

# Executive Function Associated to Symptoms of Attention Deficit Hyperactivity Disorder and Paediatric Bipolar Disorder

## *Função Executiva Associado a Sintomas do Transtorno de Déficit de Atenção/Hiperatividade e do Transtorno Bipolar Pediátrico*

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### **Abstract**

Very little is known about the differences of the neurocognitive functioning of Attention Deficit Hyperactivity Disorder (ADHD) and Paediatric Bipolar Disorder (PBD), since current studies do not agree on a differentiation of Executive Function (EF) between the two disorders. The aim of this study was to determine the EF deficits associated with symptomatology of ADHD and the PBD phenotype. Participants were 76 children/adolescents aged 6-17 years and their parents, submitted to a diagnostic interview and a tool for assessing EF, Behaviour Rating Inventory of Executive Function. Structural Equation Modeling was used to examine associations between symptoms of ADHD and the PBD phenotype, and the EF. A model for parents and a model for children/adolescents were performed. The model indexes showed a satisfactory fit. ADHD was found to be associated with deficits in all areas of EF, especially when the predominant symptom is inattention. The presence of symptoms of PBD phenotype was associated only with difficulties in finding new strategies to solve problems and inhibiting new behaviour. The article concluded that the presence of ADHD symptoms is associated with cognitive deficits different from those that may occur with PBD symptoms. It is advisable that professionals consider patients' neurocognitive profiles in order to achieve an appropriate differential diagnosis.

**Keywords:** Executive function, attention deficit hyperactivity disorder, paediatric bipolar disorder.

### **Resumo**

Ainda é pouco o que se sabe do funcionamento do Transtorno de Déficit de Atenção/Hiperatividade (TDAH) e do Transtorno Bipolar Pediátrico (TBP), já que atualmente os investigadores não concordam quanto a uma diferenciação da Função Executiva (FE) nos dois transtornos. O objetivo deste estudo é determinar os déficits da FE associados às sintomatologias de TDAH e do fenótipo do TBP. Foram avaliados 76 crianças/adolescentes com idades entre 6-17 anos e seus pais, com uma entrevista diagnóstica e um instrumento para avaliação da FE, Behaviour Rating Inventory of Executive Function. Modelos de equações estruturais foram usados para examinar associações entre a sintomatologia de TDAH e do fenótipo de TBP, e a FE. Foi realizado um modelo para pais e outro para crianças/adolescentes. Os índices do modelo indicaram um ajuste satisfatório. Foi encontrado que o TDAH está associado a deficiências em todas as áreas da FE, sobretudo se a sintomatologia predominante é a desatenção. A presença de sintomatologia do fenótipo de TBP somente apresentou associação a dificuldades na busca de novas estratégias na solução de problemas e na inibição de novas condutas. Conclui-se que a presença de sintomatologia de TDAH está associada a deficiências cognitivas diferentes das que podem estar presentes no TBP. É recomendável que os profissionais considerem o perfil neurocognitivo de seus pacientes para alcançarem um diagnóstico diferencial adequado.

**Palavras-chave:** Função executiva, transtorno de déficit de atenção/hiperatividade, transtorno bipolar pediátrico.

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Executive function (EF) refers to higher cognitive processes that regulate the cognitive, emotional, and social behaviour of persons (Ardila & Ostrosky-Solís, 2008; Barkley, 2000; Trujillo & Pineda, 2008). Their function is to solve new and complex situations to which the subject is exposed (Anderson, 2002). The neural basis of EF are

the prefrontal lobes (Goldberg, 2002). It includes aspects such as maintaining focus on problem solving, initiative for planning and organizing actions, control of emotions and impulses, fluidity in the process of execution, flexibility for changing and correcting strategies, keeping a goal in mind, monitoring of activities until reaching the solution of the problem, and awareness of one's actions (Anderson, 2002; Barkley, 2000; Lopera, 2008; Senn, Espy, & Kaufmann, 2004). Barkley (2000) states that each EF has an important role for the person to achieve his/her goals and solving his/her problems effectively.

The EF begins its development from the earliest ages of the individual (Isquith, Crawford, Espy, & Gioia, 2005; Zelazo, 2004). Children acquire the ability to self-regulate their behaviour, setting and meeting goals without external directions, even when there is a certain degree of impulsivity and lack of control (Zelazo & Müller, 2002 cited in Goswami, 2002). At the age of 12 years, children's cognitive development is very close to that observed in adulthood (Welsh, Pennington, & Groisser, 1991) and its full development is achieved around 16 years of age (Levin et al., 1991 cited in Rosselli et al., 2008).

Recent studies associated various neurodevelopmental disorders to deficits in EF (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Lopera, 2008; López-Campo, Gómez-Betancur, Aguirre-Acevedo, Puerta, & Pineda, 2005; Pennington & Ozonoff, 1996; Rucklidge, 2006; Trott, 2006). Many authors are inclined to the study of Attention Deficit with Hyperactivity Disorder (ADHD) in children and adolescents (Barkley et al., 2001; López-Campo et al., 2005; Trott, 2006). Also recently, there has been interest in the study of executive dysfunction in children and adolescents with broad phenotype of Paediatric Bipolar Disorder (PBD; Leibenluft, Charney, Towbin, Bhangoo, & Pine, 2003; Mattis, Papolos, Luck, Cockerham, & Thode, 2011; Rucklidge, 2006). Some authors strive to differentiate between ADHD and PBD, since there are three symptoms described by DSM-IV-TR (American Psychiatric Association [APA], 2000) that are common in ADHD and Bipolar Disorder (Mania phase): rapid speech, distractibility, and motor restlessness or hyperactivity (APA, 2000). Other similar symptoms are: talking too much, inadequate actions and responses in social situations, and lack of emotional and behavioural inhibition (Geller et al., 2002 cited in Walshaw, Alloy, & Saab, 2010). Considering these aspects, Geller et al. (1995) have shown that these two disorders may be comorbid. However, little is known about the differentiation in its neurocognitive functioning, since most of research emphasizes the study of comorbidity rather than distinguishing and/or comparing between the two disorders (Rucklidge, 2006). The lack of information and the heterogeneity of how symptoms and executive dysfunction are shown in children and adolescents with PBD have caused great controversy for achieving a differential diagnosis with ADHD.

### *Attention Deficit and Hyperactivity Disorder*

This disorder is characterized by an extreme and persistent pattern, accompanied by inattention, disorganization, hyperactivity and impulsivity, which affect academic work, family, and social activities of the individual with this syndrome (APA, 2000).

