



nesplora aula

PUBLICATIONS DOSSIER

A DISRUPTIVE CONCEPTION OF EVALUATING HUMAN COGNITION AND BEHAVIOUR USING
STANDARDIZED AND SCIENTIFICALLY VALIDATED VIRTUAL REALITY SCENARIOS

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OBJETIVES OF THE DOSSIER

This dossier aims to show the works done with Nesplora Aula, our investigations and the investigations in which third parties mention us. Also seeks to disseminate the contributions of Nesplora Aula to science through different investigations carried out by both Nesplora and different authors of reference. It also collects papers where Nesplora Aula has been quoted.

Thank you for relying on our product and for linking it to your product portfolio. Nesplora hopes that all the data of this dossier will be valuable for your company and will allow you to know more about our product Nesplora Aula.

NESPLORA

NESPLORA is a company born in the field of research. It is located in the technological and scientific park of Gipuzkoa and began its journey in October 2008.

NESPLORA is formed by a group of people committed to improving the knowledge about the human behavior. Nesplora's mission is to provide clinicians and researchers technological solutions that allow them to accurately study, diagnose or treat problems of the human behavior, improving the quality of life of their patients.

Nesplora designs and develops innovative tools to improve the diagnosis and treatment of patients with such transcendental and universal problems as Alzheimer, hyperactivity, mental illness, ictus or autism, among others. For doing that, Nesplora replicates real environments in virtual reality, so that the clinician can objectively measure the symptoms of these problems as if they were observing a real situation.

We reduce errors and evaluation times, with the consequent improvement of the quality of

life of the patients.

You can know more about us in <http://www.nesplora.com>

One of our products is Nesplora Aula, a virtual school classroom in which children can interact through virtual reality glasses. Within the simulation there are attention tasks to perform, and the software evaluates the tasks and gives a report back. This document assists the clinician in the assessment of Attention Deficit Disorder with or without Hyperactivity (ADHD).

With 398 clinics in 22 countries are using Nesplora Aula, and more than 40.000 children have benefited from a more accurate assessment of the attentional processes that underlie disorders.

* Throughout this dossier, the current name of the Nesplora Aula product is maintained, although in the articles themselves it may appear with the corresponding commercial name it had when published.

BOOKS & ARTICLES

The present work has two main objectives: to analyze the external validity of the AULA test and to study its diagnostic effectiveness with regard to ADHD. The selected sample consisted of 407 children (272 men and 135 women) between 6 and 16 years of the north of Spain. Among these, 213 had a diagnosis of ADHD (105 inattentive, 108 of combined type and 194 were controls). The results obtained show, on the one hand, an optimal convergent validity between the comparable variables of the Conners scale (validated in Spain with the name of EDAH) and the variables studied with AULA. On the other hand, they prove the efficacy of AULA to classify the subjects as pathological or healthy. These results provide a greater external validity to the tool.

Zulueta, A., Díaz-Orueta, U., Crespo-Eguilaz, N. & Torrano, F. (2018). Virtual Reality-based Assessment and Rating Scales in ADHD Diagnosis. Psicología Educativa. DOI: 10.5093/psed2018a18.

The goal of this project is to analyze the areas of application of virtual reality in Attention Deficit Disorder with Hyperactivity. Taking into account the brief and recent history of this technology in the childhood area, we have reviewed all publications dealing with the topic from 1990 until 2012. Based on our research, we have distinguished two basic applications: 1) Virtual reality as an instrument for the assessment and diagnosis of this disorder; 2) Virtual reality as a procedure for intervention and treatment. In this case, virtual reality can be applied as the sole technique or as part of multimodal programs, combined with cognitive behavioral techniques or with neurofeedback. This project presents the advances and drawbacks of this technology with respect to attention deficit-hyperactivity disorder.

Moreno, I., Díaz-Orueta, U., other authors (in press). Evaluación del TDAH basado en realidad virtual. Revisión monográfica sobre TDAH y realidad virtual.

Nesplora Aula virtual reality test, by means of quantifiable measures of cognitive symptoms, and third parties' direct observations of children's behaviors, collected by means of scales like EDAH, may complement each other and increase the accuracy of clinical diagnosis of ADHD.



Díaz-Orueta, U., Zulueta, A., & Crespo-Eguilaz, N. (in press). AULA NESPLORA virtual reality test and EDAH observation scale: complementary resources in the identification of ADHD. The Clinical Neuropsychologist.

In recent years, publications about Attention Deficit Hyperactivity Disorder (ADHD) using continuous performance tests are frequent, although there are few studies that allow us to have an overview of the numerous uses of these instruments and their variety. This project describes and analyzes the characteristics of this kind of tests, in relation to its use and application in ADHD with particular emphasis in the relationship between ADHD and the Integrated Visual and Auditory Continuous Performance Test (IVA/CPT). For this purpose, the scientific literature on the subject, covering the period from 1990 to May 2015 was reviewed. The results observed in 139 collected researches suggest two main utilities: 1) As a complementary tool for evaluation and diagnosis of ADHD and, 2) Regarding treatment, as a test to assess the efficacy of therapeutic interventions. The advantages and disadvantages of these instruments and its future projection are exposed.

Díaz-Orueta, U., Climent-Martínez, G., other authors (in press). *Los Tests de Rendimiento Continuo en Neurofeedback. Utilidad y Aplicaciones*. In: I. Moreno (Ed.). *Use of Neurofeedback at ADHD*.

In the chapter “*Advances in Neuropsychological Assessment of Attention: From initial computerized continuous performance test to Nesplora Aula*”, the tool Nesplora Aula is described in detail and refers that it is the only test in Virtual Reality with an extensive normative study carried out with clinic population. The combination of auditory and visual stimuli and distractors, which contribute more information to the diagnosis than unimodal CPTs, are emphasized. In the studies carried out with the tool, several results stand out: a) Nesplora Aula’s ability to discriminate between children with ADHD diagnosis and without diagnosis and, children with pharmacological treatment and without it; b) the influence of distractors on the performance of children; c) Nesplora Aula administered at a 1- week interval does not have a learning effect; d) it shows convergent validity with test d2 and faces; and finally, e) it is concluded that Nesplora Aula is able to differentiate between different cognitive profiles of ADHD. In summary, the studies show that Nesplora Aula is a valid test to measure attention and impulsivity, and is very useful to complete the diagnosis of ADHD with information about cognitive performance in an ecologically relevant simulation.

Díaz-Orueta, U. (2017). *Advances in Neuropsychological Assessment of Attention: From initial computerized continuous performance test to AULA*. En Kane, R.L. y Parsons, T.D. (Eds), *The Role of Technology in Clinical Neuropsychology* (pp. 103-136). New York, USA: Oxford University Press.

Currently, there’s no research that confirms the effectiveness of the lisdexanfetamina (LDX/ Elvanse®) on the improvement of cognitive functions in ADHD patients. The objective of this research was to assess the effectiveness of lisdexanfetamina (LDX/Elvanse®) in the improvement of behavioral and cognitive symptoms in a group of patients with ADHD. The effectiveness was measured using the test Nesplora Aula both before and after 7.5 months of the pharmacological treatment. The sample was composed by 88 ADHD patients who were between 5 and 20 years old. The results showed significant improvement in the post-treatment evaluation on selective and sustained attention, quality of the attention focus and hyperactivity, also moderate improvements

were found on impulsivity and an incidence almost nearly zero on processing speed. It can be concluded that Lisdexanfetamina (LDX/Elvanse®) is an adequate treatment for the improvement of the attention and hyperactivity and this improvement can be monitored with the virtual reality test Nesplora Aula.

Díaz-Orueta, U., Fernández-Fernández, M.A., Morillo-Rojas, M.D., & Climent-Martínez, G. (2016). Eficacia de la lisdexanfetamina en la mejora sintomática conductual y cognitiva trastorno por déficit de atención/hiperactividad: tratamiento monitorizado mediante el test AULA Nesplora de realidad virtual. Revista de Neurología, 63 (1): 19-27.

The current chapter describes the serious games and the game tools used for the psychological intervention in the book titled “*Integrating Technology in Positive Psychology Practice.*” In this chapter, a state of the art about the “serious games,” currently available in different formats (virtual reality, computer videogames) as psychological interventions, is provided as well as its effectiveness, when this data is provided. One of the examples described in this chapter is Nesplora Aula.

Díaz-Orueta, U. (2016). Serious Games and Gamified Tools for Psychological Intervention: A review. In: Villani, D., Cipresso, P., Gaggioli, A., & Riva, G. (Eds.). Integrating Technology in Positive Psychology Practice (pp. 290-314). Hershey, PA: IGI Global.

The aim of this study is to analyze the correlation between the ADHD Rating Scale-IV and Nesplora Aula, by means of analyzing how these two instruments correlate with the evaluation of the ADHD. The results found a significant and negative correlation between the score provided by the parents in the inattention variable and the mean of the reaction time when the child successes in the Nesplora Aula tasks. Besides, the scores provided by the parents in the rating scores have also correlated with the variability of the response in the test. Nesplora Aula and ADHD Rating Scale-IV address different aspects or dimensions of the patients and, hence, to complement each other in order to improve the accuracy of the diagnosis of the ADHD is a beneficial choice.

Moreno-García, I., Espinosa-Oneto, N., Camacho-Vara, C., Díaz-Orueta, U. (2015). Evaluación del trastorno por déficit de atención e hiperactividad mediante realidad virtual. Comparación con escalas conductuales. Comunicación y Pedagogía, 287-288: 33-37.

In this chapter a review about the neuropsychological intervention programs in different modalities is presented. In the introduction of this chapter, Nesplora Aula is mentioned as a neuropsychological evaluation test in virtual reality, which has been standardized for the Spanish population, and which is, according to its authors, the most accurate, sensible and specific test for the support to the diagnosis of the ADHD currently available.

