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Predictive Associations of Executive Functions and Oppositional Defiant Problems and Obsessive-Compulsive Problems in Preschoolers

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Abstract

Oppositional defiant problems (ODP) and obsessive-compulsive problems (OCP) may co-occur in children, though the way they interact is not known. The aim of the study was to examine longitudinal associations between executive functions at age 3 and ODP, ODP dimensions, and OCP at age 6. The sample consisted of 622 preschoolers (50% were boys) from the general population. Executive functions were assessed by teachers using the Behavior Rating Inventory of Executive Functioning – Preschool version questionnaire when children were 3 years old, and ODP and OCP were informed by parents and teachers at the age of 6 years. Multiple linear regression analyses indicated that higher Inhibit and Emotional Control and lower Shift deficits were associated with higher ODP reported by teachers, while higher Shift but lower Inhibit deficits were related to higher OCP. Moreover, ODP and OCP shared difficulties on the Flexibility Index, which means that the capacity to modulate emotions and behavior according to contextual and environmental demands is compromised in both disorders. The findings inform etiology and prevention, pointing out not only the executive function specificities related to each problem, but also common cognitive challenges related to Flexibility. Young children could benefit from training and programs designed to improve executive function processes at an early age to prevent later behavioral difficulties.

Keywords: cognition, headstrong, irritability, flexibility, psychopathology

Predictive Associations of Executive Functions and Oppositional Defiant Problems and Obsessive-Compulsive Problems in Preschoolers

Executive function encompasses a range of interrelated cognitive processes necessary for regulating emotions and goal-driven behaviors (Miyake et al., 2000). Inhibition (i.e., the ability to control, stop, and shape one's behavior), working memory (i.e., the ability to retain basic information necessary to complete a task) and shifting (i.e., the ability to switch between tasks and situations effortlessly) are considered primary domains (Diamond, 2013). These processes are categorized as either “cold”, typically measured through neuropsychological tests, or “hot”, assessed in emotionally laden contexts or scenarios involving rewards (Zelazo & Carlson, 2012).

Deficiencies in executive function have been associated with a wide range of adverse outcomes, including behavioral difficulties (Schoemaker et al., 2013), suboptimal educational outcomes (Cantin et al., 2016), and diminished overall well-being among other negative impacts. The accelerated maturation of executive function during the preschool period, along with its malleable nature, make this stage an optimal timeframe for intervention (Zelazo & Carlson, 2012). Executive function performance is contingent on the development of the prefrontal cortex (Ferguson et al., 2021) and differences in this area have been linked to Oppositional Defiant Disorder (Noordermeer et al., 2016) and Obsessive-Compulsive Disorder (Malloy, 2019).

The current study aims to examine the association between executive functions and Oppositional Defiant Problems (ODP) and Obsessive-Compulsive Problems (OCP), which to our knowledge, have not been concurrently investigated. The etiology of these problems is multifaceted, with evidence suggesting that a combination of environmental, genetic, and biological factors contribute to their development.

Executive functions, Oppositional Defiant Disorder and Oppositional Defiant Disorder dimensions

Oppositional Defiant Disorder is a widespread disruptive behavior among children and adolescents and is explained as “a pattern of angry/irritable mood, argumentative/defiant behavior, or vindictiveness lasting at least 6 months” (American Psychiatric Association, 2013). Oppositional Defiant Disorder is further described as a multifactorial disorder (Coskun et al., 2012) caused by genetic, biological, and environmental factors (Azeredo et al., 2018).

In regards to the relationship between executive functions and Oppositional Defiant Disorder, there is no consensus among the researchers on their association, and most frequently, this is analyzed and explained in conjunction with other diagnoses such as Attention-Deficit/Hyperactivity Disorder (ADHD) or Conduct Disorder (CD) (Hobson et al., 2011; Schoorl et al., 2018). Some studies suggested that deficiencies in executive functions are not distinctive features of Oppositional Defiant Disorder but rather they are ADHD-specific (Granero et al., 2015; Hobson et al., 2011; Thorell & Wahlstedt, 2006), whereas other studies suggest that comorbid ADHD/Oppositional Defiant Disorder condition results in more severe impairments (Skogan et al., 2016; Trani et al., 2011). However, a small number of studies reported executive function deficits in Oppositional Defiant Disorder, mainly in the visual working memory and inhibition domains, while accounting for hyperactivity (Kleine Deters et al., 2020; Rhodes et al., 2012).