Research on ADHD agrees that this disorder is accompanied by severe executive dysfunctions: lack of inhibition of behaviour accompanied by impulsive responses, poor organization of activities, difficulty to stop ongoing behaviours, problems keeping attention focused on a single activity, difficulty of monitoring one's activities, little ability to assess possible future consequences of one's actions (Barkley et al., 2001; Brocki, Eninger, Thorell, & Bohlin, 2009; Fischer, Barkley, Smallish, & Fletcher, 2005; Holmes et al., 2010; Re, De Franchis, & Cornoldi, 2010; Willcutt, Pennington, Olson, Chhabildas, & Hulslander, 2005).

These problems make the individual unable to function adequately in social contexts, and do not allow a proper process for achieving goals (Barkley et al., 2001; López-Campo et al., 2005; Trott, 2006).

According to Brocki et al. (2009), EF deficits depend on the type of ADHD suffered by children. For these authors, children with ADHD inattentive type have more EF deficits than children with hyperactivity.

### *Broad Phenotype of Paediatric Bipolar Disorder*

Until recently, Bipolar Disorder has been considered a disorder exclusive to adulthood, and cases in children or adolescents were scarcely known. It is estimated that the prevalence of adolescents with PBD is similar to that of adults (i.e., 1.2%; Soutullo et al., 1990 cited in Diez, Figueroa, & Soutullo, 2006). Other authors have found a prevalence of 1% in adolescents aged 14-18 years with phenotype of PBD (Lewinsohn, Klein, & Seeley, 1995).

Validation of this infant diagnosis has been controversial (Rucklidge, 2006). However, some studies have produced lists of characteristic symptoms of PBD. Geller, Warner, Williams and Zimmerman (1998) and Leibenluft et al. (2003) state that the PBD is characterized by elevated mood, extreme irritability, disinhibiting, emotional dysregulation, and hyperactivity. Geller, Tillman, Craney, and Bolhofner (2004) state that PBD is presented as a chronic course of symptoms that move quickly from one mood to another, from euphoria to irritability or to a violent state.

This study will focus on those children who have symptoms of broad phenotype of bipolar disorder. Relying on the diagnostic criteria of unspecified bipolar disorder from the DSM-IV-TR (APA, 2000) and those given by Leibenluft et al. (2003) for the broad phenotype of youth mania. The unspecified bipolar disorder refers to a broad category that includes symptoms that do not meet the threshold necessary to be considered a diagnostic criterion, and which may include extreme symptoms of irritability and emotional lability presented by these children and

adolescents (Galanter & Leibenluft, 2008). Leibenluft et al. (2003) and Serra Giacobbo, Jané, Bonillo, Balleespí and Díaz-Regañon (2012) take the same notion of broad phenotype or Severe Mood and Behavioural Dysregulation to

refer to children who have a chronic non-episodic illness (mania-depression), without the characteristic symptoms of hypomania, but show persistent symptoms of irritability and hyperarousal. Table 1 shows the criteria to be considered for the phenotype of PBD.

Table 1  
*Criteria of the Broad Phenotype of PBD*

Unspecified bipolar disorder (DSM-IV)	Broad phenotype of juvenile mania (Leibenluft et al., 2003)
<ul style="list-style-type: none"> <li>- Very fast alternation between manic and depressive symptoms that do not meet the minimum criteria for a manic episode or major depressive episode.</li> <li>- Recurrent hypomanic episodes without intercurrent depressive symptoms.</li> <li>- A manic or mixed episode superimposed on delusional disorder, residual schizophrenia or unspecified psychotic disorder.</li> <li>- Situations in which the clinician has concluded that there is a bipolar disorder, but is unable to determine whether it is primary, due to medical illness or substance has been induced.</li> </ul>	<ul style="list-style-type: none"> <li>- Aged 7-17 years, with presence of symptoms before 12 years of age.</li> <li>- Abnormal mood for more than half a day, many days, and severe enough to be noticed by people around him/her.</li> <li>- Three of the following symptoms: insomnia, restlessness, distractibility, flight of ideas, pressured speech, intrusive.</li> <li>- Shows increased reaction to stimuli emotionally negative. Three times a week, the last four weeks.</li> <li>- Presence of the above symptoms in the last 12 months without periods of more than 2 months without symptoms.</li> <li>- Symptoms are severe and they occur together at least two (distraction and intrusion).</li> <li>- Irritability.</li> </ul>

As for the EF, different studies show that children with PBD have deficits in planning activities, lack of flexibility, inhibition of behaviour and working memory (Mattis et al., 2011; Passarotti, Sweeney, & Pavuluri, 2010; Walshaw et al., 2010).

*ADHD and PBD Phenotype*

Although the differentiation of behavioural symptoms experienced by children with ADHD or PBD is confusing, we can base it on the following characteristics: children with PBD phenotype show motor restlessness and irritability in a very intense way, and usually both are accompanied by aggressiveness and outbursts of anger. In contrast, children with ADHD manifest verbal aggression without physical violence, and it is of lower intensity (Palacios Cruz et al., 2008).

With respect to the EF, the differences between these disorders are less clear. For Walshaw et al. (2010), deficits in the inhibition of external stimuli, planning and flexibility are specific to the PBD. For their part, Mattis et al. (2011) consider that the lack of flexibility in planning and strategies is an exclusive feature of PBD, as well as the lack of initiative and the difficulties in speed processing or working memory. Passarotti et al. (2010) found that inhibition and working memory show serious deficiencies in both ADHD and PBD. However, Barkley (2000) states that deficiencies in working memory are exclusive to ADHD. For his part, unlike the studies mentioned above, Rucklidge (2006) concluded that PBD does not show deficiencies in its EF.

From the literature review, it is possible to note that researchers on this subject do not totally agree on the differences in EF between the two disorders. The prevalence of comorbidity makes it necessary for clinicians to carefully explore the presence of other disorders when diagnosing ADHD. As mentioned by Rucklidge (2006), to achieve this, it is essential to know the distinctive characteristics of each disorder, from the behavioural to the neurocognitive functions. Thus, the main objective of this study is to observe the EF deficits associated with the symptomatology of ADHD and the broad phenotype of PBD. Knowing the differences in EF between the two disorders allows us to conduct clinical psychological treatments in a more adequate way. As a hypothesis we expect to find deficits in all areas of EF in children/adolescents with ADHD symptomatology, and problems in organization, planning, working memory, flexibility, and inhibition in children with symptoms of PBD phenotype.

