors that influence children's development, establishing a theoretical distinction from "parenting styles", which refers to a more general emotional attitude toward children. After more than two decades and despite the broad consensus about the effects of parenting practices on child development, many questions regarding the construct "parenting style" still remain unanswered (Darling and Steinberg 1993).

In this study, we adhere to Gómez and Muñoz's (2014) definition of parental skills, which refers to "the demonstrated acquisition of knowledge and skills to lead one's own parental behavior… with the ultimate aim of guaranteeing the child's well-being and the full exercise of his or her human rights (p.20)." Gómez and Muñoz's (2014) definition aligns with Bornstein's (2002) three main dimensions of "parenting", which refer to a) care and protection of the child, b) the parent-child interactions that support emotional and physical health, and c) the enhancement of parenting strategies to facilitate their children's effective growth and development. Gómez and Muñoz (2014) also subdivided the parental skills in terms of four theoretical dimensions, which are: a) protective, b) relational, c) formative, and d) reflective. Protective skills are defined as the knowledge and set of abilities and daily parenting practices oriented at adequately caring for and protecting children, safeguarding their human development needs, guaranteeing their rights, and favoring their physical, emotional and sexual integrity. Relational skills are those aimed at promoting a style of safe attachment and adequate socio-emotional development (Gómez and Muñoz 2014). Formative skills are defined as those directed at favoring the development, learning and socialization of children. Finally, reflective skills are those which allow parents to think about the influences and direction of parenthood itself, as well as monitoring their current parental practices, with the goal of providing feedback to other areas of parental competence (Gómez and Muñoz 2014).

With some exceptions (Bernier et al. 2010; Hughes and Ensor 2009), most studies of the parent's influence on the development of children's EFs either address the general influence of the family structure and/or its interactions, or focus on only one aspect of parenting (Rhoades et al. 2011). Some of these studies have mainly focused on parental dimensions related to stimulation provided by the parents

(Landry and Smith 2010; Landry et al. 2002; Bornstein 2002), the process of passing down norms and the control of children's behavior (Smith et al. 2004; Hughes and Ensor 2006), and affective aspects related to the development of a secure attachment (Sulik et al. 2015; Ewell Foster et al. 2008). Despite the latter, there is scarce research directly examining which specific "parental skills" are related to EFs emergence and development (Carlson 2003; Rhoades et al. 2011). This issue is critical since different aspects of parental behavior may show specific associations with different characteristics of children's cognitive abilities (Devine et al. 2016).

There is evidence suggesting that parenting styles characterized by affection, good treatment, care and stimulation not only positively influence early brain organization, development and functioning, but also foster the development of social skills, reduce the likelihood of behavioral problems, and improve executive performance (Müller et al. 2013; Eisenberg et al. 2003, 2005, 2009, 2010; Crockenberg et al. 2008; Ensor and Hughes 2008; Hughes and Ensor 2009). On the other hand, chaotic home routines and family environments have shown inverse associations with EFs development in early childhood, both in concurrent and longitudinal studies (Vernon-Feagans et al. 2016; Hughes and Ensor 2009). Likewise, Hopkins et al. (2013) reported that parental hostility is inversely correlated with children's EFs development (Hopkins et al. 2013), and Ferrier et al. (2014) observed that positive emotional experiences predict later executive functioning and act as a catalyzing agent in understanding the development of self-regulatory processes. Furthermore, De Cook et al. (2017) assert that "parenting behavior has proven to be a key environmental determinant of child executive functioning" (p. 1723). Similarly, Devine et al. (2016), concluded that children whose parents provide them with high levels of cognitive support, recurrent opportunities to participate in informal learning activities, and low levels of negative interaction, showed superior executive performance in inhibition, cognitive flexibility, and working memory.

Other studies have explored more specific relationships between EFs and parenting styles. Several studies (Kok et al. 2013; Karreman et al. 2006; Schroeder and Kelley 2010) reported that some dimensions such as family organization, parental support and sensitivity, positive parenting providing support and guidance, and positive control with clear limit setting are associated with children's increased capacity for working memory, planning, inhibition, monitoring, shifting attention focus, and self-regulation. Other authors observed that parental stimulation has been prospectively associated with sustained growth in inhibitory control and cognitive flexibility (Bradley et al. 2011; Clark et al. 2013), increased attentional control (Mezzacappa et al. 2011), and sustained attention, working memory, and planning (Hackman et al. 2015). Recent findings provided by Halse et al. (2019) revealed that hard parenting with severe discipline poorly predicts children's EFs development, compared to parenting characterized by positive discipline. Finally, Hughes and Devine (2017) concluded that both scaffolding and negative parent-child interactions are key predictors of children's EFs development.

