

## Neuropsychological Intervention with Children and Adolescents - A Review of the literature.

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### Abstract

Stigmatizing attitudes toward persons with mental syndromes are prevalent in the This article aimed to carry out a literary review of the scientific studies published in the last ten years in neuropsychological rehabilitation/ intervention with children and adolescents, seeking to identify how programs with approaches focused on academic and executive difficulties are articulated with family and school demands. The main databases used were PubMed, SciELO and Redalyc. Among the 89 articles found, ten were selected because they included methods for teaching strategies that facilitated school learning and adaptive behaviors. The results of the studies suggest that neuropsychological intervention in children and adolescents promotes the development of cognitive abilities and the processes of language acquisition. However, in view of the distance between the clinical context of intervention and the educational context, more studies need to be promoted in search of a more integrated view of these spaces for promoting development.

**Keywords:** Neuropsychological Intervention; Cognitive Rehabilitation; Childhood; Adolescence

### Introduction:

Neuropsychological rehabilitation (NB) can be conceptualized in several ways, which can be defined as an active process of education and training, focused on the appropriate management of acquired cognitive changes (Gindri, G., Frison, TB, Oliveira, CR, Zimmermann, N., Netto, TM, Landeira-Fernandez, J., Parente, MAMP, Ferré, P., Joannette, Y. & Fonseca, RP, 2012). In relation to pediatric cases, Santos and Nascimento (2016) mention that the first rehabilitation programs emerged as derivations of adult programs and, little by little, were modified to meet the peculiarities inherent to the nervous system in formation.

When a child has difficulties resulting from inefficiency or inability to process information, to interact with the environment, it is essential that there is the monitoring of a neuropsychologist to assess, contextualize and re-enable these cognitive deficits, providing conditions for the child to develop in the environment and minimizing the effect of future difficulties (Santos, 2004).

In certain cases, the term "rehabilitation" is appropriate when some children need a therapeutic intervention after suffering brain injuries in periods that preceded the acquisition of certain functions such as language or walking. However, in many cases, children may present a transient immaturity due to more subtle changes in the central nervous system, such as delayed development and, in such situations, the intervention process is called "neuropsychological habilitation". Therefore, these children would need stimulation to "enable" their abilities, especially those related to the acquisition and development of perceptual, linguistic, motor skills, among others (Gindri et al., 2012; Santos & Nascimento, 2016). Although these definitions of rehabilitation and habilitation seem coherent and well defined by these authors, they are used in several studies in a non-judicious way. There are studies that deal with stimulation without injury and still use the term rehabilitation indiscriminately.

According to Santos and Nascimento (2016), cognitive rehabilitation (CR) is one



of the components of neuropsychological rehabilitation (NR) and can be restorative, compensatory or metacognitive, its main activity being cognitive training, i.e., the stimulation of cognitive skills such as attention and memory, in order to remedy dysfunctional cognitive processes, regardless of the stage of development. The authors also emphasize the importance that, in pediatric cases, CR occurs as early as possible in order to minimize the side effects of learning difficulties and prevent complications derived from experiences that bring losses to self-esteem, such as bullying (Santos & Nascimento, 2016). It is observed, therefore, that there is differentiated nomenclature and conceptualization on this theme and that it is still recent and little explored in the field of clinical and educational performance of childhood and adolescence.

In the 1990s, integrated pediatric assessment and rehabilitation models emerged, among them the DNRR (Developmental Neuropsychological Remediation / Rehabilitation) intervention model, which was developed in response to learning difficulties, that is, spoken and written language, coordination, self-control and attention. The DNRR represents a milestone in the management of literacy-related deficits (SANTOS, 2005). Since then, several therapeutic programs and models have expanded this area of neuropsychology, enabling greater therapeutic coverage. There are programs aimed at learning disorders, attentional deficits, stimulation of self-regulation and also those focused on socio-emotional interventions, such as the Amigos do Zippy, Emotion Based Program (EBP) and Social Skills Training (Santos & Nascimento, 2016).

