Irritability and parenting practices as mediators between executive functions and oppositional and obsessive-compulsive problems in preschool children

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Abstract

Oppositional defiant disorder and obsessive-compulsive disorder can co-occur in some children yet the factors that contribute to this comorbidity have not been thoroughly examined. We examined prospective associations between executive functions, namely Inhibitory Self-Control (ISCI) and Flexibility (FI), and oppositional defiant problems (ODP) and obsessive-compulsive problems (OCP) through irritability and parenting practices. The sample included 622 preschoolers from the community. Using questionnaires, teachers assessed children's executive functions at age 3, and parents reported irritability at age 4, parenting practices at age 6, and ODP and OCP at age 7. Structural equation modeling revealed: (a) a direct and an indirect effect via punitive parenting from ISCI to ODP, (b) an indirect effect from FI to ODP via irritability and serially via both irritability and punitive parenting, (c) a direct effect from ISCI to OCP, and (d) a direct and an indirect effect from FI to OCP via irritability. Deficits in FI are present in both problems, and irritability is a mediating factor between flexibility and ODP and OCP that may help to understand the comorbidity of these problems.

Highlights

- Irritability is a mediator between flexibility and oppositional and obsessive-compulsive problems.
- Punitive parenting mediates in the pathway from executive function to oppositional problems.
- Inhibitory deficits are directly involved in both problems, although the nature of the relationship varies.

Oppositional Defiant Disorder, a disruptive behavior disorder marked by persistent irritability, defiance and argumentativeness, and Obsessive-Compulsive Disorder, a chronic condition involving intrusive thoughts and ritualized behaviors, can co-occur in childhood (Coskun et al., 2012) and such co-occurrence is associated with greater symptom severity, difficulties in daily functioning and academic performance, parental stress, and poorer treatment outcomes (Storch et al., 2012). However, the developmental processes that may underlie this heterotypic-comorbidity are not well understood.

The present study, situated within the framework of developmental psychopathology (Matthys et al., 2013), examines prospective associations between early executive functions in preschool (age 3) and oppositional defiant problems (ODP) and obsessive-compulsive problems (OCP) in mid-childhood (age 7) via irritability (age 4) and parenting practices (age 6). Throughout, we use ODP/OCP to refer to CBCL DSM-oriented problem symptoms (study outcomes) and Oppositional Defiant Disorder /Obsessive-Compulsive Disorder only when discussing diagnostic literature. For a better understanding, the main concepts involved in the path

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from executive functions to ODP and ODP will be defined first.

Executive functions are top-down processes that support goal-directed behavior, with core components of inhibition, working memory, and flexibility that underlie higher-order skills such as planning (Diamond, 2013). This study focuses on inhibition and flexibility, central to regulating behavior and emotion during preschool. Inhibition is the capacity to pause and adjust actions or emotions to situational demands, while flexibility is the ability to switch between actions, responses, emotions, and behaviors (Gioia et al., 2000). When assessed in daily life via questionnaires, executive functions often reflect children's ability to regulate emotions and behavior in affectively salient contexts, also described as "hot" executive functions, in contrast to "cold" functions assessed in neutral testing situations (Zelazo, 2020). Irritability, defined as a pronounced tendency toward anger or annoyance compared to age peers, is a prominent feature of dysregulation (Brotman et al., 2017) and a key transdiagnostic indicator, associated with anxiety, mood disorders, and disruptive behaviors (Hobson et al., 2016; Stringaris et al., 2013). Parenting practices refer to caregivers' behaviors (e.g., positive, inconsistent, punitive) that shape a child's development and behavioral outcomes. Across theoretical and empirical models, these practices are strongly linked to development, and specific patterns are associated with psychopathology, including depression, anxiety, and behavioral problems. Given their impact on child outcomes, early assessment of parenting practices is important.

We propose that deficits in executive functions, mainly inhibition and flexibility, may lead to increased irritability, which, in turn, triggers maladaptive parental responses and reinforcement cycles contributing to the development of oppositional and compulsive problems. To our knowledge, this is the first study to examine these paths across both symptom dimensions beginning in preschool, despite their frequent co-occurrence and the transdiagnostic relevance of executive functions, irritability, and parenting. The research may facilitate more accurate assessments and inform targeted prevention and intervention strategies.

Executive function and irritability

Executive function plays a key role in developmental outcomes and is strongly correlated with internalizing and externalizing symptoms, neurodevelopmental disorders (Yang et al., 2022), school readiness (Cantin et al., 2016), academic achievement (Pascual et al., 2019), and quality of life (Diamond, 2013). The theoretical link between executive function and irritability can be understood through its role in emotion regulation. Executive function supports the

modulation of behavior and emotional responses through strategies such as cognitive reappraisal (e.g., inhibiting undesired appraisals of the emotion-eliciting event) (Toh et al., 2024). Similarly, executive function enables regulation of the frustration that may arise in reward-based contexts. When executive functions, particularly inhibition and flexibility, are weaker, children are less able to regulate their responses, leading to increased irritability (Kryza-Lacombe et al., 2022). Previous research has also associated alteration in reward processing with increased irritability in youth (Brotman et al., 2017). Given the role of executive function in helping (or, when impaired, compromising) children's ability to manage frustration and guide behaviors influencing irritability, this relationship may be particularly relevant for later behavioral outcomes such as Oppositional Defiant Disorder and Obsessive-Compulsive Behavior, where alterations in reward processing have also been observed (Matthys et al., 2013; McDonald et al., 2024).

Although measures of preschool irritability have been associated with internalizing and externalizing symptoms, the cognitive mechanisms linking executive function and irritability at an early age remain poorly understood. According to Kryza-Lacombe et al. (2022), executive function (cognitive flexibility and inhibitory control) modulates irritability during reward processing; greater executive function downregulates irritability, whereas deficits in executive function increase it. Additionally, prior neuroimaging research has identified common neural pathways involved in executive function processes and irritability. For example, cognitive flexibility and irritability were positively correlated at a neural level involving lateral prefrontal cortex activation in a preschooler cohort (Li et al., 2017). Similarly, higher levels of irritability were associated with prefrontal cortex activation during an inhibitory control task (Fishburn et al., 2019). Further, self-regulation abilities vary significantly among children, and we can predict clinical outcomes more accurately by understanding the interaction between inhibitory control and irritability (Nili et al., 2022).

Executive function and parenting

Prior research has shown that parenting shapes the development of children's executive functions (Hughes & Ensor, 2009); however, further research is required to determine how children's executive functions elicit distinct parenting practices (e.g., more punitive or inconsistent responses). Positive parenting (e.g., warmth, responsiveness, encouragement, consistency, autonomy support, and scaffolding) is associated with stronger executive function in children, supporting the development of inhibitory control, cognitive flexibility, and working memory (Bindman et al., 2015; Mileva-Seitz et al., 2015; Valcan et al., 2018). Conversely,

negative parenting (e.g., excessive control, punishment, intrusiveness) is linked to weaker executive function, especially reduced inhibitory control in school-aged children (Valcan et al., 2018).