**Method**

*Participants*

The sample consisted of 76 subjects between 6 and 17 years of age who are treated at the Child and Adolescent Mental Health Services department, at a hospital in Barcelona, Spain. The participants were 84.2% male and 15.8% female, all with an average IQ and a middle socioeconomic level. All new cases over six years of age treated for ADHD and PBD, which were presented at the hospital in the course of two years, were invited to par-

ticipate in the study. The children/adolescents and their parents were interviewed.

Table 2  
*Sociodemographic Data*

	Sex	
	Boy %	Girl %
<b>Age</b>		
7-8	12.5	8.3
9-10	25	8.3
11-12	34.4	58.4
13-14	18.7	16.7
15-16	9.4	8.3
<b>Grade</b>		
1 <sup>st</sup> grade	1.6	0
2 <sup>nd</sup> grade	6.3	8.3
3 <sup>rd</sup> grade	12.5	0
4 <sup>th</sup> grade	18.8	0
5 <sup>th</sup> grade	12.5	33.3
6 <sup>th</sup> grade	12.5	16.7
1 <sup>st</sup> High school	23.4	16.7
2 <sup>nd</sup> High school	12.5	16.7
3 <sup>rd</sup> High school	0	8.3
<b>Family Type</b>		
Single parent	4.8	0
Divorced without couple	1.6	25
Divorced with couple	1.6	16.7
Nuclear	91.9	58.3
<b>Child's birth order among siblings</b>		
First	57.8	75
Second	35.9	25
Third	6.3	0

*Instruments*

Diagnostic Criteria. Diagnostic interview “Schedule for affective Disorders and Schizophrenia for School-Age Children Present and Lifetime version” (Kaufman et al., 1997). This is a semi-structured interview used to

collect information from children or adolescents and their parents. It includes diagnoses in accordance with DSM-IV. It consists of 82 symptoms associated with 20 diagnostic areas and 5 diagnostic supplements (emotional disorders, psychotic disorders, anxiety disorders, disruptive behaviour disorders, and the last one consisting of: substance abuse, tic disorders, eating disorders, and elimination disorders). These are encoded as absent, probable, or present, and supplements are only applied when at least one of the main symptoms assessed at screening is definitive. The interview was conducted separately for parents and children/adolescents.

Evaluation of Executive Function. Behaviour rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000, translated and adapted by Capdevila-Brophy, Artigas-Pallarés, & Obiols-Llandrich, 2006). It consists of two self-administered questionnaires: one for parents and one for teachers. In this study we used only the parent version. This questionnaire assesses executive function in children and adolescents between 5 and 18 years of age. The BRIEF contains 86 items that form 8 clinical scales and 2 validity scales, which in turn form 3 broader indices: Conduct regulation, Metacognition and Global Executive Composite (GEC) score. They are classified in a three-point scale: 1 (“Never”), 2 (“Sometimes”), and 3 (“Often”). The 8 scales correspond to: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor. The BRIEF was standardized and validated for use with children and adolescents aged 5 to 18 years. It has a strong validity, since the items were selected from clinical interviews.

The family data questionnaire (Domènech-Llaberia, Canals, Viñas, & Jané, 1998) was used to collect demographic data.

*Procedure*

Permission was requested, from the Ethics Committee of the department for Child and Adolescent Mental Health Services, to conduct evaluations. Parents and children/adolescents were asked to sign an informed consent to participate in the study. Contact details were requested in order to arrange appointments for interviews. The interview was applied to parents and children/adolescents in the facilities of the Hospital. Each interview was conducted in one hour; first with the child/adolescent and after with the parents. The interview could be applied to either both parents or just one.

*Data Analysis*

SPSS version 18.0 was used for the description of the sample and for the demographic data. Analysis of Structural Equation Modeling (SEM) were performed with Mplus version 6.11. A hypothetical model based on the reviewed theory on the subject of study was conducted (see Figure 1). The maximum likelihood estimation was used to fit it.