An important aspect from the perspective of childhood neuropsychology is that, unlike adults, neuropsychological rehabilitation or habilitation is part of a horizontal evolutionary perspective. In this sense, neuropsychological reevaluation and updating of rehabilitation programs are essential for two reasons: 1) neuropsychological dysfunctions reevaluated after a period of six months or a year may be in a totally different way due to the various phenomena of plasticity, development maturational and environmental influences, and 2) several behavioral and learning problems arise during the child's schooling period and need to be detected (Santos, 2004).

In general, cognitive rehabilitation programs aim at functional restoration and the establishment of compensatory strategies for affected cognitive functions, especially in relation to the demands of the family and school environment of the child with neurological dysfunction. In particular, cognitive difficulties and problems of self-regulation and behavior at school have raised challenges regarding the development of specific and / or multidisciplinary educational curricular programs to promote executive functions and pro-social and collaborative attitudes among children, contributing to the teaching and learning environment (Carvalho, 2017).

Different researchers highlight the importance of executive functions for different aspects of life such as mental and physical health, quality of life and academic success. Executive function skills are considered as essential building blocks for the development of cognitive and socioemotional capacities, they form the basis for learning reading, writing and arithmetic, in addition, experiences of adversity in childhood can alter these

functions indicating that they are more susceptible to disruptions at the beginning of development (Schiavon, BK, Vieira, BS, Viola, TW, Souza, LSA, Rigoli, MM, Fonseca, RP & Oliveira, RG, 2013; Carvalho, 2017; Macsween, 2017; Jiménez-Jiménez & Marques, 2018).

In this sense, several authors have emphasized the need for systematic and explicit teaching of strategies based on the contribution of executive functions and self-regulation in the school context, such as teaching strategies for planning, organization, memory, inhibitory control and regulation of emotions (Schiavon et al, 2013; Carvalho, 2017; Jiménez-Jiménez & Marques, 2018). These findings support the need to create curricular programs for the school that aim to focus on promoting executive functions and self-regulation such as controlling impulsivity, problem solving strategies, and cognitive functions such as working memory and cognitive flexibility.

Although neuropsychological assessment promotes a sophisticated understanding of cognitive problems and guides the design of an intervention program, standardized tests fail to answer questions about how the child and family are affected by cognitive problems, whether the child will resume their studies with autonomy on his earnings or he will return home without strategies for coping with difficulties being mobilized.

The school follows the child's growth. It is in the school that the child spends a large part of his/ her time, either performing learning tasks or playing, and socializing. The school has been an environment for the development of academic skills, in which the importance of developing executive function skills, emotional and social self-regulation, mechanisms for controlling aggression and impulsivity is increasingly perceived, in addition to creating strategies for solving of problems (Schiavon et al, 2013; Loaliza, JG, Calderón-Delgado, L. & Barrera-Valencia, M., 2014; Carvalho, 2017; Jiménez-Jiménez & Marques, 2018).

In view of this, this study aimed to carry out a literary review of scientific studies published in the last ten years in neuropsychological intervention / rehabilitation with children and adolescents, seeking to identify how programs with approaches aimed at academic and executive difficulties become articulate with family and school demands.

#### Method

The present work is a systematic review in which articles referring to neuropsychological treatment in children and adolescents were taken as units of analysis. The main databases used were PubMed, SciELO and Redalyc, including publications from 2007 to 2017. The terms "Neuropsychological Rehabilitation, Neuropsychological Intervention, Cognitive Training, Cognitive Stimulation, Neuropsychological Stimulation and Cognitive Rehabilitation" were included as main descriptors, in Portuguese, Spanish or English.

The selected publications had as inclusion criteria the following aspects:

- a) Empirical articles in which the sample consisted of children and / or adolescents;
- b) Articles whose intervention programs were based on



approaches aimed at academic difficulties, such as reading and writing, for example, or for cognitive functions, such as memory, attention, language, working memory and executive functions (EF) in general.

Studies whose intervention programs focused on the recovery of acquired brain injuries were discarded, configuring a sample restricted to cases in which there was only the description of a previously diagnosed neurological or neuropsychological condition, causing cognitive deficits.

For the analysis, the information was organized into the following categories: study title, author and year, method and results. Finally, the evidence found in each study was classified around its therapeutic approach, which allowed us to draw a current picture about neuropsychological interventions for children and adolescents.