While the referenced studies support that some cognitive processes are more sensitive to parenting characteristics such as responsiveness, normative control and boundary setting, the uniqueness and specificity of parental skills as predictors of children's specific EFs domains still remain to be fully examined. Therefore, we propose that addressing the predictive role of specific parental skills dimensions could allow for a clearer understanding of the nature of children's EFs specific domains. In this context, the main goal of our study was to investigate the existence of association and/or the effect of specific dimensions of parental skills (i.e., protective, relational, formative, reflective) on children's global and domain-specific executive functions (i.e., global, planning and problem-solving, semantic and phonological fluency, attention, inhibitory control, and cognitive flexibility). In particular, we hypothesize that, at least, both protective and relational parental skills would exert a significant effect on children's global executive functioning performance and its specific domains.

Method

Participants

The sample included ninety-six parent/child dyads recruited from both a public ($N = 51$) and a private school ($N = 45$). Each dyad consisted of a child and one of its parents (mother $N = 77$, mean age $= 33.55$ SD $= 5.08$; father $N = 19$, mean age $= 37.05$ SD $= 3.93$), who were also the children's school guardians. All children were first grade students (male $N = 39$, mean age $= 6.80$ SD $= 0.56$; female $N = 57$, mean age $= 6.77$ SD $= 0.57$). All parent/child dyads were recruited from Escuela Naciones Unidas (public) and from Scuola Italiana Arturo dell'Oro (private), both located in the city of Valparaíso, Chile. Children had to meet a single inclusion criterion, which was to be officially enrolled in first grade at one of these two schools. Among children exclusion criteria were: a) to present any diagnosed neurodevelopmental disorder (i.e., ADHD, speech and language disorders, motor disorders, among others), b) to be under psychopharmacological or medical treatment that may affect performance in the assessed executive functions domains, and c) refusal to participate in the study. As a result, none of the students was excluded

from the sample. All parents gave their written informed consent and approved their children's involvement in this study. All procedures were implemented in compliance with the Helsinki declaration of ethical principles for research involving human participants (World Medical Association 2013).

Design

We implemented a non-experimental ex post facto design. This design is aimed to examine, retrospectively, the effects of a naturally occurring event on a subsequent outcome with a view of establishing a causal or correlational association between them (Kerlinger and Lee 2000). In this case, we intended to observe the influence or effect of parental skills on children's executive functions (EFs) performance. An ex post facto design may be seen as a substitute for true experimental research and, therefore, can be used to test cause-effect or correlational hypotheses, where it is not possible, practical, or even ethical to implement a true experimental design (Cohen et al. 2000). Moreover, observing variables as they occur naturally improves the external validity and generalization of findings. Therefore, we first evaluated the existence of association between parental skills and children's EFs performance. Later, we performed regression analyses to evaluate the predictive capacity of specific parental skills dimensions (i.e., protective, relational, formative or reflective) on children's EFs performance in different executive domains (i.e., global, planning and problem-solving, semantic fluency, phonological fluency, attention, inhibitory control, and cognitive flexibility). Finally, based on regression analysis results, we classified parental skills into a categorical independent variable which represented levels of parenting skills. This allowed us to compare children's EFs performance (i.e., global and domain-specific) based on their parent's parental skills. Parental skills levels were classified as "optimal," "monitoring," and "risk" using the recommended cutoff scores provided by a positive parenting scale (e2p) (Gómez and Muñoz 2014). Dependent variables were represented by children's EFs scores in the above-mentioned executive domains, measured by an EFs battery (Portellano et al. 2009). Both instruments are described in the measures section.

