THE USE OF ORANGE CANVAS PROGRAM TO ANALYZE THE PERFORMANCE OF CHILDREN WITH CONGENITAL BLINDNESS IN THE PLANNED CODES SUBTEST ADAPTED

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Abstract: At Laboratory of Cognitive Neuropsychology of the Benjamin Constant Institute (NEUROLAB-IBC) was realized a study aiming at exploiting the cognitive component and a possible clinical guidelines of children with congenital blindness from the adaptation of Planned Codes subtest of Das and Naglieri and the use of artificial intelligence laboratory Orange Canvas of the University of Ljubljana. Due to the scarcity of neuropsychological tests that assess brain function in congenital blind children in Brazil, Planned Codes provided satisfactory scenery and needed to adapt to the reality of the applicator and children, containing, therefore, features tactile, visual and translated into Portuguese. Moreover, the high-tech offered by Orange Canvas program, favored the possibility of completely automating the entire subtest. The sample consisted of 59 congenital blind children which are students of Specialized School, where 32 realized the whole subtest being 2 of 7 years old and 28 from 8 to 12 years old. To validate this study, was made a clustering of data inherent to the subtest with predictions drawn from behavioral analysis of children, through the Orange Canvas, where it was confirmed the effectiveness of that procedure in clustering the data associated with the predictions suggested. From the children performance, opens itself an intervention and creation field of neuropedagogical strategies computerized to improve the cognitive processing of congenital blind children.

1 INTRODUCTION

The shortage of Brazilian studies related to human cognition area in congenital blind children, makes this field promising for psychological and technology science to explore. The cognitive science involves many disciplines and one thing in common: the study of intelligence. As a consequence, after the initiative of researching on human intelligence, many theories have been produced including the highlighting research of Alexander Luria Romanov on the brain cognitive functions and organization. In this work, published in 1973, he proposes three main units of the brain function: the functional unit which regulates the cortical tonus, the gait and mental states, the functional unit to receive and analyze information stored and the programming, regulation and verification of the activity functional unit. Okuhata and collaborators (2007), in the studies based on the Electroencephalogram (EEG) results,

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suggest that Luria has successfully captured the brain activity in three distinct functional units, and ultimately support the view that there are three functional units working on cooperation for a variety of activities.

Deriving from Luria studies, Das and Naglieri developed a theory, where information processing is seen as something dynamic, possessing different cognitive skills. This theory suggests four processes involved in the information processing: Planning, Attention, and the Simultaneous and Successive Processing called the (PASS) theory. Based on this, the same authors created the Cognitive Assessment System, CAS (Das & Naglieri, 1997). This test, according to Das and Naglieri, 1997, measures intelligence as a limited range of multiple skills, as well as the Cognitive Abilities Woodcock-Johnson Tests (Woodcock & Johnson, 1977), the Intelligence Scale Stanford-Binet, Fourth Edition (SB. IV, Thorndike, Hagen, & Sattler, 1986), the Differential Abilities Scale (Das, Elliot, 1990), the WISC-III (Wechsler, 1991) and the WAIS-III (Wechsler, 1997).

The present study reports the cognitive evaluation analysis in congenital blind children according to their ability to create strategies for problems presented, thus, setting the table that occurs during the planning process. This process works with the cognitive control, intentionality and self-regulation to achieve a goal (Das & Naglieri, 1997). As a pioneer exploration of this type of class, this work aims at developing of cognition exploration in blind children with the help of the artificial intelligence laboratory Orange Canvas University of Ljubljana (2004) and the Planned Codes subtest from the Das and Naglieri (1997) Cognitive Assessment System battery test.

According to Das and Naglieri (1997), planning is a mental process whereby the individual determines, selects, applies and evaluates solutions to problems, in what it is thought as a cause-effect relationship between two actions within a specific time window, inhibiting prepotent responses, forming goals and performing activities. Moura and Correa (1997) report that Alexander Luria proposes a new brain organization and cognitive functions model through of a study with brain injured patients. Accordingly, Das (1980) points to the idea presented by Luria, in which the brain could be divided into three blocks. One of these blocks would be responsible for developing plans and action programs, beyond the regulation and control of human behavior. He also reveals that this unit would contain the frontal lobe.