However, poor parental quality, whether inconsistent or harsh, can also arise from the parent's frustration or sense of helplessness when dealing with a child's executive function challenges. For example, a child exhibiting flexibility challenges may consistently refuse to shift from play to more task-oriented activities. This, in turn, can trigger parental frustration and increase stress over time, leading to poorer parental quality. Blair et al. (2014) found, for example, that children's executive function at an early age can predict changes in the quality of parenting. Findings about associations between executive functions in early childhood and parenting can inform psychoeducation and parent-training by helping caregivers recognize how executive function impairments (e.g., in inhibition and flexibility) contribute to irritability, and by emphasizing scaffolding and consistency in responding to these executive function-linked challenges.

Irritability, oppositional defiant disorder and obsessive-compulsive disorder

Both children with Oppositional Defiant Disorder and children with Obsessive-Compulsive Disorder have difficulty regulating their emotions (Guzick et al., 2021; Jiang et al., 2016), and as previously described, cognitive flexibility and inhibition may play a key role in modulating irritability (Kryza-Lacombe et al., 2022). In Oppositional Defiant Disorder, angry/irritable mood (often loses temper, touchy or easily annoyed, often angry and resentful) is a fundamental symptom dimension that holds a prevailing position within the construct of the disorder (Burke et al., 2014). Furthermore, high levels of irritability in Oppositional Defiant Disorder identify a subset of children more likely to suffer adverse clinical outcomes, diminished daily functioning, comorbidities, and internalizing and externalizing behaviors Ezpeleta et al. (2016). Similarly, children with Obsessive-Compulsive Disorder may display high levels of irritability (rage, temper outbursts) if their routines are disrupted or they are unable to engage in compulsive behaviors or their obsessions interfere with datentionally bily activities (Krebs et al., 2013; Storch et al., 2012). Moreover, difficulties in emotion control were linked to Obsessive-Compulsive Disorder severity, family accommodation and likelihood of a comorbid diagnosis of Oppositional Defiant Disorder (McKenzie et al., 2020). Other authors have suggested that while irritability is not directly associated with the severity of Obsessive-Compulsive Disorder, its presence is nevertheless linked to increased family accommodation, depressive symptoms and defiance (Guzick et al., 2021). Despite

conflicting findings regarding the link between irritability and Obsessive-Compulsive Disorder severity, it is generally agreed that irritability contributes to a more severe clinical profile and emotional regulation deficits should be targeted during treatment (Guzick et al., 2021; McKenzie et al., 2020).

Irritability and parenting

The impact of parenting on irritability has been extensively studied, with substantial evidence highlighting the role of environmental and parenting factors, in addition to genetic factors, in the development and maintenance of irritability (Stringaris et al., 2012; Vidal-Ribas et al., 2016). A less studied relationship, particularly during key developmental stages such as transition to school, when parenting is critical in modulating behavior, is the potential effect of irritability on parenting. The fact that children with high levels of irritability may elicit less supportive or more negative parenting practices aligns with the theory of parenting determinants, which emphasizes that child characteristics, such as temperament, can influence parental responses (Belsky, 1984). For instance, Padilla et al. (2020) found that negative reactivity in children predicts lower-quality parenting practices (e.g., lower levels of warmth and responsiveness, reliance on punitive strategies). Given that irritability is a feature present in both Oppositional Defiant Disorder and Obsessive-Compulsive Disorder, it may be critical to better understand the impact of irritability on parenting. A less optimal response to high irritability may contribute to the escalation of behavioral problems over time or the persistence of obsessive-compulsive symptoms. One example of such parental response to increased irritability in children with Obsessive-Compulsive Disorder is family accommodation, which refers to behaviors parents engage in to alleviate their child's distress by helping or enabling compulsions or rituals (e.g., helping their child wash their hands multiple times) (Guzick et al., 2020). While the accommodation may temporarily ease their anxiety, it often reinforces the child's compulsive behavior over time. A similar mechanism may occur when parents give in to tantrums or emotional outbursts by engaging in more permissive or inconsistent parenting to prevent escalation, which in turn reinforces oppositional behaviors.

Parenting, oppositional defiant disorder and obsessive-compulsive disorder

Several factors, including genetic, biological, and environmental factors, are involved in the etiology of Oppositional Defiant Disorder and Obsessive-Compulsive Disorder. Among these factors, parenting practices have

been consistently associated with the development and maintenance of symptoms present in both disorders. In the case of Oppositional Defiant Disorder, punitive practices (Derella et al., 2020; Lin et al., 2019), parental hostility (Lavigne et al., 2016), poor monitoring and inconsistent parenting (Brown et al., 2017) have been associated with the disorder.

Regarding Obsessive-Compulsive Disorder, a meta-analysis findings suggest that an authoritative parenting style (e.g., clear guidelines and expectations, warmth, support) tends to be associated with better outcomes and lower levels of obsessive-compulsive symptoms (Goli et al., 2020). In contrast, authoritarian (e.g., rigidity, harshness), permissive, and neglectful parenting styles are associated with higher obsessive-compulsive symptoms (Goli et al., 2020). Overall, punitive parenting is associated with an increase in externalizing and internalizing behaviors in children (Zubizarreta et al., 2019).

Assessing executive function, irritability, parenting practices, and children's outcomes across various developmental stages strengthens our understanding of longitudinal changes. During preschool years, the rapid development of executive function skills and early caregiver relationships serve as foundational indicators of social and emotional development. Furthermore, the influence of irritability on parenting during earlier stages can contribute to behavioral outcomes commonly recognized around age 7, especially within school environments, when symptoms of psychopathology often become more apparent. Assessing parenting practices at age 6, when children begin formal schooling in Spain, is supported by research highlighting the role of parents in children's school transition, which has been linked to externalizing problems in both boys and girls (Hosokawa & Katsura, 2019). During this period, increased demands on self-regulation, combined with inappropriate parenting styles, may contribute to the emergence of these behavioral difficulties. Moreover, Obsessive-Compulsive Disorder is highly comorbid, with up to 80% of cases presenting at least one additional diagnosis, and comorbidity with Oppositional Defiant Disorder reaching up to 48% in some samples (Coskun et al., 2012). Deficits in executive functions and the presence of irritability have been associated with both disorders, and parenting is frequently addressed in intervention strategies targeting these conditions. However, these are diagnoses from distinct diagnostic families, and previous research has rarely examined them together. What remains unclear is what is unique to each developmental pathway and what common mechanisms may explain their co-occurrence.

Hence, the current study aims to examine prospective patterns of associations between executive functions (at age 3) and ODP and OCP (at age 7) through irritability (at age 4) and parenting practices (at age 6). We expected irritability to be a mediational variable between flexibility and ODP

and OCP and parenting practices to mediate the relationship between executive functions and ODP and OCP. The findings can expose underlying factors contributing to these behavioral symptoms and guide intervention strategies.

Method

Participants

The sample consisted of 622 participants drawn from a broader longitudinal project focusing on risk factors associated with problematic behaviors in preschoolers. The participants were selected in two phases. In the first phase, a sample of 2,283 families of 3-year-old preschoolers was randomly selected from 54 schools in the area of Barcelona. Out of these, 1,341 families agreed to participate and underwent screening for behavioral problems using four items (temper tantrums, disobedient, argumentative, spiteful) of the conduct problems scale from the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), and four additional items (annoys, blames, touchy, angry-resentful) to meet the Oppositional Defiant Disorder diagnostic symptoms according to the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV).