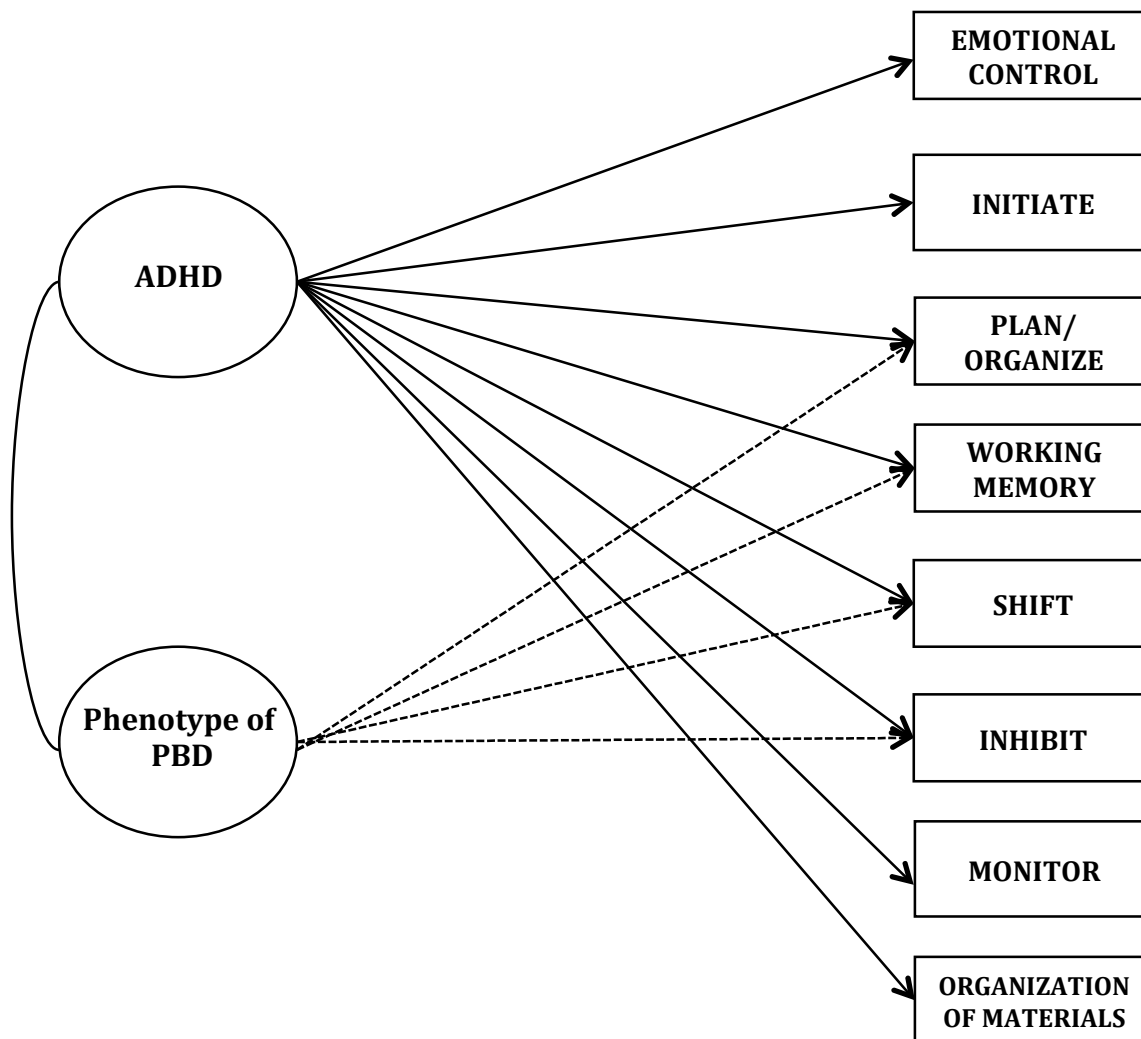


Figure 1. Theoretical model. ADHD: Attention deficit hyperactivity disorder; PBD: Pediatric bipolar disorder.

At first, Confirmatory Factor Analyses (CFA) were estimated for each of the latent variables. These variables include the symptomatology of ADHD hyperactive type, ADHD inattentive type, and the broad phenotype of PBD. The latent variables of inattention and hyperactivity are based on the symptoms of ADHD established by the DSM-IV-TR, and the latent variable broad phenotype of PBD symptoms is based on the unspecified bipolar disorder from the DSM-IV-TR and the criteria specified by Leibenluft et al., 2003. This process was carried out with the information provided by children/adolescents and parents. Correlations among the variables comprising the factors were sought in order to improve the model fit. The following fit indices were observed: Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), chi-square ( $\chi^2$ ) and the Tucker-Lewis Index (TLI). A value  $>.90$  indicates a good fit on the CFI and the TLI indices (Bentler, 1989, quoted by Agostino, Johnson, & Pascual-Leone, 2010). RMSEA values  $<.08$  indicate a good fit (Browne & Cudeck, 1993).

In order to carry out the SEM, as the independent latent variables used were: ADHD combined type, ADHD inattentive type, and PBD broad phenotype, and the dependent patents variables according to the model were: inhibit, working memory, shift, emotional control, initiate, plan / organize, organization of materials, monitor. A final model for parents and one for children/adolescentes was produced based on the information collected with the instruments used. For Beta coefficients ( $\beta$ ) a significance  $<.10$  in some cases was considered, as mentioned by other authors (Lopez et al., 2008).

### Results

Based on the SEM, the proposed model fits according to information from parents on the following indices:  $\chi^2=344$ ,  $df=277$ ,  $p=.0035$ , CFI=.92, TLI=.90, RMSEA=.057. The division of the chi-square between the degrees of freedom estimates a further fit of the model:  $\chi^2/df = 1.24$  (the commonly accepted standard is a ratio less than 3.0,

Carmines & McIver, 1981, cited in Agostino et al., 2010). The standardized parameters of the final model of parents are shown in Figure 2. It explains the relation between the factors (hyperactivity, inattention, PBD phenotype) and the EF variables. We found that presenting diagnostic criteria for ADHD inattentive type, significantly predicts the presence of executive dysfunctions in children and adolescents, emotional control ( $p \leq .0005$ ,  $t=3.785$ ), initiation ( $p \leq .0005$ ,  $t=4.002$ ), plan / organize ( $p \leq .0005$ ,  $t=5.360$ ), working memory ( $p \leq .0005$ ,  $t=7.454$ ), shift ( $p = .035$ ,  $t=2.104$ ), inhibit ( $p \leq .0005$ ,  $t=4.769$ ), moni-

tor ( $p=.001$ ,  $t=3.263$ ) and organization of materials ( $p \leq .0005$ ,  $t=4.689$ ). On the other hand, the results indicate that the presence of criteria for ADHD hyperactive type predicts dysfunctions only in memory ( $p=.05$ ,  $t=1.959$ ) and inhibit ( $p \leq .0005$ ,  $t=5.031$ ). For its part, the presence of diagnostic criteria of the broad phenotype of the PBD is a strong predictor of dysfunction in the flexibility ( $p=.05$ ,  $t=1.923$ ); also it involves less deterioration in the inhibition ( $p=.016$ ,  $t=-2.419$ ). A strong correlation between symptoms of ADHD in its two types and the PBD broad phenotype was found (inattentive with PBD,  $p \leq .0005$ ,  $t=3.786$ ; Hyperactive with PBD,  $p \leq .0005$ ,  $t=6.2$ ).