An adjustment for the visually impaired of Planned Codes subtest was used to assess this construct of cognitive functioning. Thus, the use of this subtest intends to measure and verify how the child develops a plan of action, implements it, considers whether their objectives were achieved and how one modifies their action plans, should the need arise (Das & Naglieri, 1997 *apud* Cruz, 2007). This was possible, because this subtest allows the children to decide how they want to accomplish the task within the shortest time possible (Haddad, 2004).

The artificial intelligence laboratory Orange Canvas is a machine learning and data mining, i. e., a collection of modules based on the Python[1] programming language which are located on a core library and performs a feature in which the time fulfillment is not crucial. Through this program, a core objects library and programming sets instructions designed to perform routines, it was made a clustering of data inherent in the adapted subtest and predictions obtained by the children`s behavioral analysis.

Visually impaired population studies, offers two new opportunities for the computer contribution advance in the context of cognition and neuropsychological assessment. In a first moment the computing environments advance for processing information allows the researchers easier access for non-specialist meta-heuristic treatment (heuristic method for solving general optimization problems) database. A second opportunity lies in the possibility of creating applications that allow automated access of this population to a service evaluation and prognosis of their cognitive ability.

In both cases, the visual deficient offers a significant differential of the scientific research property. That difference lies at the cognitive level with morphogenetic channels preponderance which are the means of organism transmission and

[1] The Python language was chosen to develop this program, because it is considered at high level and contains different paradigms programming such as object-oriented programming, structured programming and some elements of functional programming, being possible the use of more appropriate paradigm to solve the problem. This makes Python unique, because the quality of the code is more readable, more compact, easier to maintain and to reuse it. It requires fewer lines, does not require prior declaration of the type of variables and neither a cycle of build. This gives to the programme the possibility of being executed immediately and still having portability. Many programs developed in this language does not have any restriction on Linux and Windows platforms. (http://www.python.org.br/wiki, accessed in March of 2010).

formation according to Seminério (1984). This author gets to this theory through the English school distinction in 20th century, where intelligence is compared to energy and it is distributed in two areas, the verb-educational area and practical performance area. Based on this classical duality, Seminério deepens this perspective and, based on anthropological and psychophysiological data, verified that in human nature, the proximity senses (smell, touch and taste) show retraction signs while sight and hearing accuse expansion when related to their kinesthetic. It is also noted, that, throughout the phylogeny, two channels involving afferent and efferent pathways became specific to the superior mental development activity, the visual-motor channels and the audio-phonetic channels. The first is the mean of transmitting and processing information that connects visual perception and motor action with their feedback executable on the environment covered by the vision. The second is the mean of transmitting information that links the perception of the auditory environment and the motor organization action to the speech phonemes perception and motor production (Seminério, 1984). The predominance of audio-phonetic channels in visually impaired drives the heuristics to a faster convergence, eliminating arising interference from visual-motor channel. This same feature sets the immediate automation process applicability of this procedure, since this population will benefit from the prognostics offered by the applicative towards the cognitive evolution direction.

2 OBJECTIVE

This paper aimed to assess the congenital blind children cognition in relation to cognitive valence, planning and proposing a computerized process as a whole and not just as statistical analysis. The use of the laboratory Orange Canvas allowed not only standardized evaluation, but also a prognostic assessment, which enables, depending on the prognosis confirmation, a cognitive disabilities classification that have influenced in the child's performance, as reported by Pendley, Myers and Brown (2004) by claiming that CAS may indicate Disorder Attention Deficit Hyperactivity Disorder (ADHD). This allows a more objective and effective treatment, besides allowing the advance in the Planned Codes subtest administration as a whole, an administration fully computerized to automate the application and evaluation of subtest.

Therefore this study intended to classify visually impaired children in possible clinical situations from the results generated by laboratory Orange Canvas. The researcher made prognostics based on behavioral observation of each child generating a total of seven forecasts. From this, the statistical program grouped the data inherent to the Planned Codes subtest with the prognostics generated by the researcher. With the efficiency of such an analysis, it also aimed a possible adaptation of the computerized subtest as a whole so that more data were computed with greater precision.

3 METHODS

3.1 Participants

The sample consisted in 59 visually impaired children from 7 to 12 years old, in which 32 realized the entire subtest. 19 boys (being 7 children from 7 to 9 years old and 12 children from 10 to 12 years) and 13 girls (being 5 children from 7 to 9 years and 8 children from 10 to 12 years), students from kindergarten to the 6th year of Elementary School, who are attending the Specialized School of Benjamin Constant Institute in Rio de Janeiro. According to the information sheet of the children, they belong to the underclass.

