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INSTRUMENTS USED IN THE ASSESSMENT OF EXECUTIVE FUNCTIONS IN PRESCHOOL

Rafaella Sales de Sousa Oliveira
Student of the Neuropsychology Course –Center for Neurology Studies
Prof. Dr. Antonio Branco Lefevre
Porto Velho-RO

Abstract: Introduction: Executive functions (EF) have a regulatory role in human behavior, they develop throughout childhood and adolescence and when their development is not satisfactory, it may indicate developmental, learning or behavioral disorders. Therefore, the survey of EF investigation instruments in preschool children is important, mainly for the identification of dysfunctions and the development of early interventions. from 2019 to January 2020. Descriptors considered important for the proposed objectives were used, namely: neuropsychological assessment, instruments, executive functions, preschoolers. Results: Trail Test for Preschoolers, followed by the Attention Cancellation Test, of the Columbia Mental Maturity Scale and the Stroop test. The average age of the children tested was 3 to 6 years and most of the articles aimed to correlate the results of the EF tests with learning disorders and cognitive development disorders. Discussion: It was possible to notice that studies aimed at evaluating EF in preschool-age children are still scarce, especially empirical studies. It was also noted that the number of tests adapted and validated for this age group are small, which can make access and diagnosis of dysfunctions difficult, thus reducing the chances of early intervention.
Keywords: Neuropsychological Assessment. Instruments, Executive Functions, Preschoolers.

INTRODUCTION

Executive functions (EF) are skills responsible for planning and carrying out intentional behaviors, which help the individual to achieve an established goal (Pereira *et al.,* 2012; Costa et al., 2016; Miotto et al., 2018). These are complex and superior functions, responsible for the self-regulation and flexibility of the human being in the face of the challenges and demands of the environment in which they find themselves, but because there is no consensus in the scientific environment, they do not have a single definition, being considered an undefined construct(Barros & Hazin, 2013).

Factors such as inhibition, selective attention, cognitive flexibility and working memory are part of cognitive functions. Inhibition is the ability to inhibit inappropriate behavior, thereby demonstrating control. Cognitive flexibility is the ability to change focus, perspective or action (Almeida et al., 2018). Selective attention refers to the ability to retain important information and working memory refers to the ability to retain information for short periods and use it to solve problems (Cardoso et al., 2019). Also, planning, decision-making, categorization, monitoring and fluency are classified as cognitive functions. (Miotto et al., 2018)

EFs are responsible for the behavior of obedience to social norms. The more developed, the greater the understanding of norms and the greater the child's ability to respond correctly to the rules (Uehara, Charchat-Fichman & Landeira-Fernandez, 2013). They are found only in humans and, although the maturation of the prefrontal cortex is slow, from the age of 1 year, EFs can already be observed to some degree in humans. observe the development of inhibitory cognitive processes. At around 4 years of age, flexible thinking can be noticed, which develops satisfactorily throughout childhood. From the age of 6, the development of EF has a qualitative leap and its complete maturation takes place around the age of 20 (Axelson & Pena, 2015).

Failures in any of the EF domains are called executive dysfunctions. Most people with executive dysfunction have suffered brain damage to the prefrontal cortex (Herreras, 2014), an area known to be responsible for inhibitory control, social interactions, and

planning. However, the development of research in the areas of neuropsychology and cognitive psychology, together with new imaging techniques and new studies of the processes involved in EF, the use of a locationist theory has become inadequate. It is currently understood that the prefrontal region is responsible for mediating EF, however, there are links with other brain areas, interconnecting the entire central nervous system (Miotto et al., 2018). Despite the growth of studies related to EF, when the study group is preschool children, the topic is still little studied (Costa et al., 2016; Dias et al., 2018).

At preschool age, factors such as inattention and hyperactivity are linked to EF, so that children who have these symptoms perform less well than children without any disorder. This is due to the existence of a relationship between low rates of EF with autism, epilepsies, learning disorders and ADHD (Barros & Hazin, 2013; Costa et al., 2016). The study of EF in preschoolers needs to consider the maturity of each child, which will indicate their stage of development and their degree of functionality, planning and self-regulation, because depending on the age at which the child is, there may be difficulties in performing the tasks. EF, even without the presence of disorders. From the child's development and maturation, and as he improves his emotional control and his actions, EFs also develop (León, 2015).

