



## D6.6 – VRMIND Clinical evidence info kit



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VRMIND (GA 733901)

## 1. EXECUTIVE SUMMARY

The different studies of the VRMIND result in different scientific documents. The spread of these documents have several aims:

- To contribute to the scientific corpus of neuropsychological studies.
- To keep our clients informed about the features and properties of our tools.
- To inform potential customers about the scientific basis of our tools.

In general in psychology, and also in neuropsychology, it is very important to demonstrate the scientific background of the evaluation tools. That is why we have tried to compile all the information which supports the use of Nesplora tools in different leaflets, brochures, dossiers, etc, and we also disseminate it through different international congresses and publications in open access journals.

## 2. RELATIONSHIP WITH OTHER WPS AND DELIVERABLES

This deliverable is closely related to the WP4 and WP5 deliverables since the studies carried out in these WPs are disseminate through different leaflets, brochures, etc... and also in congresses and scientific publications.

## 3. INTRODUCTION

During this year we have created and / or updated several documents which help us to demonstrate the scientific strengths of our tools and their applications in the clinical field. As Nesplora Aquarium and Nesplora Aula School are not yet in the market, we have started completing the set of document we already have for Nesplora Aula. We develop all the documents in Spanish and we translate them into English afterwards.

Currently we have the different kind of clinical evidence documents:

- Publications Dossier
- Roadmap
- Collaborators' map
- Documents used in scientific communication:

- o Poster and oral communications presented in different congresses
- o Papers for scientific journals

In the next section we describe each type of document that can be found in the different annexes.

#### 4. PUBLICATION DOSSIER

The Publication Dossier is the document which summarizes the scientific evidence of the tool. So the reader can quickly and easily have an idea of the scientific value of the tools. This document incorporates an abstract of the different publications of each specific tool and the corresponding bibliographical reference. Concretely, the Publication Dossier has several sections:

- ✓ Books and Articles: In this section we include the summary of the publication we have published, alone or together with collaborators, in book or paper format.
- ✓ Contribution to Congresses: All the abstracts which have been accepted and presented in congresses, in both poster and oral communication format, are included in this section. Again, these contributions can be made just by ourselves or together with collaborators.
- ✓ Nesplora (*name of the tool*) also appears in: This section is dedicated to the publications in any format made by others authors, not by Nesplora researchers.
- ✓ Manuals: In this last section we collect a summary of those manuals which describe our tools.

Currently we have a Publication Dossier for Nesplora Aula (Annex 1) and other Publication Dossier for Nesplora Aquarium (Annex 2). As soon as we start publishing with the other tools we will create their own Publication Dossier.

This Dossier is on the Nesplora web page, and we also send it to those potential customers who are thinking about buying our tools.

Due to the length of the document we just include the English version, and not the Spanish one, in the annexes.

## 5. ROADMAP

The Roadmap infographic is a document which aims to help the customer or the potential customer in their use with the Nesplora products. The roadmap starts with the usual queries where the Nesplora tool can be administered. Once the queries have been identified the evaluation process starts. And according to the results the clinician finds, the roadmap illustrates the different uses of Nesplora tool. We create this document based on our experience, and also the experience of our clients, using the tool. That is the reason why currently we only have this document for Nesplora Aula and, in the next year, the Roadmap of the other products will be developed.

Currently we have the Roadmap of the Nesplora Aula tool in English (Annex 3), Spanish (Annex 4) and French (Annex 5), since we have started talking to potential customers, associations and distributors in France.

We distribute this infographic in the different congresses and events we attend. And also we send it to the potential clients in order to help them to take a decision.

## 6. COLLABORATORS' MAP

The collaborators' map illustrates the international peers we currently have, most of them thanks to an agreement under VRMIND project. Also, this map includes information about with which tool are they researching and what type of study (clinical or normative) are they carrying out. This is a "live document" since whenever we sign a new agreement we include the new collaborator in this map.

The English version of the Collaborator's Map can be found in Annex 6, and the Spanish version in Annex 7.

This map is on the Nesplora website and we also usually send it to the potential collaborators who are thinking about establishing collaboration with us. Sometimes, they want to see who the other collaborators are in order to take a decision.

## 7. DOCUMENTS USED IN SCIENTIFIC COMMUNICATION

Apart from the Publication Dossier and the different infographic we create to be shared with collaborators and clients or potential customers, we also create scientific documents to be presented in congresses and also send to open access journals.

### 7.1 Poster and oral communications presented in different congresses

#### 7.1.1 Contributions prepared and presented by Nesplora

These contributions have been mainly prepared by Nesplora team and professionals from Nesplora have presented them in congresses.

- a) XIX Congreso Internacional en Actualización en Trastornos del Neurodesarrollo [*19th International Congress on Update on Neurodevelopmental Disorders*] (Valencia, 3<sup>rd</sup>-4<sup>th</sup> March, 2017).

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 [*Impulsivity and inattention profiles in children with ADHD according to the age*]. XIX Congreso internacional de actualización en trastornos del neurodesarrollo. Valencia, Spain, 3<sup>rd</sup>-4<sup>th</sup> March 2017 [Annex 8].



b) IX Congreso de la FANPSE [9th Fanpse Congress, Federation of Spanish Neuropsychological Associations]. (Barcelona, 9th-11th March 2017)

González, M.F., Mejías, M., Iradi, M., Guinea, J., Fernández, M., Olmo, J., Alonso, L. (2017). Evaluación de la atención en adultos a través de la realidad virtual [Attention assessment in adults through virtual reality]. VIII Congreso Nacional de Neuropsicología FANPSE, Barcelona, Spain, 9th-11th March 2017 [Annex 9].



c) 6th World Congress on ADHD (Vancouver, 20<sup>th</sup>-23<sup>rd</sup> April, 2017)

Mejías, M., Delgado-Mejía, I.D., González, M.F., Redondo, C., Abadi, A. y Lalor, S. (2017). Comparison between processing speed of WISC-IV and response time of the CPT NESPLORA AULA in children with ADHD. Póster presentado en 6th World Conference on ADHD, Vancouver, Canada, 20<sup>th</sup>-23<sup>rd</sup> April, 2017. [Annex 10].



d) III Congreso Nacional de Psicología [*3rd National Congress on Psychology*] (Oviedo, 3<sup>rd</sup>-7<sup>th</sup> July, 2017)

González, M.F., Redondo, M., Mejías, M., Aierbe, A. y Moreno, M. (2017). Evolución de los procesos atencionales en función de la edad, medidos a través de una herramienta en realidad virtual. [*Evolution of the attentional processes measured with a virtual-reality based tool*]. Congreso Nacional de Psicología, Oviedo, 3<sup>rd</sup>-7<sup>th</sup> July, 2017. [Annex 11].



- e) 6th Scientific Meeting of the Federation of the European Societies of Neuropsychology (Maastricht, 15<sup>th</sup>-17<sup>th</sup> September, 2017)

Mejías, M., González, M.F., Redondo, M., Aierbe, A., Moreno, M. y Guinea, J. (2017). Attention assessment in adults through virtual reality. 6th Scientific Meeting of the Federation of the European Societies of Neuropsychology, Maastricht, 15<sup>th</sup>-17<sup>th</sup> September, 2017. [Annex 12]



- f) SIMO Educación [SIMO education] (Madrid, 25<sup>th</sup>-27<sup>th</sup> October, 2017).