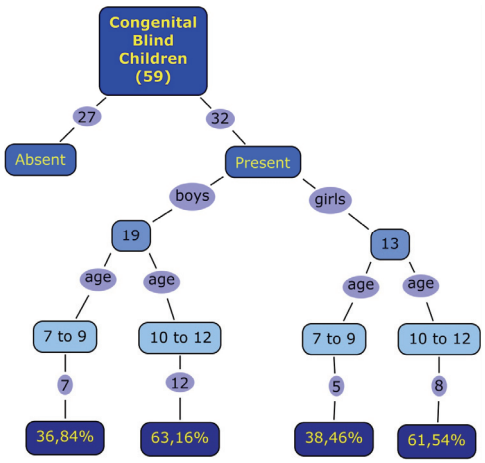

Figure 1: Sample Data.

3.2 Material

The Planned Codes subtest and its administration were adapted to the reality of both the researcher and the visually impaired. Therefore, it started containing tactile and visual features, besides the translation into Portuguese and the receipt to the tested person.

The original subtest consisted of four pages, in which two are referring to item 1 and two to item 2. On the first page of each item there is an example and a line for the child to practice before fulfilling the activity. In the second page of each item, on the bottom, there are seven rows and eight columns of letters without their codes. The top of each page contains the correlation between letters and the corresponding encodings. Thus, in the first item the correlation between letters and codes is A = OX, B = XX, C = OO, D = XO, and in the second item the correlation is A = XO, B = OO, C = XX and D = OX. Another difference between the items is given on the second page at the bottom of each item on the arrangement of the boxes with the letters: while in the first item all the letters (A, B, C and D) are arranged vertically and there are eight ABCDABCD columns, in the second item the letters are arranged according a diagonal pattern, in which each diagonal is formed by a sequence of the same letter.

The first step in the adaptation of the subtest was the translation into Portuguese. Then, the visual stimuli, as proposed in the original model were replaced by tactile stimuli, so that the test would fit to the children population with visual impairments. The subtest Key Book leaves were transformed into four plates (with the dimensions of 460 mm x 360 mm) containing a page of paper and another of thermoform (pellicle PVC that has an elevation which is detected tactually) on each plate. The contours around the columns were partially transformed into thermoform and in graphic printing writing - "ink" - in the background visually recognized). The letters (A, B, C and D) were both converted to "ink", in the background, and in Braille, on the surface. Codes present on the top of each page (OX, OO, XX and XO), within the boxes they were also printed in thermoform and in "ink".

This adaptation was made not only for blind children, but also for the researcher to recognize the letters or the symbols. In the paper part, there were four boxes with letters and their codes in "ink" for the applicator. Inside of each box there was a letter on the top, right below it a horizontal line and once again below it two codes separated by a vertical line. In the PVC pellicle, there were the same four boxes with their letters and respective codes, but in braille, for the visual impaired, in which, within each box represented by a square, at the top there was a letter, right below it an elevation indicating an horizontal line and below this line, the two symbols without the division in the middle.

The test physical adaptation had two models, the first was adequately reliable to the original test with lumps in each row and column, but the children got confused groping the last letter code with the first code of the next letter. Also, in the first model, on the second plate of every item, the bottom (in which the children would have to grope the letters in Braille and tell their codes), there were horizontal lines in high embossed what would influence children to a horizontal reading, from left to right from top to bottom and there would be no formation of strategies for solving the test. Therefore, it was necessary to readapt the plates, in which the vertical elevations located in the middle boxes and the horizontal lines situated on the second plate of each item, at the bottom were removed.

3.3 Procedures

The Planned Codes subtest was administered individually to each one of the congenital blind children. The subtest adaptation also occurred in the application procedure, but without compromising the original characteristics.

At first, there was the conduction of the child to the room application, who set on a chair and answer about some personal info (name, age, date of birth, school level). Then, it was explained to the child in a playful and detailed way, what she was doing there and how to undertake the test. After that, it was said to the child that he would play a game in which he had to be as fast as possible. The first plate was presented, the sample A, was picked up by the child's hands, led him to explore the entire plate asking him to say everything that was being tactually perceived. When performing the Example A and having identified that there were two codes for each letter, they passed to item 1 and it was repeated t the child to perceive all the plate and be as fast as possible during the subtest, and at the end of each item, to report what strategy did he used. The same was done also during the Sample B and item 2, drawing attention to the inversion of the symbols on the second step.