In the second phase, all children who scored ≥ 4 on the SDQ conduct problem scale or who had at least one score of 2 (*certainly true*) on any of the eight DSM-IV Oppositional Defiant Disorder symptoms were included in the screen positive sample ($n = 417$). In the case of children who did not meet the criteria, i.e., who screened negative, a random sample of 28% was retained ($n = 205$). Sample size was calculated using nQuery Advisor 7.0 to detect an odds ratio of 1.8 between psychopathology and risk factors, based on a 15% estimated prevalence, a 0.40 correlation, $\alpha = 0.05$, and 80% power. To ensure representativeness, both screening-positive and screening-negative participants were included, with the latter comprising approximately 28–30% of the sample. The sample size was further adjusted for an anticipated 50% attrition over 12 years. Therefore, the total sample was made up of 622 3-year-old children. For the present study we analysed early assessments at ages 3, 4 ($n = 600$), 6 ($n = 482$), and 7 ($n = 461$) years. The characteristics of the sample are illustrated in Table 1. No differences were found between the percentage of participants and non-participants in terms of sex ($p = .95$) or type of school ($p = .85$).

Measures

Executive functions were assessed by teachers at age 3 using The Behavior Rating Inventory of Executive Function – Preschool version (BRIEF-P; Gioia et al., 2000). The

Table 1 Description of the sample

		At age 3 ($N=622$)
Sex; %	Female	50.0
Socioeconomic status; %	High	32.8
	Medium-High/Medium	45.2
	Medium-low/Low	22.0
School type; %	Public	64.0
	Semi-Public	36.0
Ethnicity; %	Caucasian	89.1
	Hispanic (South America)	6.4
	Other	4.5
Prevalence of diagnosis; %	Oppositional Defiant Disorder	10.5
	Obsessive-Compulsive Disorder	1.4

instrument consists of a 63-item form on a 3-point Likert scale ranging from 0 to 2 (*never*, *sometimes*, *often*) and is used to measure dimensions of executive functioning considering the child's behavior observed in real-life context over the last 6 months. It comprises five first-order scales (Inhibit, Emotional Control, Shift, Working Memory, and Plan/Organize), three second-order scales (Inhibitory Self-Control Index, ISCI; Flexibility, FI and Emergent Meta-cognition Index, EMI), and a total score of all five scales (Global Executive Composite, GEC). The scales of interest for this study were ISCI (consisting of Inhibit and Emotional Control scales) and FI (consisting of Shift and Emotional Control). Internal consistency (ordinal alpha coefficient) of scale scores used in this sample were 0.96 for ISCI and 0.95 for FI.

Irritability, one of the constituent dimensions of Oppositional Defiant Disorder (e.g., Stringaris & Goodman, 2009) was assessed by parents at age 4. The irritability measure comprised three items, one already existing in the conduct problems scale of the SDQ ("loses temper"), and two others ("touchy-easily annoyed" and "angry and resentful") not included in the SDQ but added to the list of questions with the same format, i.e., a 3-point rating scale ranging from 0 (*not true*) to 2 (*certainly true*) to be able to obtain, together with others, Oppositional Defiant Disorder symptomatology scores (Ezpeleta et al., 2012). The ordinal alpha for this measure of Irritability was 0.75. in the sample.

Parenting practices were assessed at age 6 using the Spanish adaptation of the Alabama Parenting Questionnaire for preschoolers (APQ-Pr; de la Osa et al., 2014), a 3-factor version questionnaire consisting of 24 items rated on a 5-point format scale (1=*Never* to 5=*Always*). The parental dimensions measured were positive (12 items, e.g., *friendly talk with your child*, *praise your child if he/she behaves well*), inconsistent (7 items, e.g., *threaten to punish your child and then do not punish*, *the punishment you give your child depends on the mood*) and punitive (5 items, e.g., *spank your child with hand when something wrong*, *yell/scream at your child when something wrong*). Internal consistency (ordinal alpha coefficient) of scale scores for positive parenting, inconsistent parenting, and punitive parenting were 0.85, 0.72, and 0.73, respectively, in this sample.

Families' socioeconomic status was measured using Hollingshead's Four Factor Index of Social Status (Hollingshead, 1975), which combines parents' occupation (9-point scale) and education (7-point scale). Scores are weighted and summed to classify families into five social classes, ranging from high to low SES; high-SES families had greater participation than low-status ones ($p<.001$). Preliminary analyses comparing means for the variables to be included in the SEM model among Hollingshead's five SES levels revealed no significant differences among groups, therefore, SES was not included as a covariate.

ODP and OCP were rated by parents with the Child Behavior Checklist/6–18 (CBCL; Achenbach & Rescorla, 2001) when the children were 7 years old. The CBCL consists of 113 items rated on a 3-point Likert scale ranging from 0 (*not true)* to 2 (*very/often true*). To assess ODP, we focused on the oppositional defiant problems DSM IV-oriented scale, containing 6 items (*argues*, *defiant*, *disobey home*, *disobey school*, *stubborn* and *temper*). Internal consistency (ordinal alpha coefficient) of the ODP scale score in the present sample was 0.85. As for the OCP, this was measured by the 2007 obsessive-compulsive problem scale (2007-OCP) of the CBCL/6–18 containing 8 items (*mind off*, *fear do bad*, *perfect*, *guilty*, *repeats acts*, *strange behavior*, *strange ideas*, and *worries*) (Achenbach & Rescorla, 2007). The internal consistency (ordinal alpha coefficient) of the OCP scale score in the sample was 0.80.

Lastly, the SDQ-hyperactivity/inattention scale score, reported by parents when children were 3 years old, was included as a covariate. By doing so, we ensured that any observed relationships between executive functions and ODP and OCP were not confounded by symptoms of hyperactivity or inattention, which are commonly present in preschoolers with these behavioral problems. The scale consists of five items rated on a 3-point scale (0=*not true*, 1=*somewhat true*, 2=*certainly true*). Internal consistency (ordinal alpha coefficient) of scale score in the presented sample was 0.78.

Procedure

The study was approved by the Ethics Commission of Animal and Human Experimentation of the authors' institution. Families of 3-year-old children were recruited at the schools and their written consent was obtained. SDQ was administered to all families of 3-year-old children in the screening

phase. Participants who met screening criteria were invited to follow-ups and on-site assessments on a yearly basis and the assessments of ages 3, 4, 6 and 7 years-old were used for this study. Families' permission was sought before teachers responded to the questionnaires.

Statistical analysis

The statistical analyses were performed with Mplus8.9. Due to the multistage sampling, all analyses were weighted based on the inverse probability of selection in the second phase. Initially, a correlation matrix (Table 2) was obtained, which provided insight into the extent of association among the measures. Structural Equation Modeling (SEM) using the robust maximum-likelihood (MLR) method of estimation was used to determine the pathways from ISCI and FI to ODP and OCP, via irritability and positive, punitive, and inconsistent parenting practices, adjusted by hyperactivity. This method is robust to non-normality and estimates missing data using the FIML approach (Enders & Bandalos, 2001; Graham, 2009). The following indices were used to evaluate the goodness of fit: χ^2 test ($p>.05$), Root Mean Square Error of Approximation (RMSEA<0.06), Comparative Fit Index (CFI>0.90), Tucker-Lewis Index (TLI>0.90), and Standardized Root Mean Squared Residual (SMSR<0.08).