We attended this event with a stand which was part of Samsung's stand.



g) Pediatric (Madrid, 27<sup>th</sup> May, 2017)

We attend to this event but we could not present a poster, an oral communication nor a stand because these options of participation were not available. Anyway we attended to establish relationships with pediatricians, and other professionals in the field of health.



## 7.1.2. Contributions prepared by Nesplora and currently accepted

The following works have also been sent and have already been accepted in congresses:

INS 46th Annual Meeting of the International Neuropsychological Society (Washington, 14<sup>th</sup>-17<sup>th</sup> February, 2018).

Aierbe, A., Redondo, M., González, M.F., Moreno, M., Mejías, M. Nesplora Aquarium: Utility of the Tool to Identify People with Attention-Deficit Hyperactivity Disorder.

Aierbe, A., Redondo, M., González, M.F., Moreno, M., Mejías, M. Flexibility Capacity: Differences between Young and Older People in Nesplora Aquarium Test.

### 7.1.3. Contributions prepared by Nesplora and currently being evaluated

The following abstracts have also been sent to be presented at congresses next year but have not yet confirmed their acceptance:

- a) FANPSE (Valencia, 1<sup>st</sup>-3<sup>rd</sup> March, 2018).

Aierbe, A., Moreno, M., Redondo, M., Mejías, M. y González, M.F. Comparación de la ejecución en el test Nesplora Aquarium entre personas monolingües y bilingües [*Comparison of the performance on the test Nesplora Aquarium between monolingual and bilingual people*].

- II Congreso Iberoamericano de Neuropsicología [2nd Iberoamerican Congress on Neuropsychology] (Almería, 3<sup>rd</sup>-5<sup>th</sup> May, 2018).

Redondo, M., González, N., Mejías, M., González, MF., Aierbe, A., Moreno, M., Pérez, C. Validez convergente entre las herramientas Nesplora Aula y el CPT de Conners 3 [*Convergent validity between the tools Nesplora Aula and CPT Conners 3*].

### 7.1.4. Contributions prepared together with other collaborators and presented

Likewise, other collaborators have attended congresses in which they have presented works they have done in collaboration with us:

- a) Fernández, Fernández, M., Redondo, Zaballos, M., Mejías, M., González, Pérez, M.F. y 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 [*Differential effect of methylphenidate and lisdexamfetamine in the execution of the neuropsychological test AULA Nesplora in*

*children under treatment for ADHD*]. XI Reunión Anual de la SENEP, Madrid, España. [Annex 13]

### 7.1.5. Contributions prepared and presented by our collaborators

Also this abstract is derived of the multicenter study of Nesplora Aula between INECO, Randall Institute and INPAULA. Even we have not actively collaborated in this abstract and that is why we do not appeared as authors of it, we will include it, if accepted, in our Publication Dossier of the tool.

- II Congreso Iberoamericano de Neuropsicología [2nd Iberoamerican Congress on Neuropsychology] (Almería, 3rd-5th May, 2018). Fernández, P., Cánovas, R., Moreno, M., Delgado-Mejía, I.D., Lator, S., Sánchez-Santed, F., Flores, P. Attention and inhibitory control in neurodevelopmental disorders: a new assessment approach through Nesplora AULA.

### 7.2 Papers for scientific journals

The following articles are being worked on:

a. An article with the results on the normative study of Nesplora Aquarium. We are working in this article together with Oviedo University, who has collaborated with us in the normative study. The plan is to submit this article to the *Journal of Attention Disorders* under the Open Source format of this journal.

b. Article of the multicenter study between the Universidad Autónoma de la Asunción, INECO and INPAULA, in which a comparison between children with Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD) and Specific Language Impairment (SLI) in carried out with the tools Nesplora Aula and WISC. We do not have a journal selected to send this paper yet.

## 8. CONCLUSIONS

In 2017, and mainly thanks to the scientific studies with our tools, we have created some scientific documents which aim to spread the knowledge gained in these studies. We have also been present in 7 congresses

representing either Nesplora Aula or Nesplora Aquarium tool. We have also started the 2018 attendance to congresses plan and we have submitted contributions to 3 congresses.

Next year we will continue developing new documents which support our clinical and scientific evidence not only for the upcoming tools (Nesplora Ice Cream and Nesplora Suite) but also for the already developed tools (Nesplora Aula, Nesplora Aula School and Nesplora Aquarium).

Even we generate all the documents in English and Spanish by default, we will translate some of these documents into other different languages according to the market needs.

VRMIND (GA 133901)

**ANNEX I – PUBLICATION DOSSIER  
NESPLORA AULA**

VRMIND (GA 733901)



nesplora  
aula

nesplora aula

# PUBLICATIONS DOSSIER

VRMIND (GA733901)

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



nesplora  
Technology & Behavior

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VRMIND (GA 733901)

## 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 transcendent 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  
vr.nesplora.com  
<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).

More than 300 clinics in 15 countries are using Nesplora Aula, and more than 10.000 children have benefited from a more accurate assessment of the attentional processes that underlie disorders.

Soon, Nesplora is going to commercialize two more products, one for the evaluation of attentional processes in adults and other one for the evaluation of strengths of students.

## BOOKS & ARTICLES

In the chapter *Advances in Neuropsychological Assessment of Attention: From initial computerized continuous performance test to 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) AULA administered at a 1- week interval does not have a learning effect; d) it shows convergent validity with test d2 and faces deffer; and finally, e) it is concluded that AULA is able to differentiate between different cognitive profiles of ADHD. In summary, the studies show that 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 Attention 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 Attention 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 NESPLORA Attention AULA system analyzes the behavior of a child in the context of a virtual classroom. The tool is perceived initially as a game, in which the child performs a task while typical distracters of a classroom are presented to him or her. The NESPLORA Attention AULA test evaluates factors determining the existence of ADHD, such as sustained attention, impulsivity, divided visual and auditory attention, excessive motor activity, and a tendency to distraction (by means of a movement sensor.) After the test, the system returns an evaluation report that helps the clinician to perform a more accurate and reliable diagnosis.

*Tour around different programs and serious games for psychological intervention. It will be published in October, 2016*

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 (2016). Los Tests de Rendimiento Continuo en Neurofeedback. Utilidad y Aplicaciones. In: I. Moreno (Ed.). Use of Neurofeedback at ADHD, IN PRESS*

An essential tension can be found between researchers interested in ecological validity and those concerned with maintaining experimental control. Research in the human neurosciences often involves the use of simple and static stimuli lacking many of the potentially important aspects of real world activities and interactions. While this research is valuable, there is a growing interest in the human neurosciences to use cues about target states in the real world via multimodal scenarios that involve visual, semantic, and prosodic information. These scenarios should include dynamic stimuli presented concurrently or serially in a manner that allows researchers to assess the integrative processes carried out by perceivers over time. The present review highlights the potential of virtual reality environments which combine the experimental control of laboratory measures with emotionally engaging background narratives to enhance affective experience and social interactions.