Measures

ENFEN Evaluación Neuropsicológica de las Funciones Ejecutivas en Niños [Neuropsychological evaluation of executive functions in Children]

The ENFEN (Portellano et al. 2009) is a battery that evaluates the overall mature development of children between ages six and twelve, with special emphasis on EFs. The ENFEN allows the assessment of different domains of EFs in children by means of four tests: a) fluidez (i.e., semantic and phonological fluency), b) senderos (i.e., attention and cognitive flexibility), c) anillas (i.e., planning and problem solving) and d) interferencia (i.e., inhibitory control). The application is individual with a duration between 20 and 30 min. Several published studies have used the ENFEN battery as a measure of EF in samples of Spanish speaking children (e.g., Ruiz et al. 2018; Pérez-Pichardo et al. 2018; López and Calero 2018). The ENFEN was validated in a sample of 837 school children between ages six and twelve. Implementing an exploratory factor analysis (EFA) through principal components method, the ENFEN showed good validity. Both Kaiser–Meyer–Olkin (KMO = 0.84) and Bartlett's sphericity test ($p < 0.001$) indicate an excellent sampling adequacy and that factor analysis can be successfully conducted. The reliability of the ENFEN was evaluated through the estimation of its internal consistency. The total scale Cronbach's alpha was equal to .76 (95% CI [0.73–0.78]), which has been considered high when developing novel measures (Taber 2018).

Escala de Parentalidad Positiva e2p [Positive parenting scale e2p]

The e2p (Gómez and Muñoz 2014) is a self-administered questionnaire that consists of 54 items that assess habitual parental practices in four dimensions: a) protective, b) relational, c) formative, and d) reflective. A total score and also four-dimension related scores can be obtained. Based on different cut-off scores, parents (or primary caregivers) are classified into three categories that represent their parental skills: a) optimal, b) monitoring, and c) risk, for both overall scale and specific dimensions. A content validity analysis (Wilson et al. 2012) through a panel of seven independent experts was conducted to assess whether the items adequately represent the four parenting dimensions evaluated in the questionnaire. The final form of the e2p consists of 54 items, from an initial number of 130 items. Internal consistency of the total scale (Cronbach's $\alpha = 0.946$) and for each parenting dimension (i.e., relational [Cronbach's $\alpha = 0.898$], formative [Cronbach's $\alpha = 0.860$], protective [Cronbach's $\alpha = 0.845$], and reflective [Cronbach's $\alpha = 0.817$]) can be considered appropriate for research purposes (Streiner 2003).

Procedure

In the first stage, we met with the principal of each school to explain the objective and characteristics of the study, and to obtain authorization to contact the students. Subsequently, we participated in the schools' monthly meetings with

parents (i.e., guardians), where we explained the purpose and details of the study, invited them to participate, and asked them to sign the informed consent. Parents who agreed to participate answered the self-administered parenting practice questionnaire (e2p), which took between thirty minutes one hour to complete. They were supervised by a trained psychologist, who explained the questionnaire and clarified any doubts that arose while completing it. In the second stage, those students whose parents authorized their participation were individually evaluated by a psychologist using the ENFEN battery. The children's evaluations took an average of thirty minutes and were carried out during the school day in a room that was prepared to meet the standard specifications for conducting cognitive evaluations. The children's assessment period was completed in one month, at a rate of approximately twenty-four children per week. Finally, in recognition of their participation in the study, we invited all of the children's guardians to participate in a positive parenting workshop conducted by an educational psychologist.

Data Analysis

We performed descriptive analyses to summarize the demographic information of the sample. Later we performed different inferential analyses, consisting of a) bivariate correlations between parental skills dimensions (i.e., protective, relational, formative or reflective) and children's executive functions (EFs) performance (i.e., global and domain-specific), b) multiple linear regression analyses, and c) one-way ANOVA analyses using the parental skills that better predict the children's EFs performance as a categorical variable. First, we conducted Pearson's bivariate correlation analyses to estimate the presence of an association between parental skills and children's EFs performance. As a result, we identified which parental skills dimensions were positively correlated with any particular children's EFs specific domain (i.e., global, planning and problem-solving, semantic fluency, phonological fluency, attention, inhibitory control or cognitive flexibility). Second, we performed multiple regression analyses to evaluate the predictive capacity of different parental skills dimensions over children's EFs performance (i.e., global and domain-specific). We implemented a stepwise method for each regression model (i.e., first incorporating those predictors showing the highest bivariate correlation with the criterion). We evaluated the existence of collinearity (i.e., presence of correlation between predictors) and autocorrelation (i.e., presence of correlation among the residuals of each predictor) through the VIF (i.e., Variance Inflation Factor) and Durbin-Watson indices, respectively. We reported both model coefficients (i.e., non-standardized and standardized estimates) and model fit indices (R^2 and R^2 change). Finally, we performed one-way ANOVA analyses using the best predictors defined in categorical terms (i.e., optimal, monitoring, and risk) to evaluate the existence of significant differences in children's EFs performance for each cognitive domain. Before the null hypothesis significance testing (NHST) procedure, assumptions of univariate normality and homoscedasticity were evaluated. A significance level $\alpha = 0.05$ was considered for all analyses. We also estimated effect sizes for each significant result, considering Cohen's (1988) criteria for their interpretation. We used the statistical Open-Source software Jamovi, version 1.1.9.0, for all the analytical procedures (The Jamovi Project 2020).