Díaz-Orueta, U. (2015). *Procesos y programas para desarrollar la atención y mejorar el déficit de atención y la hiperactividad. Procesos y programas de neuropsicología educativa. Secretaría General Técnica. Centro de Publicaciones. Ministerio de Educación, Cultura y Deporte, pp. 154-168.*

In this chapter, the many points of criticism raised about the validity of traditional neuropsychological tests regarding their validity and questioning their predicting level of decline that individuals may show in their daily lives are described. In order to overcome this, and in parallel with the development and cost decreases of virtual reality (VR) technology, integration of informatics and neuroscience is approaching the achievement of a more objective, precise, and ecologically valid neuropsychological assessment based on VR technology. The current chapter describes the problems faced with classical neuropsychological assessment tools and the need of improvement of their validity; the potential advantages of using VR based neuropsychological tests versus classical tests; and the actual progress made in using VR based tools to measure cognitive functions such as attention, memory or executive functions, with some of these tools already standardized and available in the market. In the section of the VRtest for the measurement of the attention, Nesplora Aula is described.

Díaz-Orueta, U., Lizarazu, B., Climent-Martínez, G., & Banterla, F. (2014). *Virtual reality for neuropsychological assessment. In Ma, M., Jain, L.C., & Anderson, P. Virtual, augmented reality and serious games for healthcare 1 (pp. 233-255). Berlin: Springer-Verla.*



The aim of the present study is to analyze the convergent validity between the Nesplora Aula Test and the Continuous Performance Test (CPT) of Conners. The Nesplora Aula and CPT were administered correlatively to 57 children, aged 6-16 years with average cognitive ability, who had a diagnosis of attention deficit/hyperactivity disorder (ADHD) according to DSM-IV-TR criteria. Significant correlations were observed between both tests in every analyzed variable (omissions, commissions, reaction time, and variability of reaction time), including for those measures of the Nesplora Aula based on different sensorial modalities. Hence, convergent validity between

both tests was confirmed. In addition, the Nesplora Aula (but not Conners' CPT) was able to differentiate between ADHD children with and without pharmacological treatment for a wide range of measures related to inattention, impulsivity, processing speed, motor activity, and quality of attention focus. Additional measures and advantages of the Nesplora Aula versus Conners' CPT are found in the discussion section.

Díaz-Orueta, U., García-López, C., Crespo-Eguílaz, N., Sánchez-Carpintero, R., Climent-Martínez, G., & Narbona, J. (2014). AULA virtual reality test as an attention measure: Convergent validity with Conners. Continuous Performance Test, Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence, 20 (3), 328-342.

This chapter focuses on the use and effectiveness of serious gaming in rehabilitation and illustrates the possibilities and strengths in this new and exciting field. Furthermore, a review of the literature and examples of rehabilitation games are presented. The state-of-the-art technologies and directions for future research are also discussed. Rehabilitation gaming has great potential for today's and future health care, and despite the research gaps, there is increasing evidence that gaming can positively contribute to the rehabilitation and recovery process. The Nesplora Aula test is described in this chapter as an example of VR test for the evaluation of the ADHD.

Herman, H., Díaz-Orueta, U. (2013). Rehabilitation Gaming. In Arnab, S., Dunwell, I., & Debattista, K. (Eds.). Serious Games for Healthcare: Applications and Implication, (pp. 50-75.) United States of America: Medical Information Science Reference.

The aim of this paper is to analyze the convergent validity between the Nesplora Aula test and the CARAS perception of differences test (extended version). The final sample for the study consisted of 62 children between the ages of 6 and 16. The analysis measured similarity among variables using the cosine between score vectors. Significant correlations and over 0.6 were found between the results of the Nesplora Aula and the CARAS perception of differences test (extended version) in the selective attention, sustained attention, and cognitive impulsivity variables. This study establishes the convergent validity between the Nesplora Aula and the CARAS perception of differences test (extended version), meaning that in addition to being a highly ecological test, Nesplora Aula is an effective instrument for assessing attention processes.

Zulueta, A., Iriarte, Y., Díaz-Orueta, U., Climent-Martínez, G. (2013). AULA NESPLORA: Avance en la evaluación de los procesos atencionales. Estudio de la validez convergente con el test de percepción de diferencias "caras" (versión ampliada). ISEP Science. 04/2013.

The current study describes the main features of the Nesplora Aula test, and analyzes the performance of the Spanish normative sample of 1272 children from 6 to 16 years old from the

perspective of the influence of ecological visual and auditory distractors present in the test. Results show influence of distractors in both increasing reaction time for providing both correct answers and commission errors, and increasing the time the patients deviate their attention focus. Some of the anecdotes happened in different evaluation settings with relation to children's reactions to distractors appearing in Nesplora Aula are also presented.

Díaz-Orueta, U., Iriarte, Y., Climent-Martínez, G. & Banterla, F. (2012). An ecological virtual reality test with distractors for attention in children and adolescents. Journal of Virtual Reality, 5, 1-20.

The present study describes the collection of normative data for the Nesplora Aula test, a virtual reality tool designed to evaluate attention problems, especially in children and teenagers. The normative sample comprised 1,272 participants (48.2% female) with an age range from 6 to 16 years ($M=10.25$, $SD=2.83$). The Nesplora Aula test shows both visual and auditory stimuli, while randomized distractors of ecological nature progressively appear. Differences by age and gender were analyzed, resulting in 14 groups, 7 per sex group. Differences between visual and auditory attention were also obtained. Obtained normative data are relevant for the use of Nesplora Aula for evaluating attention in Spanish children and teenagers in a more ecological way.

Iriarte, Y., Díaz-Orueta, U., Cueto, E., Irazustabarrena, P., Banterla, F., Climent-Martínez, G. (2012). AULA-Advanced Virtual Reality Tool for assessment of Attention: Normative Study in Spain. J. of Atten. Disorders DOI: 10.1177/1087054712465335.



The purpose of the Nesplora Aula project has been to create a lab test team, or an objective variables test, ecological and useful, in order to help the clinicians to better diagnose the attention disorders and, in this way, prevent subsequent development and attention problems. In this manual, a review about the concept and characteristics of the ADHD as well as about the virtual reality, technologies used for the evaluation of the behavior is described. After this review, Nesplora Aula test is described and its statistical justification is presented. Finally, the process of installation and use is also described.

Climent-Martínez, G., Banterla, F. (2011). AULA. Theoretical Manual. San Sebastián: Nesplora.

“Nesplora Aula is the first well developed, norm referenced, virtual reality measure to evaluate attention, vigilance, impulse control and activity level in a simulated classroom. It represents assessment of the future yet available today”.

Dr Sam Goldstein. FEBRUARY 2016.

CONTRIBUTIONS TO CONGRESSES

This oral communication, presented at the 9th International Congress of School Psychology in Logroño (Spain), aims to define the fluctuation of the attentional processes through the developmental process in neurotypical children. The results, obtained from 1286 participants, show great stability of these processes in the ages of 6, 9 and 10 years old, targeting these periods as ideal for the neuropsychological assessment. On the other hand, ages of 11, 12, and 13 years old, are the periods with more instability in the results, coinciding with a critical period in the frontoparietal network development.

Moreno, M., Rebón, F., Aierbe, A., Mejías, M., González, M., Climent, G. (2018). Desarrollo atencional en la infancia: Estabilidad en los resultados de la exploración cognitiva. [Attention development in childhood: Stability in the results of cognitive evaluation]. XIX Congreso Internacional de Psicología y Educación, 20-23 Junio, Logroño, Spain.

The main objective of this study is to analyze the convergent validity of the Test Nesplora Classroom with the CPT 3 by Conners. The hypothesis is that both tools show an appropriate convergent validity in the variables that can be compared. The sample was composed of 43 participants (72.1% boys) between 6 and 14 years, with an average of 8.81 (SD = 1.68). The sample was incidental, the students of 2 centers of Madrid participated voluntarily. Non-parametric correlations (Spearman) were carried out to check the relationship between the variables evaluated by both tests. The results indicate that there is a relationship between the commissions, the average response time and the deviation of the average response time. No significant correlations between the omission scores of both tests were found. In conclusion, both tests show convergence in most of the indexes analyzed. However, there is no relation between the omission scores. This may be due to the different nature of both tests (visual stimuli vs. auditory and visual stimuli, computerized test vs. virtual reality test, etc.).

Redondo, M., González, N., Mejías, M., González, MF., Aierbe, A., Moreno, M., Pérez, C. (2018). Validez convergente entre las herramientas Nesplora Aula y el CPT de Conners 3. [Convergent validity between the tools Nesplora Aula and the CPT of Conners 3]. Oral communication presented at the II Ibero-American Congress Of Neuropsychology, Almería, 3-5 May 2018.

The data obtained up to now show good disposition on the part of the people before the RV and it has been proven that it is applicable in both clinical and non pathological population. This system, in addition to objective data, provides ecological validity to the tests.

Mejías, M., Climent, G., González, M., Moreno, M., Aierbe, A. (2018). VRMIND: Development of neuropsychological assessment tools in Virtual Reality. Oral presentation conducted at the 1st International Congress of Psychology, Technological Innovation and Entrepreneurship, 19-21 abril, Almería, Spain.

This process has resulted in an evaluation tool that issues an automatic report in which the results of the attention tasks are included, a section with a description of the attentional profile of the child and psycho-pedagogical strategies according to this profile.

Mejías, M., Redondo, M., Moreno, M., Aierbe, A. and González, M (2018). Nesplora Aula School: Development of a Neuropsychological Tool for the educational field. Oral presentation held at the I Congress of Psychology, Technological innovation and Entrepreneurship, 19-21 April, Almería, Spain.

The objective of this work is to analyze the convergent validity between a Continuous Performance Test (CPT) in virtual reality, such as Nesplora Aula, and the classic computerized CPT T.O.V.A. To carry out the research, a sample of 47 patients (46.8% female, age $m = 10.9$) with a diagnosis of ADHD (72.34%) or learning difficulties were used and their scores on both tests were compared. The results showed the existence of convergent validity between both tests at visual level by means of positive correlations with a level of significance between 0.003 and 0.019. In addition, Nesplora Aula provides greater ecological validity and combines visual and auditory stimuli.

Moreno, M., Aierbe, A., González, M.F. Mejías, M. (2018, March). Validez convergente entre tarea de ejecución continua computerizada y en realidad virtual [Convergent validity between computerized continuous execution task and virtual reality]. Poster presented at XX Congreso Internacional de Actualización en Trastornos del Neurodesarrollo, Valencia,

The aim of the present study is to assess the differential effect of Methylphenidate and Lisdexanfetamine (LDX) in the behavioral and cognitive symptomatic improvement of ADHD. The sample consists of 123 children (76.4% boys) between 5 and 20 years, all of them with ADHD diagnosis based on criteria of DSM-V and divided into two groups according to each pharmacological treatment. The virtual reality CPT Nesplora Aula was used to assess attentional processes and motor activity before and after having received treatment. The results showed significant differences in the Motor Activity scores when the distracting elements are present and in the No-Go task, as a reduced Activity is observed in the group with Methylphenidate.

