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Article

Executive Function Impairments in Children with Neurofibromatosis Type 1 (NF1): A Review and Intervention Perspectives

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Abstract

Antecedents: From a functional perspective, executive functions—such as self-regulation and meta-cognition—emerge as key dimensions affected transversally across various neurodevelopmental disorders. **Aim:** The aim of this study is to analyze and compare executive functioning profiles in children with various neurodevelopmental disorders, as reported by parents and teachers. It is hypothesized that children with neurodevelopmental disorders exhibit executive function deficits, as measured by the BRIEF-P, in comparison to typically developing children. **Methodology:** Non-experimental methodology, ex post facto design, descriptive, cross-sectional evolution study. **Participants:** The normative sample is composed of 1.979 participants with typical (normotypical) development and 205 participants belonging to a clinical sample. **Measurement:** The instrumental development of EFs was evaluated using BRIEF-P by key informants. **Results:** The highest F-values were observed in: (i) Working Memory: (a) Parents: [F = 195.76, $p < .001$]; (b) Teachers: [F = 199.63, $p < .001$]; (ii) Emergent Metacognition Index: (a) Parents: [F = 176.15, $p < .001$], (b) Teachers: [F = 187.87, $p < .001$]; (iii) Executive Function Global: (a) Parents: [F = 168.07, $p < .001$], (b) Teachers: [F = 207.47, $p < .001$]. **Conclusions:** This study provides a clear framework for identifying dysexecutive syndrome. Executive functioning is one of the most important abilities, and its disruption can lead to dysexecutive syndrome.

Keywords: BRIEF; dysexecutive syndrome; executive function; neurodevelopmental disorders

1. Introduction

Traditionally, the approach to neurodevelopmental disorders has been shaped by a categorical logic: specific diagnoses (such as ADHD, ASD, dyslexia, etc.) that define clinical groups based on distinct diagnostic criteria (see DSM-5R) (Hynd et al., 1991) (Tannock, 2013) (Wilson & Bishop, 2022). However, this approach presents significant limitations, and alternative models have been proposed (Moreno-Llanos et al., 2024). One of them is that it tends to label individuals in ways that do not always accurately reflect their functional profile or their actual intervention needs (DeYoung et al., 2024) (Ousley & Cermak, 2014) (Poletti et al., 2017) (Snyder et al., 2023).

From a functional perspective, executive functions—such as self-regulation and metacognition—emerge as key dimensions affected transversally across various neurodevelopmental disorders (Ceruti et al., 2024) (Pennington & Ozonoff, 1996). Understanding these skills beyond diagnostic labels allows for more personalized and effective interventions (Margari et al., 2016).

Dysexecutive syndrome or Executive dysfunction is a set of impairments in executive functions, which include processes like planning, inhibiting impulses, maintaining information, and adapting to change (Jones & Graff-Radford, 2021) (Rabinovici et al., 2015) (Stuss & Alexander, 2000). This syndrome is not exclusive to a single disorder but appears in various neurodevelopmental conditions such as ADHD, ASD, learning, language, and coordination disorders. Although these disorders

differ, they share difficulties in executive functions, which often form the core of their symptoms (Ossenkoppele et al., 2015) (Roussel et al., 2017) (Tang et al., 2020).

Alterations in key executive functions are directly related to the development of self-regulation in childhood (Ben-Asher et al., 2023) (Dörrenbächer-Ulrich & Bregulla, 2024)

1.1. What is Self-Regulated Learning?

The concept of self-regulated learning is based on the premise that students should take responsibility for their own learning and play an active role in the learning process (Zimmerman, 2000) (Zimmerman, 2002). This is a cyclical process in which students divide learning into three phases: the forethought phase, the performance phase, and the self-reflection phase. These phases are cyclical because self-regulated students use feedback from previously learned behaviors and attempt to make adjustments in future behaviors.

As demonstrated by the review by (Boekaerts & Cascallar, 2006) (Dinsmore et al., 2008), self-regulation is conceptualized as a set of three domains of psychological functioning: cognition, metacognition, and motivation.

(Schraw et al., 2006) believe that the role of metacognition is the most important “because it allows individuals to monitor their current levels of knowledge and skills, plan and allocate limited learning resources with maximum efficiency, and evaluate their own learning resources. ‘The current state of learning’” (p. 116). A meta-analysis of 61 studies conducted by (Dent & Koenka, 2016) showed that measures of metacognitive processes were comparable to measures of cognitive strategy use and were more closely related to performance. They argued that this means that “deciding when to use different cognitive strategies may be more important than how often students implement those strategies” (p. 459).