Results

Descriptive Analyses

Table 1 summarizes the demographic information of both parents (i.e., guardians) and children that encompassed the sample. For categorical variables (i.e., parent/child dyads, school type, and sex), frequency (*N*) and percentages (%) are provided, whereas for numerical variables (i.e., age), mean and standard deviations are reported.

Correlational Analysis between Parental Skills Dimensions and Children's Executive Domains

Univariate normality assumption for Pearson's correlation analysis was met. Subsequently, we obtained the correlation matrix between parental skills dimensions (i.e., protective, relational, formative, and reflective) and children's executive functions (EFs) specific domains (i.e., global, planning, and problem-solving, semantic fluency, phonological fluency, attention, inhibitory control, and cognitive flexibility). We observed significant correlations at different significance levels (i.e., $p < 0.05$, $p < 0.01$) between most parental skills dimensions and children's EFs specific domains, ranging from $r = 0.212$ to $r = 0.693$. Table 2 shows the correlation matrix between parental skills dimensions and children's EFs domains.

Table 1 Sample and demographic descriptive of parent–child dyads

	Parent/Child dyads ($N = 96$)			
	School guardians		Children	
Sex	Male	Female	Male	Female
	$N = 19$ (19.8%)	$N = 77$ (80.2%)	$N = 39$ (40.6%)	$N = 57$ (59.4%)
Age	37.1 (9.33)	34.1 (7.93)	6.79 (0.57)	6.77 (0.57)

Table 2 Correlation matrix of parental skills dimensions with children executive domains

	Parental skills								Children executive domains													
	PS		RLS		FS		RFS		GEF		PhF		SF		A		CF		PPS		IC	
PS																						
Pearson's *r*	–																					
p value	–																					
RLS																						
Pearson's *r*	0.722	***	–																			
p value	<0.001		–																			
FS																						
Pearson's *r*	0.717	***	0.649	***	–																	
p value	<0.001		<0.001		–																	
RFS																						
Pearson's *r*	0.432	***	0.361	***	0.460	***	–															
p value	<0.001		<0.001		<0.001		–															
GEF																						
Pearson's *r*	0.568	***	0.474	***	0.484	***	0.212	*	–													
p value	<0.001		<0.001		<0.001		0.038		–													
PhF																						
Pearson's *r*	0.439	***	0.361	***	0.429	***	0.172	n.s.	0.648	***	–											
p value	<0.001		<0.001		<0.001		0.093		<0.001		–											
SF																						
Pearson's *r*	0.584	***	0.502	***	0.531	***	0.235	*	0.749	***	0.527	**	–									
p value	<0.001		<0.001		<0.001		0.021		<0.001		<0.001		–									
A																						
Pearson's *r*	0.300	***	0.200	n.s.	0.361	***	0.267	**	0.641	***	0.342	**	0.386	**	–							
p value	0.003		0.050		<0.001		0.009		<0.001		<0.001		<0.001		–							
CF																						
Pearson's *r*	−0.082	n.s.	−0.131	n.s.	−0.133	n.s.	−0.111	n.s.	0.495	***	0.210	*	0.150	n.s.	0.211	*	–					
p value	0.428		0.204		0.197		0.255		<0.001		0.040		0.144		0.039		–					
PPS																						
Pearson's *r*	0.693	***	0.607	***	0.497	***	0.259	*	0.715	***	0.311	**	0.545	***	0.382	***	0.114	n.s.	–			
p-value	<0.001		<0.001		<0.001		0.011		<0.001		0.002		<0.001		<0.001		0.270		–			
IC																						
Pearson's *r*	0.241	*	0.271	**	0.167	n.s.	−0.01	n.s.	0.554	***	0.107	n.s.	0.285	**	0.095	n.s.	0.203	*	0.364	***	–	
p value	0.018		0.008		0.104		0.965		<0.001		0.298		0.005		0.355		0.048		<0.001		–	