*Díaz-Orueta, U. (2016). Advances in Neuropsychological Assessment of Attention: from initial computerized CPTs to AULA virtual reality norm validated test. In: Thomas D. Parsons & Robert Kane (Eds). The Role of Technology in Clinical Neuropsychology. Oxford University Press, IN PRESS*

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 Attention 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 Attention 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 fathers in the inattention variable and the mean of the reaction time when the child successes in the NESPLORA Attention AULA tasks. Besides, the scores provided by the mothers in the rating scores have also correlated with the variability of the response in the test. NESPLORA Attention 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 Attention 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*

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 (2015). Evaluación del TDAH basado en realidad virtual. Revisión monográfica sobre TDAH y realidad virtual, IN PRESS*



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 Attention 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-Verlag*

The aim of the present study is to analyze the convergent validity between the NESPLORA Attention AULA Test and the Continuous Performance Test (CPT) of Conners. The NESPLORA Attention 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 Attention AULA based on different sensorial modalities. Hence, convergent validity between both tests was confirmed. In addition, the NESPLORA Attention 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 Attention 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 review shows the current problems of the neuropsychological evaluation of the executive functions and the latest advances in the achievement of a better accuracy and validity in the evaluation through new technologies and virtual reality. Some developments in Spain are described in this review. One of the examples described is the NESPLORA Attention AULA and references about its convergence validity are provided. The NESPLORA Exec Test also is presented. This test is a virtual reality tool to evaluate the executive functions in both the general and the clinical population and it is based on the virtual environment of an ice cream shop. This instrument measures: planning, learning and working memory, processing time and speed, attention and cognitive flexibility.

*Climent-Martínez, G., Luna-Lario, P., Bombín-González, I., Cifuentes-Rodríguez, A., Tirapu-Ustarroz, J., Díaz-Orueta, U. (2014). Evaluación neuropsicológica de las funciones ejecutivas mediante realidad virtual. Revista de Neurología, 58(10): 465-475*

NESPLORA AULA is 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 (4rd ed.). Barcelona: Masson*

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 Attention 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

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. (2013). AULA NESPLORA virtual reality test and EDAH observation scale: complementary resources in the identification of ADHD. The Clinical Neuropsychologist, IN PRESS*

“The aim of this paper is to analyze the convergent validity between the NESPLORA Attention 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 Attention 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 Attention AULA and the CARAS perception of differences test (extended version), meaning that in addition to being a highly ecological test, NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 Attention 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 Attention 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 Attention 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 Attention 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: Nesp*

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*



VRMIND (GA 733901)

## CONTRIBUTIONS TO CONGRESSES

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 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 AULA do not measure the same construct.

*Mejias, 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 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, Madrid, Spain.*

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) AULA NESPLORA. 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 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.

The objective of the research was to check out the ceiling effect and ground effect of the AULA NESPLORA 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 AULA NESPLORA 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). AULA NESPLORA, 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 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 AULA NESPLORA 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. 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 Attention 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 Attention 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 Attention 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 Attention AULA test in order to differentiate between the different clinical presentations of the ADHD. The NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 Attention AULA and d2 attention test and to show NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 Attention AULA and EDAH and DSM-IV, being the highest correlation values for the inattention variable. Results support the structure of NESPLORA Attention AULA of one single factor. With regards to convergent validity, different nature of NESPLORA Attention 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-Eguilaz, 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 Attention 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 Attention 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 Attention 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 work is to analyze the convergent validity of the NESPLORA Attention 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 Attention AULA test to assess attention processes in ADHD children was confirmed with regards to a traditional attention measurement as is the CPT. NESPLORA Attention 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 objective of this study was to determine the NESPLORA Attention 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 Attention 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 aim of this study was to verify the test-retest validation of the NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 SENE Annual Meeting, Santander, Spain, 31st May-2nd June, 2012*

In this study, NESPLORA Attention 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 Attention 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*

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 Attention AULA is a Continuous Performance Test based on virtual reality which assesses attention, impulsivity and motor activity. NESPLORA Attention 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

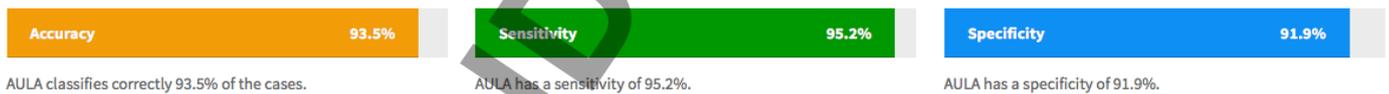
Iriarte, Y. (2011). AULA, la última innovación en la medición neuropsicológica del TDAH. Oral presentation made in the I Pediatric Neuropsychology International Congress. Madrid, Spain. 22nd-24th October, 2011

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 201

In this publication, the NESPLORA Attention 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 Attention 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

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.

## NESPLORA AULA ALSO APPEARS IN

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.*

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, 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:e3508 <https://doi.org/10.7717/peerj.3508>*

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 there are no significant differences in the obtained scores between the BrainGaze Test and the NESPLORA AULA Test in the evaluation of the CPT at an overall level. In addition, 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, 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 AULA Nesplora, 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. (in press) (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*

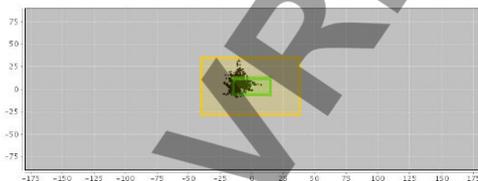
Neuropsychological Assessment 3.0 AULA NESPLORA is presented as perhaps the best validated test of the virtual classrooms. AULA is significantly correlated with the traditional CPT and can distinguish between children with ADHD with and without pharmacological interventions. In comparison with the TOVA, 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.*

#### 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).

	Raw direct	Percentile	T scores
Total motor activity	0.38	71	55



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).



This study has three objectives: (1) To check if the NESPLORA Attention 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 Attention 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 Attention AULA variables did not were statistically significant. The discriminant analysis showed an agreement between DSM-5 and NESPLORA Attention AULA in the 70.5% of the cases. The authors conclude that the NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 Attention 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 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 Attention 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 Attention 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 Attention 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 Attention

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 Attention 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 as valid, accepted and it helps to the understanding of the context. The authors describe the NESPLORA Attention 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 Attention 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 Attention 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 Attention 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 teletherapies 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 Attention AULA and highlight its applicability outside of a laboratory setting.

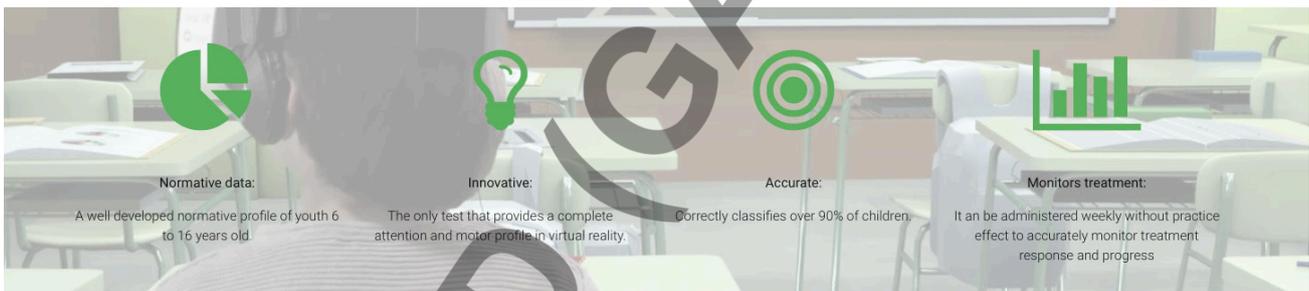
*Frutos-Pascual, M., Zapirain, BG., Zorrilla, AM. (2014). Adaptive tele-therapies based on serious games for health for people with time-management and organizational problems: preliminary results. Int. J. Environ. Res. Public Health, 11, 749-772*

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 Attention AULA is summarized and the authors highlight that NESPLORA Attention AULA has a better ecological validity than 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 Attention 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 Attention 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 AULA NESPLORA 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 Attention 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, HY., Hsieh, HC., Lee, P., Hong, FY., Chang, WD., Liu, KC. (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 Attention AULA test for the evaluation of the children with ADHD. In this announcement they highlight that NESPLORA Attention 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, N° 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 Attention AULA is mentioned as one of the Continuous Performance Test (CPT) most frequently used.