## Results

Among the 89 articles found, ten were selected and are characterized in Table 1. Table 1 deals with studies with intervention and rehabilitation programs that include methods for the systematic teaching of strategies that seek to facilitate school learning and adaptive behaviors. Such strategies involve, above all, aspects of behavioral inhibition, emotional self-regulation, memorization strategies and use of language (oral and written). Regarding the production of knowledge between 2007 and 2017 about neuropsychological interventions in children and adolescents where the picture of cognitive impairment did not refer to brain injuries, there was a reduced volume of articles in the researched databases, being mostly review articles.

#	Study	Author / Year	Method	Result
1	Impacto de la intervención neuropsicológica infantil en desarrollo del sistema ejecutivo. Analisis de un caso	Jimenez-Jimenez and Marques, 2018	Case study with an 8-year-old girl with school difficulties and complaints of inattention. Evaluation, neuropsychological intervention (12 sessions of 45 minutes each) and reassessment were performed.	The intervention with a focus on executive functions benefits the learning of reading and writing.
2	Intervención neuropsicológica de la memoria en un caso infantil diagnosticado con HIV	Jimenez-Jimenez and Morales, 2014	Case study with an 11-year-old patient diagnosed with HIV with developmental delay and learning problems. The child was assessed and identified a large deficit in audioverbal and visual memory and also, secondarily to regulation and control. Intervention was performed in 32 sessions of 45 minute	After reassessment, it was found not only an improvement in memory processes with greater evocation of words and retention, but also an improvement in academic aspects such as accuracy and reading comprehension, improvement of
			and reassessment.	narrative production and precision of writing and also in comprehensive language.
3	Intervention for executive functions in attention deficit and hyperactivity disorder	Menezes, A., Dias, N. M., Trevisan, B. T., Carreiro, L. R. R., Seabra, A. G., 2015	18 children and adolescents, 7-13 years old, participated in an Experimental Group (EG, N = 8) and Control (CG, N = 10), evaluated in the WISC III Blocks and Vocabulary subtests and seven EF tests. Parents responded to two scales measuring EF and symptoms of	Gains from intervention in measures of attention / inhibition and auditory working memory for the EG. No effect was found for the most complex EF scales or measurements. The results are not conclusive, but they illustrate promising trends regarding EF interventions in children and adolescents with ADHD.



			inattention and hyperactivity. EG children participated in an EF promotion program (PIAFEx, in group sessions of one hour each, twice a week. After eight months of intervention, the groups were reevaluated	
4	Evaluación y corrección neuropsicológica del lenguaje en la infancia	González, M. A. M., Garcia, E.L., Solovieva, Y., Rojas, L. Q., 2014	Evaluation with qualitative protocols with a historical-cultural focus, rehabilitation with a focus on outdated neuropsychological skills and reassessment. The intervention program was individual for 18 months with weekly sessions of 50 minutes not only focusing on language, but also on	There was an improvement in performance with the intervention and it was concluded that it is extremely important to rethink traditional children's language correction programs that are based on only 1 neuropsychological function.
			kinesthetic synthesis and sequential motor organization.	
5	Corrección neuropsicológica en las dificultades de la expresión y la comprensión del lenguaje	Barrera e Sánchez, 2014	Case study based on Luria's methodology, with a 6-year-old child, a dizygotic twin of another child. An initial neuropsychological assessment was carried out, which revealed functional weakness of the kinesthetic analysis and synthesis mechanisms, phonemic ear and kinetic organization. A structured intervention program was formulated and applied on a weekly basis, contained activities of ascending complexity and worked on several higher psychological processes simultaneously.	The post-test evaluation demonstrated the effectiveness of this program in strengthening the weak mechanisms, with greater control over the child's oral expressions, as well as the regulation of his own behavior based on the adult's language, enabling the comprehension of the listener.