In order to assess EF in the preschool phase, more than one test is needed, applied in an integrative way, as this can cover all its complexity, evaluating factors such as inhibitory control, selective attention, cognitive flexibility, planning, memory operational and organization (Barros & Hazin, 2013). There are few instruments suitable for use with children to assess EF, in many cases having to adapt tests used in adults, which makes the results susceptible to criticism, giving margins for wide interpretations because they do not have stable measures (Uehara, Charchat-Fichman & Landeira-Fernandez, 2013). Furthermore, in Brazil there is a lack of adapted and validated instruments aimed at children (Sales et al., 2011).

When carrying out a child neuropsychological assessment, one must take into account, in addition to their maturation and development, the entire psychosocial context, since the objective of applying tests in children is to identify changes and disorders, to develop strategies in order to assist in the healthy development (Sales et al., 2011). This is because the preschool phase, which constitutes early childhood, is a very important phase for interventions, due to the possibilities that the developing brain can offer (Malmberg, Mwaurab & Sylvaa, 2011). Neuronal plasticity in this period is great, and with the correct stimuli, different skills can be developed in a potentiated way, including EF (Costa et al., 2016).

In addition, children with low EF tend to demonstrate worse behaviors, greater impulsiveness and emotional lack of control (Dias et al., 2018). Thus, this study is justified, since identifying the tests that can be used in the assessment of EF in preschool children helps both in research on EF and in raising the debate about the lack of scientific research and validated instruments for this purpose. this age group, since when diagnosing failures in the development of these functions or other disorders in early childhood, interventions can be initiated early so that their development is improved and potentiated. Thus, as an objective, it sought to identify which instruments are being used to assess the development of EF in the preschool phase, as well as the way in which they have been used by researchers.

METHOD

The present literature review was conducted to answer the following question: what are the instruments used in the assessment of executive functions in Preschoolers? Therefore, a search was carried out in electronic databases such as Scielo, PubMed, Capes Periodical, Medline, Science Direct and Pepsic. The descriptors in Portuguese used for the research were: preschool children, executive functions, cognitive development, cognitive stimulation, neuropsychological intervention and prevention. In English, the following descriptors were used: preschool, cognitivedevelopment; cognitive stimulation; executive functions; neuropsychological intervention; prevention. Boolean operators used: "and", "or".

As inclusion criteria, the articles selected for analysis in this study must have a sample of preschool children aged up to 6 years; use instruments to assess executive functions; have been carried out in the last ten years and be an original article. The research design was not used as an exclusion or inclusion criterion. Articles with a sample of children older than the stipulated age, studies with more than 10 years of publication and that did not use instruments to assess EF were excluded.

From the survey, carried out between February 2019 and January 2020, more than 200 articles were identified, in addition to the search bases. After reading their abstracts, 31 articles were selected for this study, 01 master's thesis and 01 book for the bibliographic review. Among the articles, 10 were selected for analysis and discussion of the results. The objectives of the articles, the age of the children, the tests used and the results found were analyzed.