PS protective skills, *RLS* relational skills, *FS* formative skills, *RFS* reflective skills, *GEF* global executive functions, *PhF* phonological fluency, *SF* semantic fluency, *A* attention, *CF* cognitive flexibility, *PPS* planning and problem solving, *IC* inhibitory control, *n.s.* non-significant

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Predictive Capacity of Parental Skills Domains on Children's Executive Domains: Multiple Regression Models

We performed multiple regression models to evaluate the predictive capacity of each parental skill dimension on each children's executive domain. In all cases we tested regression models including the four dimensions of parental skills as predictors, incorporating as the first predictor the parental skill dimension that showed the highest correlation coefficient with the criterion, that is, with each specific executive domain. All regression models met both collinearity (i.e., VIF < 5) and autocorrelation (i.e., Durbin–Watson values >2; $p > 0.05$) assumptions. Table 3 provides a summary of all regression models.

Parental Skills Dimensions as Predictors of Children's Executive Performance

A multiple regression model including protective, formative, relational, and reflective parental skills as predictors was implemented to evaluate its predictive capacity on each children's executive domain separately. As shown in Table 3, protective skills better predicted children's global executive performance ($\beta = 0.420$, $p < 0.05$), planning and problem-solving ($\beta = 0.577$, $p < 0.001$), and semantic fluency ($\beta = 0.373$, $p < 0.05$), compared to the rest of the predictors which appeared to be non-significant (see Table 3). Protective skills accounted for 48.1% of the variability in children's planning and problem-solving ($p < 0.001$), whereas a two-predictor model consisting of protective and relational skills significantly predicted 50.4% of children's planning and problem-solving performance ($p = 0.032$). Therefore, a two-predictor model better predicted children's planning and problem-solving abilities. Later, protective skills also explained 34.1% of children's semantic fluency variability ($p = 0.008$) and 32.3% of global executive performance ($p = 0.004$). Additionally, formative skills better predicted children's attentional performance ($\beta = 0.298$, $p = 0.046$), accounting for 13.1% of the variability in this cognitive domain. Table 3 also shows that multiple regression models predicting phonological fluency, cognitive flexibility and inhibitory control, were not statistically significant.

Differences in Children's Executive Performance: Analysis of Variance (One-way ANOVA)

Parental skills were classified in categorical terms (i.e., optimal, monitoring, and risk) according to the positive parenting scale (e2p) cutoff scores (Gómez and Muñoz 2014). Based on the previous regression analyses, we performed one-way ANOVA analyses to evaluate the effect of parental skills on children's planning and problem-solving, global executive, semantic fluency, and attentional performance (Table 4).

Main results show a significant influence of protective skills on children's performance in the cognitive domains of planning and problem-solving, global executive, and semantic fluency. The observed effect sizes of protective skills on children's executive performance ranged from $\eta^2 = 0.129$ (i.e., attention) to $\eta^2 = 0.570$ (i.e., planning and problem-solving), which can be interpreted as between large and huge, according Sawilowsky's (2009) updated effect size criteria. Tukey's post hoc comparisons showed that children's executive performance on the above-mentioned domains was significantly lower for those children whose parent's protective skills were classified as "risk" ($p < 0.001$). We also observed a significant influence of formative skills on children's attention, with an effect size of $\eta^2 = 0.129$, which can be interpreted as large (Cohen 1988). Finally, Tukey's post hoc comparisons showed that attentional performance was significantly lower for children whose parent's protective skills were classified as "risk" ($p < 0.001$).

Discussion

Our main findings allow us to highlight the important influence of protective skills on children's planning and problem-solving, global executive, and semantic fluency domains. In particular, regression analyses reveal the excellent predictive capacity of protective skills on children's planning and problem-solving abilities, which explained almost half of the variance of children's performance in this executive domain. Moreover, a combined model that incorporates protective and relational skills was the best predictor for planning and problem-solving. The latter is in line with our hypothesis regarding the importance of both protective and relational skills on children's EFs development. Likewise, ANOVA analyses showed significant differences in children's planning and problem-solving performance depending on their parents' protective skills. The observed effect size can be interpreted as huge according Sawilowsky's (2009) guidelines. Particularly, children whose parents were classified as "risk" showed significantly lower performance in planning and problem-solving, compared to their peers whose parents' protective skills were classified as "optimal" or "monitoring". Furthermore, the effect of protective skills was also observed in children's global executive and semantic fluency as corroborated by ANOVA analyses, whose effect sizes can be interpreted as large according to Cohen's (1988) criteria. The described findings corroborate our hypothesis regarding the influence of protective skills on children's executive