Research on Oppositional Defiant Disorder emphasizes its multidimensional nature, which can provide insight into potential associations and pathways leading to problematic behaviors (Waldman et al., 2021). Prior studies have identified a 2-dimensional model including *irritable* and *headstrong* (Rowe et al., 2010) or a 3-component model where *hurtful* is included in addition to irritable and headstrong (Stringaris & Goodman 2009). Research has shown that the irritable dimension (e.g., symptoms of anger, tantrums, and annoyance)

predicts internalizing disorders and emotional problems, whereas headstrong (e.g., argumentative behaviors with adults, rule defiance) relates to ADHD, and hurtful forecasts CD and aggressive symptoms (Rowe et al. 2010; Stringaris & Goodman 2009). Hence, assessing the relationships between executive function and Oppositional Defiant Disorder dimensions may elucidate potential associations between specific cognitive processes and internalizing or externalizing problems, including Obsessive-Compulsive Disorder. The irritability dimension, for example, has previously been related to difficulties in shifting and emotional control (also the Flexibility Index - FI), and headstrong to challenges in inhibitory self-control (Ezpeleta et al., 2012).

Executive functions and Obsessive-Compulsive Disorder

Similar to Oppositional Defiant Disorder, Obsessive-Compulsive Disorder is a common condition in childhood and adolescence that results from both genetic and environmental factors (Krebs & Heyman, 2015). Obsessive-Compulsive Disorder is a chronic condition described by “recurrent intrusive thoughts/impulses and contingent ritualized behavior” (Lewin et al., 2014, p.108).

In terms of executive functions and Obsessive-Compulsive Disorder, although impaired inhibition, set-shifting, and working memory difficulties are admittedly present in adults (Abramovitch et al., 2015a), studies among preschoolers are scarce. A meta-analysis conducted by Abramovitch et al. (2015b) reports a small effect size or no evidence of executive function deficits among children with Obsessive-Compulsive Disorder. The findings are also supported by Hybel et al. (2017). In contrast, other studies suggest deficits in several areas of executive functions in school-age children, such as set-shifting (Ornstein et al., 2010), inhibition (Mancini et al., 2018), working memory (Bernardes et al., 2020; Fakhri & Yuzbashi, 2020) and planning (Negreiros et al., 2020; Ornstein et al., 2010). Moreover, these deficits are associated with Obsessive-Compulsive Disorder severity and suboptimal

treatment response (Fakhri & Yuzbashi, 2020; McNamara et al., 2014). Even so, the results are inconsistent across studies, and deficits are primarily reflected in assessments based on parent or teacher ratings rather than performance-based tests, suggesting that children with Obsessive-Compulsive Disorder may experience significant difficulties in daily executive function-related activities (Negreiros et al., 2020).

Comorbidity Oppositional Defiant Disorder and Obsessive-Compulsive Disorder

Oppositional Defiant Disorder and Obsessive-Compulsive Disorder have received limited joint research attention. Despite their potential comorbidity falling within the range of 12-40% (Ale & Krackow, 2011; Coskun et al., 2012), the underlying factors contributing to the co-occurrence of Obsessive-Compulsive Disorder and Oppositional Defiant Disorder are not yet fully understood. For instance, a neuroimaging study has revealed that both Obsessive-Compulsive Disorder and Oppositional Defiant Disorder exhibit analogous overactivation patterns in the anterior medial area of the frontal lobes with role in attention shifting (Amen & Carmichael, 1997). This similarity prompts the question of whether executive function plays a role in the relationship between the two disorders. Previous research has shown that the irritability dimension of Oppositional Defiant Disorder is linked to obsessive-compulsive behaviors in a sample of children with Gilles de la Tourette syndrome and chronic tic disorder (Thériault et al., 2014), and emotional control deficits in children with Obsessive-Compulsive Disorder suggest a greater probability of coexisting Oppositional Defiant Disorder (McKenzie et al., 2020). Overall, considering these disorders jointly can provide insight into the shared and distinct executive function deficits potentially contributing to their early onset.