6	Intervención neuropsicológica en un adolescente con problemas de aprendizaje: Estudio de caso	Ronquillo, N. M., Flores, M. A. G., Machinskaya, R. I., García, E.M. L., 2013.	The clinical case showed the application and the results of an intervention program under Luria's neuropsychological perspective in a case of an adolescent with a history of learning difficulties and school failure. It also showed the usefulness of qualitative-visual analyzes of electroencephalograms to	The analysis of the syndrome identified that the central mechanism characterized as insufficient in the psychophysiological development was that of regulation and control, because the program developed was directed to this mechanism, demonstrating positive
			show brain changes after the application of the program.	systemic effects after the reevaluation of reading, writing, calculation, and intellectual activities, as well as favorable exchanges in brain electrical activity.
7	Intervención neuropsicológica en adolescente con problemas de aprendizaje. Análisis de caso.	Agundis and Sánchez, 2013.	Within the method proposed by Luria, the main neuropsychological mechanisms that affected the teaching-learning process of an adolescent were analyzed, finding, mainly, effects on the mechanisms of regulation and control of voluntary activity and kinetic organization of movements. With the intervention program, investments were made in strengthening certain mechanisms by working in stages developed by the principles of activity theory.	The results showed positive exchanges in the post-treatment evaluation compared to the pre-treatment evaluation, with an improvement mainly observed in his ability to organize his school activity, in tasks of auditory-verbal and visual memory, analysis and text synthesis, motor organization at the graphic and verbal level, problem solving, among others.
8	Impact of working memory training on hot executive functions (decision-making and theory of mind) in children with	Bigorra, A., Garolera, M., Guijarro, S., Hervas, A., 2016.	The main objective of this study was to analyze the effectiveness of computerized Cogmed Working Memory Training™ (CWMT) in decision making and theory of mind (ToM). 66 children with combined type ADHD, aged between 7 and 12	There was no relationship between WM and decision making in ADHD. The explanation for this fact, in turn, supports the view that there are different paths in ADHD, with dissociable contributions from
	ADHD: a randomized controlled trial		years were included. At the beginning of the study (1-2 weeks) and 6 months after the	decision-making and deficits in “cold” EF that respond differently to WM training.



			intervention, participants were evaluated using measures based on the performance of WM (back span, sequence of number-letters of WISC-IV and spatial span back of WMS- III), decision (Iowa Gambling Task), and ToM (Strange Stories and Happé's Popular Psychology).	A relationship was found between WM and ToM, but CWMT did not show remote transfer effects on ToM deficits in ADHD.
9	The Effects of Executive Function and Attention Training for Children: The Role of Motivation and Self-Concept	Macswen, 2017.	The aim of the study was to evaluate the effectiveness of a cognitive and metacognitive intervention program (Caribbean Quest; CQ), in improving cognitive and social self-concepts, executive function (EF) and attention. The effect of motivation on the benefits derived from cognitive training was also assessed. Participants included 55 male children, aged 6 to 12 years, with reported EF deficits and attention.	The results indicated that the cognitive self-concept and the state of motivation increased for the younger group of children (under 8 years old); for the older group of children, the state of motivation decreased. The transfer of the effects of cognitive training to neuropsychological measures of WM and attention were not significant, although the findings tended towards greater benefit for the intervention group.
10	Programa de estimulação das funções executivas: contribuições para o desenvolvimento cognitivo de crianças em situação de vulnerabilidade e expostas ao manganês	Carvalho, 2017	The objective was to characterize cognitive deficits associated with exposure to Mn in children aged 7-12 years, and from there to develop and evaluate the effectiveness of a stimulation program focusing on the promotion of EF for students from the 2nd to the 5th year in this context exposure. The Stimulating Program for Executive Functions Heroes of the Mind (PHM). The PHM is composed of six comic strips and four modules for the stimulation of EF.	The findings showed that the stimulation program was able to bring benefits in some aspects of EF, representing a decrease in the differences in neuropsychological development between the group exposed to Mn and children with no history of exposure who participated in PHM. This study presents relevant data in terms of public policies, offering a low-cost program to be implemented by teachers and can be easily inserted into the school curriculum.