Despite the guidelines, there were no cases of timeout less than 180 seconds as the subtest for children who sees. It was decided, then, for the no stipulation of a time limit because of the study pioneer and absence of previous parameters to fix an average. The tactile perception is slower than the visual and this is the main explanation for the fact the children had presented a high rate in the timing.

3.4 Proposal Automation

With the goal of automating the entire process of

neuropsychological assessment, two studies for a new Planned Codes adaptation subtest were developed. The first is based on input and output of information via Augmented Reality (AR), in which the computer acts as disseminator and receiver of information via webcam from the perceived movements. The second is via Augmented Reality on input and output via voice command, where the computer is the vector of information and receiver of responses via verbalization. We opted for the first method, because the technology is already under construction and eliminates the process of training voice, in other words, adequacy of the machine to the vocal tone of each sample subject that is necessary for the second method.

Therefore, the computed adaptation is idealized as follows: the visually impaired will be exposed to a wooden board containing subdivisions into several squares. There will be a camera connected to this object with the function of capturing the movements made by the blind child on the board surface to the computer. These movements will represent the codes referents to each subtest letter. The visually impaired have to touch the center of the square to find out which letter matches it, because the camera will pick up the position of the finger and will return, with synthesized speech, the letter in question. The codes for each letter will have specific senses and direction, because there will be an internal configuration in the software in which each square vertex will receive an identification, i.e., when the sense will be forward, top to bottom, left to right and the direction will be the sum of a horizontal with a vertical, has itself a diagonal to the right and this will indicate the code "X"; when the felt will be back, top to bottom, right to the left and the direction will be the subtraction of a horizontal with a vertical, has itself a diagonal to the left and this will indicate the code "O". Figure 2 illustrates the structure of the automated adaptation.

$$x = y + 1h + 1v \quad (X)$$

$$o = y - 1h + 1v \quad (O)$$

During the instructions, the original subtest processes will remain, before each item there will be an example so there is no doubt over the two following items. And besides, in four squares located above will be the four boxes with their letters and their codes that, when touched, the synthesized voice of the computer will say whatever requested. This whole procedure will be reported, as well as the explanation that the beginning of each response should start by one of the edges above the square and by putting your finger in the center of the square, the computer will inform the corresponding letter. That is, in the four boxes situated above, which serve as an aid in case of forgetting the answer. If you touch one of the upper extremities of the square, the computer will tell what are next directions, in order to obtain the correct answers.

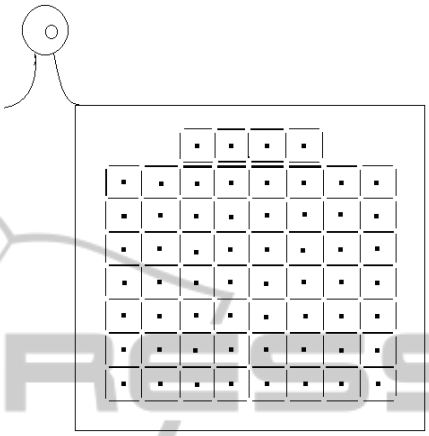

Figure 2: Wooden board containing subdivisions into several squares and a camera.

4 RESULTS

The analysis consisted in the grouping of raw scores, weighted scores, times in the item 1, times in the item 2 and prognostics, which the researcher produced during the subtest application phase, with the help of statistical program Orange Canvas. Such predictions were categorized into seven levels: standard (0), lack of attention (1), tiredness (2), agitation (3), motor and speech difficulty (4) difficulty of understanding (5), impatience (6) and non-realization of the subtest (7); which received numbers for statistical purposes.

Using the Orange Canvas program, it verified the correlation between variables inherent to the subtest and prognostics, in which their veracity was checked. The scatterplot tool observed the linear grouping of subjects in relation to the raw score (abscissa axis) and the weighted score (ordinate axis) according to the classified prognostics, figure 3. The results indicated the standard and lack of attention prognostics had a cluster in specific regions of tiredness, agitation, motor difficulty and on speech, difficulty of understanding and impatience, clustered between the two pertinent prognostics.