Therefore, this exploratory study aims to determine whether executive functions at the age of 3 years are prospectively associated with ODP and its dimensions – irritability and headstrong -, and with OCP, all of them at the age of 6 years. The results on common

executive function difficulties can inform the development of more targeted treatments for children with oppositional and obsessive-compulsive problems. For example, an approach that has shown efficacy in such cases is a modified treatment protocol that employs cognitive-behavioral therapy and parent management training (Sukhodolsky et al., 2013). Similarly, treatment can be customized to tackle executive function skills.

Method

Participants

The sample was drawn from a longitudinal study on behavioral problems that followed a cohort of children from 3 years old.

The initial sample consisted of 2283 participants from 54 schools (74.1 % public and 25.9% semi-public) randomly selected from the registry of infant schools in Barcelona for 2009-10. The selection process consisted of two phases. In the first screening phase, a total of 1,341 families (58.7%) consented to participate. The screening was based on the main study focus, which was Oppositional Defiant Disorder. Thus, a dimensional measure containing the eight symptoms according to the DSM-IV (American Psychiatric Association, 1994) was used and answered by parents. This measure contained four items of Oppositional Defiant Disorder (loses temper, defies rules, argues with adults, spiteful/vindictive) included in the conduct scale of the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) along with four additional symptoms (annoys people, blames others, touchy/annoyed, angry/resentful) to complete the Oppositional Defiant Disorder definition of DSM-IV. For the second phase, two groups were further regarded. As screen positive, children who met the SDQ scores ≥ 4 criteria or obtained a score 2 “*certainly true*” in at least one of the eight DSM-IV Oppositional Defiant Disorder symptoms reported by parents were selected (a total of 417 children). And as screen negative, a random sample of 205 children who did not meet

the aforementioned conditions was also included in the study sample. Therefore, the total sample to participate in the follow-ups included 622 children aged 3, of these, 311 (50%) were boys, 35.4% were of high socioeconomic status (SES), 46.3% were of middle status, and 18.3% were of low status. Ninety-seven point two percent were born in Spain, 2.8% were born outside Spain, and 91.1% were Caucasian. Figure 1 details the flow-chart with the screening process and the measures administered at the two time-points. No differences in sex ($p = .95$) or type of school ($p = .85$) were found between participants and non-participants. High-SES families had greater participation than low-status ones ($p < .001$). Families' socioeconomic status was measured using Hollingshead's Four Factor Index of Social Status (Hollingshead, 1975). A total of 516 children remained in the follow-up at 6 years. The average time between the two study timepoints was 2.97 years ($SD = 0.20$). A description of the sample followed at age 6 is shown in Table 1. No differences were found in sex and type of school between children who stayed in the study at age 6 compared to those lost to follow-up from age 3 ($p \geq .537$). With respect to socioeconomic status, the available sample at age 6 had a higher percentage of high SES children ($p = .033$).

INSERT FIGURE 1 HERE

INSERT TABLE 1 HERE

The level of nesting between children and teachers was low. A total of 91 teachers (from 54 different schools) and 100 (from 71 different schools) participated at ages 3 and 6, respectively. At age 3, the range of children per teacher was 1-13 ($Mdn = 7$) and most of the teachers (mode = 19, 20.9%) rated 7 children each. At age 6, the range of children per teacher was 1-11 ($Mdn = 5$) and most of the teachers (mode = 18, 18.0%) rated 5 children each. Given that the level of non-independence regarding teachers could therefore be considered negligible, we found it not necessary to account for this issue in the models.