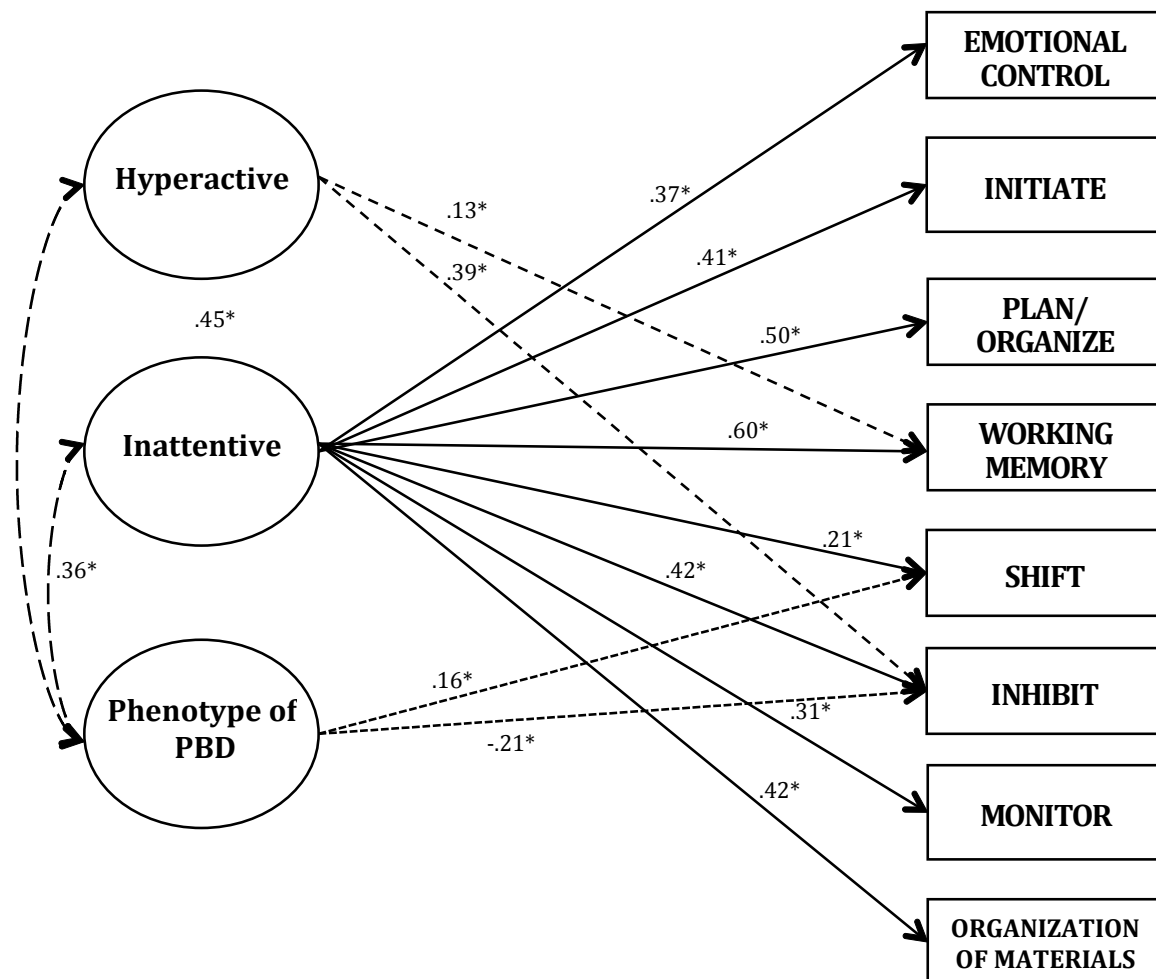


Figure 2. Final structural equation model by parents.

Note. Final model with standardized parameter estimates. K-SADS-PL: Schedule for affective disorders and schizophrenia for school-age children present and lifetime version; ADHD-HYP: Attention deficit hyperactivity disorder predominantly hyperactive; ADHD-INA: Attention deficit hyperactivity disorder predominantly inattentive; PBD: Pediatric bipolar disorder. \* $p < .05$

The final model based on information provided by children/adolescents was very different (see Figure 3). The fit indices are:  $\chi^2=347$ ,  $df=275$ ,  $\chi^2/df=1.26$ ,  $p=.0022$ , CFI=.905, TLI=.90, RMSEA=.059. We found that the presence of inattention criteria is a strong predictor of deficits in the EF of initiate ( $p=.023$ ,  $t=2.278$ ) and plan / organize

( $\beta=.383$ ,  $p=.004$ ,  $t=2.855$ ). The deterioration in emotional control is also predicted, considering the significance  $< .10$  ( $p=.078$ ,  $t=1.761$ ). Regarding the presence of hyperactivity, problems in working memory ( $p=.086$ ,  $t=1.717$ ) are predicted with significance  $< .10$ . Moreover, the results indicate that the smaller the decline in the initiation, the

greater the presence of symptoms of hyperactivity ( $p=.063$ ,  $t=1.859$ ). The presence of diagnostic criteria of the broad phenotype of PBD does not predict the deterioration of EF, according to information gathered from interviews with children/adolescents. Significant correlations were found

between ADHD and PBD broad phenotype (inattention with PBD,  $p=.001$ ,  $t=3.275$ ; Hyperactivity with PBD,  $p\leq .0005$ ,  $t=4.503$ ).

No significant relationship was found between the presence of diagnostic criteria for ADHD and PBD, and sex and age.