Fernández, Fernández, M., Redondo, Zaballos, M., Mejías, M., González, Pérez, M.F. & Díaz-Orueta, U. (2017). Efecto diferencial del metilfenidato y la lisdexanfetamina en la ejecución del Test neuropsicológico AULA Nesplora en niños/as en tratamiento para TDAH. Poster exposed in XI Reunión Anual de la SENEP, 27 mayo, Madrid, Spain.

The objective of this study is to compare the Processing Speed Index (PSI) scores of WISC-IV with Response Time (RT) of Nesplora Aula, a CPT in virtual reality that measures attentional processes and motor activity. 35 children diagnosed with ADHD participated (74.3% male), with an age range from 6 to 16 years olds ($M=9.89$; $SD= 3.18$). The results showed that there is not significant relationship between the WISC-IV processing speed and the total mean value of response time

of visual stimuli on Nesplora Aula. However, there is a significant inverse relationship between the PSI of WISC-IV and RT of Nesplora Aula in the auditory stimuli. It is concluded that RT is a reliable measure of the time taken to respond to a stimulus, while the PSI corresponds to the time taken to complete a task. Therefore, PSI of the WISC and RT of Nesplora Aula do not measure the same construct.

Mejías, M., Delgado-Mejía, I.D., González, M.F., Redondo, C., Abadi, A. & Lalor, S. (2017). Comparison between processing speed of WISC-IV and response time of the CPT NESPLORA AULA in children with ADHD. Poster presented in the 6th World Conference on ADHD, Vancouver, Canada, 20-23 April 2017.

The aim of this study was to confirm whether children with ADHD, as they grow up, show less impulsiveness and if they maintain attention deficit. For that purpose, attentional profile of two groups (between the ages of 6 and 9 and between 12 and 16) were analyzed through virtual reality and continuous performance test (CPT) Nesplora Aula. 93 children with ADHD participated in each age group (72% male in the young group and 71% male in the old one). Nonparametric analysis for mean differences (Kruskal-Wallis) were carried out. The youngest group showed greater variability for reaction time (RT) and higher motor activity. The RT for the young group was longer in commission variables without distracting elements and in correct answers in GO task. The old group demonstrated a greater deviation of the focus of attention with distracting elements in both GO and No-GO tasks. We conclude that the RT of the youngest group is more heterogeneous during the test. Although its motor activity is higher than the other group's, they don't divert the focus of attention so much. Longitudinal studies which allow to deepen in this aspects are needed.

González, M.F., Mejías, M., Redondo, M., Otaduy, C., Crespo, N. y Pérez, C. (2017). Perfiles de impulsividad e inatención en niños con TDAH según la edad. XIX Congreso internacional de actualización en trastornos del neurodesarrollo. Valencia, España, 3-4 marzo 2017.

The objective of the research was to check out the ceiling effect and ground effect of the Nesplora Aula test. 13,046 people's data (69.8% male; mean age: 9.95 years) was analyzed to check the proportion of omissions and commissions (no omissions nor commissions indicate a ceiling effect and a maximum number of omissions and commissions indicate a ground effect) in total and in each condition (type of task, sensorial modality and with/without distractors) of the test. Only 5 people (0.035% of the sample) showed a ceiling effect by not making any mistake in the task. Regarding the ground effect, none of the people made the maximum number of omissions and commissions of the task. Finally, in relation to the people who made the maximum number of omissions and commissions, a clear pattern was not observed in the results. It was concluded that Nesplora Aula has a high discriminatory power, since it allows for evaluating the attentional abilities in children between 6 and 16 years of age without ceiling and ground effect.

Redondo, M., González, M.F., Mejías, M., Lizarazu, B., Rebón, F. (2016). Efecto techo y efecto suelo en un test (NESPLORA

Attention AULA) para la evaluación de procesos atencionales. II International Congress of Clinical and Health Psychology on Children and Adolescent. Barcelona, Spain, 17-19 November, 2016.

The objective of the research was to compare if children with ADHD diagnosis and impulsivity traits show faster reaction time (RT) than children without this trait. 208 children participated in the investigation (73.6% male, mean age: 10.20 years old, SD: 2.69). Nesplora Aula, a Continuous Performance Task (CPT) carried out in virtual reality, was used for the assessment. The RT of the underperforming children in the commission variable, impulsivity trait (score $T > 60$; $N = 89$) and the RT of the children with a high or normal performance (score $T < 60$; $N = 119$) was analyzed to see if there are significant differences between both groups. The result showed significant differences in all the RT between children with higher cognitive impulsivity and children who commission in Nesplora Aula's normal range, being shorter the RT of the first group. Therefore, in this study is concluded that the cognitive impulsivity of children with ADHD in a CPT paradigm is associated with shorter RT.

Redondo, M., Mejías, M., González, M.F., Zulueta, A. & Lizarazu, B. (2016). Effects of impulsivity (commissions) in the reaction times of children with ADHD. II International Congress of Clinical and Health Psychology on Children and Adolescent. Barcelona, Spain, 17-19 November 2016.



Traditionally, test with only visual stimuli have been employed for the evaluation of ADHD. Nevertheless, some researches underline that there is a difference between the cognitive processing of auditory and visual stimuli. The aim of this study was to analyze inter-group (ADHD and control) and intra-group differences in an attentional task with visual and auditory stimuli. For that purpose, the Nesplora Aula virtual reality test was used in a sample of 499 subjects aged 6 to 16 (66.3% male), 232 of them with ADHD. The results showed more mistakes in children with ADHD both in visual and auditory modality. Moreover, their RT (reaction time) was lower with visual correct answers and auditory commissions. This difference in the correct answers depending on the modality could have been due to the way of processing stimuli. Finally, the SD (standard

deviation) indicated a higher variability in subjects with ADHD. These results demonstrated the need to evaluate ADHD presenting both visual and auditory stimuli.

González, M.F., Zulueta, A., Redondo, M., Mejías, M., Otaduy, C. & González-Fraile, E. (2016) Patrón diferencial de respuestas de niños con TDAH ante los estímulos visuales y auditivos. IX International and XIV National Congress of Clinical Psychology.. Santander, Spain, 17-20 November 2016.

There is little evidence about the treatment with methylphenidate (MFT) through objective measures in children with ADHD. This study assesses the effectiveness in the behavioral and cognitive symptoms of the ADHD using the Nesplora Aula test before and after the pharmacological treatment. The sample was composed of 35 subjects between 6 and 19 years of age with a diagnosis of ADHD. After the treatment, the subjects commit less mistakes, the reaction time was shorter and more stable through the test and the motor activity index also decreases. In conclusion, the monitorization of the treatment with MTF through the Nesplora Aula test showed a significant improvement in the sustained attention, the processing speed and the motor activity.

Mejías, M., Redondo, M., Fernández, M., Díaz-Orueta, U. (2016). Eficacia del metilfenidato de liberación prolongada en la mejora sintomática cognitiva y conductual del TDAH monitorizado a través del Test AULA Nesplora. XXIV Congress of the Latin American Academy of Pediatric Neurology (AINP). Madrid, Spain, 8th-10th September, 2016.

The objective of this study was to check if the ADHD diagnosis is related with the reaction time measured through Nesplora Aula. 475 children between 6 and 16 years of age took part on the study, 208 of them were diagnosed with ADHD and the other 267 did not show any pathology. In the comparison between both groups, all the variables showed statistically significant differences ($p < .05$), except in the variable reaction time of the auditory stimuli. The ADHD group showed smaller reaction times in comparison with the control group. When the inattentive and combined subtypes were compared, no statistically significant differences were found ($p < .05$). This result shows the need of carrying out studies about the reaction time and the ADHD in Continuous Performance Test tasks, with the aim of identifying whether the slow reaction time is a symptom of the ADHD.

Zulueta, A., Redondo, M., Mejías, M., González, E. (2016). Tiempo de reacción en tarea GO/NO GO de AULA en niños/as de 6 a 16 años con y sin TDAH. 60ª Childhood and Adolescence's Psychiatry Congress (AEPNYA). Donostia, Spain, 1st-4th June, 2016.

The aim of this study was to verify the usefulness of the Nesplora Aula test in order to differentiate between the different clinical presentations of the ADHD. The Nesplora Aula test was administered to 124 children with ADHD diagnosis aged between 6 and 16 years. The results showed worse

performance for ADHD combined-type children than for inattentive in all presented variables. Combined-type children also showed (1) Worse visual processing speed and sustained attention and (2) More inattention and impulsivity when faced with auditory stimuli. Nesplora Aula test may provide objective information and increase the accuracy of differential diagnosis between ADHD clinical presentations, especially by measuring motor activity and deviation from the focus, as a low performance in these measures may be more representative of the hyperactivity component.

Díaz-Orueta, U., Fernández-Fernández, M.A., & Climent-Martínez, G. (2015). Objectivity in Clinical Diagnosis of ADHD by means of AULA virtual reality based neuropsychological test: Initial findings. 5th World Conference on ADHD. Glasgow, Scotland, UK. 28th-31st May, 2015.

The current study presents initial findings obtained from complementing observations measured by EDAH scale for teachers with cognitive variables assessed with Nesplora Aula. The sample was composed by 211 children aged between 6 and 16 years. Hyperactivity items were especially addressed by commission errors, means of motor activity, and deviation from the focus. Differences in inattention symptoms observed by teachers in EDAH were more significant for Nesplora Aula scores in auditory omissions and variability (SD) in reaction time, by means of quantifiable measures of cognitive symptoms, and third parties' direct observations of children's behaviors, collected by means of scales like EDAH, may complement each other and increase the accuracy of clinical diagnosis of ADHD.

Zulueta, A., Díaz-Orueta, U., Crespo-Eguilaz, N. & Ruiz de Eguino, S. Test de realidad virtual AULA y escala EDAH: recursos complementarios en la identificación del TDAH. Presented in the 7th National Congress of Neuropsychology 3.0. Bilbao, Spain, 15th-17th October, 2014.