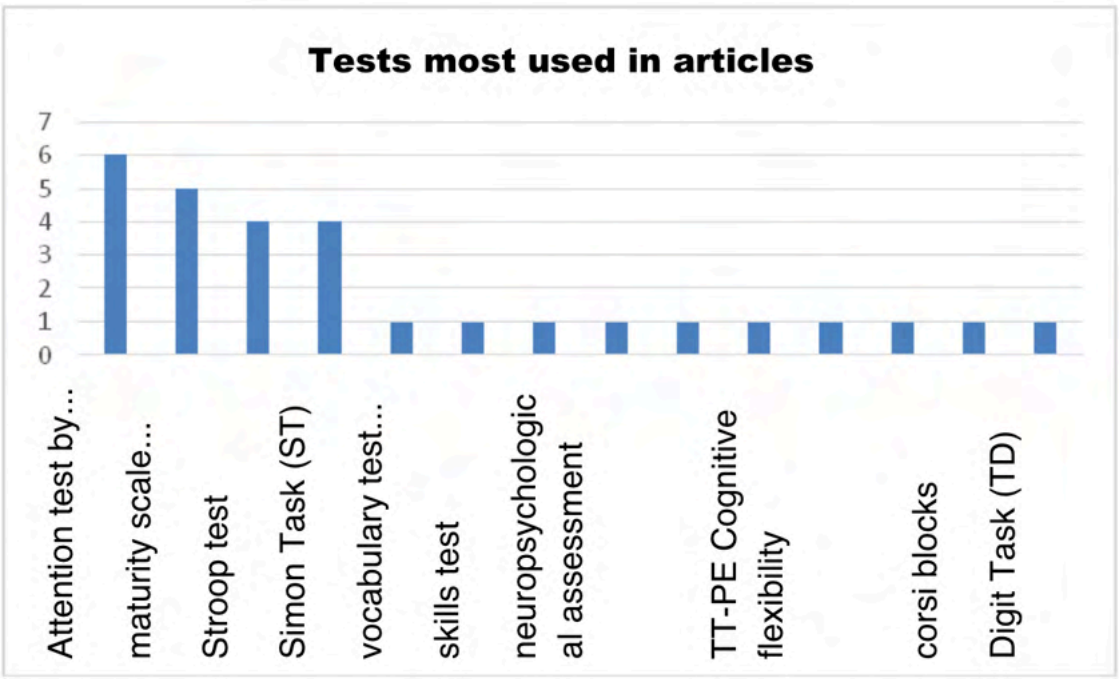
RESULTS AND DISCUSSION

The articles selected for this study are shown in Table 1, in the annex, and were analyzed in an attempt to identify the tests used to assess EF in preschool children. It is important to highlight that the articles that contained field studies with the exact cut of the inclusion criteria, were scarce, as already pointed out by Pereira et al. (2012), Costa et al. (2016) and Dias et al. (2018). According to Billstedt et al. (2019), one of the possible reasons for this lack of study is the difficulty in identifying executive dysfunctions in children before they enter school life, as the demand for the use of EF is greater when literacy and school coexistence begin., making it easier to identify any changes.

Among the surveys, the age of the children invited to participate in the articles ranged between 3 and 6 years old, fulfilling the proposal to analyze children of preschool age. Among the articles, the objectives varied, but all used tests that aimed to measure the EF in these children directly or associating the EF with developmental or learning disorders.

The most used tests were the Trail Test for Preschoolers, followed by the Attention Cancellation Test, the Columbia Mental Maturity Scale and the Stroop test, as shown in graph 1.

In four of the ten studies selected for analysis, questionnaires were applied to parents and teachers, in order to more comprehensively assess the EFs, as well as to compare their observation with the test results: SNAP-IV (Pereira et al., 2012; Trevisan et al., 2017), FE's Inventory, Child Regulation (IFERI) (León, 2015); Questionnaire for Parents (Qp) (Almeida et al., 2018). Skills and Difficulties Questionnaire (SDQ) (Almeida et al., 2018; Dias et al., 2018). The application of questionnaires to parents and teachers is important, as they provide behavioral information from children that can help for a more assertive analysis and more consistent results (Martoni et al., 2016). In addition, the teacher has the chance to



Graph 1: Most used tests.

Source: Research data.

observe development in a comparative way and more easily identify differences between children (Fuhs, Farran & Nesbitt, 2013).

In the selected studies, the research clippings ranged from investigating the relationship between EFs and cognitive development delays or disorders, socio-emotional skills, the relationship between parenting styles and the development of EFs, results of early interventions aimed at EF in children and, also, studies that sought to validate and adapt tests that measure EF in the age group surveyed. The most evaluated aspects were those related to learning (León, 2015; Almeida et al., 2018; Santos, Roazzi&Melo, 2019), cognitive development (Srzentic, Ragu &Ozreti, 2019; Machado & Almeida, 2017) and validation of tests (Trevisan, 2017; Pereira et al., 2018).