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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

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In this interview to the pediatrician Mr. Miguel Rufo, from the IHP Center, the NESPLORA Attention AULA test is described. According to doctor Rufo, NESPLORA Attention 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 Attention 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*

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In this article a large description of the test AULA NESPLORA 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, Nº 26. March, 2012*

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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 Attention 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 Attention 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*

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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 Attention AULA is presented. The author of this thesis adds that the authors of NESPLORA Attention 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 Attention 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 Attention 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*

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.

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

 <p><b>IMMEDIATE</b></p> <p>The report is generated immediately.</p>	 <p><b>CLEAR RESULTS</b></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><b>AUTOMATIC</b></p> <p>AULA is self working. Once started the program guides the child through practice and test tasks.</p>	 <p><b>FACILITATES COMMUNICATION</b></p> <p>Reports are concise and easy to read, which helps to establish a dialogue between the clinician, parents and children.</p>
 <p><b>PERSONALIZABLE</b></p> <p>The report can be personalized. Notes can be added about the child's behavior and the clinician's test impressions.</p>	 <p><b>COMPLETE</b></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>

Nesplora Aula 2017

info@nesplora.com

Nesplora Technology & Behavior  
 Paseo Mikeletegi 58, 0 floor, door 8  
 Parque Tecnológico y Centífico de Miramon  
 20009 Donostia - San Sebastián - Spain

**ANNEX II - PUBLICATION DOSSIER  
NESPLORA AQUARIUM**

VRMIND (GA733901)



nesplora  
aquarium

nesplora aquarium

# PUBLICATIONS DOSSIER

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

VRMIND (GA 133901)



nesplora  
Technology & Behavior

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· NESPLORA	3
· CONTRIBUTION TO CONGRESSES	4

VRMIND (GA 733901)

## OBJETIVES OF THE DOSSIER

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

## 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, stroke (ictus) or autism, among others. For doing that, Nesplora replicates real environments in virtual reality, so that the doctor 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  
[vr.nesplora.com](http://vr.nesplora.com)  
<http://www.nesplora.com>

One of our products is Nesplora Aquarium, a virtual aquarium in which adults can interact through virtual reality glasses. Within the simulation there are attention and working memory tasks to perform, and the software evaluates the tasks and gives a report back. This document assists the clinician in the assessment of attention and working memory.

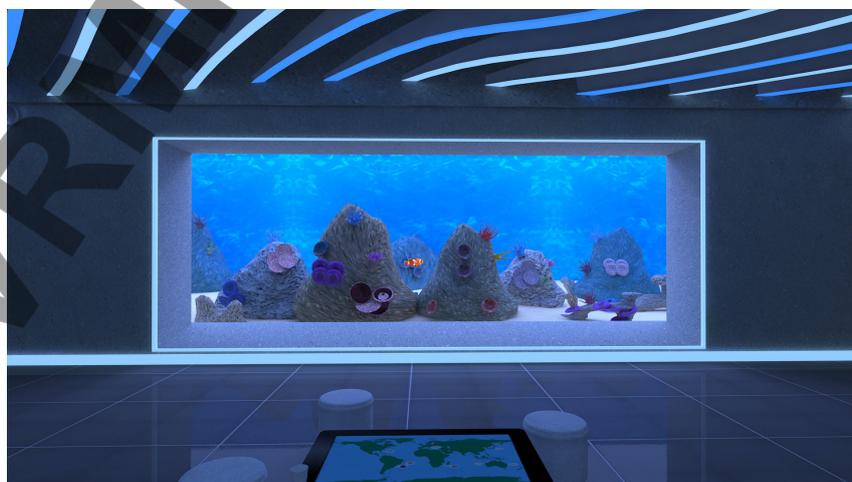
## CONTRIBUTIONS TO CONGRESSES

The objectives of the pilot study were to create an ecological tool which assess attention in adults, to improve the validity of the current neuropsychological assessment test and, to facilitate the evaluation and the diagnosis. The participants were 205 people between the ages of 17 and 86 (70% female). The sample was evaluated using Nesplora Aquarium, the test in virtual reality for the assessment of attentional processes which is composed by 3 CPT paradigms: AX, Dual No-go, Dual No-go. The results obtained showed the difficulty (0.829; 0.818; 0.786) and reliability (0.927; 0.926; 0.929) rates of the tasks. All of them were accepted. We concluded that the tool is appropriate, attractive and ecological and it is reliable and difficult enough to assess attention in subjects over the age of 16.

*Mejías, M., González, M.F., Redondo, M., Aierbe, A., Moreno, M. & Guinea, J. (2017). Attention assessment in adults through virtual reality. Presented in the 6th Scientific Meeting of the Federation of the European Societies of Neuropsychology, Maastricht, 13-15 September 2017.*

The aim of this study is to analyze, through a tool in virtual reality (VR), the attentional changes associated to the age. 205 people between 17 and 86 years old, without pathology, have been assessed using a new assessment tool in VR developed to measure the attentional processes. After a usability task, the test is divided into 3 subtasks: training and AX task; training and dual Xno task with AB stimuli and; training and dual Xno task with CD stimuli. The results show that people under 30 make less omissions and they have a faster response time in the second and third tasks. Furthermore, in the third segment, people over 30, make more commissions. It is concluded that there is a decrease in the attentional capacity associated to the age.

*González, M.F., Redondo, M., Mejías, M., Aierbe, A. & Moreno, M. (2017). Evolución de los procesos atencionales en función de la edad, medidos a través de una herramienta en realidad virtual. Presented in Congreso Nacional de Psicología, Oviedo, Spain, 3-7 July 2017.*



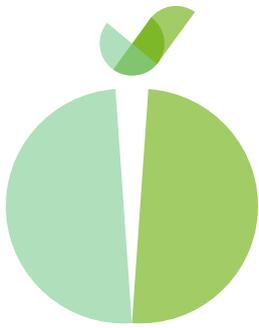
In this study, on the one hand, the development of the Nesplora Aquarium tool is described and, on the other hand, the results obtain during the field trials are presented. A total of 77 people between 18 and 83 years old participated: 18 with acquired brain injury, 18 with ADHD and 41 without cognitive impairment. After a usability task and a training, the test is divided into 3 segments: one Xno task, one to assess working memory and a X task. The results show that the difficulty index are higher than 0.90 so, they are considered too easy. Changes have been made in the tasks, in the instructions and in the scenario. Currently, the test is divided into 3 task: one AX paradigm and two Xno dual paradigms. After the field trials with more than 200 subjects, a normative study of Nesplora Aquarium is in progress.