**Table 1.** Summary data from articles on Neuropsychological Interventions in Children and Adolescents.

The works of Jimenez-Jimenez and Marques (2018) and Gonzáles et al. (2014) show the impact of children's neuropsychological intervention in cases where there is impairment in executive functioning and problems related to language, such as reading and writing, and particularly, to the sequential motor organization. In both works, the results showed improvement both in executive functioning and in activities

such as reading and writing. Such studies show that the intervention focused on the direction and organization of the cognitive activity of the executive system benefits the learning of reading and writing, since these functions are related and impact each other. Even in the absence of specific strategies for language intervention, this function has been improved In a study whose initial focus was the difficulty in expressing and





understanding language, Barrera and Sánchez(2014) show that, from the syndromic analysis, the mechanisms identified with insufficient functional development affected not only the understanding and expression of language, but also they weakened the regulatory function of language, specifically affecting the development of organized and planned activity, voluntary attention, the formation of mental images and graphic activity. The authors report that the neuropsychological correction program under study favored the stimulation of weak mechanisms in the child's development and the guidance provided by the therapist was gradually assimilated by the minor, even using them in other more complex tasks.

Conceived and applied from a historical-cultural perspective, the intervention programs reported by Barrera and Sánchez (2014) and by Jimenez-Jimenez and Morales (2014), describe and reveal how a cognitive function influences the function of language, even if there are no direct intervention for that skill or function.

Menezes et al. (2015) and Bigorra et al. (2016) investigated rehabilitation programs aimed at samples of children with Attention Deficit Hyperactivity Disorder (ADHD). In both articles, the results were inconclusive, but promising, showing that it is possible to promote inhibitory control, selective attention and working memory in children and adolescents with ADHD. Among the explanations for the limitations found in the studies, the authors include the lack of activities with the parents and / or teachers of the participants, which could contribute to the generalization of gains for other environments, such as home and school. Still regarding the limitations found in the study, Menezes et al. (2015) defend the increase in research with the objective of providing cognitive interventions with more ecological characteristics for a sample of individuals with ADHD. Bigorra et al. (2016) point out in their results the presence of a relationship between working memory (WM) and Theory of Mind (ToM), but the lack of improvement in post-training WM and in the 6-month follow-up seems to indicate that the rehabilitation program does not produced remote transfer effects on ToM.

Based on the historical-cultural neuropsychology proposed by Luria (1986), the works of Ronquillo et al. (2013) and Agundis and Sánchez (2013) propose programs where the intervention procedures necessarily start from the results of the evaluation and are designed individually for each patient, considering their psychological age and previous educational level. In addition, these authors emphasize that the action is considered the unit of analysis of the theory of activity, considered as fundamental in the development of the neuropsychological clinic from this approach. In action, invariant structural elements are identified, such as the reason (objective), the object of the action, the guiding principle of the action, the operations and their means of execution, control and verification. Therefore, during the neuropsychological intervention, the reasons for the action are especially considered and explained to the adolescents participating in the program.

The results of research by Ronquillo et al. (2013) and Agundis and Sánchez (2013) showed improvement mainly in the ability to organize school activity, in the tasks of auditory-verbal and

visual memory, analysis and synthesis of texts, motor organization at the graphic and verbal level, of resolution of problems, among others.

Macsween (2017) and Carvalho (2017) concentrated their studies on intervention programs aimed at Executive Functions (EF). While Macsween (2017) evaluated the effectiveness of a cognitive intervention program in improving cognitive and social self-concepts, EF and attention, Carvalho's research (2017) demonstrated that the stimulation program was able to bring benefits in some aspects of EF, showing a decrease in differences in neuropsychological development between a group exposed to manganese and children with no history of exposure who participated in the program. This study was the only one that presented relevant data in terms of public policies, with regard to the implementation of a neuropsychological intervention program that can be easily inserted in the school curriculum, with the participation of teachers.

#### Discussion

The main results of the studies included in this review suggest that neuropsychological intervention in children and adolescents promotes the development of cognitive skills, such as attention, planning and carrying out actions, as well as improving language acquisition processes, being recommended in cases where there are academic and / or executive difficulties.

In cases of language disorders in children, the timing and form of their assessment and treatment can have a decisive influence on the prognosis for correcting the present difficulties. That is why the research and implementation of appropriate neuropsychological correction programs are of great relevance for overcoming this type of disorder (Barreira & Sanchez, 2014).

The interface is evident not only between cognitive skills, but also their relationship with the subject's behavior and emotional condition. The stimulation of a skill influences other cognitive skills leading to an improvement not only in the chosen target, in the planning of this intervention, but bringing quality of life and benefiting the subject's activities, relationships and productivity. Thus, the magnitude of the importance of this type of monitoring in the well-being and quality of life of these individuals is clear.