The objective of the current study is to show convergent validity between Nesplora Aula and d2 attention test and to show Nesplora Aula's preliminary results in detecting attention problems and information processing patterns in children with reading disorders. Sample was composed by 60 children between 6 and 17 years of age. Sixty-eight percent of the group presented some type of learning disorders. The results showed that Nesplora Aula distinguished better than d2 between children with and without reading-writing difficulties. Convergent validity analysis showed adequate values for correct answers and concentration indexes while errors seemed to be measured differently in both tests. Compared to d2, Nesplora Aula can add value to the evaluation of attention abilities on children with reading-writing difficulties, providing valuable information on these children's information processing patterns.

Díaz-Orueta, U., Alonso-Sánchez, B., & Climent-Martínez, G. (2014). AULA versus d2 Test of Attention: Convergent validity and applicability of virtual reality in the study of reading disorders. 42nd Annual Meeting of the International Neuropsychological Society. Seattle, Washington, USA, 12th-15th February, 2014.

This study has a double aim: (1) To study the factorial validity of Nesplora Aula and (2) To analyze its convergent validity with EDAH scale and DSM-IV criteria. For the first aim, a sample of 2074 children were recruited and the results pointed out that the 18 variables studied tended to saturate a single factor. For the analysis of the convergent validity two subsamples of 188 and 360 children were analyzed. Results show low to moderate correlations between Nesplora Aula and EDAH and DSM-IV, being the highest correlation values for the inattention variable. Results support the structure of Nesplora Aula of one single factor. With regards to convergent validity, different nature of Nesplora Aula as an objective cognitive measure and EDAH and DSM-IV as observational scales suggest they target different aspects or dimensions of patients' behavior and, hence, they may complement each other in the increase of ADHD diagnosis accuracy.

Díaz-Orueta, U., García-Cueto, E., Alonso-Sánchez, B., Crespo-Eguílaz, N., Fernández-Fernández, M.A., Otaduy, C., Pérez-Lozano, C., & Zulueta, A. (2014). AULA Virtual Reality based attention test: factorial validity and convergent validity with EDAH scale and DSM criteria. 9th Conference of the International Test Commission, San Sebastián, Spain, 2nd-5th July, 2014.

The objective of this study was to analyze the neuropsychological processes of the executive function underlying in Nesplora Aula, in order to specify the cognitive profile which complements the behavioral diagnosis of the ADHD. In this study, 130 with ADHD diagnosis participated. The authors found that these children can be classified, according to their performance in Nesplora Aula in six groups: (1) inattention; (2) inattention and cognitive impulsivity; (3) inattention and motor hyperactivity; (4) inattention, impulsivity and hyperactivity; (5) moderate inattention and severe impulsivity-hyperactivity; (6) normal performance with an impulsive but effective cognitive style. Nesplora Aula allows the depth and accurate approach of the cognitive performance on kids with ADHD in order to plan intervention strategies.

Sánchez-Carpintero, R., Crespo-Eguílaz, N., Banterla, F., Climent-Martínez, G. (2013). Perfiles cognitivos de disfunción ejecutiva en el trastorno por déficit de atención según el rendimiento en la prueba de realidad virtual AULA. XV International Update Course of Neuropediatrics and Childhood Neuropsychology. Valencia, Spain, 28th February-1st March, 2013.

The objective of this study was to determine the Nesplora Aula ability to discriminate children diagnosed with ADHD versus a control group, being the sample composed by 62 children in each group. The result obtained showed that, by means of using the variables provided by Nesplora Aula, it is possible to obtain a correct classification of the 93.5% of the cases. Consequently we can say that the sensibility of the test as well as its diagnostic power are excellent.

Rufo-Campos, M., Cueto, E., Iriarte, Y., & Rufo-Muñoz, M. (2012). Estudio de sensibilidad de un nuevo método diagnóstico

para el TDAH: Aula Nesplora. *Neurol Magazine*; 54 (Supl3): S67-S93.

The general objective is to know the latest advances in the evaluation and measurement in the field of child neuropsychology and to know the most advanced tool available in the market as a support in the diagnosis of the ADHD. Nesplora Aula is a Continuous Performance Test based on virtual reality which assesses attention, impulsivity and motor activity. Nesplora Aula simulates an organic classroom so it has a high ecological validity. The test is attractive and it is perceived as a game, so the cooperation of the patient increases and the dropout rate is reduced at a minimum level.

Iriarte, Y., Climent, G., Banterla, F. (2011). AULA, la última innovación en la medición neuropsicológica del TDAH. Oral presentation in the Official Psychology Institution in Madrid and Asturias, Spain. November, 2011.

Iriarte, Y. (2011). AULA, la última innovación en la medición neuropsicológica del TDAH. Oral presentation made in the XII Latin American Neuropsychology Society Congress. Santiago de Chile, Chile. 7th-10th November, 2011.

Iriarte, Y. (2011). AULA, la última innovación en la medición neuropsicológica del TDAH. Oral presentation made in the I Pediatric Neuropsychology International Congress. Madrid, Spain. 22nd-24th October, 2011.

Iriarte, Y. (2011). AULA, la última innovación en la medición neuropsicológica del TDAH. Presentation made in the XIX Congress/ XXIII Postgraduate Course of the Latin American Academy of Pediatric Neurology. Buenos Aires, Argentina. 11th-14th October 2011.

In this publication, the Nesplora Aula tool is presented. This tool, besides the traditional indicator such as mistakes and successes, reaction times and others derived from these, also offers the possibility to evaluate other interesting data such as motor activity, the answer to distractor events, and the different performance to auditory and visual stimuli. Nesplora Aula also allows to know if the performance varies due to a generalized slowing or only when distractors are present, or if the sterile movements are responsible of the attention deficit.

Mujika, J., Climent, G., & Banterla F. (2011). Aula, una tarea en realidad virtual para la evaluación de la atención y el apoyo al diagnóstico del TDA. *Neurol Magazine*; 53 (10): 619-635.

NESPLORA AULA ALSO APPEARS IN

In order to provide specific information to guide the intervention, a study was carried out with a sample of 14 subjects with and without medication associated with ADHD, whose ages are between 13 and 16 years, and with a similar intellectual quotient (IQ) estimated through the use of 2 tests of the Wechsler Scale of Intelligence for Children (WISC-IV). Nesplora Aula, a Virtual Reality (VR) task, was used to assess attention and inhibitory control of the sample. Comparative analysis showed differences associated with increased vigilance and, to a lesser extent, processing speed by the group with medication. In general terms, an improvement in the performance of the medicated subjects has been observed, bringing their execution closer to the norm.

Cruz Campos, M. I. (2018). Valoración de la atención y el control inhibitorio en adolescentes con Trastorno por Déficit de Atención con Hiperactividad medicado y no medicado a través de una tarea en realidad virtual. (Master's degree thesis). Faculty of Psychology, University of Almería, Almería, Spain.

The main objective of this doctoral thesis is to study the relationship between ADHD and the intellectual profile, the selective and sustained attention of the subjects who suffer from it. For this, the results obtained in various scientific publications are collected in reference to the convergent validity of the tests most used in Spain when evaluating the care of subjects with ADHD, highlighting the Nesplora Aula test. The mentioned results indicate a significant correlation of this test with the concentration index of the attention test d2; with the means of commissions and omissions of the CPT-II and with the number of correct answers of the "Caras" perception of differences test. At the same time, the high levels of reliability obtained with Nesplora Aula are mentioned in the following variables: auditory corrects, visual corrects, total corrects, corrects in X (Go) task and corrects in X-no (No-go) task.

Relación entre diagnóstico de TDAH y los procesos intelectuales y atencionales en muestra clínica: comparación entre TDAH y Trastorno del aprendizaje [Relationship between the diagnosis of ADHD and the intellectual and attentional processes in a clinical sample: comparison between ADHD and Learning Disorder] (Doctoral thesis). Universidad Autónoma de Madrid, Madrid.

Recent research into the assessment of leadership competencies has proposed the use of objective methods and measurements based on neuroscience. A way to address this question is to take advantage of virtual environments to recreate real-life situations that might arise in performance-based assessments.

It has been shown that the neural mechanisms that humans have when immersed in virtual environments are very similar to the mechanisms that originate in real life. A recent wide-ranging review of the existing literature on VR and social cognitive neuroscience reported the effective use of VR in several domains. In cognitive neuropsychological assessment, VR can measure the complexity of responses with high correspondence with daily situations. Among these

tools is Nesplora Aula. In conclusion, by embedding assessment methods into virtual learning environments, VR can provide objective assessment methods with high ecological validity.

Alcañiz, M., Parra, E. & Chicci, I.A. (2018). *Virtual Reality as an Emerging Methodology for Leadership Assessment and Training*. *Frontiers in Psychology*, 9. doi: 10.3389/fpsyg.2018.01658

alladares-Rodríguez, S., Fernández-Iglesias, MJ., Anido-Rifón, L., Facal, D., Pérez-Rodríguez, R. (2018). *Episodix: a serious game to detect cognitive impairment in senior adults. A psychometric study* *PeerJ*. 5;6:e5478. doi: 10.7717/peerj.5478. eCollection 2018

Álava, S. (2018). *Relación entre diagnóstico de TDAH y los procesos intelectuales y atencionales en muestra clínica: comparación entre TDAH y Trastorno del aprendizaje [Relationship between the diagnosis of ADHD and the intellectual and attentional processes in a clinical sample: comparison between ADHD and Learning Disorder]* (Doctoral thesis). Universidad Autónoma de Madrid, Madrid.

This article analyses the psychometric validity of the serious game Episodix to evaluate episodic memory and its ability to discriminate between Mild Cognitive Impairment (MCI), Alzheimer's Disease (AD) and people without cognitive impairment. A cross-sectional pilot study was conducted with 64 people (28 controls without impairment, 16 with MCI and 20 with AD) to which they were administered both classical pen-and-pencil test and the games developed. The authors found promising results about the psychometric validity of Episodix which, in their view, represents a step forward towards the introduction of serious games and machine learning to detect MCI or AD. The authors of this article highlight the need to develop alternative ecological mechanisms that support early diagnosis of cognitive impairment and, among others, talk about the implementation of technology-based solutions such as the virtual reality, within which they refer the Nesplora Aula tool.