Results

We found an excellent fit for the model we tested with values for $\chi^2=0.942$ df=2 ($p=.624$), RMSEA=0.000 (90% CI=0.000–0.064.000.064), CFI=1.000, TLI=1.000, and SRMR=0.008. Figure 1 shows direct effects and Table 3 provides detailed information of indirect effects (standardized parameters in both cases).

Regarding ODP, the effect from ISCI to ODP was direct ($\beta=0.138$; $p=.032$) and it was also mediated by punitive parenting ($\beta=0.035$; $p=.049$): higher ISCI difficulties were associated directly with higher ODP, and with higher punitive parenting and this in turn was associated with higher ODP. The effect from FI to ODP was not direct; it was mediated by irritability ($\beta=0.067$; $p=.001$) and by both irritability and punitive parenting ($\beta=0.011$; $p=.014$). Higher FI was associated with higher irritability, and this in turn with higher ODP. Also, higher punitive parenting, in addition to higher irritability, was associated with higher ODP.

In relation to OCP, the effect from ISCI was only direct: higher ISCI difficulties were associated with lower OCP ($\beta=-0.130$; $p=.022$). In addition, the effect from FI to OCP was both direct ($\beta=0.155$; $p=.008$) and it was also mediated by irritability ($\beta=0.056$; $p=.003$). Similar to ODP, higher

Table 2 Means, standard deviations and bivariate pearson's correlations

Measure (minimum-maximum scale score)	N	M	SD	1	2	3	4	5	6	7	8	9
1. ISCI (BRIEF-P Teacher) at age 3 (0–52)	619	35.20	9.28	1								
2. FI (BRIEF-P Teacher) at age 3 (0–40)	617	25.28	6.21	0.66***	1							
3. Irritability (SDQ Parent) at age 4 (0–6)	600	1.39	1.21	0.12**	0.19***	1						
4. Punitive (APQ-Pr Parent) at age 6 (0–15)	482	3.38	1.93	0.10*	0.02	0.18***	1					
5. Inconsistent (APQ-Pr Parent) at age 6 (0–21)	482	6.81	3.28	−0.02	−0.01	0.13**	0.32***	1				
6. Positive (APQ-Pr Parent) at age 6 (0–60)	482	40.97	4.07	0.08	0.13**	0.00	−0.20***	−0.24***	1			
7. ODP (CBCL Parent) at age 7 (0–12)	461	1.94	1.97	0.18***	0.11*	0.35***	0.35***	0.24***	−0.07	1		
8. OCP (CBCL Parent) at age 7 (0–16)	461	0.84	1.28	−0.01	0.09*	0.27***	0.09	0.17***	−0.12*	0.31***	1	
9. Hyperactivity/Inattention (SDQ Parent) at age 3 (0–10)	621	3.91	2.48	0.26***	0.01	0.11**	0.13**	0.03	−0.01	0.18***	0.03	1

In bold: significant correlations; * $p<.05$, ** $p<.01$, *** $p<.001$

BRIEF-P behavior rating inventory for executive function − preschool version, *ISCI* inhibitory self-control index, *FI* flexibility index, *SDQ* strengths and difficulties questionnaire, *APQ-Pr* alabama parenting questionnaire for preschoolers, *OCP* obsessive-compulsive problems, *CBCL* child behavior checklist, *ODP* oppositional defiant problems
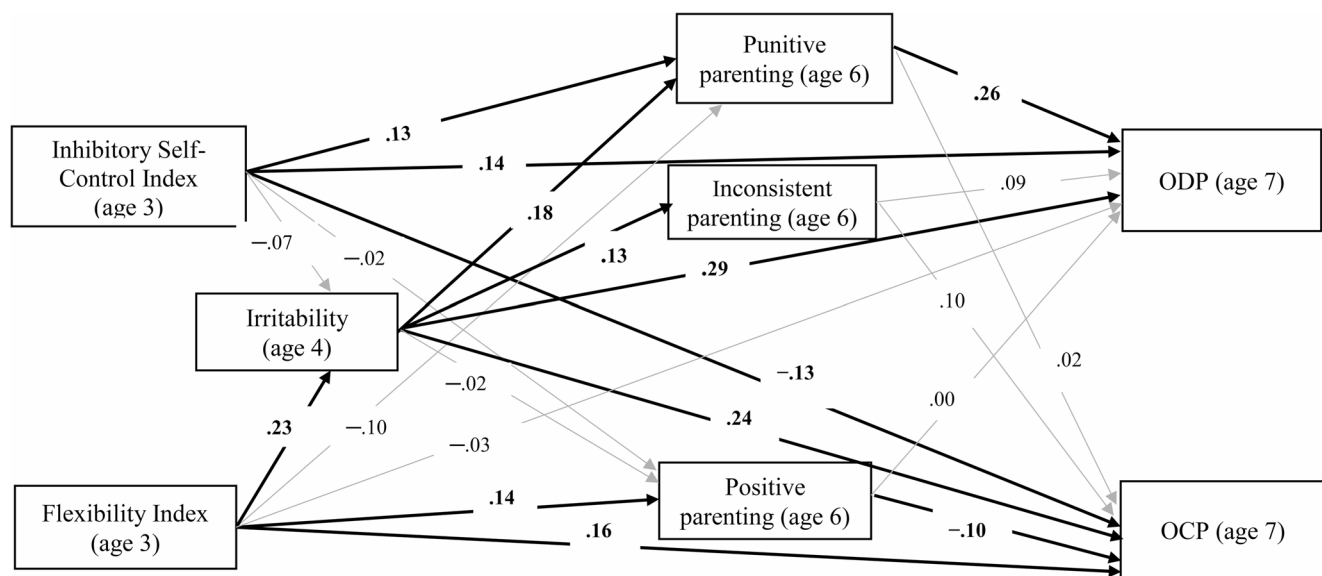
Fig. 1 Hypothesized model and paths involved in statistically significant direct effects for ODP and OCP controlling for hyperactivity/inattention. *Note.* In bold: statistically significant direct effects; in gray: non-significant direct effects; covariances among concurrent measures and adjustment by hyperactivity/inattention are not shown; ODP = Oppositional Defiant Problems; OCP = Obsessive Compulsive Problems