In this sense, it is important that more research be conducted, as a consideration raised in this work is the fact that the neuropsychological intervention initiatives try to demonstrate the possibility of generalizing the intervention strategies to other contexts, such as, for example, in cases where children were able to form their own self-correction strategies during the course of the intervention and in the actions carried out at school (Agundis & Sánchez, 2013; Ronquillo et al., 2013; Barrera & Sánchez, 2014; Gonzáles et al., 2014; Jimenez-Jimenez & Morales, 2014; Jimenez-Jimenez & Marques, 2018). However, no reports were found, from the perspective of the school environment, that allow to infer about a continuity of the course of the development of a certain skill, as observed in clinical intervention situations. Nor were any strategies found that could be used by the teacher in the classroom, as a way of stimulating development. This fact suggests that there is a discontinuity between interventions of a clinical nature and those of an



educational nature, with regard to the transfer of beneficial effects to school activities and their monitoring.

It is worth mentioning that in a classroom environment it is difficult to develop the expected level of motivation for a case with a failure in the executive system (Jimenez-Jimenez & Marques, 2018). In general, educators understand learning as a continuous and sequential development process, with knowledge acquisition as a central point. Most of the time, school activities are focused on memorization and the expectation that the child will develop on their own the ability to plan their time, prioritize information, monitor their progress. However, this is often not the case. In the current conditions of Education, children and adolescents are not exposed to strategies that favor the development of executive functions (Fuentes & Lunardi, 2016). Thus, it is important to think about teaching cognitive and metacognitive learning strategies in order to effectively promote school performance and the student's relationship with this learning and all the intrinsic and adjacent processes that permeate it.

Another issue raised by the studies is the fact that neuropsychological intervention programs do not necessarily provide generalization of a controlled environment for everyday life situations (Macswen, 2017). Even if beneficial effects were transferred to daily activities, they would be restricted to a limited number of tasks. Various researches suggest that the goal of any executive rehabilitation program is to improve or allow greater autonomy for individuals in everyday situations, allowing them to solve problems (within their capabilities) rather than being trapped in a vicious cycle in which executive skills are not used. (Miotto, E. C., Serrao, V. T., Guerra, G. B., Lúcia, M. C. S. & Scaffet, M, 2008)

Thus, it is worth emphasizing the importance of research focused on more ecological interventions, especially in cases of developing strategies to deal with executive difficulties and, at the same time, including activities with parents and teachers, which could contribute to the generalization of gains for other environments, such as home and school.

The clinical course in children is modified both by the spontaneous recovery of brain functions as a response to the adopted therapy and by the continuity of developmental changes. For this reason, monitoring of academic progress, daily activities and emotional adjustment should be done regularly. Given this dynamic nature of recovery, the rehabilitation program needs to be reviewed and modified more frequently than in adults (Santos, 2004).

Finally, a relevant aspect to be discussed is the lack of consensus regarding the nomenclature used for neuropsychological intervention in the field of children and adolescents, which creates difficulties for research, considering that, different from the evaluation, there are several nomenclatures used. Neuropsychological training, neuropsychological rehabilitation, neuropsychological intervention, cognitive intervention, cognitive training, cognitive rehabilitation, cognitive training, pediatric neuropsychological rehabilitation, cognitive neuro-rehabilitation, neuropsychological rehabilitation, neuropsychological rehabilitation, neuropsychological rehabilitation, neuropsychological rehabilitation, neuropsychological correction are examples of

terminologies found in the literature they refer to treatment in neuropsychology, setting up a barrier also for professionals in the field of scientific research. It is of utmost importance to reach a consensus in order to establish a nomenclature that can be used both by the scientific, clinical and educational areas related to children's neuropsychological intervention, as it will favor multidisciplinary dialogue, the debate about its importance, in addition to facilitating the diffusion knowledge of the area.

In view of the distance between the scientific, clinical and educational contexts of formation of children and adolescents observed in the research, more studies need to be promoted in search of a more articulated and integrated look at these spaces for the promotion of knowledge, science and development..

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