Valladares-Rodríguez, S., Fernández-Iglesias, MJ., Anido-Rifón, L., Facal, D., Pérez-Rodríguez, R. (2018). *Episodix: a serious game to detect cognitive impairment in senior adults. A psychometric study* *PeerJ*. 5;6:e5478. doi: 10.7717/peerj.5478. eCollection 2018.

The present study aimed to compare the cognitive variables (working memory and processing speed) and the attentional profiles of a sample of students with and without ADHD, using scales from the WISC-IV and Nesplora Aula. At the same time, determine the extent to which the aforementioned variables may predict student group membership. A total of 88 students took part in this study, aged from 6 to 16 years. The sample was divided into two groups: an ADHD group (n = 50) and a Control group (n = 38). Students in the ADHD group obtained lower scores in working memory and in processing speed, as well as demonstrating poorer performance in Nesplora Aula than did their peers. Working memory, and the number of omissions, were both shown to be reliable predictors of group membership. This study revealed the importance of obtaining data from attentional variables differentiated by modality when considering cognitive variables, in order to better characterize the difficulties experienced by individuals diagnosed with ADHD. Nesplora Aula, unlike other traditional CPTs, provides the possibility of discriminating between tasks in both the presence and absence of distractors, an aspect which is relevant in the diagnosis of ADHD and important for the improvement of classroom learning environments. In

particular, this study showed that response time variables collected in the presence of distractors are more effective in distinguishing between children with ADHD and children without ADHD, as the effect size demonstrated. These results represent the advantages of assessing ADHD symptoms using VR instead of traditional CPTs, as VR allows the measurement of executive variables in the presence of far more realistic distractors.

Areces, D., Dockrell, J., García, T., González-Castro, P. & Rodríguez, C. (2018). Analysis of cognitive and attentional profiles in children with and without ADHD using an innovative virtual reality tool. Plos One 13(8), 1-18.

The objective of this study is to compare the discriminative value of the variables provided by the CPT based on virtual reality Nesplora Aula in comparison to those collected by the traditional CPT Test of attention variables; TOVA to identify the different presentations of ADHD. The results indicated that Nesplora Aula predicts better than TOVA the presentations of ADHD, as well as students without ADHD. The advantages of the use of virtual reality in the evaluation of ADHD are discussed, since they facilitate the diagnosis of the disorder and the differentiation of its presentations.

Rodríguez, C., Areces, D., García, T., Cueli, M. & González-Castro, P. (In press). Comparison between two continuous performance tests for identifying ADHD: Traditional vs. virtual reality. International Journal of Clinical and Health Psychology.

Brain-computer interfaces (BCI) process brain waves to transform them into actions through a machine, and there are inter-individual differences when it comes to learning to use them. One of the objectives of this work is to identify the variables that interfere in this learning. The sample consists of 91 people (75 women and 16 men) with an average age of 19.5 years ($SD = 4.9$). One of the tools used is Nesplora Aula. Among the results are significant negative correlations ($r = .654$, $p = .019$) between the learning of the BCI and the reaction time in the errors (impulsive style). On the other hand, significant positive correlations were observed with the reaction time of task Xno (hyperstimulant) ($r = .705$; $p = .014$) and with the reaction time in the absence of distractors ($r = .692$; $p = .051$).

Candela, G., Suay, F. & Quiles, E. (2018). Attentional variables and BCI performance: comparing to strategies. En C. Pracana & M. Wang (eds.), International Psychological Applications Conference and Trends (InPACT), Lisbon, Portugal.

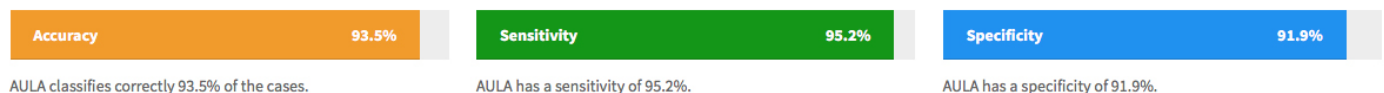
This work aims to differentiate attentional and inhibitory control profiles in Attention Deficit Hyperactivity Disorder (ADHD) and Autistic Spectrum Disorders (ASDs) using a virtual reality neuropsychological test called Nesplora Aula, which includes visual and auditory stimuli, two different tasks (Xno and X) and distracting conditions. The sample consists of 18 unmedicated boys

matched by age (7-10 years), diagnosed with ADHD-inattentive subtype (ADD) and ASDs (High-Functioning). The main results indicate that ADD and ASDs groups share attention deficit. In fact, the second group shows more attention problems than ADD group. However, their attentional profile is different depending on the type of task, since ADD patients has more problems in the X paradigm (low response rate) and ASDs remain uniform regardless of the response paradigm. Nesplora Aula is considered a useful test to study and compare attention and inhibitory control in neurodevelopmental disorders such as ADD, but also ASDs.

Fernández, P., Cánovas, R., Moreno, M., Delgado-Mejía, I.D., Lalor, S., Sánchez-Santed, F. y Flores, P. (2018). Attention and inhibitory control in neurodevelopmental disorders: a new assessment approach through nesplora aula. Poster presented in the II Congreso Iberoamericano de Neuropsicología [Ibero-American Congress of Neuropsychology], 3-5 mayo, Almería, Spain.

Neuropsychology applied to the educational context focuses on evaluation, diagnosis and intervention with students in the school environment. This discipline provides the professional community with an increasing knowledge about the learning processes, the neuropsychological bases and the levels of neurodevelopment of each educational stage. The article offers many suggestions to improve the set of knowledge in this promising area of neuropsychology, where Nesplora Aula stands out as a neuropsychological assessment tool that overcomes the barrier of ecological validity. On the other hand, it highlights its good psychometric properties in comparison with the Conners CPT, in addition to the ability to monitor a pharmacological treatment.

Studies performed with AULA show its validity, sensitivity and reliability.



AULA has a normative sample of approximately 1,500 children between 6 and 16 years old.

Martínez-Álvarez, I. (2018). Neuropsychology Applied to Education: Theoretical Framework and Intervention Areas for the Reading Competence and Attention Difficulties. Revista de investigación Magister, 2.

The main objective of this work was the detection, diagnosis and treatment of children with ADHD. For the diagnosis of ADHD the criteria of the DSM-V and the Nesplora Aula test were used. After making a differentiation between the children who did not have ADHD and those who did, the sample was divided into two groups: control group and experimental group, with which an intervention was carried out. After the intervention, the children were re-evaluated with Nesplora Aula and the DSM-V criteria. Comparing the two diagnostic tests, it was concluded

that the tools are complementary as they use different criteria. While DSM-V only classifies 3 subtypes of ADHD (predominantly attention deficit, predominantly impulsivity/hyperactivity and combined), Nesplora Aula distinguishes between 5 subtypes (no ADHD, impulsive without ADHD, slow reaction time (RT) without ADHD, slow RT with ADHD and ADHD), in this way we can obtain a broader view of the symptomatology.

Otaduy Vivo, M. C. (2017). Análisis y propuesta de intervención psicopedagógica en niños de primaria con déficit de atención: del trastorno al síntoma (Doctoral Thesis). Universitat de València, Valencia, Spain.

The objective of this work was the detection, diagnosis and treatment of children with ADHD through Aula Nesplora and the DSM-5. The secondary objective was to detect, diagnose and treat the learning difficulties underlying this pathology (dyslexia and dyscalculia, ELD and language delay). The sample of 112 children (6-12 years old) is divided into an experimental group and another control group. A pre and post test design has been used, with a multidimensional intervention in the experimental group. The results concluded that the number of children diagnosed according to the DSM-5 criteria was not replicated with AULA Nesplora, since a small proportion of children were not diagnosed as ADHD through Nesplora AULA, but with attention deficit without ADHD or impulsivity without ADHD. After the intervention, quantitative and qualitative improvements were evidenced both in ADHD and in dyslexia.

Otaduy, M.C.L. (2017). Análisis y propuesta de intervención psicopedagógica en niños de primaria con déficit de atención: del trastorno al síntoma [Analysis and proposal of psychopedagogical intervention in primary school children with attention deficit: from the disorder to the symptom] (Doctoral thesis). Universitat de València, Valencia, Spain.



In order to analyze the functioning and usefulness of the virtual reality test Nesplora Aula in the Guidance Department to improve the evaluation of ADHD, a sample of 20 students was selected: 10 with ADHD and another 10 without any type of learning difficulty. A questionnaire was also applied to 20 counselors from different centers to obtain a realistic view of the need for virtual reality tests in the Guidance Departments. The results show that the test is interesting for the counselors, since, in addition to the high ecological validity, it provides a very complete information on the attention processes of the students and measures certain aspects, such as motor activity, which are not easy to evaluate without a tool of these characteristics. In addition, Nesplora Aula

efficiently discriminates subjects with and without ADHD, in addition to evidencing differences between the different types of ADHD. For students it is a very attractive and motivating tool, contemplating the test as a game.

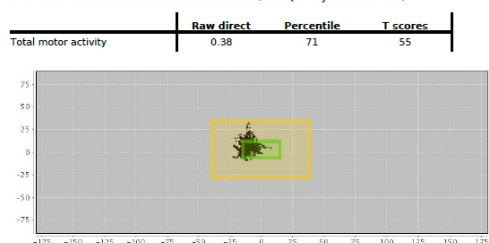
Martínez Feu, A. (2017). *Realidad virtual aplicada a la evaluación del TDAH en el departamento de orientación. Aula Nesplora* [Virtual reality applied to the evaluation of ADHD in the guidance department. Aula Nesplora] (Master's dissertation). University of Salamanca, Salamanca.

Since Virtual Environments (VEs) allow for precise presentation and control of dynamic perceptual stimuli, they can provide ecologically valid assessments that combine the control and rigour of laboratory measures with a simulation that reflects real-life. Therefore, VE-based neuropsychological assessments can provide a balance between naturalistic observation and the need for exacting control over key variables. Nesplora Aula, which contains Go/No-Go stimuli, is considered to have good convergent and discriminant validity. Furthermore, it offers enhanced classification of attentional deficits when distractors are introduced into the VE.