In general, the results showed that the EFs improve as the child grows and, to the same extent, it becomes easier to identify the dysfunctions. In addition, the results showed that there is a relationship between EFs and learning and behavior and that the earlier the identification of dysfunctions, the better it is to work with prevention and insert stimuli to improve symptoms (Dias et al., 2018).

In order to identify which instruments are being used to assess the development of EF in preschool children, as well as the way in which they have been used, it was noted that, for the most part, research is focused on early identification. of disorders, disorders or deficits in more than one area of human development. This is because there is a direct link between EF and children's school performance in reading (León et al., 2015; Pazeto, Seabra & Dias, 2014) and mathematics (Rato &Caldas, 2010; Pereira *et al* ., 2012), as the control of attention is one of the important tools for these disciplines (Hutton et al., 2019).

Attention Deficit Hyperactivity Disorder (ADHD), intellectual disability, Pervasive

Developmental Disorders (PDD) and disruptive behaviors are also being related to low EF performance. Children with disruptive behaviors tend to score lower on the inhibition factor (Schoemaker et al. 2012). Children with ADHD show slower responses, when compared to children without the disorder, in tasks that require the use of EF (Skogheim et al., 2020). Children with Autism Spectrum Disorder (ASD) have planning difficulties and sociocognitive deficits (Kimhi et al., 2014). This way, when evaluating the EF, other diagnoses can be reached, if there are negative changes in the results.

It is important to consider children's sensitivity to environmental stressors, which can hamper the maturation of EFs, since this maturation is linked to child development. At this stage, the presence of deficits in the results of EF tests can indicate, from the presence of learning difficulties, to the development of psychopathologies (Axelson & Pena, 2015).

Warsito et al., (2012) highlights that, if the environment offers good conditions and early psychosocial stimulation is done properly, it can have a positive impact on the results of EF, even in children who have difficulties. In this sense, Leerkes et al. (2012), in seeking to understand how maternal stimulation helps in the development of EF, identified that the emotional support received by the child caused significant differences in their development, especially in the problem-solving task. Martins, León & Seabra (2016) reinforces that parenting style has a direct influence on child development, thus influencing the development of EF.

Thus, when also considering brain development in preschool-aged children, Srzenti, Ragu & Ozreti (2019), in their research, found that children born prematurely had cognitive deficits, which impacts on EF. Result corroborated by Arpi et al. (2019) and Doellinger et al. (2017), who indicated that very premature children have worse results in tests that assess EFs. This way, it reinforces the importance of evaluating EFs in this age group in search of dysfunctions, in a preventive way.

It was possible to notice that some tests used do not assess EF itself, but skills such as reading, which depends on the healthy development of EF to develop satisfactorily, or behavioral problems, may be indications that the development of EF is not happening as expected. expected. Thus, as executive functions influence text production, other tests that do not directly assess EF can be used (León et al., 2016).

About the most used tests, Barros and Hazin (2013), in a literature review, found as the most used tests: Wisconsin Card Classification Test, Stroop Test, Hayling Test, Trail Test, Tower Test (Tower of London, Tower of Hanoi and Tower of Toronto) and the Go/No-Go Verbal Fluency Test and performing everyday tasks. In this study, only the Trail Test and the Stroop Test were used in the reviewed articles.

When investigating the tests used to screen the development of EF in this age group, this study found the Trail Test, the Attention Cancellation Test, the Columbia Mental Maturity Scale and the Stroop Test as the most used. In addition, the results show both the importance of seeking an early assessment of children who present any disorder in their cognitive or learning development, as well as the difficulty of this assessment, since validated tests are limited to assess children in the preschool phase. -school, as well as empirical studies. Thus, it is proposed that future studies be directed to the validation and adaptation of tests aimed at early childhood, as well as field research with these children.

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ANNEX 1

TABLE OF ARTICLES SELECTED FOR REVIEW.