To address this question, we draw on the work of (Bausela, 2021), who highlights that the development of self-regulatory processes plays a crucial role in metacognitive development. These processes are responsible for controlling situations and continuously adjusting thoughts and behavior in response to internal and external demands.

(Kopp, 1982) proposed three phases in the development of self-regulation: Unconscious Control, Self-Regulation. This phase differs quantitatively, but not qualitatively, from self-control. Both require the ability to mentally represent an object using symbols. However, self-regulation is more flexible, adaptable to change, allows for greater delay of gratification, and seems to involve reflection and strategies that include introspection, awareness, or metacognition. It is during this phase that metacognitive strategies—known as executive or self-regulation processes—begin to emerge.

Piaget (1974) citado por (Barrouillet, 2015) also proposed a theory of self-regulation, viewing it as a mechanism that allows individuals to maintain balance in response to external influences.

From Vygotsky’s perspective (1962) citado por (Yaden & Martinez, 2023), self-regulation begins with behavioral regulation and evolves through a series of stages. Verbal regulation becomes fully developed and internalized, as the child transitions from using egocentric speech to internal speech—just as Vygotsky predicted.

This developmental journey reflects how external guidance gradually becomes internal control, shaping not just behavior, but also how children think, plan, and evaluate their actions. It’s a beautiful example of how language, thought, and action converge in the growth of autonomy.

In the field of self-regulated learning and metacognition, several questions remain unanswered. One important issue is the extent to which development occurs progressively. (Veenman et al., 2006) state that metacognition steadily increases during the school years, alongside the development of intellectual abilities. However, some researchers argue that these advances do not follow a clear linear progression. Various studies suggest that most forms of metacognition observed in early stages evolve into more complex forms over time (Pappas et al., 2003). According to (Kuhn, 2000), the growth of metacognition does not follow a stage-based pattern but rather involves a shift from using a smaller to a larger number of metacognitive processes and strategies over time.

Another question that has been difficult to answer regarding the development of metacognitive skills is whether this development is primarily quantitative (children do more of the same) or qualitative (children develop different and more advanced skills). Bryce and (Whitebread & O'Sullivan, 2012) designed an observational method to study 66 English children aged 5 to 7 as they completed a problem-solving task involving the construction of a train track.

The findings showed that older children exhibited greater monitoring and control, with differences in the methods used compared to the younger children, who tended to review the execution of their plans rather than the plans themselves. There were also discrepancies in planning approaches, with younger children showing more explicit planning, while older children demonstrated more internalized preparatory behaviors.

From a functional perspective, executive functions—such as self-regulation and metacognition—emerge as key dimensions that are transversally affected across various neurodevelopmental disorders (Zelazo, 2020) as well as in typically developing populations (Wu & Was, 2023).

1.2. What is Metacognition?

Like self-regulation, metacognition is conceptualized as consisting of distinct components. A common distinction among these components is between metacognitive knowledge and metacognitive skills (Veenman et al., 2006). Metacognitive knowledge refers to a learner's understanding of how they learn or how they interact most effectively with specific tasks, while skills refer to the ability to regulate these activities. Both are crucial and interact with each other. The effective use of metacognitive skills involves applying metacognitive knowledge, including students' ability to assess their progress on cognitive tasks and their capacity to use strategies that systematically regulate that progress (Kristen & Zabrocky, 2017).

(Schraw et al., 2006) refer to the two main components as knowledge of cognition and regulation of cognition. Knowledge of cognition includes three subcomponents: (i) Declarative knowledge: knowledge about oneself as a learner and about factors that influence performance. (ii) Procedural knowledge: knowledge about strategies and procedures such as reviewing, interleaving, organizational strategies, and elaborative strategies like creating analogies and identifying main ideas (Dent & Koenka, 2016). (iii) Conditional knowledge: understanding when and why to use a particular strategy.

Regulation of cognition includes three main (Reeck et al., 2016): (a) Planning involves setting goals, activating relevant prior knowledge, selecting appropriate strategies, and allocating resources. (b) Monitoring includes self-assessment activities needed to track learning. (c) Evaluation refers to judging both learning outcomes and the regulatory processes used during learning.

Research supporting training in executive function (EF) skills is extensive. Empirical evidence has demonstrated the benefits of teaching metacognitive learning strategies linked to executive function, some of which we present below:

(Howard & Vasseleu, 2020) found that self-regulation and executive function can predict advanced learning starting from preschool.

(Meltzer, 2014) stated: "While the end product of learning is important, it is clear that students do not retain all the content taught from one year to the next. Therefore, it is even more important to teach students executive function skills that will carry over from elementary school to middle school, to high school, and to college" (pp. 186–187).