Parsons, T.D., Carlew, A.R., Magtoto, J. & Stonecipher, K. (2017). *The potential of function-led virtual environments for ecologically valid measures of executive function in experimental and clinical neuropsychology. Neuropsychological Rehabilitation*, 27(5), 777-807.

6 Motor activity

These graphics below demonstrate Stephanie's head movement throughout the test. The yellow framework represents the zone in which the virtual blackboard can be seen. Movement out of that zone makes it impossible for the child to correctly perform the visual task. The dot diagram below provides a visual image of Stephanie's attention to the blackboard and to the general task. If Stephanie has looked to the blackboard's zone and has not performed the task correctly, internal distractors should be considered (see Quality of Attention).



The index of motor activity can reflect many phenomena, including: a tendency to become distracted by external stimuli (see distractor graphic), motor activity with no relation to distractors or in the case of low activity but poor task performance, possible internal distractors (see quality of attention graphic).



The aim of the present work is to present the design, development and preliminary validation of a digital tool which assesses episodic memory in people over the age of 55, in order to overcome difficulties related to early detection, ecological validity, learning effect, etc. In this work, Nesplora Aula is considered a relevant contribution to the study of different cognitive domains, in particular, attention, through video games and serious games. This format is able to represent real life environments, helping in the standardization of the application and in the efficient data collection.

Valladares, S., Perez-Rodriguez, R., Facal, D., Fernandez-Iglesias, M.J., Anido-Rifón, L.E & Mouriño-García, M. (2017). *Design process and preliminary psychometric study of a video game to detect cognitive impairment in senior adults. PeerJ*, 5(6doi/10.7717/peerj.3508.

Attention Deficit Hyperactivity Disorder (ADHD) and Language Disorders (LD) are two of the most frequent neurodevelopmental disorders in preschool and school childhood population, but can continue in adolescence and adulthood, and affecting their quality of life. Although these disorders present clinical and etiological heterogeneity, evidence shows that they share deficits in executive functions, especially in attention, motor activity and inhibitory control. The virtual reality (VR) test Nesplora Aula, specially designed for the evaluation of attention, vigilance, inhibitory control and activity level, was used to compare the attentional and inhibitory control profiles of ADHD and LD groups of children (6-12 years old), since VR technology is proposed as an useful tool that allows a better and accurate assessment because of their greater sensibility and power of discrimination. ADHD group showed higher attentional problems than LD group. The LD performance is influenced by the sensory modality in which the stimuli are presented, while ADHD performance is related to the response rate demanded by the task.

Fernández, P., Cánovas, R., Moreno, M., Sánchez-Santed, F. & Flores, P. (2017, July). Neuropsychological profiles of attention and inhibitory control in neurodevelopmental disorders through a virtual reality test. Presented on the II International congress of Psychobiology, Ávila, Spain.

The aim of this work was to evaluate the similarities and differences between Nesplora Aula and BrainGaze studies' results in the assessment of ADHD, bearing in mind the importance of an objective measure when doing a diagnosis. The sample consists of 30 children (65% boys) between 6 and 18 years and all of them have a diagnosis of ADHD based on criteria of DSM-V. The results show that the assessment of ocular vergences obtained results consistently similar with an 85% correlation compared to the CPT. Authors conclude that the combination of different digital assessment tools, together with the personal interview and the elaboration of assessment scales, is the most effective and efficient strategy for the assessment and diagnosis of ADHD.

Fernández, Fernández, M. & Morillo, Rojas, M.D. (2017, May). Estudio comparativo entre AULA NESPLORA y BRAINGAZE en la evaluación funcional del TDAH. Poster exposed at the XI Reunión Anual de la SENEP, 27 mayo 2017, Madrid, Spain.

The process of evaluation-diagnosis of ADHD is far from being easy since there are many factors involved in it. The attentional profile of ADHD is nowadays commonly examined by means of Continuous Performance Tests (CPTs). Nonetheless, they are also criticized for their low ecological validity, as these settings differ considerably from most of the daily settings in which the children and adolescents are immersed. Due to the limitations of CPTs, new tools utilizing virtual reality technology have recently been developed. One such development mentioned in this publication is Nesplora Aula, which is considered a reliable and valid diagnostic system for children, replicating as closely as possible the typical conditions of a classroom.

Rodríguez, C., García, T., & Areces, D. (2017). New and Future Challenges Concerning the Use of Virtual Reality Tools for Assessing ADHD. Current Developmental Disorders Reports. DOI: 10.1007/s40474-017-0103-4.

The aim of the present work was to determine the prevalence of sleep disorders in children with attention deficit/hyperactivity disorder (ADHD) and in a control population, as well as to examine the relationship between sleep disorders and symptoms of inattention, hyperactivity/impulsiveness and executive dysfunction. To do so, executive functions, sustained attention and impulse control were assessed in a sample of 126 children from 5 to 18 years through the Conner's CPT (Continuous Performance Test) and the virtual reality based CPT Nesplora Aula. Authors consider Nesplora Aula a reliable virtual reality measure of continuous performance that provides information about sustained attention and impulse control. It has been validated, norm referenced, and has convergent validity with the Conner's CPT. Results showed that children with ADHD slept less at night and that there is a correlation between shorter duration of night-time sleep and omission errors. Difficulty falling sleep were more frequent in children with ADHD whose symptoms were not treated pharmacologically, than in children receiving treatment.

Vélez, R., Guillén, F., Crespo, N. & Sánchez, R. (2016). *Prevalence of sleep disorders and their relationship with core symptoms of inattention and hyperactivity in children with attention-deficit/hyperactivity disorder. European journal of pediatric neurology: EJPN*, 20(6), 925-937.

Neuropsychological Assessment 3.0 Nesplora Aula is presented as perhaps the best validated test of the virtual classrooms. Nesplora Aula is significantly correlated with the traditional CPT and can distinguish between children with ADHD with and without pharmacological interventions. In comparison with the TOVA, Nesplora Aula was found to be more sensitive to reaction time and rate of omission errors and was also rated as more enjoyable. In relation to the Conners' CPT, a significant correlation was indicated in the variables of omissions, commissions, reaction time, and variability of reaction time.

Parsons, T.D. (2016). *Clinical Neuropsychology and Technology: What's New and How We Can Use It*. Switzerland: Springer.

This study has three objectives: (1) To check if the Nesplora Aula test gives complementary information to the ADHD diagnosis; (2) To explore ADHD subtypes not included in the DSM-5; (3) To compare the results obtained in Nesplora Aula with the DSM-5 results in order to see if they are complementary. The sample consisted of 96 patients between 6 and 16 years of age with ADHD diagnosis. Among their findings, the authors found ADHD subtypes not included in the DSM-5. The correlations between DSM-5 and Nesplora Aula variables did not were statistically significant. The discriminant analysis showed an agreement between DSM-5 and Nesplora Aula in the 70.5% of the cases. The authors conclude that the Nesplora Aula test complements the clinical diagnosis of the ADHD specifying cognitive profiles.

Erostarbe, M., Crespo-Eguílaz, N. (2016). *Evaluación Neuropsicológica complementaria al Diagnóstico Clínico del Trastorno por Déficit de Atención e Hiperactividad. Poster presented in the XXXIX Annual SENEP Meeting*. May, 2016.

This study compares the performance in a continuous performance test within a virtual reality classroom (CPT-VRC) in 94 children divided into three groups: (1) Medicated children with ADHD; (2) Unmedicated children with ADHD; (3) Healthy children. The authors found that the unmedicated ADHD group showed more omission errors and showed slower reaction times than the healthy group. Likewise, reaction time variability was higher in the unmedicated ADHD group compared with the other two groups. The authors wrapped up that virtual reality is a promising technology to assess ADHD symptoms in an ecologically valid environment. In this article the authors describe the Nesplora Aula test and mention the capacity of this test to differentiate between those children taking medication and those who do not take it.

Mühlberger, A., Jekel, K., Probst, T., Schecklmann, M., Conzelmann, A., Andreatta, M., et al. (2016). The influence of methylphenidate on hyperactivity and attention deficits in children with ADHD: a virtual classroom test. *Journal of Attention Disorders*, 1-13. DOI:10.1177/1087054716647480.

This review investigates the advantages and challenges inherent in the application of virtual reality technologies to psychological assessment and interventions. In this review, Nesplora Aula is mentioned in the section of validated tests that are developed in a virtual classroom for the assessment of attentional processing. The normative study and the convergent validity study with the Conners Continuous Performance Test are mentioned. The authors conclude that “the addition of virtual reality to a psychological battery provides an opportunity for psychologists to obtain more ecologically valid data about client functioning in simulations of dynamic perceptual stimuli and the sensitivity of the test while capturing data about client performance in activities of daily living.

Parsons, TD. (2016). *Virtual Reality for Psychological Assessment in Clinical Practice*. *Practice Innovations*, 1(3): 197-217.

In this study, the authors analyze the diagnostic effectiveness of the Nesplora Aula test to discriminate between different ADHD presentations. A total of 117 students participated, and were divided into three groups with ADHD according to their presentation, and a control group. Each of the test conditions allowed the discrimination between the impulsive/hyperactive (I/P) and combined presentations with respect to the control group, and between the I/H and inattentive presentations. However, differences among ADHD presentations were only evident when the results were separately analyzed for the visual and auditory modalities. This study showed that the indicators offered by the Nesplora Aula test (omissions, commissions, response times, and motor activity) makes possible to establish a differential diagnosis of ADHD presentations when analyzed under different contextual conditions.

Areces, D., Rodríguez, C., García, T., Cueli, M., González-Castro, P. (2016). Efficacy of a continuous performance test based on virtual reality in the diagnosis of ADHD and its clinical presentations. *J. of Atten. Disord.* DOI: 1087054716629711.

This book deals with ADHD by going from its definition and evaluation, to intervention, orientations for parents and teachers, experts opinions and families' stories. Within the Chapter on "Evaluation, diagnosis and treatment of ADHD", in the test subsection Standardized to evaluate care, describes the Nesplora Aula test highlighting expressly that one of the most outstanding characteristics is that it has a very high ecological validity and that is the most sensitive test to detect ADHD (95.2% of cases correctly identified) and also the most specific for those who are not (91.9% Correctly discarded).