Author (year)	Casuistry	Sample	Instruments	Conclusion
Pereira et al (2012)	EFs may be compromised in some developmental disorders, such as ADHD.	Participants were 85 children aged between 4 and 6 years, their parents and teachers.	Trail Test for Preschoolers (TT-PE); Cancellation Attention Test (TAC). Parents and Teachers: SNAP-IV.	There are relationships between performance in EF and indicators of inattention and hyperactivity, which can be seen early in children.
Leon (2015)	Children with better results in EF do better in school.	32 children aged between 3 and 6 years, their parents and teachers.	Trail Test, Stroop Test; Caution for cancellation (TAC). Parents and teachers: FE's Inventory, Child Regulation (IFERI).	EF measures are directly related to behavioral and language development measures. Through the evaluation of EFs one can find developmental delays and plan interventions.
Almeida et al. (2018)	Investigated the relationship between time of schooling and performance on cognitive and skills measures socioemotional.	55 children between 5 and 6 years old and their parents participated	Vocabulary Test by Images Peabody (TVIP); Cancellation Attention Test (TAC); Mental Maturity Scale Columbia (EMMC); Simon Task (ST). Parents answered the SDQ and the Parent Questionnaire (Qp).	children with longer time of schooling have worse results. The quality of Early Childhood Education can explain these results, it is reinforced that school curricula must be based on scientific evidence.
Santos, Roazzi, Melo (2019)	It was sought verify which EF components are most associated with phonological awareness and how is this relationship	152 children aged 4 to 6 years	Columbia Mental Maturity Scale (CMMS), Test of Predictive Reading Skills (THPL), Trail Test for Preschoolers (TT-P) and the Stroop Test.	Memory is related to rhyme and alliteration, inhibitory control With the rhyme and the segmentation and the cognitive flexibility with segmentation
Srzentic, Ragu and Ozreti (2019)	Investigate whether there was cognitive deficit in premature children.	21 children aged between 3 and 5 years	Wechsler Preschool and Primary Intelligence Scale (WPPSI-III) and Neuropsychological Developmental Assessment (NEPSY-II).	Children born prematurely with identified structural abnormalities showed specific cognitive deficits at preschool age in several domains (visual-spatial processing, memory, executive functions, and language).

Pereira et al (2018)	Investigated evidence of validity of the Attention Cancellation Test (TAC) and Test of Trails for preschoolers (TT-PE)	105 children, aged 5 and 6 years.	TAC (attention) and TT-PE (cognitive flexibility)	In the TAC, the effect of age can be observed, with different developmental trajectories for the assessed skills. Evidence of preliminary validity and normalization is provided.
Martins, Leon & Seabra (2016)	It analyzed the relationship between parenting style and executive functions in preschoolers.	30 children, aged 3 to 6 years.	Stroop Test; Cancellation Attention Test and Trail Test for preschoolers.	The parenting style of the parents has a direct influence on the interference control of the children's executive functions.
Machado&&, Almeida (2017)	It sought to describe the cognitive profile of children participating in an early intervention program, with and without developmental delay.	48 children aged 3 to 5 years old.	Revised Psychoeducational Profile (PEP-R) and the Trail Test for Preschoolers (TT-P) children's version	The children had a similar profile between the groups divided by age and developmental level.
Trevisan (2017)	Investigate psychometric properties, translate and adapt the Childhood Executive Functioning Inventory (CHEXI) for Brazilian children.	208 children aged between 4 and 6 years and their parents.	Columbia Mental Maturity Scale; Childhood Executive Functioning Inventory (CHEXI). Parents responded to the SNAP-IV.	Good psychometric parameters were found for CHEXI. One can contribute with studies on executive functions and ADHD indicators in the country.
Dias et al (2018)	Investigated the prediction of behavior patterns from EF in preschool children.	98 preschool-age children parents and teachers	Columbia Mental Maturity Scale; Corsi Blocks (BC); Digit Task (TD); Trail Test for Preschoolers Stroop Test. Parents and teachers answered the Skills and Difficulties Questionnaire (SDQ).	EFs contribute to behavioral patterns in preschoolers. An early assessment is important as a way to predict possible behavior problems in this age group.

Table 1. Articles selected for discussion.