Procedure

Families of 3-year-old children were recruited at the schools and written consent was obtained. Preschool education in Spain is publicly financed and 3-year-olds are enrolled in preschool education. In the screening phase, 1,341 families of 3-year-old children filled out the SDQ. The families that constituted the study sample were invited to participate in the follow-ups and on-site yearly assessments. Teachers answered the questionnaires after permission from the families was obtained. The project was approved by the Ethical Committee at the corresponding authors' institution.

Measures

The Behavior Rating Inventory of Executive Function – Preschool version (BRIEF-P) (Gioia et al., 2000) is an assessment questionnaire of executive function behaviors in daily life for preschool children aged 2-5 years. The teachers' rating form consists of 63 items on a 3-point ordered scale (0- *Never*, 1-*Sometimes*, 2-*Often*), and is used to measure executive functions in a preschool environment over a 6-month period. The five dimensions measured are Inhibit, Emotional Control, Shift, Working Memory, and Plan/Organize. These first-order scale scores form three indexes or second-order scale scores: 1) Inhibitory Self-Control Index (ISCI) consisting of Inhibit and Emotional Control, 2) Flexibility (FI) which includes the scores of Shift and Emotional Control, 3) Emergent Metacognition Index (EMI) embodying Working Memory and Plan/Organize, in addition to a total score of all five scale scores – the Global Executive Composite (GEC), which is as a general indicator of executive functions' difficulties. For all BRIEF-P scores, higher values indicate more deficits. The study used raw scores from the data collected from teachers when the children were 3 years old. Internal consistency (ordinal alpha coefficient) of scale scores in the present sample ranged from .94 (Shift and Emotional Control) to .98 (Working Memory, EMI, and GEC).

Similarly, to the screening procedure, ODP was measured with the SDQ at the age of 6 years. The 8 symptoms were coded on a 3-point Likert-type scale (0: *not true*; 1: *somewhat true*; 2: *certainly true*) and filled out by parents and teachers at 6 years old. ODP dimension scores based on Rowe's 2-factor model (Rowe et al., 2010) were determined by summing the ratings of each item: Irritability (*loses temper, touchy annoyed, angry resentful*) and Headstrong (*argues with adults, defies rules, annoys people, blames others, spiteful/vindictive*) (Ezpeleta et al., 2012). SDQ-hyperactivity/inattention score was used to adjust for hyperactivity and was reported by both informants. Internal consistency (ordinal alpha coefficient) of scale scores used in the presented sample ranged from .76 (headstrong rated by parents) to .94 (total score rated by teachers). Higher values are indicative of more ODP and hyperactivity.

OCP was measured by the 2007-OCP CBCL/6-18 scale (Achenbach & Rescorla, 2007). The scale contains 8 items (obsessions, fear doing/thinking something bad, perfectionism, feels too guilty, compulsions, strange behavior, strange ideas, worries) rated on a 3-point format from 0 (*not true*) to 2 (*sometimes or often true*) that were answered only by parents when the children were 6 years old. Higher values are indicative of more OCP. Internal consistency (ordinal alpha coefficient) of scale score in the presented sample was .81.

Statistical Analysis

Data analyses were conducted with Stata version 16. Given the multistage sampling procedure used, all the analyses were weighted by the inverse probability of selection in the second phase of sampling.

All the analyses used raw scores for questionnaire measures. A correlation matrix (Table 2) was initially performed, providing insight into the magnitude of association among measures. Given that two first-order BRIEF-P scale scores, Working Memory and

Plan/Organize, were highly correlated (.89), the former was selected based on the ordinal alpha, which had a higher value (.98) than the latter (.95).