*Gonzalez, M.F., Mejías, M., Iradi, M., Guinea, J., Fernández, M., Olmo, J., ... Alonso, L. (2017). Evaluación de la atención en adultos a través de la realidad virtual. VIII Congreso Nacional de Neuropsicología FANPSE, Barcelona, Spain, 9-11 march 2017.*

VRMIND (GA 733901)

**ANNEX III – NESPLORA AULA  
ROADMAP (ENGLISH)**

VRMIND (GA733901)



nesplora

# aula applications



## USUAL QUERIES

- Behavioral problems: difficulties to follow the rules
- Learning and attention difficulties: doing poorly at school, difficulties to learn, literacy problems...
- High capacities
- Lack of social skills
- Neuropsychological evaluation
- Brain injury
- Other demands with attentional processes involved

## START OF THE EVALUATION PROCESS

**NESPLORA AULA**



- Administration of the test
- Analysis and return of the report

## WITH ATTENTIONAL DIFFICULTIES



Schedule the intervention

Diagnosis



## DRUG THERAPY



## OTHER TYPE OF TREATMENT

- Psychology
- Speech therapy
- Neuropsychology
- Occupational therapy
- ...

Treatment time determined by the professional



## MONITORING



**NESPLORA AULA**



**NESPLORA AULA**

- Administration of the test
- Analysis and return of the report

## MONITORING OF THE INTERVENTION



TREATMENT ADJUSTEMENT

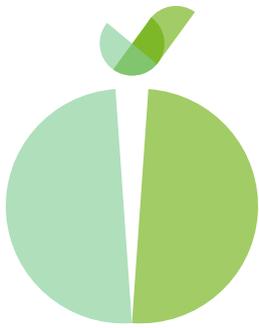
- Administration of the test
- Analysis and return of the report



nesplora  
Technology & Behavior

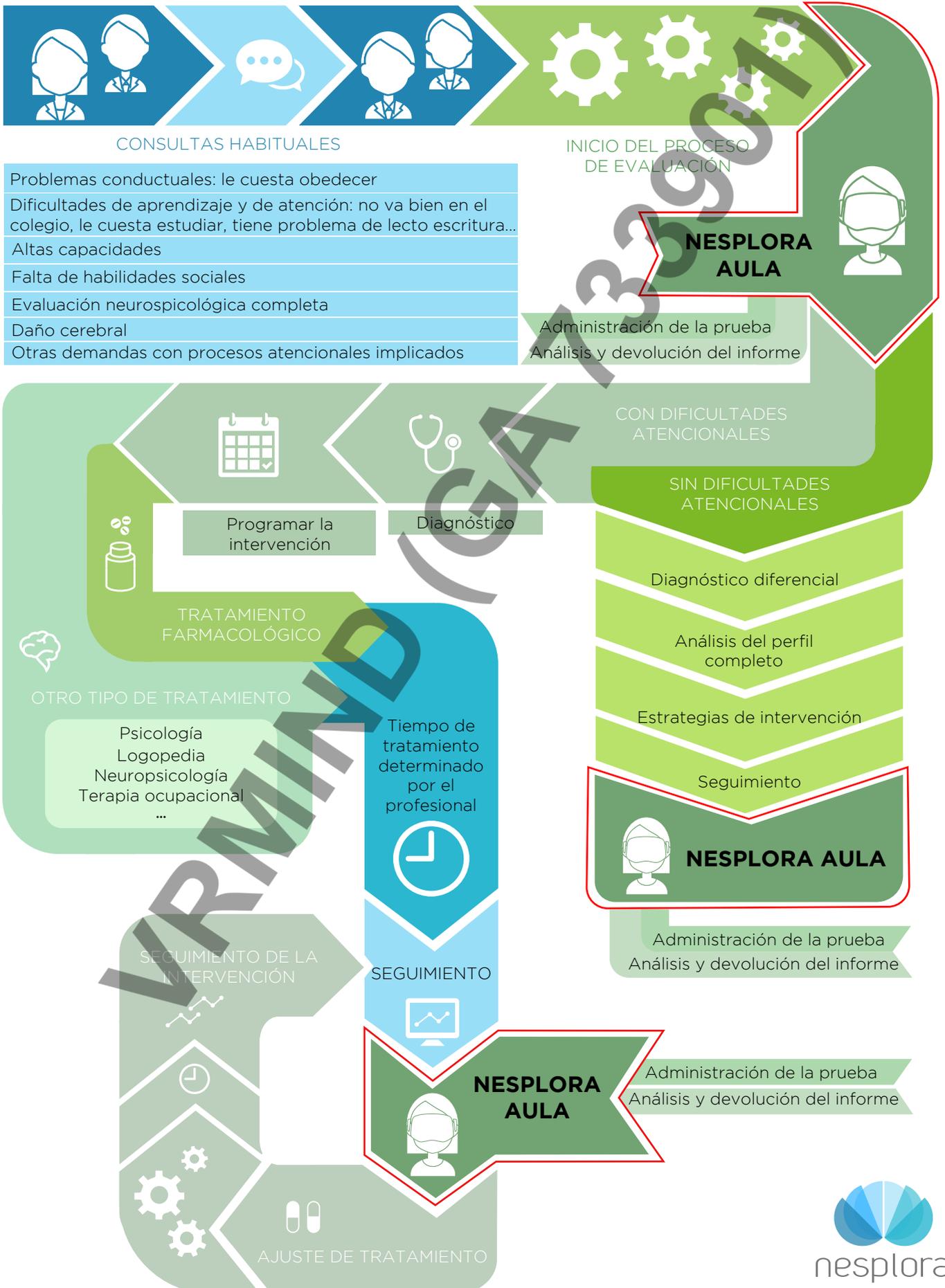
**ANNEX IV – NESPLORA AULA  
ROADMAP (SPANISH)**

VRMIND (GA733901)



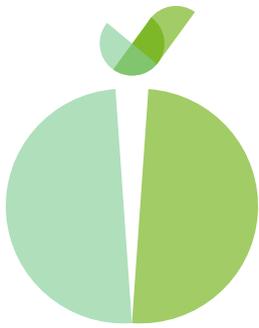
nesplora

# aula aplicaciones



**ANNEX V - NESPLORA AULA  
ROADMAP (FRENCH)**

VRMIND (GA733901)



nesplora

# aula applications



## DEMANDES HABITUELLES

- Problèmes comportementaux: difficile à obéir
- Difficultés d'apprentissage et d'attention: ça ne va pas bien à l'école, avoir du mal à étudier, il y a des problèmes de lecture et d'écriture
- Hautes capacités
- Manque de compétences sociales
- Evaluation neuropsychologique complète
- Lésions cérébrales
- Autres demandes avec des processus attentionnels impliqués

## DÉBUT DU PROCESSUS D'ÉVALUATION

**NESPLORA AULA**



- Administration du test
- Analyse et retour du rapport

## AVEC DES DIFFICULTÉS D'ATTENTION



Planifier l'intervention

Diagnostic



TRAITEMENT PHARMACOLOGIQUE



## UN AUTRE TYPE DE TRAITEMENT

- Psychologie
- Orthophoniste
- Neuropsychologie
- Thérapie occupationnelle
- ...