In the U.S. Department of Education publication *Executive Function: Implications for Education* (2017), (Zelazo, 2015) (Zelazo et al., 2005) asserted: "Children who enter school with well-practiced executive function skills may learn more easily, and this can spark a positive cascade of indirect effects, such as enjoying school and being motivated to work hard. Conversely, poor executive function skills may interfere with children's (and others) learning and can lead to behavior problems, suspension, expulsion, or grade repetition" (p. 19). They also noted: "Research shows that [executive function] can be improved with relatively brief interventions that allow opportunities to practice at

increasing levels of challenge” (p. 38). They also found that executive function training is helpful in cases of academic disabilities, predictions for math and reading comprehension, differentiated instruction, interventions, and individual progress monitoring.

A longitudinal study titled *Deficits in Executive Functions in Kindergarten Predict Repeated Academic Difficulties Throughout Elementary School* by (Morgan et al., 2019) followed 11,000 kindergarten students through third grade. A key finding was that children who exhibited executive function difficulties in kindergarten—regardless of race, socioeconomic status, or academic ability—continued to face academic challenges in later years (Morgan et al., 2019).

(Diamond & Lee, 2011) found that executive function training not only improved school readiness but also positively impacted academic success in students aged 4 to 12. Executive function skills also continue to predict aptitude in reading and math throughout students’ school and life experiences.

(Durlak et al., 2011) conducted a meta-analysis of 213 studies involving over 270,000 students that addressed social-emotional learning and its impact on academic performance. Of the 213 studies, 120 were conducted at the elementary level. The study found that students who received training in social-emotional skills showed an 11% increase in academic performance, appropriate behavior, and the ability to manage stress.

All students should learn executive function skills such as goal setting, planning, time management, and self-regulation. (Cases et al., 1995) found that the development of Self-Regulated Strategy Development (SRSD) strategies is effective for the success of students with learning disabilities in writing (Chen et al., 2021) (Graham & Harris, 2018) This strategy teaches students to follow a process involving goal setting and learning how to apply learning strategies through self-monitoring, self-instruction, and self-regulation. The teacher provides independent practice across various tasks and contexts to foster generalization and maintenance.

Multiple elements of executive function can contribute to low performance in mathematical problem-solving. Current research identifies three specific domains most clearly associated with poor performance: attention, working memory, and cognitive flexibility (Pritchard et al., 2016).

Studies (Follmer & Sperling, 2016) confirm and extend prior research by showing that executive functions—mediated by metacognition—are central predictors of self-regulated learning. They highlight how these cognitive processes are linked and discuss their contribution to learning regulation.

1.3. What Is the Connection Between Executive Function, Metacognition and Self-Regulation?

Executive function and metacognition are cognitive processes that develop throughout childhood and are crucial for learning (Cristofori et al., 2019). Although often studied separately, this review explores their similarities and differences and proposes a unifying framework of cognitive self-regulation to better understand their joint development (Roebers, 2017).

To effectively teach executive function skills, it is essential to consider the important relationship between executive function, metacognition, and self-regulation (Dörrenbächer & Bregulla, 2024). In many cases, strategies are deemed ineffective in helping students learn because this critical connection is not taken into account during strategy instruction.

Through this connection, students can use metacognition to manage their executive function skills—visualizing their goals, developing a plan that includes strategies for completing tasks, monitoring their progress, and evaluating their achievements. Self-control skills help students adjust and appropriately adapt to their environment while engaging in activities. Promoting student success depends on the interaction between these three components: executive functioning, metacognition, and self-regulation.

Some classroom-based examples we can apply come from (Sharpe & Strosnider, 2022) and (Strosnider & Sharpe, 2019): (i) Supporting self-assessment through the use of checklists; (ii) Encouraging students to predict the outcome of a situation; (iii) Modeling self-talk skills by verbalizing thoughts and problem-solving strategies aloud; (iv) Providing prompts to help students

identify and recognize their own strengths and weaknesses; (v) Asking students to explain how to succeed in one of their favorite video games or board games; (vi) Using video game time as an opportunity to help students reflect on their strategic thinking.

1.4. Aim and Research Hypotheses

We rely on the study by (Sadozai et al., 2024), who - based on transdiagnostic models of neurodevelopment - highlights the importance of understanding delays in executive function from a developmental perspective. This can improve the design of early and personalized interventions for all children with neurodevelopmental conditions, regardless of their specific diagnosis (Mareva et al., 2024).

The aim of this study is to analyze and compare executive functioning profiles in children with various neurodevelopmental disorders, as reported by parents and teachers.

It is hypothesized that children with neurodevelopmental disorders exhibit executive function deficits, as measured by the BRIEF-P, in comparison to typically developing children. Additionally, it is hypothesized that perceptions of executive functioning vary depending on the informant (parent vs. teacher).