In order to assess the relationship between executive functions reported by teachers at age 3 and ODP (reported by parents and teachers) and OCP (reported by parents), both at age 6, multiple linear regressions were performed. Specifically, and regarding BRIEF-P scores, we conducted one regression model for the first-order scales entered simultaneously as predictors, one for each of the three considered second-order scales entered separately, and one for GEC. Furthermore, another set of multiple linear regression analysis was undertaken to investigate the relationship between executive functions and each specific ODP dimension. Each of the models was adjusted by the potential confounding variables (sex, SES, hyperactivity reported by the same informant at age 3) when necessary. Covariates were included when the difference between parameter estimates of adjusted and crude models was > 10% (Maldonado & Greenland 1993).

INSERT TABLE 2 HERE

Results

Predictive Associations of Executive functions and ODP

The left part of Table 3 present executive function associations at age 3 on ODP at age 6 reported by parents, adjusted by hyperactivity when necessary. The first-order scale results did not show any associations between executive functions and ODP reported by parents. However, the results for the composite scales ISCI, FI, and the GEC showed that higher scores, hence higher difficulties in ISCI, FI, and GEC at age 3, were associated with more severe ODP at age 6.

As illustrated in the central part of Table 3, based on teacher’s ratings and adjusted by hyperactivity when necessary, the first-order scale results revealed significant associations between executive functions at age 3 and ODP at age 6, specifically, higher Inhibit and

Emotional Control challenges and lower Shift scores at age 3 were associated with more severe ODP at age 6. Also, higher difficulties on the composite ISCI at age 3 were linked to higher ODP scores at age 6.

Predictive Associations of Executive Functions and OCP

Right part of Table 3 present executive function associations at age 3 on OCP at age 6 reported by parents, adjusted by hyperactivity when necessary. The first-order scale results showed associations between executive functions and OCP, namely higher Shift and lower Inhibit scores at age 3 were associated with more heightened OCP at age 6. Furthermore, higher scores in the composite FI difficulties at age 3 were related to higher scores in OCP at age 6.

INSERT TABLE 3 HERE

INSERT TABLE 4 HERE

Predictive Associations of Executive Functions and ODP Dimensions

The results of the multiple linear regression analyzing the predictive association of executive functions reported by teachers and ODP dimensions (irritability and headstrong) reported by parents (Table 4, left), adjusted by hyperactivity when necessary, revealed that higher ISCI, FI, and GEC at age 3 were associated with higher irritability at age 6, and higher ISCI and GEC at age 3 were associated with higher headstrong at age 6. Regarding teachers as reporters (Table 4, right), higher Emotional Control challenges and ISCI at age 3 and lower Shift scores were associated with higher irritability at age 6. Furthermore, higher scores in Inhibit and ISCI were associated with higher headstrong at age 6.

Discussion

The study aimed to investigate the relationship between executive functions evaluated at 3 years old and ODP and OCP at 6 years old, focusing on the specificity of each problem

but also the common characteristics these problems may share in relation to executive functions. In addition to showing specific associations, such as inhibition difficulties in ODP and shifting difficulties in OCP, the findings revealed a previously unknown commonality between OCP and ODP, indicating that both problems are related to FI deficits. To the author's knowledge, this is the first study to ascertain common cognitive factors that may play a role in explaining the comorbidity between ODP and OCP among preschool children. While other reasons besides cognitive challenges can contribute to comorbidity (e.g. genetics, parenting), deficits in flexibility may indicate either oppositional, obsessive-compulsive, or the concurrent presence of both difficulties. It was also determined that ODP was associated with several measures of EF, such as ISCI, FI and GEC indexes, meanwhile, OCP was associated with FI.

Relations between Executive Functions and ODP and ODP Dimensions

Higher difficulties in ISCI, FI, and GEC, when ODP is reported by parents, and difficulties in Inhibit, Emotional Control, and ISCI, based on ODP teachers' ratings, were associated with higher oppositional difficulties at age 6. According to both informants, ISCI difficulties are associated with higher ODP, meaning that the ability to regulate actions, emotions, and demeanor via inhibitory control is altered in children with ODP, no matter the context (school or home). Both dimensions, irritability and headstrong, are associated with this ISCI index, which seems central in ODP, and that includes difficulties in inhibition and emotional control. One interpretation of these executive function challenges is that inhibition may be indicative of headstrong symptoms, while emotional control may reflect irritability symptoms. These results may indicate that one of the deficits behind the dimensions of ODP (and of OCP) may be the difficulties in the development of executive functions (Ezpeleta et al., 2012).