Temps de traitement déterminé par le professionnel



SUIVI



**NESPLORA AULA**



- Administration du test
- Analyse et retour du dossier

## SANS DIFFICULTÉS D'ATTENTION

Diagnostic différentiel

Analyse complète du profil

Stratégies d'intervention

Suivi



**NESPLORA AULA**

- Administration du test
- Analyse et retour du dossier

## SUIVI DE L'INTERVENTION



AJUSTEMENT DE TRAITEMENT



nesplora  
Technology & Behavior

**ANNEX VI – COLLABORATORS' MAP  
(ENGLISH)**

VRMIND (GT 733901)

# NESPLORA COLLABORATORS



- NESPLORA AULA
- NESPLORA AQUARIUM
- NESPLORA ICE CREAM

- Attention Disorders Clinic**  
Place: Utah  
Clinical study
- Neurology Learning and Behavior Center**  
Place: Utah  
Clinical study
- YourShrink**  
Place: Georgia  
Clinical study

- Mente Idílica**  
Place: Baltar - Porto District - Portugal  
Normative study

- Carolina Parners in Mental Health**  
Place: North Carolina (multicentres)  
Clinical study
- Clínica of Doctor Luis Méndez**  
Place: Ciudad de México - México  
Normative study

- ENMANUEL Psychotherapeutic Consultants**  
Place: Santo Domingo - Rep. Dominicana  
Clinical study

- Monteactiva**  
Place: La Paz - Bolivia  
Clinical study

- Federal University of the State of Rio de Janeiro**  
Place: Río de Janeiro - Brasil  
Normative study

- INECO**  
Place: Buenos Aires- Argentina  
Clinical study

- Autonomous Institute of Asunción**  
Place: Asunción - Paraguay  
Clinical study

- CUN**  
Place: Pamplona - Spain  
Clinical study

- University of Valencia**  
Place: Valencia - Spain  
Clinical study

- Proyecto3**  
Place: Madrid - Spain  
Clinical study

- ISEP Clinic**  
Place: Vitoria - Spain  
Clinical study

- UNIR**  
Place: La Rioja - Spain  
Clinical study

- Virgen Macarena Hospital**  
Place: Sevilla - Spain  
Clinical study

- University of Sevilla**  
Place: Sevilla - Spain  
Clinical study

- Psicotaduy Education and Health**  
Place: Valencia - Spain  
Clinical study

- MultiTimeLab**  
Place: Atenas - Greece  
Normative study

- Bilal Lahyani Hamidi**  
Place: Morocco  
Normative study

- Argibide Foundation**  
Place: Elcano - Navarra - Spain  
Theoretical review

- Inbat by mim - Miriam Martín**  
Place: Ávila - Spain  
Recruitment of Collaborators

- INANP**  
Place: Sevilla - Spain  
Clinical study

- University College of London**  
Place: London - UK  
Normative and clinical study

- Stichting Smart Homes**  
Place: Eindhoven - The Netherlands  
VR review

- ADAHgi**  
Place: San Sebastian - Spain  
Clinical study

- University of Oviedo**  
Place: Oviedo - Spain  
Normative study

- Zubimusu Cabinet**  
Place: San Sebastian - Spain  
Clinical study

- Vall d'Hebron**  
Place: Barcelona - Spain  
Normative and clinical study

- Dr. Valentín Mateos Marcos Neurological Institute**  
Place: Oviedo -Spain  
Normative and clinical study

- Sastre and Rojo Psychiatrists**  
Place: Vigo -Spain  
Normative and clinical study

- Autonomous University of Barcelona**  
Place: Barcelona -Spain  
Normative study

- Hermanas Hospitalarias**  
Place: Cataluña- Spain  
Clinical study

- Dr. José António Camacho Conde Psychology Office**  
Place: Malaga - Spain  
Clinical study

- Bilbao Psychology Center**  
Place Bilbao - Spain  
Clinical study

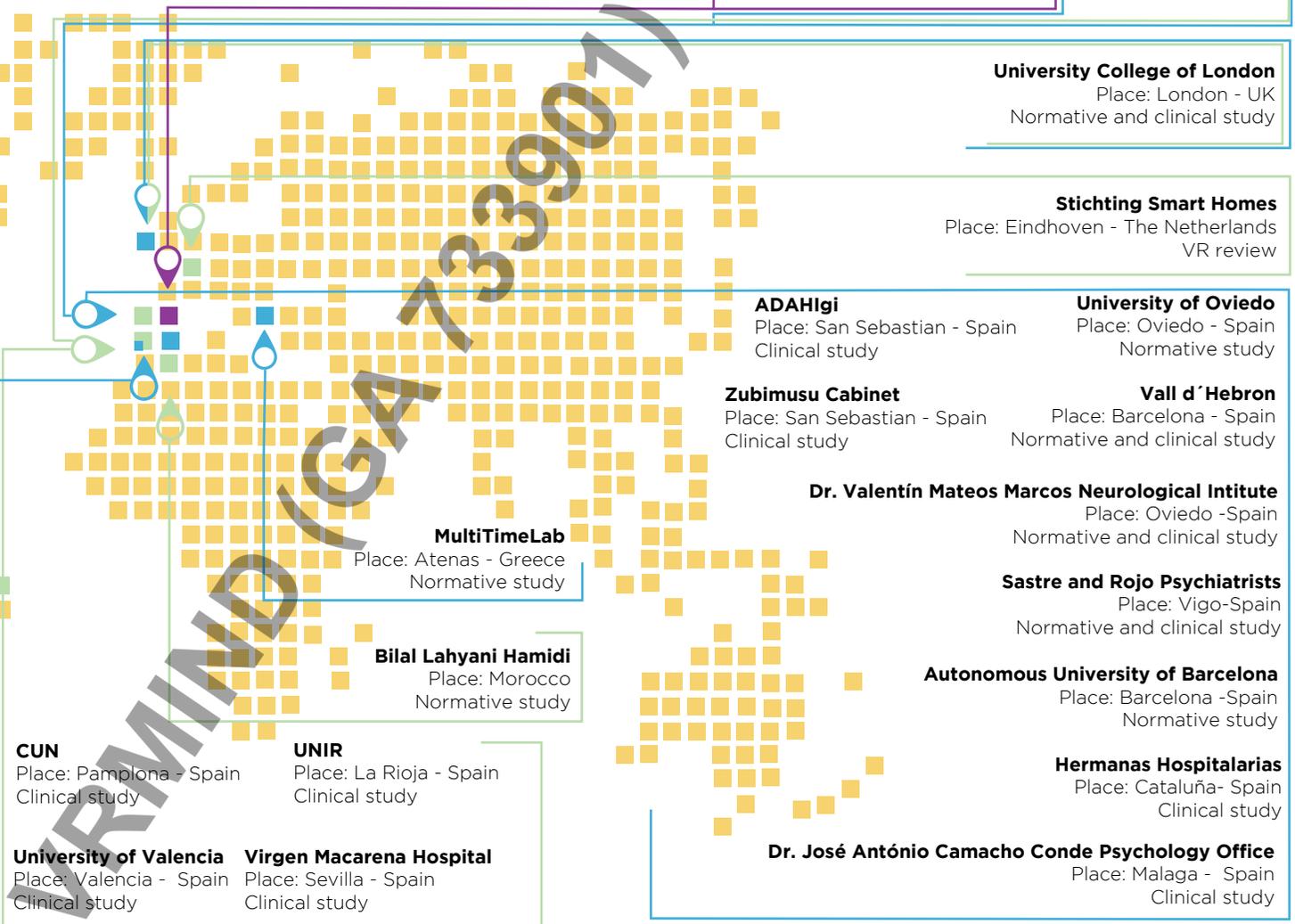
- Nisa Hospital**  
Place: Sevilla - Spain  
Psychometric properties