Guerrero, R. (2016). Trastorno por déficit de atención con hiperactividad. Entre la patología y la normalidad. [Attention deficit hyperactivity disorder. Between pathology and normalcy]. Barcelona: Planet.

This study assessed whether urinary arsenic (UA) levels are associated with attention performance and ADHD. A cross-sectional study was conducted on 261 children aged 6-9 years. Attention was measured by using 4 independent tools: a) tests from the Behavioral Assessment and Research System (BARS): RTT, CPT and SAT; b) Nesplora Aula Test; c) Child Behavior Checklist (CBCL), administered to parents; and d) Teacher's Report Form (TRF), administered to teachers. Higher UA levels were associated with an increased latency of response in RTT and SAT as well as with a worse performance on selective and focalized attention in the Nesplora Aula test. A dose-response relationship was observed between UA levels and inattention and impulsivity scores. On the other hand, results from the CBCL and TRF tests failed to show a significant association with UA levels. In conclusion, UA levels were associated with impaired attention/cognitive function, even at levels considered safe.

Rodríguez-Barranco, M., Gil, F., Hernández, AF., Alguacil, J., Lorca, A., Mendoza, R., Gómez, I., Molina-Villalba, I., González-Alzaga, B., Aguilar-Garduño, C., Rohlman, DS., Lacasaña, M. (2016). Postnatal arsenic exposure and attention impairment in school children. Cortex, 74: 370-382.

The current meta-analysis aimed: (1) To investigate the sensitivity of virtual reality-based measures of cognitive processes between clinical and healthy populations; (2) To investigate potential moderators of the results. The findings support the sensitivity of virtual reality-based measures in detecting cognitive impairment. That means that the control groups of this meta-analysis obtained better scores in these evaluation tools in comparison to the clinical groups. These authors highlight that Nesplora Aula is the only virtual reality-based tool designed to measure attention impairments in children with ADHD which has been standardized.

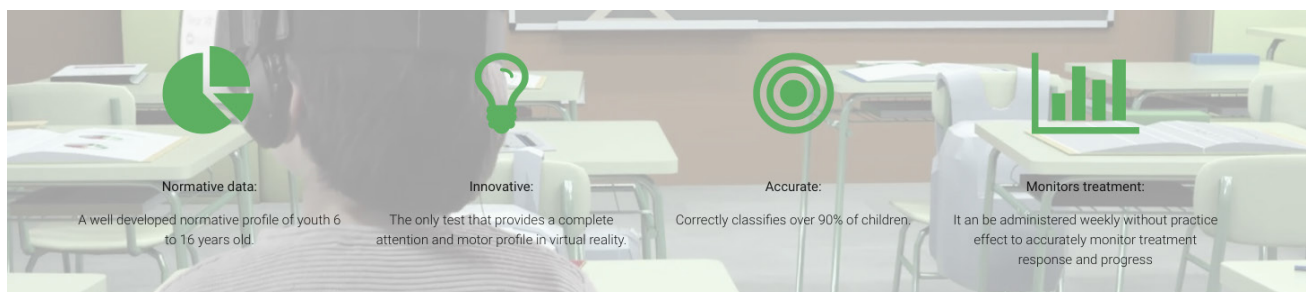
Negut, A., Matu, SA., Sava, FA., David, D. (2016). Virtual reality measures in neuropsychological assessment: a meta-analytic review. The Clinical Neuropsychologist, 29: 1-20, DOI: 10.1080/13854046.2016.1144793.

In the current paper, the authors review the virtual reality instruments for the neuropsychological assessment of executive functions. Within these instruments, they mention Nesplora Aula as a virtual environment which has proven to have a good convergent and discriminant validity.

Parsons, TD., Carlew, AR., Magtoto, J., Stonecipher, K. (2015). The potential of function-led virtual environments for ecologically valid measures of executive function in experimental and clinical neuropsychology. Neuropsychological Rehabilitation, 11: 1-31.

This work describes the characteristics of continuous performance tests, in relation to its use and application on ADHD. For this purpose, the scientific literature on the subject, covering the period from 1990 to May 2015 was reviewed. The results observed in 139 collected researches suggest two main utilities: 1) As a complementary tool for evaluation and diagnosis of ADHD and, 2) Regarding treatment, as a test to assess the efficacy of therapeutic interventions. The advantages and disadvantages of these instruments and its future projection are exposed. One of the tests described in this review is Nesplora Aula. The authors say that this test is an example of virtual reality assessment tool which is useful and sensible for the ADHD diagnosis.

Meneres-Sancho, S., Delgado-Pardo, G., Aires-González, MM., Moreno-García, I. (2015). Tests de ejecución continua: Integrated visual and auditory continuous performance test (IVA/CPT) y TDAH. A Review. Revista de Psicología Clínica con niños y adolescentes, 2(2): 107-113.



This project consists of an application which allows the user to interact with a virtual environment by means of a web interface where there are models in three dimensions which simulate different activities. The application is focused on the education through the use of virtual reality. This fact allows enriching the student's perception through the use of different objects in an artificial world. The results obtained in the questionnaires show that the use of the virtual reality is valid, accepted and it helps to the understanding of the context. The authors describe the Nesplora Aula system and highlight that the children perceive this test as a game where they have to perform a task at the same time the different distractors are present.

Obrist, VU., Martínez, EA. (2015). *Aplicación de la Realidad Virtual en una experiencia de aprendizaje. Corrientes*, 11th-12th June, 2015.

The main aim of this exploratory study is to analyze the descriptive statistical criteria of the TEA-Ch Battery version A, *Test of Everyday Attention for Children*, in a sample of 133 Spanish children between 6 and 11 years of age, in order to compare the results with the original study and with other attention tests (questionnaire and CPT). In the section dedicated to the review of the instruments for the assessment of the attention, the author of this thesis describes Nesplora Aula and points out that the most used test in Spain which cover the needed requirements are: Conners CPT (CPT, 1998), CSAT, adapted by Severa into Spanish (2004) and Nesplora Aula.

Pardos, A. (2014). *Análisis descriptivo de la batería Test of everyday attention for children (TEA-Ch) en niños españoles de educación primaria. (Tesis Doctoral)*. Complutense University. Madrid, Spain.

This study aims to analyze if the naming speed can be a predictor of both the learning of reading and the attention problems. In the state of the art section of this work, Nesplora Aula is mentioned as a recommended test for the evaluation of the attention and concentration capacities.

Areces, D., González, MP. (2014). *La velocidad de nombramiento en la detección temprana de las dificultades lectoras y atencionales. Master's dissertation. Universidad de Oviedo*. <http://hdl.handle.net/10651/27786>.

This article shows the preliminary results of the pilot-phase of a tele-therapy tool based on Serious Games for Health. This tool has the objective of improving the time management abilities and the prioritization of the tasks in children and teenagers with ADHD. After the results, the authors concluded that there is a need for new interactive content in order to work on time management skills in this sample. Nevertheless, authors consider that this kind of adaptive tele-therapies should be adopted as a support tool for traditional therapies, not as a substitute for conventional interventions. In the section dedicated to the review of the ADHD assessment tools, the authors describe Nesplora Aula and highlight its applicability outside of a laboratory setting.

Frutos-Pascual, M., Zapirain, BG., Zorrilla, AM. (2014). *Adaptive tele-therapies based on serious games for health for people with time-management and organizational problems: preliminary results*. *Int. J. Environ. Res. Public Health*, 11, 749-772.

The aim of this work is to analyze the characteristics of the most frequently used evaluation measures and their degree of applicability in clinical and educative context with their consequent practical implications. The first conclusion is the relevance of the executive functions as determinants of the behavior and performance of children and teenagers in contexts as diverse as it's the education, the family or social relationships. The second conclusion is the need for reliable and valid assessment tools that not only enable the evaluation of these components, but also predict the extent to which possible deficits in the executive functions may determine the daily functioning of children and teenagers in significant contexts. In this work, Nesplora Aula is summarized and the authors highlight that Nesplora Aula has a better ecological validity that the rest of the paper-pencil based measures.

García, T., González-Castro, P., Areces, D., Cueli, M., Rodríguez, C. (2014). Funciones ejecutivas en niños y adolescentes: implicaciones del tipo de medidas de evaluación empleadas para su validez en contextos clínicos y educativos. Papeles del Psicólogo, 35(3): 215-223.



In this book, the authors review the instruments currently available for the evaluation of the cognitive functions used both in the clinical practice and in the research field. In one of the chapters of this book dedicated to the instruments for the evaluation of the executive functions, Nesplora Aula is mentioned as a CPT carried out in a virtual reality environment that seeks to reproduce conditions as similar as possible to the classroom reality. It has greater ecological validity than the rest of the measures.

García, T., Rodríguez, C., González-Castro, P., González-Pienda, JA. (2014). The assessment of executive functioning in childhood and adolescence: current situation and future lines of research. En KP. Bennett (Eds). Executive Functioning: Role in Early Learning Processes, Impairments in Neurological Disorders and Impact of Cognitive Behavior Therapy (CBT), (pp. 219-244), New York: Nova Sciences Publishers, Inc.

To carry out a comparison between what the scientific literature expose about the traditional way to conceptualize, diagnose and the make the treatment of the ADHD and what it is really done by the professionals of Tres Arroyos. Nesplora Aula is described in this work as one of the instruments used to help with the diagnosis of ADHD.

Alberca, T., Carlé, E., Díaz, G. (2014). TDAH: Diagnóstico, prácticas y estrategias de tratamiento en la ciudad de Tres Arroyos. URI: <http://rpsico.mdp.edu.ar/handle/123456789/48>. Date: 2014-03-18. Research project.

Attention Deficit Hyperactivity Disorder is a common neurobehavioral disorder in school population. However, its diagnosis is complicated due to the difficulty of the objective assessment of subjective aspects such as inattention or impulsiveness. The aim of the present study was to describe the most used assessment scales as tools for the diagnosis of this disorder, its subtypes and comorbidity. These include Nesplora Aula as a novel tool which provides a combination of continuous performance tests which assesses sustained attention, divided visual and auditory attention, impulsiveness, excessive motor activity, tendency to distraction and processing speed in a virtual classroom. It is also concluded that the sensitivity of the test and its diagnostic capacity are excellent.