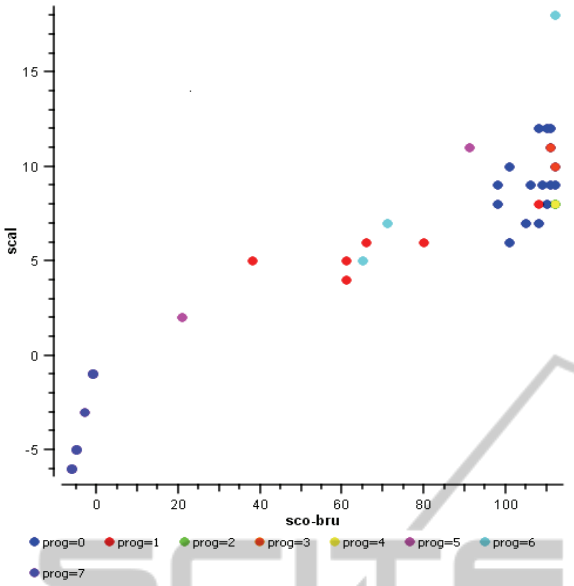

Figure 3: Scatterplot graph, where prog = 0 (standard), prog = 1 (lack of attention), prog = 2 (tiredness), prog = 3 (restlessness), prog = 4 (motor and speech difficulty), prog = 5 (difficulty comprehension), prog = 6 (impatience), prog = 7 (absent).

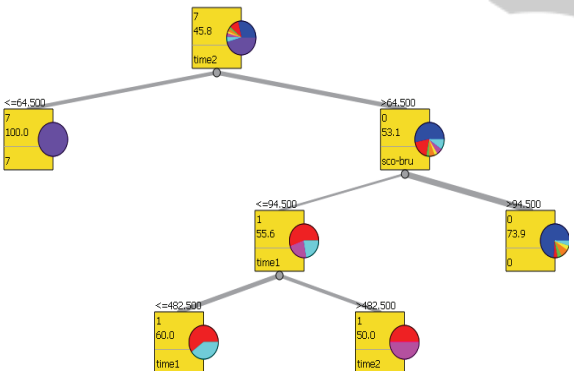

Figure 4: Classification Tree Graph.

The Classification Tree Graph was also used, in which a diagram was traced with the prognostic and its relation with all the variables above. According to figure 4, it was found that 23 of the 32 participants are in a same classification (having a gross score ≥ 94 500 and time in the item 2 ≥ 64 500), in which there were 17 subjects classified as standard, one as lack of attention, another as tiredness, two as agitation, one as motor and speech difficulty and another as impatience. The other nine participants were a group in which five were in ratings of lack of attention, 2 in difficulty of understanding and 2 in impatience, where the raw score was ≤ 94 500 and the time in the item 2 was ≥ 64 500. From this latter group was derived two more, in which there were three in lack of attention and two in impatience (raw score ≤ 94 500, time in item 1 ≤ 482 500 and time in item 2 ≥ 64 500), and the other had two of inattention and 2 as lack of comprehension (raw score ≤ 94 500, an item on time and time ≥ 482 500 ≥ 64 500 in item 2).

5 DISCUSS

From these results it is noticed that the cognitive planning of these children is to be encouraged for a better utilization and better intellectual training. Some of the points are to be used to substantiate this assertion are the fact of conditioning in reading (from left to right, top to bottom) and the excess in the chronological count, even with the guidance to be as fast as possible. However, according to Haddad, F. A. (2004), Planned Codes subtest measures, in fact, planning and not the processing speed. E Naglieri, J. A. (1999) rejected the criticism made to the planning subtests as speed tests, saying that the data involving the use of strategies and do no correlation with the conduct of speed tests such as the task of having to be simple, involving little or non thought and the fact that there was no use of strategies or anything more than repeating the same act as soon as possible. Therefore there was no significant loss as to the original proceedings, because the children continued having to develop strategies of better resolution to identify letters and their codes. This adaptation keeps maintaining the characteristics of the subtest that is to measure the cognitive valence, planning, because it does not take away the need to develop strategies for its resolution, i.e., to exploit the full spatial field for the cognitive artifices formulation.

It can be concluded, also, that the prognosis "lack of attention" was precise; which supports the hypothesis that CAS can trace compatible profiles with Deficit Disorder and Hyperactivity (PENDLEY, MYERS & BROWN, 2004). Studies on the relationship between CAS and the cognitive dysfunction indication have been held. Van Luit, Kroesbergen and Naglieri (2005) conducted a study comparing performance of Dutch children with and without ADHD with the performance of American children with and without ADHD. The findings showed that children with ADHD in both countries, showed relatively low scores on Planning and Attention scales of the CAS, although median scores in the Simultaneous and Successive scales.