Table 3 Standardized indirect effects from ISCI and FI to ODP and OCP

X-variable	Y-variable	Mediator	Standardized parameter	*p*-value
ISCI_3	ODP_7	SDQ_Irritability_4	−0.020	0.271
ISCI_3	ODP_7	APQ-Pr_Positive_6	0.000	0.988
ISCI_3	ODP_7	APQ-Pr_ Punitive_6	**0.035**	**0.049**
ISCI_3	ODP_7	APQ-Pr_Positive_6; SDQ_Irritability_4	0.000	0.989
ISCI_3	ODP_7	APQ-Pr_ Inconsistent_6; SDQ_Irritability_4	−0.001	0.363
ISCI_3	ODP_7	APQ-Pr_ Punitive_6; SDQ_Irritability_4	−0.003	0.273
FI_3	ODP_7	SDQ_Irritability_4	**0.067**	**0.001**
FI_3	ODP_7	APQ-Pr_Positive_6	0.000	0.989
FI_3	ODP_7	APQ-Pr_ Punitive_6	−0.025	0.147
FI_3	ODP_7	APQ-Pr_Positive_6; SDQ_Irritability_4	0.000	0.989
FI_3	ODP_7	APQ-Pr_ Inconsistent_6; SDQ_Irritability_4	0.003	0.168
FI_3	ODP_7	APQ-Pr_ Punitive_6; SDQ_Irritability_4	**0.011**	**0.014**
ISCI_3	OCP_7	SDQ_Irritability_4	−0.017	0.280
ISCI_3	OCP_7	APQ-Pr_Positive_6	0.002	0.829
ISCI_3	OCP_7	APQ-Pr_ Punitive_6	0.002	0.788
ISCI_3	OCP_7	APQ-Pr_Positive_6; SDQ_Irritability_4	0.000	0.649
ISCI_3	OCP_7	APQ-Pr_ Inconsistent_6; SDQ_Irritability_4	−0.001	0.345
ISCI_3	OCP_7	APQ-Pr_ Punitive_6; SDQ_Irritability_4	0.000	0.792
FI_3	OCP_7	SDQ_Irritability_4	**0.056**	**0.003**
FI_3	OCP_7	APQ-Pr_Positive_6	−0.014	0.123
FI_3	OCP_7	APQ-Pr_ Punitive_6	−0.001	0.785
FI_3	OCP_7	APQ-Pr_Positive_6; SDQ_Irritability_4	0.000	0.641
FI_3	OCP_7	APQ-Pr_ Inconsistent_6; SDQ_Irritability_4	0.003	0.140
FI_3	OCP_7	APQ-Pr_ Punitive_6; SDQ_Irritability_4	0.001	0.786

In bold: statistically significant effects

ISCI inhibitory self-control index, *FI* flexibility index, *APQ-Pr* alabama parenting questionnaire-preschool, *CBCL* child behavior checklist, *SDQ* strengths and difficulties questionnaire, *OCP* obsessive compulsive problems, *ODP* oppositional defiant problems

The number at the end of each measure corresponds to the age at which it was assessed

FI was associated with higher irritability and this in turn was associated with higher OCP. In addition, the following associations emerged: higher FI was associated with higher positive parenting, and this was associated with lower OCP, but the indirect effect was not significant (p =.122).

Discussion

The study aimed to investigate the prospective associations between executive functions (ISCI and FI) and ODP and OCP through irritability and positive, punitive, and inconsistent parenting practices. We found (a) a direct and an indirect effect via punitive parenting from ISCI to ODP, (b) an indirect effect from FI to ODP via irritability and also serially via both irritability and punitive parenting, (c) a direct effect from ISCI to OCP, and (d) a direct and a mediated effect via irritability from FI to OCP. The paths to each problem revealed both similarities and differences. Specifically, the underlying mechanisms for executive functions in ODP and OCP are different: they differ in associated executive functions (ISCI or FI), the direction of the relationship of ISCI (positive with ODP and negative with OCP), and the direct or indirect effect. However, a common path from flexibility through irritability to both problems emerged.

On the one hand, ISCI deficits appear more closely associated with ODP, as reflected in a higher effect size. Previous studies linked ISCI components, inhibition and emotional control, with the headstrong and anger-irritability symptom dimensions of Oppositional Defiant Disorder (Ezpeleta et al., 2012; Griffith et al., 2019). Specifically, inhibition deficits were associated with the headstrong dimension, while deficits in emotional control were linked to irritability (Ezpeleta et al., 2012). Our findings suggest that difficulties in the development of ISCI may play a central role in ODP, even after controlling for hyperactivity/inattention scores.

On the other hand, FI deficits were more OCP-specific, as reflected by the direct effect. This aligns with prior research suggesting cognitive flexibility deficits in children with Obsessive-Compulsive Disorder (McNamara et al., 2014; Ornstein et al., 2010). As the FI index includes Emotional Control plus Shifting, results may suggest that emotion regulation and executive function are intertwined, and that children with OCP may struggle more in everyday, emotionally charged contexts (hot executive functions). Further studies may examine how executive function and obsessive-compulsive symptoms interact across environments (home, school) and/or when emotion and motivation are salient.

Similar to ODP, ISCI showed a significant association with OCP, albeit not in the same direction. Our findings align with those of Pietrefesa and Evans (2007), who revealed age-related variability in how difficulties in

inhibition relate to compulsive behaviors: negative in children over 7, but positive in younger children. A recent meta-analysis also found a significant relationship between age and the extent of response inhibition deficits in adults with Obsessive-Compulsive Disorder, with older patients presenting more deficits than younger ones (Mar et al., 2021). Moreover, considering the heterogeneity of Obsessive-Compulsive Disorder, individuals with this condition may exhibit a diverse range of cognitive patterns depending on their symptoms' sub-type and severity. Additional longitudinal studies are needed to clarify how inhibition interacts with obsessive-compulsive symptoms subtypes across age groups. However, the fact that ISCI showed a direct effect on OCP, while the bivariate correlation between them was almost null but with the same sign, may suggest a suppression situation, probably due to negative confounding of FI. This issue, alongside the potential moderating role of irritability and/or parenting style, warrants further exploration.

The common path to ODP and to OCP is from flexibility through irritability. This commonality may help explain their co-occurrence. Flexibility and irritability relate to lateral orbitofrontal activation (Li et al., 2017); a region involved in the neurobiology of Obsessive-Compulsive Disorder (Evans et al., 2004) and in rewards and punishment processing leading to impaired decision-making in disruptive behavior (Matthys et al., 2013). Based on a recent meta-analysis, decision-making deficits have been consistently found in Obsessive-Compulsive Disorder adults' samples (Nisticò et al., 2021), but few studies address this in young children. To better understand their shared mechanisms, future research may consider motivational factors and decision-making in the interaction between flexibility, irritability, and Oppositional Defiant Disorder and Obsessive-Compulsive Disorder. Our findings align with previous work linking irritability to defiant behavior in Obsessive-Compulsive Disorder youth (Guzick et al., 2021). Also, deficits in shift, emotional control and FI index have been previously associated with the anger-irritability dimension in ODP (Ezpeleta et al., 2012). Considering the mediated relationship between FI and ODP through irritability (but also via both irritability and punitive parenting) and the fact that children with oppositional problems are particularly sensitive to negative emotions (Jiang et al., 2016), it can be concurred that emotional factors (anger-irritability) and environmental factors (punitive parenting) may contribute to the escalation and persistence of negative emotional experiences in these children. Consequently, these factors may hinder their ability to properly shift their attention and manage their behavior effectively.