2. Materials and Methods

We set out to create a non-experimental, ex post facto design, descriptive, cross-sectional development study.

2.1. Design

The study procedure is based on a non-experimental methodology, with an ex post facto and descriptive design, in which the executive profile obtained through the BRIEF-P (adapted (Gioia, et al., 2016)), is analyzed in a typically developing population in comparison with a sample of children with neurodevelopmental disorders (clinical sample). A cross-sectional study was conducted, in which participants – the typically developing sample versus the clinical sample – were evaluated by key informants, specifically parents and teachers.

The instrument used to assess executive functions was the BRIEF-P (adapted (Gioia, et al., 2016)), which provides information on self-regulation and other cognitive functions in children within an educational context. The sample includes children aged between 2 and 5 years, with a balanced distribution of gender and age, ensuring representation of both stages of early child development.

The study compares the results obtained from children with typical development to those with various neurodevelopmental disorders (clinical sample). This approach offers a clear view of developmental differences in children's executive functions and may enhance the design of early and personalized interventions for all children with neurodevelopmental conditions, regardless of their specific diagnosis.

2.2. Participants

The normative sample is composed of 1.979 participants with typical (normotypical) development and 205 participants belonging to a clinical sample, all of whom took part in the adaptation and validation process of the BRIEF-P (adapted (Gioia, et al., 2016)).

The inclusion criteria were: willingness to participate in the study, being between 2 and 6 years of age, and showing no signs or indications of any neurodevelopmental disorder and/or disability.

In this study, participants were assessed by different informants: 54.21% by parents and 45.78% by teachers.

It should be noted that these are not paired samples, but independent samples. In this study, the evaluators were not matched; instead, an independent groups design was chosen due to participant availability.

Regarding how parents and teachers assess the development of executive functions, there is no agreement between them, with these differences being more evident in the older age groups. Nevertheless, the data allow us to affirm that both parents and teachers are reliable sources for identifying symptoms of executive dysfunctions (Meuwissen & Carlson, 2015) (Ortiz Luna & Aclé Tomasini, 2006).

Information related to other demographic data is published (Bausela-Herreras & Luque-Cuenca, 2017) and (Bausela, 2024).

The clinical sample includes children with various neurodevelopmental disorders, primarily ADHD and ASD, since, according to the literature, these conditions are commonly associated with diverse executive function deficits, as reviewed in several studies (Zelazo, 2020).

Students were grouped according to typical versus clinical development. Table 1 shows the distribution of participants by type of sample and informants.

Table 1. Distribution of participants according to the type of sample and informant (own elaboration).

Sample	Informant		Subtotal
	Parents	Teachers	
Clinical	107	98	205
Normotypical	1077	902	1979
Subtotal	1184	1000	2184

Source: BRIEF-P (Spanish adaptation).

Table 2 shows the distribution of participants according to age groups, informant and sample.

Table 2. Distribution of participants according to age groups, informant and sample (own elaboration).

Informant	Sample	Age (years)				Subtotal
		2	3	4	5	
Parents	Clinical	10	26	32	39	107
	Normotypical	156	262	339	320	1077
	Subtotal	166	288	371	359	1184
Teachers	Clinical	9	24	32	33	98
	Normotypical	118	208	295	281	902
	Subtotal	127	232	327	314	1000

Source: BRIEF-P (Spanish adaptation).

Table 3 shows the distribution of participants according to sex, informant and sample.

Table 3. Distribution of participants according to sex, informant and sample (own elaboration).

Informant	Sample	Sex		Subtotal
		Man	Woman	
Parents	Clinical	82	25	107
	Normotypical	567	510	1077
	Subtotal	649	535	1184
Teachers	Clinical	74	24	98
	Normotypical	475	427	902
	Subtotal	549	451	1000

Source: BRIEF-P (Spanish adaptation).

2.3. Measurement

Executive function assessment with BRIEF-P is an instrument that was recently validated in Spain by (Bausela & Luque, 2017) with the aim of evaluating its development through the observation

of key informants (teachers or other habitual caregivers of the child) (hetero research, self-investigation).

BRIEF-P was completed by parents, legal guardians, and teachers of children with ages from 2 years to 5 years and 11 months who have had knowledge of the child for a minimum period of 6 months.

It has been used with populations exhibiting various executive dysfunctions (such as Attention Deficit with and without Hyperactivity, Autism Spectrum Disorder, brain injury, and Tourette syndrome, among others).

The study was carried out using individual and collective applications.

Its administration takes approximately 10–15 minutes.

Responses are given using a three-point Likert-type frequency scale: never, sometimes, and often.