Table 3 Regression models of parental skills predicting global executive and domain specific children executive performance

Children executive domains	Model coefficients					Model fit		Collinearity
	Predictor	Non standardized estimates	Standardized estimates (β)	t	p value	R^2	ΔR^2	VIF[a]
Global (GEF)	Intercept	−3.070	–	−0.599	0.551 n.s.	–	–	–
	Protective	0.373	0.420	2.988	0.004**	0.323	–	2.74
	Formative	0.227	0.154	1.184	0.239 n.s.	0.335	0.012	2.34
	Relational	0.108	0.091	0.764	0.447 n.s.	0.339	0.004	2.26
	Reflective	−0.105	−0.075	−0.773	0.442 n.s.	0.343	0.004	1.30
Planning and problem solving (PPS)	Intercept	−4.592	–	−3.914	<0.001***	–	–	–
	Protective	0.136	0.577	4.748	<0.001***	0.481	–	2.74
	Relational	0.070	0.241	2.181	0.032*	0.504	0.024	2.26
	Formative	−0.019	−0.048	−0.424	0.672 n.s.	0.506	0.002	2.34
	Reflective	−0.020	−0.055	−0.659	0.512 n.s.	0.508	0.002	1.30
Semantic fluency (SF)	Intercept	−2.654	–	−2.189	0.031*	–	–	–
	Protective	0.081	0.373	2.723	<0.008**	0.341	–	2.74
	Formative	0.079	0.222	1.752	0.083 n.s.	0.367	0.026	2.34
	Relational	0.031	0.114	0.915	0.362 n.s.	0.373	0.006	2.26
	Reflective	−0.023	−0.069	−0.728	0.468 n.s.	0.377	0.004	1.30
Attention (A)	Intercept	−1.518	–	−0.943	0.348 n.s.	–	–	–
	Formative	0.122	0.298	2.019	0.046*	0.131	–	2.34
	Protective	0.031	0.127	0.797	0.427 n.s.	0.134	0.003	2.74
	Reflective	0.047	0.122	1.104	0.273 n.s.	0.145	0.011	1.30
	Relational	−0.039	−0.129	−0.890	0.376 n.s.	0.153	0.007	2.26
Phonological fluency (PhF)	Intercept	−2.111	–	−1.466	0.146 n.s.	–	–	–
	Protective	0.062	0.269	1.762	0.081 n.s.	0.193	–	2.74
	Formative	0.094	0.245	1.747	0.084 n.s.	0.220	0.027	2.34
	Relational	0.009	0.031	0.224	0.823 n.s.	0.220	0.000	2.26
	Reflective	−0.245	−0.069	−0.650	0.518 n.s.	0.224	0.003	1.30
Cognitive flexibility (CF)	Intercept	5.511	–	3.410	<0.001***	–	–	–
	Formative	−0.037	−0.098	−0.618	0.538 n.s.	0.176	–	2.34
	Relational	−0.033	−0.115	−0.741	0.461 n.s.	0.021	0.003	2.26
	Reflective	−0.027	−0.076	−0.640	0.524 n.s.	0.024	0.003	1.30
	Protective	0.024	0.104	0.608	0.545 n.s.	0.028	0.004	2.74
Inhibitory control (IC)	Intercept	2.294	–	1.352	0.180 n.s.	–	–	–
	Relational	0.070	0.226	1.506	0.135 n.s.	0.074	–	2.26
	Protective	0.040	0.156	0.970	0.335 n.s.	0.078	0.004	2.74
	Formative	−0.012	−0.029	−0.190	0.850 n.s.	0.080	0.002	2.34
	Reflective	−0.056	−0.142	−1.246	0.216 n.s.	0.096	0.015	1.30

n.s. non-significant

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Variance inflation factor

performance and align with the idea that successful, consistent and regular experiences of parental care and protection contribute to the development of cognitive abilities in children (Lecannelier 2006; Montoya-Arenas et al. 2017). Moreover, the observed effect of protective skills is supported by existing studies showing the positive impact of care and support on children's planning, organizing, and problem solving abilities (Landry et al. 2002; Samuelson et al. 2012; Schroeder and Kelley 2010; De Cook et al. 2017). Explanations of our main findings are linked to both maturational and contextual aspects. From the perspective of brain development, it is widely known that EFs domains mature at different stages (Romine and Reynolds 2005). For instance, between ages six and eight, there is sensitivity in