ODP was also associated with deficits in FI (shift + emotional control) at home. When ODP was split in their dimensions, the association was due to irritability symptoms (not to headstrong). This is consistent with studies indicating that children with Oppositional Defiant Disorder are susceptible to negative emotions and when these are experienced, they get caught up in their emotions, unable to redirect their attention and switch from one action, emotional response, or behavior to another (Jiang et al., 2016; Kleine Deters et al., 2020). When the reporter is the teacher, only Shift (a component of FI) is significantly and negatively associated to ODP (due to irritability association). In this case, higher impairments in shifting are associated with a decrease in oppositional problems at age 6. This counterintuitive result is difficult to explain and needs further research. However, it may be due to the fact that preschool children with externalizing behavior recover some of their delays as their development of executive functions improves, typically when they start school which may explain the reduction in these behaviors (Schoemaker et al. 2013). Also, other environmental factors such as the school context, where the limits are clearly established, might have a role shaping child's behavior boosting the development of flexibility. Moreover, it is plausible that the implementation of appropriate interventions or behavior management programming facilitated through the school system may have contributed to this improvement.

Finally, the global index GEC reflects an association between executive function challenges at age 3 and higher ODP (and irritability and headstrong) at age 6, meaning that, developmentally, early difficulties in summary executive functions are predictably associated with later behavioral difficulties related to oppositional behavior.

In sum, ODP are related with deficits in the development of EF that imply inhibition, emotional control, and flexibility and, specifically, the irritability dimension of ODP is associated with deficits in inhibition, emotional control and flexibility, and the headstrong

dimension with inhibition and emotional control. These findings have implications for etiological research and for intervention.

Relations between Executive Functions and OCP

The association between higher OCP and difficulties in Shift and FI index (shift + emotional control) aligns with prior research pointing out a link between deficits in set-shifting and elevated levels of OCP in children aged 11-12 years (McNamara et al., 2014; Ornstein et al., 2010). This may be an indication that shifting difficulties identified in early childhood may be an attribute of early-onset Obsessive-Compulsive Disorder as these difficulties persist later in adolescence and continue into adulthood (Zhang et al., 2015).

Also, higher Inhibit scores were related to lower OCP, and children who evinced higher difficulties in inhibition at age 3 engaged in fewer obsessive-compulsive behaviors at age 6. Although inhibition deficits are prevalent in adults with Obsessive-Compulsive Disorder (Lei et al., 2015), the results are contradictory in children with Obsessive-Compulsive Disorder. Some studies reflect the presence of inhibition deficits in relatively small samples of children (Mancini et al., 2018), but others suggest that deficits in flexibility and planning are rather associated with obsessive-compulsive symptoms in children and that they do not experience inhibition difficulties like adults (Ornstein et al., 2010). Similar to our findings, Pietrefesa and Evans (2007) reported an inverse relationship between inhibition and compulsive-like behaviors among children over 6 years old, while a positive relationship emerged in younger children. One possible explanation is that younger children are prone to engage in compulsions (e.g. rituals around meals or bed time) as “a more involuntary yet adaptive response “ (p.44) and, once performed, these have a role in reducing anxiety (Pietrefesa & Evans, 2007). The results indicate that the relationship between inhibition and compulsive behaviors could interact differently over time and that the development of inhibition entails significant changes, specifically between 3 and 6 years (Anderson & Reidy,

2012). In addition to age, Obsessive-Compulsive Disorder-specific symptoms, and their correlation to cognitive (obsessive symptoms) versus behavioral inhibition (compulsive symptoms) should be factored in for a better understanding of the relationship. If in adult samples, cognitive inhibition deficits are associated with obsessive symptoms (Glover & Moyer, 2018), these may be difficult to measure in early childhood since compulsions develop before obsessions or children may not be able to articulate intrusive thoughts (Evans et al., 2004).