Herrán, M.E., Ortiz, R., Herrán, M.A., Rodríguez, A. & García, A.K. (2014). Una revisión narrativa de las escalas de evaluación usadas para el diagnóstico del trastorno por déficit de atención e hiperactividad en niños y adolescentes. *Medwave*, 14(1):e5887 doi: 10.5867/medwave.2014.01.5887.

This study explored auditory and visual attention in 50 children with ADHD in comparison with control children. The authors found that deficiency of visual attention is more serious than auditory attention in children with ADHD. On the auditory modality, only the deficit of attentional inconsistency is enough to explain most cases of ADHD; however, most of the children with ADHD suffered from deficits of sustained attention, response inhibition, and attentional inconsistency on the visual modality. According to the authors, these results also showed that the deficit of attentional inconsistency is the most important indicator in diagnosing and intervening in ADHD when both auditory and visual modalities are considered. The authors of this article support their findings in an article of Nesplora Aula in which the importance of the study of the variability in the reaction time, as a measure of the attentional consistency both in auditory and visual attention in children with ADHD, is highlighted.

Lin, H.Y., Hsieh, H.C., Lee, P., Hong, F.Y., Chang, W.D., Liu, K.C. (2014). Auditory and Visual Attention Performance in Children With ADHD: The Attentional Deficiency of ADHD Is Modality Specific. *J. Atten. Disord.* DOI: 1087054714542004.

In this issue of the journal it is announced that the Instituto Psicopedagógico EOS Perú has incorporated the Nesplora Aula test for the evaluation of the children with ADHD. In this announcement they highlight that Nesplora Aula: (1) Is the only test which provides complete attention and movement profiles; (2) The test is more attractive than other tests, so it facilitates

the work of the clinician and the participation of the child; (3) It carries out an ecological evaluation in which the child is immersed in a daily environment close to reality.

Online magazine EOS Perú (2013). Volume 1, Nº 2, pp. 51-52. September, 2013.

The aim of this study was to know executive functioning in a sample of 108 children and adolescents with ADHD and ADHD with reading disabilities associated, through the administration of the Behavior Rating Inventory of Executive Functions-BRIEF in its parents form. We found a higher executive deficit in the comorbid group than in the ADHD isolated group, being working memory and planning the most relevant domains. In this article, Nesplora Aula is mentioned as one of the Continuous Performance Test (CPT) most frequently used.

García, T., Rodríguez, D., González-Castro, P., Álvarez, D., Cueli, M., González-Pienda, JA. (2013). Executive functions in kids and adolescents with ADHD and reading difficulties. International Journal of Psychology and Psychological Therapy, 13, 2, 179-194.

The objective of this work is to analyze the convergent validity of the Nesplora Aula test with respect to the Continuous Performance Test de Conners (CPT) in a sample of 53 school pupils with ADHD. After the statistical analysis, the validation of Nesplora Aula test to assess attention processes in ADHD children was confirmed with regards to a traditional attention measurement as is the CPT. Nesplora Aula also provides an ecological scenario, the differentiation between visual and auditory attention and measures of the divided attention, interference caused by distractors, quality of the attention focus, motor activity and hypo and hyper-stimulation tasks.

García-López, C., Sánchez-Carpintero, R., Crespo-Eguílaz, N., & Narbona-García, J. (2012). AULA Nesplora como medida de la atención: Validación convergente con el Continuous Performance Test en niños con TDAH. Poster presented in the XVI International Update Course of Neuropediatrics and Childhood Neuropsychology. March, 2012.

The aim of this study was to verify the test-retest validation of the Nesplora Aula test with a sample of 30 patients with ADHD diagnosis. There were not significant differences between the results obtained in the test and in the re-test sessions. Based on the lack of statistically significant differences between data collected in the two sessions, in the same clinical conditions and a week apart, we can conclude that the administration of Nesplora Aula performed to the same patient with a week of separation does not carries with memory effect, and therefore, this period is sufficient to detect variations in the clinical course of patients studied. This endorses the usefulness of Nesplora Aula to monitor short-term clinical changes. The objectivity, speed, stability and ability to perform periodic comparisons of the situation of each individual in a short

space of time are such, that Nesplora Aula is a test of great practical value in assessing patients with ADHD.

Fernández-Fernández, M., Morillo-Rojas, M. (2012). Test-retest validation of AULA Nesplora. Poster presented in the XXXVI SENEP Annual Meeting, Santander, Spain, 31st May-2nd June, 2012.

In this study, Nesplora Aula was administered to 40 patients between 6 and 16 years old and diagnosed with ADHD. The 100% of the participants could finish the study without any kind of alteration. 97% of the participants showed results compatible with the existence of excessive levels of inattention, motor restlessness or impulsivity, confirming the clinical diagnosis. In the other 3% of the participants, the authors confirmed the existence of the high intellectual capacities which biased the execution of the study. Besides, the results correlated in direct proportion with the results of the clinical evaluation scales. It can be concluded that Nesplora Aula is a test easy to complete, with a high predictive value and reliable to diagnose the ADHD with a good clinical correlation. In some groups, the children with high intellectual capacities, the results can be affected by their intellectual level.

Fernández-Fernández, M. Morillo-Rojas, M., Alonso-Romero, L. (2012). Utilidad del estudio Aula Nesplora en la valoración del TDAH. Neurol Magazine; 54 (Supl3): S67-S93.

In this interview to the pediatrician Mr. Miguel Rufo, from the IHP Center, the Nesplora Aula test is described. According to doctor Rufo, Nesplora Aula “is a great advance in order to do a more accurate diagnosis of the ADHD and it implies a huge leap in quality with respect to the existing tools, because Nesplora Aula evaluates in a very easy and convenient way for the children, their parents and the doctors.

Diario Médico, 28th February, 2012. Interview to Miguel Rufo, children’s neuropsychologist of the Seville’s Pediatric Institute – IHP.

In this article a large description of the test Nesplora Aula is carried out, concluding that we stand at a pioneer test in the domain of behavioural assessment via virtual reality. It is added that it is going to be an essential tool for assessment and decision making for clinicians working in an office evaluation environment and devoid of the possibility of direct observation in a natural environment.

Cantero, A. (2012). AULA caja de herramientas. ACLPP informa, N° 26. March, 2012.

The goal of this work is to analyze the areas of application of virtual reality in ADHD, reviewing all publications dealing with the topic from 1990-2012. Based on our research, we have distinguished two basic applications: 1) Virtual reality as an instrument for the assessment and diagnosis of this disorder; 2) virtual reality as a procedure for intervention and treatment. Nesplora Aula is described as one application for the assessment and diagnosis of ADHD. The authors affirm that the results obtained in the different research of Nesplora Aula endorse the efficacy of this tool for the evaluation of ADHD.

Delgado, G., Moreno, I. (2012). Virtual Reality Applications in Attention Deficit Disorder with Hyperactivity: An Approximation. Annuary of Clinical and Health Psychology, 8, 29-37.

In this doctoral dissertation the different patterns of cortical activation and of executive control in the different presentations of ADHD are analyzed. According to his author, the findings confirm that each pattern is configured but a profile with its own entity; hence it is possible to talk about three different disorders instead of a single disorder with different intensity degrees. In the theoretical framework of this thesis the different continuous execution test are reviewed and Nesplora Aula is presented. The author of this thesis adds that the authors of Nesplora Aula carried out the validation process and the results show a high sensibility of the scale (>0.97) and an excellence internal consistency.

López, A. (2012). Análisis y Valoración De Algunos Patrones Diagnósticos Diferenciales En Los Subtipos Del TDAH (Doctoral dissertation). Universidad de Oviedo. Oviedo, Spain.







The aim of this study is to know the intellectual and academic profile of 21 clinical cases with ADHD combined subtype and 19 ADHD inattentive subtypes. The statistical analysis used, values the differences between working memory (WM), processing speed (PS), global cognitive profile (GCP) and academic performance between both subtypes. All the subjects were evaluated by the tests WISC-IV, Nesplora Aula and a behavior and performance scale. There were not significant differences between PS and WM in the ADHD subtypes respect their global cognitive profile and his academic performance. These results were the same in WISC-IV and Nesplora Aula. The author concludes that it does not exist an intellectual and academic profile which discriminates between ADHD's subtypes.

Álvarez, V. Perfil Cognitivo en niños con Trastorno por Déficit de Atención con o sin Hiperactividad evaluados mediante realidad virtual: influencia sobre el rendimiento académico. Master's dissertation. Universidad de Sevilla, Spain.

MANUALS

In the section devoted to the attention evaluation instruments of this manual, the authors include the NESPLORA Attention AULA test and highlight that it is a reliable tool for children between 6 and 16 years of age. They add that this a computerized attention test which uses virtual reality to assess the different variables taken into account in a continuous performance test.

Enseñat, A., Roig, T., García, A. (2015). Manual de Neuropsicología pediátrica. Madrid: Síntesis

 <p>IMMEDIATE</p> <p>The report is generated immediately.</p>	 <p>CLEAR RESULTS</p> <p>Results are clearly displayed in graphics and include explanatory texts for each variable. The patient's motor activity is represented with graphics about movements, where it is clearly shown in which precise point the child focused attention.</p>
 <p>AUTOMATIC</p> <p>AULA is self working. Once started the program guides the child through practice and test tasks.</p>	 <p>FACILITATES COMMUNICATION</p> <p>Reports are concise and easy to read, which helps to establish a dialogue between the clinician, parents and children.</p>
 <p>PERSONALIZABLE</p> <p>The report can be personalized. Notes can be added about the child's behavior and the clinician's test impressions.</p>	 <p>COMPLETE</p> <p>Data are presented both in a general as well as in a detailed manner, which facilitates the detection of the source of the disorder.</p>

Work of reference about the speech problems from a scientific point of view. This manual has been written by a multidisciplinary team involved in the work of this pathology. In this manual, Nesplora Aula is mentioned as a virtual reality test that provides the discriminatory capacity of continuous performance tests simulating a three dimensional environment (a classroom) in which you interact dynamically. It adds greater opportunities in the analysis of neuropsychological processes (divided attention and sustained visual and verbal attention; control of impulsivity, distracting elements and motor activity), and reflects the usual child's behaviour while the own situation of the exam does not reduce the attentional requirements demanded.

Peña Casanova, J. (2013). Manual de Logopedia (4ª ed.). Barcelona: Masson

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