6 CONCLUSIONS

The study demonstrates the weakness in researches aimed at exploiting blind children's cognitive in Brazil and a very prosperous area for research by cognitive sciences such as psychology and computing. This study reported a small but significant, influence of both sciences in neuropsychological development, in principle, and a future investment in neuropsychological research fully computerized for better coverage of data and facilities provided by computation for the advance in education cognitive and the formulation of possible neuropedagogic interventions.

7 FUTURE WORK

The process of adapting the CAS to the public of the visual impaired until the produced results showed us how the adaptation of a test for a different audience is laborious, because changes do not only occur in the physical structure of the instrument, but also in the language and method application. However, the whole adaptive process can not detract from the original proposal, and needs to be as reliable as possible. From this conjecture, I suggest the proposal for a future work, that is, to automate this whole adapted subtest process , in other words, we are proposing to develop a software, through which the webcam, can capture the movements of the blind student's finger on a concrete surface in high relief, reproducing on the computer screen the circle and / or 'X' shown by students in this area, giving a return, on the synthesized voice, about what was run by students, and this process will be stored internally in database of the system to prepare the evidentiary findings.

To develop this program, we are counting on infrastructure (computers and space) of GINAPE (Group Information Technology Applied to Education) of NCE / UFRJ, Federal trainees of the College Peter II and support of faculty of PPGI / UFRJ. We will use the Python language and libraries available on the website: www.hitl.washington.edu/ artoolkit/.

We are confident that this program will assist the applicator in the production of systematic results, it will also provide a larger sample and, finally, it will be an encouragement for visually impaired people performing the subtest in a dynamic, interactive and better adapted to their needs.

REFERENCES

Blaz Z., Gregor L., Janez D., Tomaz C., 2004. *Orange Canvas: Data Mining Fruitful & Fun.* Available at http://www.ailab.si/orange/ (accessed April 12, 2010).

Cruz, V., 2007. *O Cognitive Assessment System como instrumento de avaliação psicológica.* Revista de Psicologia da Vetor Editora, v. 8, n. 1.

Das, J. P., 1980. *Planning: Theoretical Considerations and Empirical Evidence.* Psychological Research, n. 41, p. 141-151.

Das, J. P. & Naglieri, J. A., 1997. *Cognitive Assessment System: Interpretative Handbook.* Riverside Publishing. Itasca, Illinois.

Luria, A. R., 1981. *Fundamentos da Neuropsicologia.* Editora da Universidade de São Paulo. São Paulo.

Haddad, F. A., 2004. *Planning versus speed: an experimental examination of what Planned Codes of the Cognitive Assessment System measures.* Archives of Clinical Neuropsychology, v. 19, n. 2, 313-317. doi: 10.1016/s0087-6177(03)00027-1

Moura, M. L. S. & Correa, J., 1997. *Estudo Psicológico do Pensamento: de W. Wundt a uma Ciência da Cognição.* Ed. UERJ. Rio de Janeiro.

Naglieri, J. A., 1999. How valid is the PASS theory and CAS? The School Psychology Review, v. 28, n. 1, p. 145-62.

Owen, Adrian M., 1977. *Cognitive Planning in Humans: Neuropsychological, Neuroanatomical and Neuropharmacologiacal perspectives.* Progress in Neurobiology, Great-Britain, v. 53.

Pendley, J. D., Myers, C. L., & Brown, R. D., 2004. *The Universal Nonverbal Intelligence Test with children with attention-deficit hyperactivity disorder.* Journal of Psychoeducational Assessment, v. 22, 124-135.

Seminério, F. L. P., 1984. *Infra-Estrutura da Cognição: Fatores ou linguagens?* Ed. Fundação Getúlio Vargas. Rio de Janeiro, Cadernos do ISOP nº4.

Shiho, T. O., Okazaki, S., Maekawa, H., 2007. *Differential topographic pattern of EEG coherence between simultaneous and successive coding tasks.* International Journal of Psychophysiology, v. 66, p. 66–80.

Silva, L. F., 2010. Geometrix *: Ensinado conceitos geométricos a deficientes visuais.* Rio de Janeiro: IM/NCE/UFRJ. Proposal of master's thesis.

Van Luit, J. E. H., Kroesbergen, E. H., & Naglieri, J. A., 2005. *Utility of the PASS theory and cognitive assessment system for Dutch children with and without ADHD.* Journal of Learning Disabilities, v. 38(5), p. 434-439.