The psychometric properties can be consulted in (Bausela & Luque, 2017), where the relevant aspects related to reliability, validity, and other essential characteristics of the instrument used are detailed.

The BRIEF-P consists of 63 items organized into five clinical scales, three indices, a Global Executive Composite and two validity scales (Negativity and Inconsistency).

The BRIEF-P provides scores on various indices (global index of executive function, inhibitory self-control index, flexibility index, emergent metacognition index) and scales related to EFs (inhibition, flexibility, emotional control, working memory, planning and organisation). The Table 4 presents the clinical scales and indices that make up the BRIEF-P (Gioia, et al., 2016).

Table 4. BRIEF-P adapted from (Gioia, et al., 2016): Clinical Scales and Indices (description and examples) (own elaboration).

Clinical Scales	Description	Examples
Inhibition	Assesses problems with controlling impulses and behavior, and difficulties stopping or appropriately regulating actions in specific moments or contexts.	During activities, the child is easily distracted from their goal.
Flexibility	Assesses difficulties in voluntarily shifting between situations and solving problems in a flexible manner.	Has trouble switching from one activity or to another.
Emotional Control	Evaluates problems with adequately regulating or modulating emotional responses according to situational demands.	Becomes upset very easily.
Working Memory	Assesses difficulties in holding information in mind to complete a task or provide an appropriate response.	Has trouble remembering things even after a short period of time.
Planning and Organization	Assesses problems with anticipating future events or consequences.	Has trouble finding their belongings in their room or play area, even when given specific directions.

Indices	Description
Inhibitory Control Index	Self- Sum of raw scores from the Inhibition and Emotional Control scales.
Flexibility Index	Sum of raw scores from the Flexibility and Emotional Control scales.
Emergent Metacognition Index	Sum of raw scores from the Working Memory and Planning and Organization scales.

Source: BRIEF-P (Spanish adaptation).

2.4. Procedure

The procedure for applying the BRIEF-P by parents and teachers involves four key stages to ensure the validity and proper implementation of the test. First, collaborators must familiarise themselves with the norms, thoroughly reading them to understand the guidelines, securely storing materials, and explaining the evaluation objectives and data handling to informants. Second, participants are randomly selected from a normal sample without prior diagnoses, as are informants, including parents or teachers familiar with the child's behaviour. Third, differentiated booklets are used—one for parents and another for teachers/caregivers—and informants must complete their respective booklets while maintaining confidentiality and returning them appropriately. Finally, data are entered into the scoring program at www.teacorriges.com, generating a graphical profile, intended as a general guide rather than a clinical diagnosis.

The study was conducted between 2013 and 2016 in co-authorship with Luque and the author of the present work, as part of the Spanish validation process of the (Bausela & Luque, 2017) (Gioia, et al., 2016).

2.5. Research Variables

In order to analyse the executive functioning profiles of the participants, a set of variables was defined for the study.

The independent variables include both the type of sample (normotypical development vs. clinical) and the type of informant (parents, legal guardians, and teachers). These variables are expected to influence the way executive function behaviours are reported.

The dependent variable is executive functioning, operationalized through the clinical scales and indices provided by the BRIEF-P (Gioia, et al., 2016), which offer a comprehensive assessment of key components such as inhibition, flexibility, emotional control, working memory, and planning/organization.

2.6. Analysis of Data

The data were submitted to descriptive and inferential analyses (bivariate and multivariate). ANOVA was used to calculate the differences in the BRIEF-P scales and clinical indices between the two groups according to sample type (normotypical development sample vs. clinical sample). The analyses were conducted using the SPSS software, version 29.0.2.0..

3. Results

The descriptive data (see Table 5) show that the clinical population exhibits greater difficulties across all dimensions assessed by the BRIEF-P, both in the home and school environments. The largest discrepancies are observed in indices that integrate multiple executive domains, such as the Emergent Metacognition Index and the Global Executive Composite, reflecting more complex and widespread impairments in self-regulation and everyday executive functioning.

Table 5. Descriptive Statistics of Participants on BRIEF-P Clinical Scales and Indices by Informant and Sample Type (own elaboration).