Parenting practices mediated in the pathway from executive function to ODP but not to OCP. Specifically, punitive parenting, is well established as reinforcing defiance and

negative emotional outcomes (Derella et al., 2020) and a treatment target in Oppositional Defiant Disorder (Costin & Chambers, 2007). Our results of ISCI associated with higher punitive practices from parents and, in turn, with higher ODP align with evidence linking harsh discipline to externalizing behaviors and poor inhibition in young children (Valcan et al., 2018; Zubizarreta et al., 2019), potentially via coercive escalation cycles between child and parental responses. This dynamic may affect the child's inhibitory capabilities over time, potentially reinforcing defiance and oppositional behaviors. However, parenting practices were not significant in the path to OCP, despite evidence that family involvement in rituals and related burden play a key role (Guzick et al., 2020). It may be that the levels of OCP in this general population sample were too modest to affect parenting practices. Subsequent studies may explore other parenting practices and use measures of family accommodation in clinical samples to better understand this relationship. For example, permissive and highly accommodating parenting may have a higher effect on reinforcing compulsive behaviors and contribute to the co-occurrence of Obsessive-Compulsive Disorder and Oppositional Defiant Disorder. This is illustrated by Ale and Krackow (2011), who in a concurrent treatment case study showed that aggressive behavior and non-compliance/defiance in Obsessive-Compulsive Disorder emerged from permissive and inconsistent parenting, leading to a presentation consistent with Oppositional Defiant Disorder. Our findings also reflect a positive association between irritability and inconsistent parenting.

The study has some notable strengths, including a relatively large sample size of preschool children, prospective assessment over time and the developmental period under investigation. Furthermore, it addresses an area that seems to have received limited attention in developmental psychopathology research, highlighting a potential link between flexibility and ODP and OCP, with irritability acting as an intermediate variable.

The study has some limitations, including relying solely on parent ratings for OCP, ODP, irritability and parenting practices, and teacher ratings only for executive functions. Moreover, the exclusive use of BRIEF measure may not capture a broader range of cognitive processes and regulatory abilities. Future research may focus on incorporating multi-informant assessments and additional measures of executive functioning that may provide a more comprehensive understanding of these relationships. Also, the measure of OCP, although using a widely recognized, valid, and reliable scale score of the CBCL for obsessive-compulsive issues within the measurement of general psychopathology (Achenbach & Rescorla, 2007), does not constitute an assessment of the disorder but a set of symptoms proved to be associated with the diagnosis of Obsessive-Compulsive Disorder with good

sensitivity and specificity (Nelson et al., 2001). Finally, a limitation is that we were only able to use a cross-sectional design, as repeated measures for all variables across follow-ups were not available. A longitudinal design with repeated measures across all time points would be advisable to examine causal effects, as encouraged by Maxwell et al. (2011).

Conclusion

Irritability and parenting are significant transdiagnostic factors whose interplay influences developmental trajectories and psychopathology, and their role in treatment and intervention is essential. In pediatric Obsessive-Compulsive Disorder, exposure and response prevention therapy has been shown to significantly improve irritability (Guzick et al., 2021). As a result, the improvement in irritability in children with Obsessive-Compulsive Disorder could potentially lower the likelihood of concurrent manifestation of externalizing behaviors. Similarly, children with Oppositional Defiant Disorder can benefit from approaches that involve modification of parental practices and interventions aimed at developing emotional awareness and regulation, particularly helping them handle negative emotions in healthier ways. A multimodal approach to intervention consisting of emotional regulation strategies and parenting training may be considered in Oppositional Defiant Disorder and Obsessive-Compulsive Disorder. Future research may test whether early interventions targeting flexibility can reduce ODP and OCP symptoms by decreasing irritability. It would also be valuable to explore whether the mediating role of irritability varies according to different aspects, such as the developmental stage. Ultimately, extending this work into neurobiological research could help clarify the mechanisms underlying this shared pathway, thereby supporting a more comprehensive and integrated understanding of early psychopathology, both developmentally and neurobiologically.

Data availability Data cannot be made publicly available due to ethical restrictions protecting the confidentiality of the families involved.

Declarations

Consent to participate Written informed consent was obtained from the parents, which included allowing teachers to answer questions about their child, before completing the questionnaires.

Consent to publish Parents had consented for publication of research results on the basis of anonymized and aggregated data

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

References

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA School-Age Forms & Profiles*. University of Vermont, Research Center for Children, Youth, & Families.

Achenbach, T. M., & Rescorla, L. A. (2007). *Multicultural supplement to the Manual for the ASEBA school-age forms & profiles*. University of Vermont, Research Center for Children, Youth & Families.

Ale, C. M., & Krackow, E. (2011). Concurrent treatment of early childhood OCD and ODD: A case illustration. *Clinical Case Studies*, *10*(4), 312–323. https://doi.org/10.1177/1534650111420283

Belsky, J. (1984). The determinants of parenting: A process model. *Child Development*, *55*(1), 83–96. https://doi.org/10.2307/1129836

Bindman, S. W., Pomerantz, E. M., & Roisman, G. I. (2015). Supplemental material for do children's executive functions account for associations between early autonomy-supportive parenting and achievement through high school? *Journal of Educational Psychology, 107*(3), 756–770. https://doi.org/10.1037/edu0000017.supp

Blair, C., Raver, C. C., & Berry, D. J. (2014). Two approaches to estimating the effect of parenting on the development of executive function in early childhood. *Developmental Psychology*, *50*(2), 554–565. https://doi.org/10.1037/a0033647

Brotman, M. A., Kircanski, K., Stringaris, A., Pine, D. S., & Leibenluft, E. (2017). Irritability in youths: A translational model. *American Journal of Psychiatry*, *174*(6), 520–532. https://doi.org/10.1176/appi.ajp.2016.16070839

Brown, C. A., Granero, R., & Ezpeleta, L. (2017). The reciprocal influence of Callous-Unemotional Traits, oppositional defiant disorder and parenting practices in preschoolers. *Child Psychiatry & Human Development*, *48*(2), 298–307. https://doi.org/10.1007/s10578-016-0641-8

Burke, J. D., Boylan, K., Rowe, R., Duku, E., Stepp, S. D., Hipwell, A. E., & Waldman, I. D. (2014). Identifying the irritability dimension of odd: Application of a modified bifactor model across five large community samples of children. *Journal of Abnormal Psychology*, *123*(4), 841–851. https://doi.org/10.1037/a0037898

Cantin, R. H., Gnaedinger, E. K., Gallaway, K. C., Hesson-McInnis, M. S., & Hund, A. M. (2016). Executive functioning predicts reading, mathematics, and theory of Mind during the elementary years. *Journal of Experimental Child Psychology*, *146*, 66–78. https://doi.org/10.1016/j.jecp.2016.01.014

Coskun, M., Zoroglu, S., & Ozturk, M. (2012). Phenomenology, psychiatric comorbidity and family history in referred preschool children with obsessive-compulsive disorder. *Child and Adolescent Psychiatry and Mental Health*. https://doi.org/10.1186/1753-2000-6-36