Table 4 One-way ANOVA for the effects of parent's parental skills on children's global and domain-specific executive performance

	Parental skills (Categorical)		Children's executive performance		F	p value	Effect size η^2
Children's executive domain	Dimension	Level	Mean	Std. dev			
Global (GEF)	Protective	Optimal	29.82	7.32	26.313	<0.001***	0.361
		Monitoring	32.64	8.46			
		Risk	20.13	6.83			
Planning and problem solving (PPS)	Protective	Optimal	5.37	1.64	61.619	<0.001***	0.570
		Monitoring	5.86	1.88			
		Risk	1.96	1.44			
Semantic fluency (SF)	Protective	Optimal	6.22	1.70	22.744	<0.001***	0.329
		Monitoring	6.07	2.09			
		Risk	3.67	1.44			
Attention (A)	Formative	Optimal	5.38	2.45	6.877	<0.01**	0.129
		Monitoring	4.38	2.45			
		Risk	3.45	2.14			

**$p < 0.01$; ***$p < 0.001$

the maturation process of the prefontal areas (Romine and Reynolds 2005), which promote the emergence of more organized and efficient strategic behaviors and reasoning skills (Colombo and Lipina 2005). Therefore, the guidance and orientation provided by adults allow children to internalize relevant keys that become essential to control their impulses, regulate their emotions, and to solve everyday situations. The latter is in full agreement with Vygotsky's (1978) historical-cultural paradigm, which highlights the role of parents in the strengthening or hindering of children cognitive evolution. According to Vygotsky's (1978) theory, children learn to structure their thought processes and higher psychological functions through interpersonal interaction—most likely with their parents—before they become internalized, and thus, before they can be handled individually without assistance. Therefore, and consistent with our findings, protection and caregiving behavior are very important factors that influence children's executive development. Our main findings may encourage the promotion of different initiatives aimed at improving parents' protective skills in everyday interactions with their children, and thus, ecologically reinforcing their children's planning and problem-solving skills. Moreover, it seems that protective skills training for parents classified as "risk" may exert an important impact on their children's executive performance, particularly on the executive domains (i.e., planning and problem-solving, global executive, and semantic fluency). As mentioned in the introductory section, "parenting behavior has proven to be a key environmental determinant of child executive functioning" (De Cook et al. 2017, p. 1723).

Despite the described effect of protective skills on semantic fluency, we did not observe the same findings in the phonological fluency domain. We believe that while both semantic and phonological fluency tasks require executive demands (Hirshorn and Thompson-Schill 2006), in the case of semantic fluency, word retrieval is based on both semantic associations and word meanings, while phonological fluency requires more demanding memory retrieval strategies (Hurks et al. 2006). According to Hurks et al. (2006), and Matute et al. (2004), semantic and phonological fluency skills are not developed together. The existing evidence suggests that up to age twelve, the cognitive skills involved in phonological fluency tasks would still be developing (Fumagalli et al. 2017). In addition, children's scores in phonological fluency tend to be lower than those observed in semantic fluency, since the former proves more challenging because it requires the activation of inhibition mechanisms for its execution and, therefore, to avoid the production of semantically incorrect related words (Arán-Filippetti 2011).

Our hypothesis regarding the influence of relational skills was only partially corroborated. That is, our results showed that the predictive capacity of relational skills on children's planning and problem-solving performance turned out to be significant only when incorporated together with protective skills in a two-predictor model. At the same time, we did not observe any principal effect of relational skills on children's performance in the other executive domains. We expected to observe a significant predictive capacity of relational skills on children's inhibitory control, since there is evidence suggesting that positive parent-child emotional experiences and safe attachment styles (e.g., linked to relational skills) predict later executive functioning and promote the development of self-regulatory processes (e.g., linked to children's inhibitory control) (Kopp 1991; Landry

and Smith 2010). However, our results did not support this idea.