Deficits in FI - The Common Point between ODP and OCP

Our findings revealed that ODP and OCP share impairment in executive functions, specifically, deficits in FI (shifting + emotional control) at age 3 reported by parents were associated with higher ODP and OCP difficulties at age 6. ODP and OCP children may share difficulties related to “hot” executive functions and their ability to shift in emotionally charged situations may be hindered. It is important to note that FI is one of the prominent aspects of behavioral regulation, which implies the ability of the child to switch flexibly from one action to another, from one emotion to another, or from one behavior to another. If difficulties in FI are present, the capacity to regulate emotions and behaviors in response to contextual and environmental requests is compromised. The association of FI with higher ODP and OCP problems at age 6 indicates that these children face common difficulties in flexibility and emotional control when adapting their responses to contextual demands.

Consistent with previous research, children with ODP may have difficulty switching attention during emotional distress because their emotions tend to control them (Jiang et al., 2016). Similarly, children with OCP seem to exhibit shifting and emotional control deficits that are more observable in real-life environments and correlate with symptoms severity as reflected in previous research (McNamara et al., 2014). As difficulties often arise in day-to-day situations or contexts where emotional stimuli are present, future studies should examine

aspects related to "hot" processes in these disorders. For instance, one study found that “affective flexibility”, a hot aspect of executive function defined as “a subset of cognitive flexibility that involves the more specific ability to switch between emotion-focused and non-emotional cognitive sets” (Malooly et al., 2013, p.303) predicted emotion regulation in preschoolers (Martins et al., 2020). Finally, since FI is associated with the irritability dimension of ODP, it could be argued that irritability functions as an intermediary variable between FI and ODP. Studies have consistently acknowledged irritability as a transdiagnostic factor (Burke et al., 2014; Guzick et al., 2021), and higher irritability is indicative of a more acute clinical profile characterized by greater severity of oppositional symptoms and a higher incidence of comorbidities such as anxiety or depression (Ezpeleta et al., 2016; Leadbeater & Homel, 2015), conduct problems (Leadbeater & Homel, 2015), and, more recently, with impairments in Obsessive-Compulsive Disorder samples (Guzick et al., 2021; McNamara et al., 2014). Interestingly, FI is specifically associated with irritability, and FI is also the common deficit in executive functioning between ODP and OCP. Therefore, it may be that irritability is an intermediate variable between FI and ODP and OCP. This must be tested to better understand the etiological path between executive functioning and this different but associated symptomatology of ODP and OCP.

The study has several strengths, including a relatively large sample of preschool children from a general population, longitudinal assessment, multiple reporters (parents and teachers), the developmental period under study and a focus on the specificity of ODP and OCP in relation to executive functions. Choosing parents and teachers to rate ODP at age 6 emphasizes the importance of multi-informant assessments, especially when children are so young. This aligns with ongoing research focused on developing frameworks that can integrate diverse perspectives on a child's behavior, which may vary across environments, yet are crucial for assessing needs and intervention objectives (De Los Reyes et al., 2015; 2022).

The discrepancies between informants' reports may be due to variations in the assessed environments and informant differences among other factors. In line with De Los Reyes and Epkins (2023), research has progressed beyond viewing informant discrepancies as mere measurement errors; instead, it can provide valuable insights for clinicians. Children's needs may also vary across environments, as well as the expertise of informants in reporting certain behaviors. Additionally, strategies utilized in specific environments may prove more effective than others. For instance, flexibility issues are associated with ODP according to parental reports only. This may indicate that flexibility difficulties are linked to more oppositional symptoms at home rather than at school, where this association was not observed. This could reflect specific needs in home contexts and/or differences in how informants address the child's behavior. It is important to note some limitations of this study, specifically the reliance on parent ratings alone to assess OCP at age 6 and the exclusive use of BRIEF as a measure of executive function. Firstly, relying solely on a single informant's report may be subject to contextual influences or observer bias. However, evidence shows that parents are often the first to notice incipient obsessive-compulsive symptoms, as children tend to exhibit more severe functional impairments at home (77%) compared to school (23%) (Sabuncuoglu & Berkem, 2006). Future research may consider a comprehensive approach, using a combination of assessment methods and multi-informant procedures to account for contextual variations.