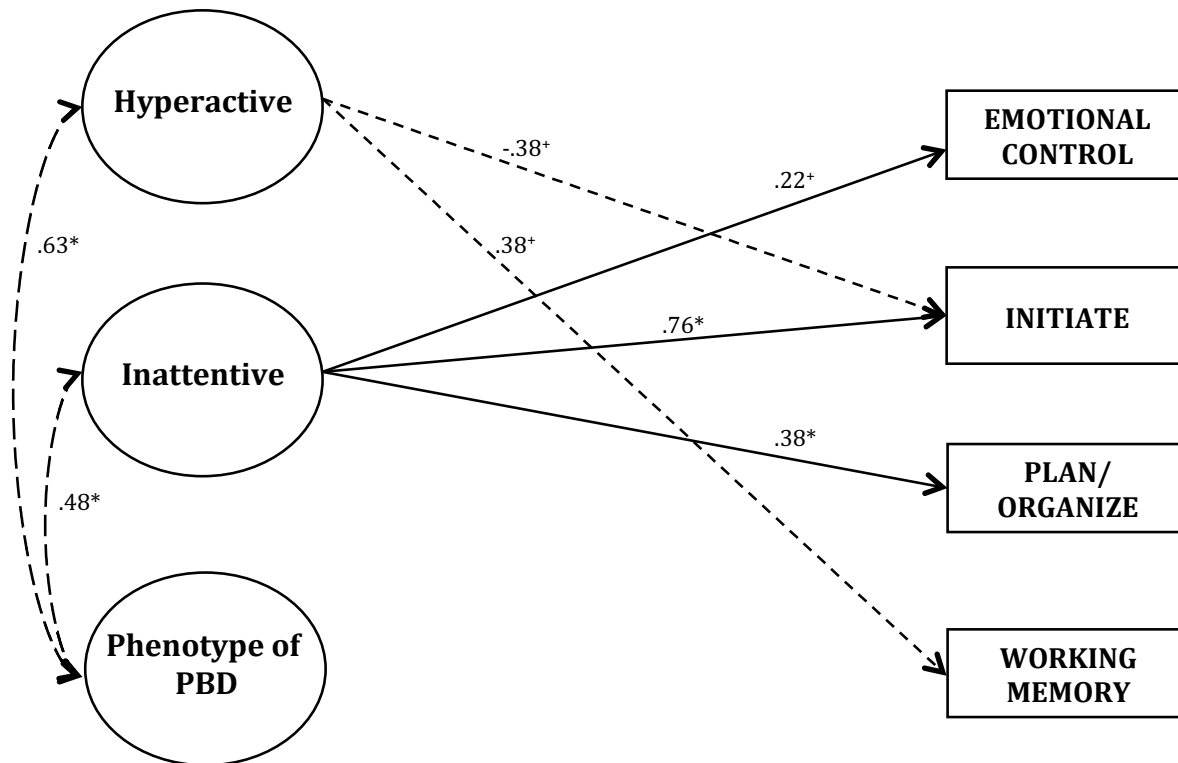


Figure 3. Final structural equation model by children.

Note. Final model with standardized parameter estimates. K-SADS-PL: Schedule for affective disorders and schizophrenia for school-age children present and lifetime version; ADHD-HYP: Attention deficit hyperactivity disorder predominantly hyperactive; ADHD-INA: Attention deficit hyperactivity disorder predominantly inattentive; PBD: Pediatric bipolar disorder.

\* $p < .05$ , + $p < .10$

### Discussion

The joint study of ADHD and PBD is justified by the necessity to obtain a clear differential diagnosis (Rucklidge, 2006). This study strengthens existing information regarding the differentiation of EF deficits that are associated with the symptomatology of ADHD and PBD in children and adolescents.

Most of the reviewed studies argue that the presence of ADHD involves deficits in all areas of EF (Barkley et al., 2001; Brocki et al., 2009; Fischer et al., 2005; Holmes et al., 2010; Re et al., 2010; Willcutt et al., 2005). These studies approach the ADHD without discriminating among the subtypes of the disorder. In the present study this distinction was carried out to have a more clear and specific view of the impairment of these children/adolescents based on their psychopathological characteristics. This study agrees with the mentioned research with regard to ADHD inattentive type where, according to the results provided

by parents, children/adolescents with these symptoms have dysfunction in all areas of the EF. However, children/adolescents reported that difficulties exist only in the capacity to plan, organize, and control emotions and initiative. Children/adolescents are unable to generate behaviours directed at a particular purpose, plan and organize strategies to solve the problem and to conclude them due to the lack of attention to different aspects of a problem. These children are likely to behave inappropriately in their context. With respect to children/adolescents with symptoms of hyperactivity, we consider that the difficulty to start an activity, maintain a task in mind, and inhibit their behaviour prevents them from carrying out complex tasks. That is, even if there are few executive deficits among these children/adolescents, they have major difficulties to solve problems in their immediate environment. In this regard, Barkley (2000) describes ADHD as a deficit of inhibition of behaviour, since children/adolescents have problems with lack of inhibition in the initial response to an event,

stopping action, and maintaining over time a directed activity. He also mentions the existence of a deficit in working memory (i.e., not keeping a task in mind does not facilitate the monitoring of plans). Thus it is possible to note that the results presented are consistent with Brocki et al. (2009), who reported that children with inattention are more affected in EF than other tested children.

On the other hand, regarding children/adolescents with symptoms of PBD phenotype, parents reported that they find it difficult to change strategies within a structured plan and are not able to find new solutions to problems that are presented during the completion of a task. This is consistent with some studies reviewed (Mattis et al., 2011; Passarotti et al., 2010; Walshaw et al., 2010). However, these children/adolescents do not have deficits in planning, inhibiting external stimuli and in working memory, as mentioned by the same authors.

These children/adolescents are able to plan and carry out the tasks proposed to them. However, when they find some difficulty, they fail to overcome it to reach their goal. This lack of flexibility leads to frustration, and perhaps can explain the outbursts of irritability and aggressiveness characteristic of this disorder (Galanter & Leibenluft, 2008; Geller et al., 2004, 1998; Leibenluft et al., 2003). When evaluating children/adolescents as informants the present study did not find any deficits in EF in children/adolescents with symptoms of PBD. These results agree with those found by Rucklidge (2006). Thus, on the one hand, marked deficiencies in flexibility and inhibition were found, as reported by parents and, on the other hand, children/adolescents reported no deficits in EF. This can be explained considering that the typical symptoms of this condition hinder its correct information. In contrast, parents often keep an eye on the activities of their children and tend to value the behaviours of their children with most clinical relevance (Winsler & Wallace, 2002).

From these results we conclude that the existence of symptoms of ADHD or PBD is strongly associated with EF deficits in children and adolescents, such as suggested by other studies (Lopera, 2008; López-Campo et al., 2005; Pennington & Ozonoff, 1996; Trott, 2006). These deficits are presented differently depending on the symptoms that children/adolescents suffer. Deficiencies in working memory, emotional control, planning, organizing, and monitoring are proper and exclusive to children/adolescents with symptoms of ADHD inattentive type. The deficit in working memory is highly associated with ADHD, as mentioned by Barkley (2000). The presence of symptoms of PBD involves no major executive deficits beyond a marked difficulty to find new strategies and inhibit one's behaviour. As mentioned above, Rucklidge (2006) in his study with adolescents with ADHD and PBD, concluded that when the PBD is presented without any comorbidity the executive deficits do not occur. However, when it occurs in comorbidity with ADHD it does have at neurocognitive dysfunction. For her, the cause of ADHD is that children/adolescents with PBD present such deficits.

This study provides a contribution to overcome the confusion in the differential diagnosis between both disorders. Although the intent of this study was not diagnosing children/adolescents, the measurement of their symptoms based on a clinical tool can direct us to the guidelines necessary to study their psychopathological characteristics. Defining a neurocognitive profile can guide us to obtain/achieve a proper diagnosis, despite the great behavioural similarity shown by previous studies (Geller et al., 2002 cited in Walshaw et al., 2010; Palacios Cruz et al., 2008). This will enable professionals to help children and adolescents to achieve their goals and cope adequately in different contexts.

On the other hand, it is important to mention that this study only used the BRIEF instrument to assess the EF, because, based on the study of Barkley and Fischer (2011), self-reports of EF are able to measure deficits in daily activities and in occupational functioning of children and adolescents. According to these authors, the cognitive deficits that accompany the disorders are expressed in daily life activities. These problems are not evident in the tests, since "they have little ecological validity" (p. 155). However, it is considered important to complement the study with laboratory neurological tests to deepen the assessment of EF.