Furthermore, we also expected to observe at least small differences in children's inhibitory control performance attributable to their parents' relational skills, which were not found in our data. Our findings were relevant since few studies have examined associations between children's executive functioning and some aspects of relational skills, which have also yielded mixed conclusions. For instance, self-reported parental disciplinary practices were unrelated to EFs (Weber 2011), but lower levels of parental control were related positively to children's EFs development (Bindman et al. 2013). Fay-Stammbach et al. (2014) emphasize the role of scaffolding on children's autonomy. For example, greater sensitivity and stimulation, as well as lesser control and discipline, of the parents are related—to a greater or lesser extent—to better executive functioning of the children (Fay-Stammbach et al. 2014). Socio-cognitive theories postulate that children's regulatory capacities can be promoted through positive control or discipline and undermined by negative control such as harsh discipline (Grolnick and Pomerantz 2009). Therefore, our challenge now is to identify what factors may be related to our findings on this parental dimension, since we also observed that relational skills did not prove to be good predictors, nor did they explain any differences in children's performance in the other executive domains. However, we observed that children's attentional performance is well predicted by the parents' formative skills, and we also observed significant differences in children's attentional performance depending on their parents' level of formative skills. Formative skills integrate parenting practices aimed at fostering the development, learning and socialization of children, through the establishment of clearly defined limits and rules, encouraging autonomy and reinforcing independent thinking styles in children (Gómez and Muñoz 2014). Our finding, therefore, is in line with studies on the association between parents' ability to provide appropriate guidance, direction and discipline for their children and their children's self-regulation, attention, and overall executive functioning skills (Hughes and Ensor 2006, 2009; Schroeder and Kelley 2010; Voelker et al. 2009; Olson et al. 2009). Studies have concluded that parents who use positive control strategies and guide their children by encouraging them to solve problems on their own can foster their children's capacity for self-regulation and thus their attention skills (Putnam et al. 2002; Strand 2002). Similarly, Karreman et al. (2006) observed that children whose parents make greater use of teaching, guidance, autonomy support and encouragement to control and direct their children are more likely to have higher levels of self-regulation and attention.

Of particular interest is that neither cognitive flexibility nor inhibitory control was significantly predicted by parental skills. Regarding these cognitive domains, our first interpretation is related to the sequential development of EFs during childhood, where certain EFs develop earlier and faster than others (Anderson 2002; Huizinga et al. 2006; Van Leijenhorst et al. 2008). Several authors (Huizinga et al. 2006; Mileva-Seitz et al. 2015; Parks et al. 1992; Levin et al. 1991) state that both cognitive flexibility and inhibitory control follow a gradual development during middle childhood that continues until adolescence, when their development reaches a level that may be comparable to that observed in adults (Anderson 2002; Vargas-Rubilar and Arán-Filippetti 2014). Therefore, since the aforementioned variables would be considered as age-dependent cognitive processes (Papazian et al. 2006), we associate this finding with the fact that children in our sample had an average age of approximately seven years, and thus, their flexibility and inhibition abilities were not completely developed yet. In our view, the effect of parental skills in the aforementioned domains could be only detected later in time, due to maturational factors. Regarding cognitive flexibility, we provide a second interpretation, which is associated with the Piagetian concept of "centration" (Alao 1981; Piaget and Inhelder 1971). Centration refers to the tendency of children under the age of seven or eight to assimilate only one aspect of reality, leading them to think in a static way, and therefore, showing little flexibility. Therefore, it is also possible to postulate that children's performance in cognitive flexibility simply reflects their early stage of prefrontal structures maturation, rather than the effect of parental skills.

Among the limitations of our study is the use of a self-report scale to evaluate parental skills, instead of being evaluated in a more ecological way (e.g., direct observation or semi-structured interviews). However, a recent meta-analysis (Solomon et al. 2017) reports that several studies also implemented self-report scales to assess parental skills. It would be ideal to implement other parental skills assessment techniques in order to improve the ecological and external validity of our findings. In any case, this study provides notable findings about the relationship between specific parental skills and children's performance in certain executive domains, which broadens the understanding of this phenomenon and suggests potential areas for future research. For example, examining the socio-familiar determinants of early development in children's executive functioning may provide an opportunity for monitoring at-risk families and children in vulnerable settings to encourage and compensate for possible disadvantages in their executive development. Our findings can also serve as evidence to encourage and support the design and implementation of parenting programs that promote the acquisition and/or strengthening of positive parenting and thus promote healthy social-emotional and

cognitive development in children. Finally, our results can encourage public policies that support the implementation of evidence-based intervention programs to help parents minimize the impact of inappropriate parenting practices and progressively modify the way they interact with their children over time.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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