Costin, J., & Chambers, S. M. (2007). Parent management training as a treatment for children with oppositional defiant disorder referred to a mental health clinic. *Clinical Child Psychology and Psychiatry*, *12*(4), 511–524. https://doi.org/10.1177/1359104507080979

de la Osa, N., Granero, R., Penelo, E., Domènech, J. M., & Ezpeleta, L. (2014). Psychometric properties of the Alabama parenting Questionnaire-Preschool revision (APQ-Pr) in 3 Year-Old Spanish preschoolers. *Journal of Child and Family Studies*, *23*(5), 776–784. https://doi.org/10.1007/s10826-013-9730-5

Derella, O. J., Burke, J. D., Stepp, S. D., & Hipwell, A. E. (2020). Reciprocity in undesirable parent – child behavior? Verbal aggression, corporal punishment, and girls' oppositional de fi ant symptoms. *Journal of Clinical Child & Adolescent Psychology, 49*(3), 420–433.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information màximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling, 8*(3), 430–457. https://doi.org/10.1207/S15328007SEM0803_5

Evans, D. W., Lewis, M. D., & Iobst, E. (2004). The role of the orbitofrontal cortex in normally developing compulsive-like behaviors and obsessive-compulsive disorder. *Brain and Cognition*, *55*(1), 220–234. https://doi.org/10.1016/S0278-2626(03)00274-4

Ezpeleta, L., Granero, R., De La Osa, N., Penelo, E., & Domènech, J. M. (2012). Dimensions of oppositional defiant disorder in 3-year-old preschoolers. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *53*(11), 1128–1138. https://doi.org/10.1111/j.1469-7610.2012.02545.x

Ezpeleta, L., Granero, R., de la Osa, N., Trepat, E., & Domènech, J. M. (2016). Trajectories of oppositional defiant disorder irritability symptoms in preschool children. *Journal of Abnormal Child Psychology*, *44*(1), 115–128. https://doi.org/10.1007/s10802-015-9972-3

Fakhri, L. S., & Yuzbashi, M. (2020). Comparison of the severity of obsession and working memory in children with obsessive compulsive disorder and healthy. 8(82), 12275–12284. https://doi.org/10.22038/ijp.2020.50337.4006

Fishburn, F. A., Hlutkowsky, C. O., Bemis, L. M., Huppert, T. J., Wakschlag, L. S., & Perlman, S. B. (2019). Irritability uniquely predicts prefrontal cortex activation during preschool inhibitory control among all temperament domains: A LASSO approach. *NeuroImage, 184*, 68–77. https://doi.org/10.1016/j.neuroimage.2018.09.023

Gioia, G. A., Isquith, P. K., Guy, S. C., Kenworthy, L., & Baron, I. S. (2000). Behavior rating inventory of executive function. *Child Neuropsychology*, *6*(3), 235–238. https://doi.org/10.1076/chin.6.3.235.3152

Goli, E., Abdekhodaie, M. S., Mashhadi, A., & Bigdeli, I. (2020). The role of parent-child interaction patterns in the development of obsessive-compulsive disorder: A literature review study. *Journal of Fundamentals of Mental Health*, *22*(1), 5–20. https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=143206805&site=ehost-live.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 38*(5), 581–586. https://doi.org/10.1111/j.1469-7610.1997.tb01545.x

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549–576. https://doi.org/10.1146/annurev.psych.58.110405.085530

Griffith, S. F., Arnold, D. H., Rolon-Arroyo, B., & Harvey, E. A. (2019). Neuropsychological predictors of ODD symptom dimensions in young children. *Journal of Clinical Child and Adolescent Psychology*, *48*(1), 80–92. https://doi.org/10.1080/15374416.2016.1266643

Guzick, A. G., Geller, D. A., Small, B. J., Murphy, T. K., Wilhelm, S., & Storch, E. A. (2020). Irritability in children and adolescents

with OCD. *Behavior Therapy*. https://doi.org/10.1016/j.beth.2020.11.001

Guzick, A. G., Geller, D. A., Small, B. J., Murphy, T. K., Wilhelm, S., & Storch, E. A. (2021). Irritability in children and adolescents with OCD. *Behavior Therapy*, *52*(4), 883–896. https://doi.org/10.1016/j.beth.2020.11.001

Hobson, C. W., Scott, S., & Rubia, K. (2016). Investigation of cool and hot executive function in ODD/CD independently of ADHD. *Journal of Abnormal Child Psychology, 44*(1), 539–551. https://doi.org/10.1111/j.1469-7610.2011.02454.x

Hollingshead, A. B. (1975). *Four-factor index of social status.* Yale University.

Hosokawa, R., & Katsura, T. (2019). Role of parenting style in children's behavioral problems through the transition from preschool to elementary school according to gender in Japan. *International Journal of Environmental Research and Public Health*, *16*(1). https://doi.org/10.3390/ijerph16010021

Hughes, C. H., & Ensor, R. A. (2009). How do families help or hinder the emergence of early executive function? *New Directions for Child and Adolescent Development, 2009*(123), 35–50. https://doi.org/10.1002/cd.234

Jiang, W., Li, Y., Du, Y., & Fan, J. (2016). Emotional regulation and executive function deficits in unmedicated Chinese children with oppositional defiant disorder. *Psychiatry Investigation*, *13*(3), 277–287. https://doi.org/10.4306/pi.2016.13.3.277

Krebs, G., Bolhuis, K., Heyman, I., Mataix-Cols, D., Turner, C., & Stringaris, A. (2013). Temper outbursts in paediatric obsessive-compulsive disorder and their association with depressed mood and treatment outcome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *54*(3), 313–322. https://doi.org/10.1111/j.1469-7610.2012.02605.x

Kryza-Lacombe, M., Palumbo, D., Wakschlag, L. S., Dougherty, L. R., & Wiggins, J. L. (2022). Executive functioning moderates neural mechanisms of irritability during reward processing in youth. *Psychiatry Research - Neuroimaging*, *323*(March), 111483. https://doi.org/10.1016/j.pscychresns.2022.111483

Lavigne, J. V., Gouze, K. R., Hopkins, J., & Bryant, F. B. (2016). A multidomain cascade model of early childhood risk factors associated with oppositional defiant disorder symptoms in a community sample of 6-year-olds. *Development and Psychopathology, 28*, 1547–1562. https://doi.org/10.1017/S0954579415001194

Li, Y., Grabell, A. S., Wakschlag, L. S., Huppert, T. J., & Perlman, S. B. (2017). The neural substrates of cognitive flexibility are related to individual differences in preschool irritability: A fNIRS investigation. *Developmental Cognitive Neuroscience*, *25*, 138–144. https://doi.org/10.1016/j.dcn.2016.07.002

Lin, X., Li, Y., Xu, S., Ding, W., Zhou, Q., Du, H., & Chi, P. (2019). Family risk factors associated with oppositional defiant disorder symptoms, depressive symptoms, and aggressive behaviors among Chinese children with oppositional defiant disorder. *Frontiers in Psychology*, *10*(SEP), 1–12. https://doi.org/10.3389/fpsyg.2019.02062

Mar, K., Townes, P., Pechlivanoglou, P., Arnold, P., & Schachar, R. (2021). Obsessive compulsive disorder and response inhibition: Meta-analysis of the Stop-Signal task. *Journal of Abnormal Psychology*. https://doi.org/10.1037/abn0000732