A limitation of this study is the small sample size and the possible effects that this has in the analysis. However, the use of SEM in small samples is a valid method according to the literature (Baker, 2007; Bentler & Yuan, 1999). Small samples tend to reject the right models as mentioned by Hu and Bentler (1999, cited in Brown, 2006): "TLI and RMSEA tend to falsely reject models when  $N$  is small" (p. 86).

It would be appropriate to undertake further research with a larger size of clinical samples which will allow addressing the EF based on the presence of ADHD in its two types, the phenotype of PBD, and the presence of a comorbidity between ADHD / PBD.

## References

- Agostino, A., Johnson, J., & Pascual-Leone, J. (2010). Executive functions underlying multiplicative reasoning: Problem type matters. *Journal of Experimental Child Psychology*, 105(4), 286-305. doi:10.1016/j.jecp.2009.09.006
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR* (4<sup>th</sup> Rev. ed.). Washington, DC: Author.
- Anderson, P. (2002). Assessment and development of Executive Function (EF) during childhood. *Child Neuropsychology*, 8(2), 71. doi:10.1076/chin.8.2.71.8724
- Ardila, A., & Ostrosky-Solis, F. (2008). Desarrollo histórico de las funciones ejecutivas. *Revista de Neuropsicología, Neuropsiquiatría y Neurociencias*, 8(1), 1-21. Retrieved from <http://scholar.google.es/>
- Baker, S. R. (2007). Testing a conceptual model of oral health: A structural equation modeling approach. *Journal of Dental Research*, 86(8), 708-712.



- Barkley, R. A. (2000). Genetics of childhood disorders: XVII. ADHD, Part 1: The executive functions and ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, 39(8), 1064-1068. doi:10.1097/00004583-200008000-00025
- Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. (2001). Executive functioning, temporal discounting, and sense of time in adolescents with Attention Deficit Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD). *Journal of Abnormal Child Psychology*, 29(6), 541-556. doi:10.1023/A:1012233310098
- Barkley, R. A., & Fischer, M. (2011). Predicting impairment in major life activities and occupational functioning in hyperactive children as adults: Self-reported Executive Function (EF) deficits versus EF Tests. *Developmental Neuropsychology*, 36(2), 137-161. doi:10.1080/87565641.2010.549877
- Bentler, P., & Yuan, K.-H. (1999). Structural equation modeling with small samples: Test statistics. *Multivariate Behavioral Research*, 34(2), 181-197. doi:10.1207/S15327906Mb340203
- Brocki, K. C., Eninger, L., Thorell, L. B., & Bohlin, G. (2009). Interrelations between executive function and symptoms of hyperactivity/impulsivity and inattention in preschoolers: A two year longitudinal study. *Journal of Abnormal Child Psychology*, 38(2), 163-171. doi:10.1007/s10802-009-9354-9
- Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: The Guilford Press.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assess model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: SAGE.
- Capdevila-Brophy, C., Artigas-Pallarés, J., & Obiols-Llandrich, J. (2006). Tempo cognitivo lento: ¿síntomas del trastorno de déficit de atención/hiperactividad predominantemente desatento o una nueva entidad clínica? *Revista de Neurología*, 42(Supl. 2). Retrieved from <http://ardilladigital.com/>
- Díez, A. S., Figueroa, A. Q., & Soutullo, C. E. (2006). Trastorno por déficit de atención e hiperactividad (TDAH): comorbilidad psiquiátrica y tratamiento farmacológico alternativo al metilfenidato. *Revista Pediatría de Atención Primaria*, 8(Supl. 4). Retrieved from <http://scholar.google.es/>
- Domènech-Llaberia, E., Canals, J., Viñas, F., & Jané, M. C. (1998). *Cuestionario de datos sociodemográficos para padres*. Manuscrito no publicado.
- Fischer, M., Barkley, R. A., Smallish, L., & Fletcher, K. (2005). Executive functioning in hyperactive children as young adults: Attention, inhibition, response perseveration, and the impact of comorbidity. *Developmental Neuropsychology*, 27(1), 107. doi:10.1207/s15326942dn2701\_5
- Galanter, C. A., & Leibenluft, E. (2008). Frontiers between attention deficit hyperactivity disorder and bipolar disorder. *Child and Adolescent Psychiatric Clinics of North America*, 17(2), 325-346. doi:10.1016/j.chc.2007.11.001
- Geller, B., Sun, K., Zimmerman, B., Luby, J., Frazier, J., & Williams, M. (1995). Complex and rapid-cycling in bipolar children and adolescents: A preliminary study. *Journal of Affective Disorders*, 34, 259-268.
- Geller, B., Tillman, R., Craney, J. L., & Bolhofner, K. (2004). Four-year prospective outcome and natural history of mania in children with a prepubertal and early adolescent bipolar disorder phenotype. *Archives of General Psychiatry*, 61(5), 459. doi:10.1001/archpsyc.61.5.459
- Geller, B., Warner, K., Williams, M., & Zimmerman, B. (1998). Prepubertal and young adolescent bipolarity versus ADHD: Assessment and validity using the WASH-U-KSADS, CBCL and TRF. *Journal of Affective Disorders*, 51(2), 93-100. doi:10.1016/S0165-0327(98)00176-1
- Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). *BRIEF: Behavior Rating Inventory of Executive Function*. Odessa, FL: Psychological Assessment Resources.
- Goldberg, E. (2002). *El cerebro ejecutivo: lóbulos frontales y mente civilizada*. Barcelona, España: Crítica.
- Goswami, U. (2002). *Blackwell handbook of childhood cognitive development*. Malden, MA: Blackwell.
- Holmes, J., Gathercole, S. E., Place, M., Alloway, T. P., Elliott, J. G., & Hilton, K. A. (2010). The diagnostic utility of executive function assessments in the identification of ADHD in children. *Child and Adolescent Mental Health*, 15(1), 37-43. doi:10.1111/j.1475-3588.2009.00536.x
- Isquith, P. K., Crawford, J. S., Espy, K. A., & Gioia, G. A. (2005). Assessment of executive function in preschool-aged children. *Mental Retardation and Developmental Disabilities Research Reviews*, 11(3), 209-215. doi:10.1002/mrdd.20075
- Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., ... Ryan, N. (1997). Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): Initial reliability and validity data. *Journal of Amer Academy of Child & Adolescent Psychiatry*, 36(7), 980.
- Leibenluft, E., Charney, D. S., Towbin, K. E., Bhangoo, R. K., & Pine, D. S. (2003). Defining clinical phenotypes of juvenile mania. *American Journal of Psychiatry*, 160(3), 430-437. Retrieved from <http://ajp.psychiatryonline.org>
- Lewinsohn, P. M., Klein, D. N., & Seeley, J. R. (1995). Bipolar disorders in a community of older adolescents: Prevalence, phenomenology, comorbidity, and course. *Journal of the American Academy of Child & Adolescent Psychiatry*, 34(4), 454-463. doi:10.1097/00004583-199504000-00012
- Lopera, F. (2008). Funciones ejecutivas: aspectos clínicos. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, 8(1), 59-76. Retrieved from <http://scholar.google.es/>
- Lopez, B., Schwartz, S. J., Prado, G., Huang, S., Rothe, E. M., Wang, W., & Pantin, H. (2008). Correlates of early alcohol and drug use in Hispanic adolescents: Examining the role of ADHD with comorbid conduct disorder, family, school, and peers. *Journal of Clinical Child & Adolescent Psychology*, 37(4), 820-832. doi:10.1080/15374410802359676
- López-Campo, G. X., Gómez-Betancur, L. A., Aguirre-Acevedo, D. C., Puerta, I. C., & Pineda, D. A. (2005). Componentes de las pruebas de atención y función ejecutiva en niños con trastorno por déficit de atención/hiperactividad. *Revista de Neurología*, 40(6), 331-339. Retrieved from <http://scholar.google.es/>
- Mattis, S., Papolos, D., Luck, D., Cockerham, M., & Thode, H. (2011). Neuropsychological factors differentiating treated children with pediatric bipolar disorder from those with attention-deficit/hyperactivity disorder. *Journal of Clinical and Experimental Neuropsychology*, 33(1), 74-84. doi:10.1080/13803395.2010.493146
- Palacios Cruz, L., Romo Nava, F., Patiño Durán, L. R., Leyva Hernández, F., Barragán Pérez, E., Becerra Palars, C., & de la Peña Olvera, F. (2008). Trastorno por déficit de atención e hiperactividad y trastorno bipolar pediátrico, ¿comorbilidad o traslape clínico?: una revisión. Segunda parte. *Salud Mental*, 31(2), 87-92. Retrieved from [http://www.scielo.org.mx/scielo.php?pid=S0185-33252008000200002&script=sci\\_arttext&tlang=pt](http://www.scielo.org.mx/scielo.php?pid=S0185-33252008000200002&script=sci_arttext&tlang=pt)