- ALCAGI**  
Place: Gipuzkoa - Spain  
Clinical study

- University of Oviedo**  
Place: Oviedo - Spain  
Psychometric properties

- Hispalense Institute of Pediatrics**  
Place: Sevilla - Spain  
Psychometric properties

- InPaula**  
Place: Almería - Spain  
Clinical study

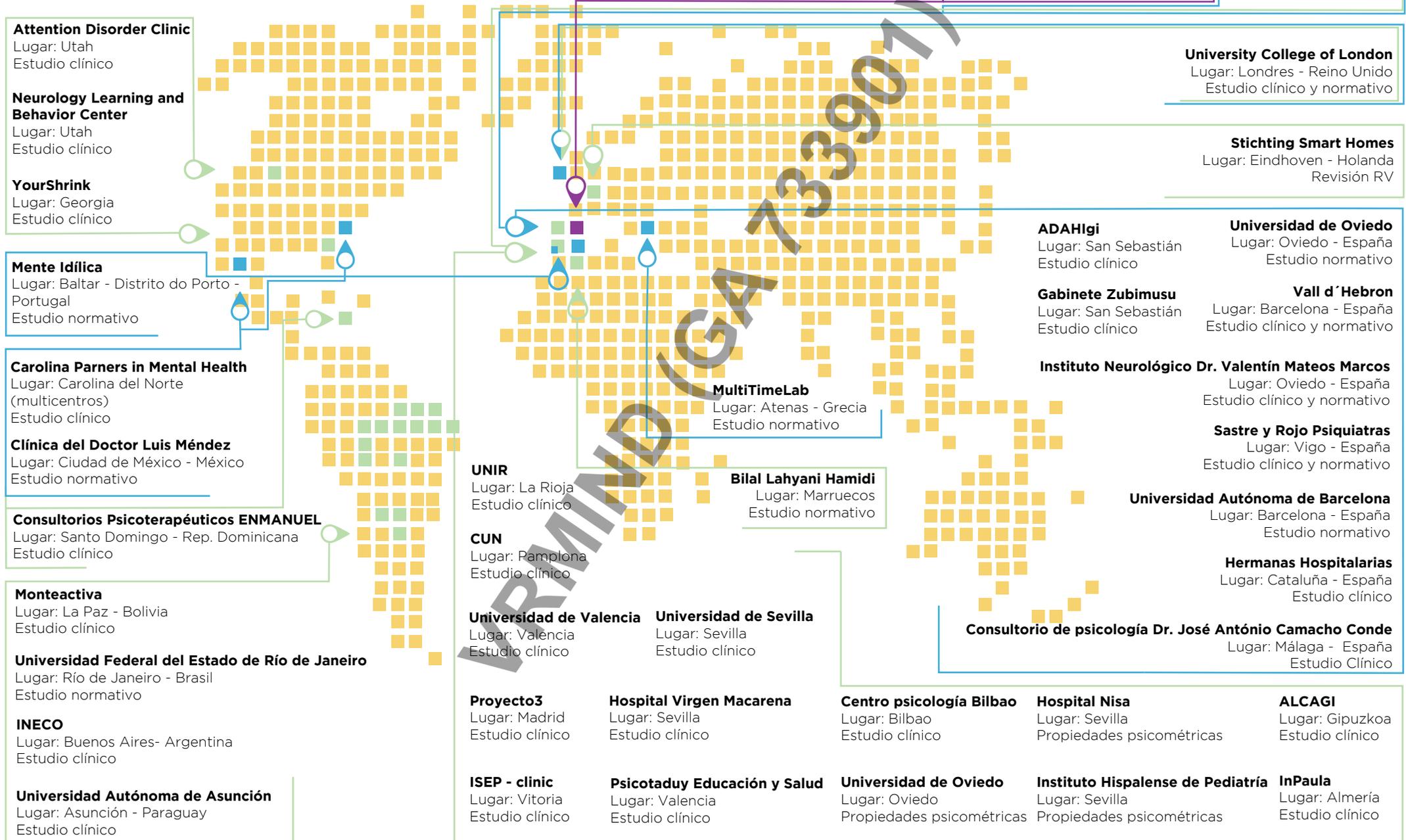


**ANNEX VII - COLLABORATORS' MAP  
(SPANISH)**

VRMIND (GT 733901)

# COLABORADORES DE NESPLORA

- NESPLORA AULA
- NESPLORA AQUARIUM
- NESPLORA ICSTEST



**ANNEX VIII – POSTER PRESENTED  
AT THE 19<sup>TH</sup> INTERNATIONAL  
CONGRESS ON UPDATE ON  
NEURODEVELOPMENTAL  
DISORDERS**

# PERFILES DE IMPULSIVIDAD E INATENCIÓN EN NIÑOS CON TDAH SEGÚN LA EDAD

González, Mari Feli<sup>1</sup>., Mejías, Miguel<sup>1</sup>., Redondo, Maite<sup>1</sup>., Otaduy, Cristina<sup>2</sup>., Crespo, Nerea<sup>3</sup>., Pérez, Carmen<sup>4</sup>.

<sup>1</sup> Nesplora Technology & Behavior. San Sebastián. [mgonzalez@nesplora.com](mailto:mgonzalez@nesplora.com)

<sup>2</sup> Psicotaduy Educación y Salud. Valencia. [ot5ady7@hotmail.com](mailto:ot5ady7@hotmail.com)

<sup>3</sup> Clínica Universitaria de Navarra. Pamplona. [necrespo@unav.es](mailto:necrespo@unav.es)

<sup>4</sup> Proyecto3 Psicólogos. Madrid. [carmen.pl@proyecto3psicologos.com](mailto:carmen.pl@proyecto3psicologos.com)

## OBJETIVO

El objetivo de este estudio fue comprobar si los niños con TDAH, a medida que van creciendo, muestran menos impulsividad y si mantienen el déficit de atención. Para ello se analizó el perfil atencional de dos grupos (entre 6 y 9 años y entre 12 y 16) mediante un test de ejecución continua (CPT).

## MÉTODO

AULA NESPLORA es un CPT que se realiza en un entorno virtual. Mide los procesos atencionales y la actividad motora mediante dos tareas (Xno y X) con estímulos auditivos y visuales mientras se van presentando distractores. Abajo se describen los 5 ejercicios.

93 niños con TDAH participaron en cada grupo de edad (72% chicos en el grupo más joven y 71% en el más mayor). Se realizaron análisis no paramétricos de diferencias de medias (Kruskal-Wallis).

### 1. Entrenamiento en realidad virtual:

Invita a explorar el aula para entender el funcionamiento de la realidad virtual y los dispositivos (gafas y botón bluetooth).

### 2-3. Entrenamiento y evaluación en ejercicio tipo "Xno":

En estos ejercicios, se debe responder a todos los estímulos salvo a uno en concreto indicado por el profesor virtual.

### 4-5. Entrenamiento y evaluación en ejercicio tipo "X":

En los dos últimos ejercicios del test, se debe responder a un estímulo concreto indicado igualmente por dicho profesor.