Matthys, W., Vanderschuren, L. J. M. J., & Schutter, D. J. L. G. (2013). The neurobiology of oppositional defiant disorder and conduct disorder: Altered functioning in three mental domains. *Development and Psychopathology*, *25*(1), 193–207. https://doi.org/10.1017/S0954579412000272

Maxwell, S. E., Cole, D. A., & Mitchell, M. A. (2011). Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. *Multivariate Behavioral Research*, *46*(5), 816–841. https://doi.org/10.1080/00273171.2011.606716

McDonald, M., Kohls, G., Henke, N., et al. (2024). Altered neural anticipation of reward and loss but not receipt in adolescents with obsessive-compulsive disorder. *BMC Psychiatry, 24*, 362. https://doi.org/10.1186/s12888-024-05808-x

McKenzie, M. L., Donovan, C. L., Zimmer-Gembeck, M. J., Waters, A. M., Mathieu, S. L., & Farrell, L. J. (2020). Examining parent-report of children's emotion regulation in paediatric OCD: Associations with symptom severity, externalising behaviour and family accommodation. *Journal of Obsessive-Compulsive and Related Disorders, 25*, Article 100508. https://doi.org/10.1016/j.jocrd.2020.100508

McNamara, J. P. H., Reid, A. M., Balkhi, A. M., Bussing, R., Storch, E. A., Murphy, T. K., Graziano, P. A., Guzick, A. G., & Geffken, G. R. (2014). Self-regulation and other executive functions relationship to pediatric OCD severity and treatment outcome. *Journal of Psychopathology and Behavioral Assessment*, *36*(3), 432–442. https://doi.org/10.1007/s10862-014-9408-3

Mileva-Seitz, V. R., Ghassabian, A., Bakermans-Kranenburg, M. J., van den Brink, J. D., Linting, M., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., Tiemeier, H., & van IJzendoorn, M. H. (2015). Are boys more sensitive to sensitivity? Parenting and executive function in preschoolers. *Journal of Experimental Child Psychology*, *130*, 193–208. https://doi.org/10.1016/j.jecp.2014.08.008

Nelson, E. C., Hanna, G. L., Hudziak, J. J., Botteron, K. N., Heath, A. C., & Todd, R. D. (2001). Obsessive-compulsive scale of the child behavior checklist: specificity, sensitivity, and predictive power. *Pediatrics, 108*(1), E14. https://doi.org/10.1542/peds.108.1.e14

Nili, A. N., Krogh-Jespersen, S., Perlman, S. B., Estabrook, R., Petit-clerc, A., Briggs-Gowan, M. J., Sherlock, P. R., Norton, E. S., & Wakschlag, L. S. (2022). Joint consideration of inhibitory control and irritability in young children: Contributions to emergent psychopathology. *Research on Child and Adolescent Psychopathology*, *50*(11), 1415–1427. https://doi.org/10.1007/s10802-022-00945-x

Nisticò, V., De Angelis, A., Erro, R., Demartini, B., & Ricciardi, L. (2021). Obsessive-compulsive disorder and decision making under ambiguity: A systematic review with meta-analysis. *Brain Sciences, 11*(2), 1–23. https://doi.org/10.3390/brainsci11020143

Ornstein, T. J., Arnold, P., Manassis, K., Mendlowitz, S., & Schachar, R. (2010). Neuropsychological performance in childhood OCD: A preliminary study. *Depression and Anxiety*, *27*(4), 372–380. https://doi.org/10.1002/da.20638

Padilla, C. M., Hines, C. T., & Ryan, R. M. (2020). Infant temperament, parenting and behavior problems: Variation by parental education and income. *Journal of Applied Developmental Psychology, 70*, Article 101179. https://doi.org/10.1016/j.appdev.2020.101179

Pascual, A. C., Moyano, N., & Robres, A. Q. (2019). The relationship between executive functions and academic performance in primary education: Review and meta-analysis. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2019.01582. 10(JULY).

Pietrefesa, A. S., & Evans, D. W. (2007). Affective and neuropsychological correlates of children's rituals and compulsive-like behaviors: Continuities and discontinuities with obsessive-compulsive disorder. *Brain and Cognition*, *65*(1), 36–46. https://doi.org/10.1016/j.bandc.2006.02.007

Storch, E. A., Jones, A. M., Lack, C. W., Ale, C. M., Sulkowski, M. L., Lewin, A. B., De Nadai, A. S., & Murphy, T. K. (2012). Rage attacks in pediatric obsessive-compulsive disorder: Phenomenology and clinical correlates. *Journal of the American Academy of Child and Adolescent Psychiatry*, *51*(6), 582–592. https://doi.org/10.1016/j.jaac.2012.02.016

Stringaris, A., & Goodman, R. (2009). Three dimensions of oppositionality in youth. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *50*(3), 216–223. https://doi.org/10.1111/j.1469-7610.2008.01989.x

Stringaris, A., Zavos, H., Leibenluft, E., Maughan, B., & Eley, T. (2012). Adolescent irritability: Phenotypic associations and genetic links with depressed mood. *American Journal of Epidemiology*, *169*(1), 47–54. https://doi.org/10.1176/appi.ajp.2011.10101549

Stringaris, A., Maughan, B., Copeland, W. S., Costello, E. J., & Angold, A. (2013). Irritable mood as a symptom of depression in youth: Prevalence, developmental, and clinical correlates in the great smoky mountains study. *Journal of the American Academy of Child and Adolescent Psychiatry*, *52*(8), 831–840. https://doi.org/10.1016/j.jaac.2013.05.017

Toh, W. X., Keh, J. S., Gross, J. J., & Carstensen, L. L. (2024). The role of executive function in cognitive reappraisal: A meta-analytic review. *Emotion, 24*(7), 1563–1581. https://doi.org/10.1037/emo0001373

Valcan, D. S., Davis, H., & Pino-Pasternak, D. (2018). Parental behaviours predicting early childhood executive functions: A meta-analysis. *Educational Psychology Review, 30*(3), 607–649. https://doi.org/10.1007/s10648-017-9411-9

Vidal-Ribas, P., Brotman, M. A., Valdivieso, I., Leibenluft, E., & Stringaris, A. (2016). The status of irritability in psychiatry: A conceptual and quantitative review. *Journal of the American Academy of Child and Adolescent Psychiatry*, *55*(7), 556–570. https://doi.org/10.1016/j.jaac.2016.04.014

Yang, Y., Shields, G. S., Zhang, Y., Wu, H., Chen, H., & Romer, A. L. (2022). Child executive function and future externalizing and internalizing problems: A meta-analysis of prospective longitudinal studies. *Clinical Psychology Review*, *97*(November 2021), 102194. https://doi.org/10.1016/j.cpr.2022.102194

Zelazo, P. D. (2020). Executive function and psychopathology: A neurodevelopmental perspective. *Annual Review of Clinical Psychology*, *16*, 431–454. https://doi.org/10.1146/annurev-clinpsy-072319-024242

Zubizarreta, A., Calvete, E., & Hankin, B. L. (2019). Punitive parenting style and psychological problems in childhood: The moderating role of warmth and temperament. *Journal of Child and Family Studies*, *28*(1), 233–244. https://doi.org/10.1007/s10826-018-1258-2