Araujo, E., Jané, M. C., Bonillo, A., Arraufat, F. J. (2015). Executive Function Associated to Symptoms of Attention Deficit with Hyperactivity Disorder and Paediatric Bipolar Disorder.

- Passarotti, A. M., Sweeney, J. A., & Pavuluri, M. N. (2010). Neural correlates of response inhibition in pediatric bipolar disorder and attention deficit hyperactivity disorder. *Psychiatry Research: Neuroimaging*, *181*(1), 36-43. doi:10.1016/j.psychres.2009.07.002
- Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *37*, 51-87. doi:10.1111/j.1469-7610.1996.tb01380.x
- Re, A., De Franchis, V., & Cornoldi, C. (2010). Working memory control deficit in kindergarten ADHD children. *Child Neuropsychology*, *16*(2), 134-144. doi:10.1080/09297040903373404
- Rosselli, M., Jurado, M. B., Matute, E., Inozemtseva, O., Reyes, A. L., Cárdenas, S. G., & Sánchez, E. A. (2008). Las funciones ejecutivas a través de la vida. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, *8*(1), 23-46. Retrieved from <http://neurociencias.udea.edu.co/revista/?action=resumen&id=34>
- Rucklidge, J. (2006). Impact of ADHD on the neurocognitive functioning of adolescents with bipolar disorder. *Biological Psychiatry*, *60*(9), 921-928. doi:10.1016/j.biopsych.2006.03.067
- Senn, T. E., Espy, K. A., & Kaufmann, P. M. (2004). Using path analysis to understand executive function organization in preschool children. *Developmental Neuropsychology*, *26*(1), 445. doi:10.1207/s15326942dn2601\_5
- Serra Jacobo, R., Jané, M. C., Bonillo, A., Ballespi, S., & Díaz-Regañón, N. (2012). Somatic symptoms, severe mood dysregulation, and aggressiveness in preschool children. *European Journal of Pediatrics*, *171*(1), 111-119. doi:10.1007/s00431-011-1495-5
- Trott, G.-E. (2006). Attention-deficit/hyperactivity disorder (ADHD) in the course of life. *European Archives of Psychiatry and Clinical Neuroscience*, *256*(Suppl. 1), i21-i25. doi:10.1007/s00406-006-1003-5
- Trujillo, N., & Pineda, D. (2008). Función ejecutiva en la investigación de los trastornos del comportamiento del niño y del adolescente. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, *8*(1), 77-94. Retrieved from <http://neurociencias.udea.edu.co/revista/?action=resumen&id=39>
- Walshaw, P. D., Alloy, L. B., & Sabb, F. W. (2010). Executive function in pediatric bipolar disorder and attention-deficit hyperactivity disorder: In search of distinct phenotypic profiles. *Neuropsychology Review*, *20*(1), 103-120. doi:10.1007/s11065-009-9126-x
- Welsh, M., Pennington, B., & Groisser, D. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology*, *7*(2), 131-149. doi:10.1080/87565649109540483
- Willcutt, E. G., Pennington, B. F., Olson, R. K., Chhabildas, N., & Hulslander, J. (2005). Neuropsychological analyses of comorbidity between reading disability and attention deficit hyperactivity disorder: In search of the common deficit. *Developmental Neuropsychology*, *27*(1), 35. doi:10.1207/s15326942dn2701\_3
- Winsler, A., & Wallace, G. L. (2002). Behavior problems and social skills in preschool children: Parent-teacher agreement and relations with classroom observations. *Early Education and Development*, *13*(1), 41-58.
- Zelazo, P. D. (2004). The development of conscious control in childhood. *Trends in Cognitive Sciences*, *8*(1), 12-17. doi:10.1016/j.tics.2003.11.001

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