Clinical Scales and Indices	Sample	Informant					
		Parents			Teachers		
		Mean	Standard Deviation	Standard Error	Mean	Standard Deviation	Standard Error
Inhibition	Clinical	30.74	7.25	0.70	30.48	8.21	0.83
	Normotypical	23.92	5.71	0.17	21.91	6.25	0.21
	Subtotal	24.54	6.18	0.18	22.75	6.95	0.22
Flexibility	Clinical	15.15	4.08	0.39	15.66	5.24	0.53
	Normotypical	13.48	3.20	0.10	12.7	3.16	0.11
	Subtotal	13.63	3.32	0.10	12.99	3.53	0.11
Emotional Control	Clinical	17.23	4.21	0.41	16.33	5.31	0.54
	Normotypical	14.48	3.62	0.11	13.14	3.73	0.12
	Subtotal	14.73	3.76	0.11	13.45	4.03	0.13
Working Memory	Clinical	31.51	7.70	0.75	32.45	8.92	0.90
	Normotypical	23.35	5.53	0.17	22.47	6.35	0.21
	Subtotal	24.09	6.21	0.18	23.45	7.27	0.23
Planning and Organization	Clinical	17.96	4.36	0.42	17.89	5.47	0.55
	Normotypical	14.38	3.33	0.10	13.14	3.53	0.12
	Subtotal	14.71	3.58	0.10	13.61	4.02	0.13
Inhibitory Control Index	Clinical	47.97	10.26	0.99	46.81	12.35	1.25
	Normotypical	38.4	8.57	0.26	35.04	9.181	0.31
	Subtotal	39.27	9.16	0.27	36.2	10.15	0.32
Flexibility Index	Clinical	32.38	6.96	0.67	31.99	9.55	0.97
	Normotypical	27.96	5.76	0.18	25.83	5.93	0.20
	Subtotal	28.36	6.01	0.18	26.44	6.63	0.21
Emergent Metacognition Index	Clinical	49.48	11.51	1.11	50.34	13.92	1.41

	Normotypical	37.73	8.41	0.26	35.61	9.60	0.32
	Subtotal	38.79	9.36	0.27	37.06	11.00	0.35
Executive Function Global	Clinical	11.26	21.61	2.09	112.81	25.88	2.61
	Normotypical	89.61	17.03	0.52	83.35	18.37	0.61
	Subtotal	91.69	18.69	0.54	86.24	21.12	0.67

Source: BRIEF-P (Spanish adaptation). Sample: (i) Clinical: (a) Parents= 107, (b) Teachers= 98. (ii) Normotypical: (a) Parents= 1077, (b) Teachers= 902

The analysis of variance (ANOVA) (see Table 6) robustly confirms the differences previously observed in the descriptive data. Statistically significant differences ($p < .001$) were found between the clinical and normotypical populations across all BRIEF-P clinical scales and indices, as reported by both parents and teachers.

The highest F-values were observed in:

(i) Working Memory: (a) Parents: [F = 195.76, $p < .001$]; (b) Teachers: [F = 199.63, $p < .001$].

(ii) Emergent Metacognition Index: (a) Parents: [F = 176.15, $p < .001$], (b) Teachers: [F = 187.87, $p < .001$].

(iii) Executive Function Global: (a) Parents: [F = 168.07, $p < .001$], (b) Teachers: [F = 207.47, $p < .001$].

These three variables reflect core components of executive functioning and are particularly sensitive to detecting difficulties in the clinical population (Miyake et al., 2000).

Similarly, variables such as Inhibition, Planning and Organization and composite indices like the Inhibitory Self-Control Index also show highly significant differences ($F > 100$ in all cases), indicating consistent impairments in self-regulation and planning.

All differences were statistically significant ($p < .001$), confirming a disrupted executive functioning profile in the clinical population that is consistent across both evaluation contexts (home and school).

Table 6. ANOVA of Participants on BRIEF-P Clinical Scales and Indices by Informant and Sample Type (own elaboration).

ANOVA	Parents		Teachers	
	F	Sig.	F	Sig.
Inhibition	131.486	<.001***	155.526	<.001***
Flexibility	25.189	<.001***	66.499	<.001***
Emotional Control	54.718	<.001***	58.764	<.001***
Working Memory	195.763	<.001***	199.632	<.001***
Planning and Organization	106.074	<.001***	140.485	<.001***
Inhibitory Self-Control Index	116.747	<.001***	134.53	<.001***
Flexibility Index	55.178	<.001***	82.615	<.001***
Emergent Metacognition Index	176.146	<.001***	187.869	<.001***
Executive Function Global	168.072	<.001***	207.474	<.001***

Source: BRIEF-P (Spanish adaptation). Sample: (i) Clinical: (a) Parents= 107, (b) Teachers= 98. (ii) Normotypical: (a) Parents= 1077, (b) Teachers= 902. *** $p < .001$ (highly significant)

The results reflect small to moderate effect sizes (see Table 7), depending on the clinical scale analyzed. In general:

(i) Teachers tend to report larger effect sizes than parents, especially in global executive functions and metacognition.

(ii) The highest estimates are observed in Working Memory, Emergent Metacognition, and Global Executive Function, suggesting that these dimensions better capture the differences between groups or conditions analyzed.