Secondly, in the case of BRIEF, although it presents a series of advantages such as good reliability and estimation of deficits in real-life contexts (Sherman & Brooks, 2010), it may not provide a comprehensive measure of executive function and other regulatory abilities. Future studies should include additional cognitive, behavioral and performance-based measures of executive function available for use in preschool and early school-aged children. Nevertheless, applying performance tests on a large scale may be unfeasible if the

goal is to detect early, prevent, and intervene promptly. In educational contexts, questionnaires can inform how executive function difficulties impact daily functioning, particularly in younger individuals. Teachers, as key observers, play a vital role in detecting these challenges. In this context, questionnaires can serve as a viable alternative for facilitating early identification and intervention. Despite teachers' ability to identify these challenges, there remains a need for further implementation of programs and projects within the classroom aimed at developing executive function. This might include introducing activities like mindfulness, self-regulation practices, and tasks designed to improve cognitive flexibility through scaffolding and set-shifting activities.

Finally, due to the common and dynamic changes in EF difficulties and behavioral problems during the preschool years it can be challenging to establish conclusive causal relationships between BRIEF results at age 3 and behavioral symptoms at age 6. Therefore, interpreting the results requires caution and future research should replicate these findings at different ages for a more comprehensive understanding. Furthermore, the initial study primarily targeted Oppositional Defiant Disorder and children were not screened for comorbid conditions such as Obsessive-Compulsive Disorder and this may have under-identified the target sample. Additionally, there was no information on whether any families sought professional assistance to address these disorders. Future studies may consider comorbid conditions and professional interventions to provide deeper insights into the interplay between executive functions, oppositional, and obsessive-compulsive challenges. Finally, the effect sizes based on the reported beta weights are relatively small. And lastly, the results are generalizable only to children from the general population.

The results have several important implications. According to parents and teachers, ISCI is associated with both dimensions of ODP, irritability, and headstrong behavior. This indicates that early ISCI difficulties (composed of Inhibit and Emotional Control scales)

showed in different contexts (at home and at school) are a risk factor for later higher irritability and headstrong. The finding suggests that improving inhibition and emotional control at an early age may be effective in mitigating the risk of developing co-occurring conditions associated with dimensions of ODP. Additionally, the findings revealed that higher Emotional Control difficulties at age 3 (first-order scale measured by teachers but also included in FI and in ISCI) correspond to heightened irritability at age 6. This underscores the importance of addressing emotional control difficulties during early childhood, as such issues are linked to an increased vulnerability to psychopathology later in life and lead to a more severe ODP and comorbid conditions (Ezpeleta et al., 2016). The early detection of emotional control challenges coupled with targeted interventions, such as parent training and emotion-focused strategies, has been associated with improvement in emotional control, resulting in decreased irritability (Leadbeater & Homel, 2015; Leibenluft, 2017). Finally, the FI results imply that incorporating assessments of hot aspects of executive functioning, which may be more perceptive to behavioral problems as they unfold in real-life contexts, may provide a more comprehensive understanding of an individual's cognitive and behavioral performance, potentially leading to more effective treatment and better outcomes.

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The authors report there are no competing interest to declare.

Author Contributions

Denisa-Elena Zevedei: Writing- Original Draft, Formal Analysis; **Eva Penelo:** Formal Analysis, Supervision, Writing-Review and Editing; **José-Blas Navarro:** Data Curation, Methodology, Supervision Final Draft; **Núria de la Osa:** Review Final Draft; **Lourdes Ezpeleta:** Conceptualization, Investigation, Supervision, Writing-Review and Editing.

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