(iii) Scales with lower effect sizes (such as Flexibility) may indicate that group differences are less pronounced in that domain.

(iv) The most affected executive functions (by group, intervention, or condition) are working memory, emergent metacognition, and global executive functioning.

(v) Teachers tend to detect stronger effects than parents in most dimensions, which may reflect greater observational sensitivity in structured school contexts.

(vi) Although some scales, such as Flexibility or Emotional Control, show lower effect sizes, they are not null, which still adds value to their analysis.

Table 7. Effect Sizes from ANOVA on BRIEF-P Clinical Scales and Indices by Informant and Sample Type (own elaboration).

Clinical Scales and Indices	Effect Sizes from ANOVA	Parents			Teachers		
		Point Estimate	95% Confidence Interval		Point Estimate	95% Confidence Interval	
			Lower	Upper		Lower	Upper
Inhibition	Eta squared	0.1	0.07	0.133	0.135	0.098	0.174
	Epsilon squared	0.099	0.069	0.132	0.134	0.097	0.173
	Fixed-effect omega squared	0.099	0.069	0.132	0.134	0.097	0.173
	Random-effect omega squared	0.099	0.069	0.132	0.134	0.097	0.173
Flexibility	Eta squared	0.021	0.008	0.04	0.062	0.037	0.093
	Epsilon squared	0.02	0.007	0.039	0.062	0.036	0.092
	Fixed-effect omega squared	0.02	0.007	0.039	0.061	0.036	0.092
	Random-effect omega squared	0.02	0.007	0.039	0.061	0.036	0.092
Emotional Control	Eta squared	0.044	0.024	0.069	0.056	0.031	0.085
	Epsilon squared	0.043	0.023	0.068	0.055	0.03	0.084
	Fixed-effect omega squared	0.043	0.023	0.068	0.055	0.03	0.084
	Random-effect omega squared	0.043	0.023	0.068	0.055	0.03	0.084
Working Memory	Eta squared	0.142	0.108	0.178	0.167	0.127	0.208
	Epsilon squared	0.141	0.107	0.178	0.166	0.126	0.207
	Fixed-effect omega squared	0.141	0.107	0.177	0.166	0.126	0.207
	Random-effect omega squared	0.141	0.107	0.177	0.166	0.126	0.207
Planning and Organization	Eta squared	0.082	0.055	0.113	0.123	0.088	0.161
	Epsilon squared	0.082	0.054	0.113	0.123	0.087	0.161
	Fixed-effect omega squared	0.082	0.054	0.112	0.122	0.087	0.161
	Random-effect omega squared	0.082	0.054	0.112	0.122	0.087	0.161
Inhibitory Control Index	Eta squared	0.09	0.061	0.122	0.119	0.084	0.156
	Epsilon squared	0.089	0.061	0.121	0.118	0.083	0.156

Flexibility Index	Fixed-effect omega squared	0.089	0.06	0.121	0.118	0.083	0.156
	Eta squared	0.045	0.024	0.07	0.076	0.048	0.109
	Epsilon squared	0.044	0.024	0.069	0.076	0.047	0.109
	Fixed-effect omega squared	0.044	0.024	0.069	0.075	0.047	0.108
Emergent Metacognition Index	Random-effect omega squared	0.044	0.024	0.069	0.075	0.047	0.108
	Eta squared	0.13	0.096	0.165	0.158	0.12	0.199
	Epsilon squared	0.129	0.096	0.164	0.158	0.119	0.198
	Fixed-effect omega squared	0.129	0.096	0.164	0.157	0.119	0.198
Executive Function Global	Random-effect omega squared	0.129	0.096	0.164	0.157	0.119	0.198
	Eta squared	0.124	0.092	0.16	0.172	0.132	0.213
	Epsilon squared	0.124	0.091	0.159	0.171	0.131	0.212
	Fixed-effect omega squared	0.124	0.091	0.159	0.171	0.131	0.212
	Random-effect omega squared	0.124	0.091	0.159	0.171	0.131	0.212

Source: BRIEF-P (Spanish adaptation). Sample: (i) Clinical: (a) Parents= 107, (b) Teachers= 98 . (ii) Normotypical: (a) Parents= 1077, (b) Teachers= 902 . For more information, see the supplementary materials.

4. Discussion

The objectives of the study were to analyze and compare executive functioning profiles in children with various neurodevelopmental disorders, based on reports provided by parents and teachers. This approach is grounded in the work of (Sadozai et al., 2024), who, from transdiagnostic models of neurodevelopment, emphasize the importance of understanding delays in executive function from a developmental perspective. Such understanding is essential for designing early and personalized interventions that address the needs of all children with neurodevelopmental conditions, regardless of their specific diagnosis. Two main hypotheses were proposed: (i) That children with neurodevelopmental disorders exhibit executive function deficits, as measured by the BRIEF-P, in comparison to typically developing peers; (ii) That perceptions of executive functioning differ depending on the informant, that is, between parents and teachers.

The inclusion of a clinical sample—comprising children with various neurodevelopmental disorders, primarily ADHD and ASD—along with a typically developing comparison group allowed us to explore whether, in the early stages of development, executive functions operate as a unified construct or, on the contrary, whether the specific dimensions that make up executive functioning are already differentiated and follow distinct developmental trajectories. This comparison provides a more comprehensive understanding of how executive functions evolve in both typical and atypical development, in line with previous literature findings (Cordova et al., 2020) (Johnson, 2012)

It is hypothesized that children with neurodevelopmental disorders exhibit executive function deficits, as measured by the BRIEF-P, in comparison to typically developing children. Additionally, it is hypothesized that perceptions of executive functioning vary depending on the informant (parent vs. teacher).

The results obtained are in line with the results obtained by (Zelazo, 2020). The hypothesis has been confirmed: children with neurodevelopmental disorders exhibit executive function deficits, as measured by the BRIEF-P (Gioia, et al., 2016), in comparison to typically developing children. These findings reinforce previous evidence indicating impairments in executive processes such as inhibition, working memory, planning, and self-regulation within this clinical population (Bausela et al., 2023) (Bausela, 2024) (Demetriou et al., 2018).

In relation to the informant, we can state in general terms that parents and teachers are reliable sources for assessing development of EFs in early childhood education. However, in agreement with other authors, there are differences and similarities in their perception of the development of EFs (Bausela, 2024). These results may indicate that, when the teachers are the informants, they are more sensitive to development compared to the parents (Lunkenheimer et al., 2019) (Ortiz & Acle, 2006) (Scott et al., 2018). This study confirms that, depending on the informants, there may be differences in the assessment of executive functioning in preschool-aged children with various neurodevelopmental disorders.

This functional approach allows us to understand that, beyond traditional categorical diagnoses (such as ADHD, ASD, or dyslexia), many individuals with neurodevelopmental disorders share impairments in common domains (Michelini et al., 2024) (DeYoung et al., 2024). One of the most relevant is executive functioning, whose disruption can give rise to what is known as the dysexecutive syndrome (Godefroy et al., 2010) (Jones, 2020) (Rabinovici et al., 2015). These functions, which are essential for adaptation to academic, social, and professional environments, may be affected to varying degrees and across different dimensions depending on the disorder, without being limited to a specific diagnostic label (Ceravolo et al., 2012) (Liebermann et al., 2013) (Roussel et al., 2017) (Ribas et al., 2023). Understanding dysexecutive syndrome as a transdiagnostic phenomenon allows interventions to be focused on the individual's actual functional needs (Dagleish et al., 2020) (Dickson et al., 2023), with particular emphasis on processes such as metacognition and self-regulation (Hennecke & Bürgler, 2023).

This study provides a clear framework for identifying dysexecutive syndrome. Since the patterns of impairment differ across conditions clinics, a structured assessment of these disorders based on established diagnostic criteria is essential (Godefroy et al., 2010).

We believe that the BRIEF-P (Gioia, et al., 2016) can serve as a valuable tool for identifying executive function deficits across various neurodevelopmental disorders, based on observations from both parents and teachers. While the study's design does not permit us to confirm the level of agreement between these informants, both tend to highlight difficulties in flexibility and emotional regulation—executive domains that appear to be affected to differing extents depending on the informant and the specific disorder.

Limitations and Future Directions

Looking ahead, we plan to implement a triangulated approach that combines direct performance-based assessments with input from key informants. This will enable a more comprehensive understanding of the executive function profiles in children with neurodevelopmental disorders.

Supplementary Materials: The following supporting information can be downloaded at: www.mdpi.com/xxx/s1.

Institutional Review Board Statement: The study was favourably evaluated by the Bioethics Committee of Universidad Nacional de Educación a Distancia (UNED) during a session held on 25 January 2011.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: These data have been provided to complement the information presented in the text, while fully respecting the confidentiality and privacy established as co-authors of the BRIEF-P Spain adaptation, as well as the commitments signed with TEA Ediciones Publishing. These data have been managed with due ethical consideration and in accordance with the established agreements, ensuring the protection of sensitive information.

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Conflicts of Interest: I am the co-author of the Spanish-language adaptation of the BRIEF-P and receive royalties for its use.

Abbreviations: The following abbreviations are used in this manuscript:

- BRIEF-P: Behavior Rating Inventory of Executive Function in Preschool
- EFs: Executive Functions

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