Todos estos índices, menos la calidad del foco atencional; se miden tanto por tarea global, como por el tipo de tarea (X - Xno), por modalidad sensorial (visual/auditiva), así como por estar en presencia o ausencia de distractores. La tarea

completa está compuesta de 360 ítems (180 en cada tarea), de los cuales 186 son visuales y 174, auditivos. Hay un total de 16 distractores (9 en la tarea Xno y 7 en la tarea X). Los ítems de la tarea que se ven afectados por la presencia de cada distractor son diferentes dependiendo del tiempo de duración de cada distractor y de la velocidad de respuesta del sujeto.

ÍNDICES PRINCIPALES	DESCRIPCIÓN	RELACIONADO CON
Errores de Omisión	La persona no pulsa el botón ante un estímulo que sí requiere pulsar	Inatención
Errores de Comisión	El sujeto presiona el botón ante un estímulo que no requiere pulsar	Impulsividad
Tiempo de Reacción	Tiempo transcurrido desde la presentación del estímulo hasta que el sujeto emite una respuesta	Velocidad perceptiva
Variabilidad en el Tiempo de Reacción	Cambios en los patrones del tiempo de reacción durante el test	Atención sostenida, vigilancia
Actividad Motora	Movimiento de cabeza	Hiperactividad
Calidad del Foco Atencional	Número de errores cometidos por el sujeto cuando este estaba mirando a la pizarra donde se presentan los estímulos visuales	Inatención

## RESULTADOS

- El grupo más joven mostró mayor variabilidad en el tiempo de reacción (TR) con estímulos auditivos, con y sin distractores, y en las dos tareas ( $p < ,05$ ). Además, su actividad motora era mayor con y sin distractores en ambas tareas ( $p < ,05$ ).
- El TR del grupo joven fue mayor en las variables de comisiones sin distractores y aciertos en la tarea X ( $p < ,05$ ).
- El grupo mayor mostró mayor desviación del foco atencional con distractores en Xno y X ( $p < .01$ ).

## CONCLUSIONES

Concluimos que el TR del grupo joven es más heterogéneo durante la prueba. Aunque su actividad motora es más alta que la del otro grupo, no desvían tanto el foco atencional. Se requieren estudios longitudinales que permitan profundizar más en este aspecto.

VARIABLE	GRUPO JOVEN	GRUPO MAYOR
TOT TR ACIERTOS DT *	58,92 ± 11,58	53,34 ± 10,75
TOT TR COMISIONES DT *	55,26 ± 9,97	51,35 ± 9,25
TOT ACTIVIDAD *	57,08 ± 11,37	51,02 ± 12,74
AUD TR ACIERTOS DT **	58,75 ± 10,74	54,8 ± 9,82
DIS TR ACIERTOS DT **	75,71 ± 86,40	51,94 ± 11,1
DIS ACTIVIDAD *	56,52 ± 10,87	50,2 ± 12,45
DIS ACTIVIDAD DESVÍO *	58,03 ± 8,11	61,85 ± 4,09
NO DIS TR ACIERTOS DT *	59,94 ± 10,96	53,84 ± 11,15
NO DIS TR COMISIONES **	53,44 ± 10,87	49,77 ± 10,19
NO DIS TR COMISIONES DT **	55,22 ± 10,5	51,63 ± 8,98
NO DIS ACTIVIDAD **	57,09 ± 11,23	51,09 ± 13,42
XNO TR ACIERTOS DT *	57,03 ± 11,77	52,38 ± 11,05
XNO TR COMISIONES DT **	54,24 ± 10,74	51,4 ± 9,06
XNO ACTIVIDAD *	56,73 ± 11,29	47,82 ± 13,88
XNO ACTIVIDAD DESVÍO *	59,48 ± 8,46	61,98 ± 4,09
X TR ACIERTOS *	55,67 ± 12,69	50,80 ± 11,73
X TR ACIERTOS DT *	58,47 ± 10,21	54,09 ± 10,24
X ACTIVIDAD **	56,47 ± 11,17	54,84 ± 12,6
X ACTIVIDAD DESVÍO *	58,25 ± 9,44	60,28 ± 5,56

\*\* < 0,01 ; \* < 0,05

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[www.aulanesplora.com](http://www.aulanesplora.com)  
[info@aulanesplora.com](mailto:info@aulanesplora.com)

**ANNEX IX – POSTER PRESENTED AT  
THE 9<sup>TH</sup> FANPSE CONGRESS,  
FEDERATION OF SPANISH  
NEUROPSYCHOLOGICAL  
ASSOCIATIONS**

# EVALUACIÓN DE LA ATENCIÓN EN ADULTOS A TRAVÉS DE LA REALIDAD VIRTUAL

González, Mari Feli<sup>1</sup>, Mejías, Miguel<sup>1</sup>, Iradi, Marko<sup>1</sup>, Guinea, Javier<sup>1</sup>, Fernández, Manuel<sup>2</sup>, Olmo, Juan<sup>3</sup>, Palacios, Marta<sup>4</sup> y Alonso, Laura<sup>3</sup>.

<sup>1</sup> Nexplora Technology & Behavior. San Sebastián. [mgonzalez@nexplora.com](mailto:mgonzalez@nexplora.com)

<sup>2</sup> Instituto Andaluz de Neurología Pediátrica - INANP

<sup>3</sup> Centro de Día EHARI

<sup>4</sup> Centro Atención Integral Goizalde

## INTRODUCCIÓN Y OBJETIVO

Diferentes patologías cursan con déficit atencional en la edad adulta. Sin embargo, la falta de validez ecológica de algunas pruebas neuropsicológicas dificulta una correcta evaluación de los procesos atencionales. Las pruebas neuropsicológicas actuales tienen poca capacidad discriminativa a la hora de diagnosticar pacientes con TDAH pero, las variables de los CPT (Continuous Performance Test) podrían contribuir a mejorar esa validez (Petersson, Söderström, Nilsson, 2015). Por lo tanto, el objetivo de este proyecto es crear una herramienta ecológica que evalúe la atención en personas mayores de 16 años.

## SUJETOS Y MÉTODO

Para el desarrollo del estudio han participado un total de 77 personas entre 18 y 83 años: 18 personas con daño cerebral adquirido, 18 diagnosticadas de TDAH, y 41 sujetos sin deterioro cognitivo.

Se ha creado una herramienta de evaluación neuropsicológica de los procesos atencionales en un entorno de realidad virtual. Tras una tarea de usabilidad y otra de entrenamiento, la prueba se divide en tres subtareas que se explican a continuación, una Xno, una de memoria de trabajo y una tarea X.

### 1. Usabilidad y entrenamiento en realidad virtual:

Invita a explorar el entorno para entender el funcionamiento de la realidad virtual y los dispositivos, tanto las gafas como el botón bluetooth.

### 2. Evaluación en ejercicio tipo "Xno":

En estos ejercicios, se debe responder a todos los estímulos salvo a uno en concreto indicado en las instrucciones.

### 3. Memoria de trabajo:

En este ejercicio del test, se debe responder cuando se vea un estímulo o cuando se piga otro.

### 4. Evaluación en ejercicio tipo "X":

En esta tarea, se debe responder a un estímulo concreto tanto cuando se presente visual como auditivamente.



## RESULTADOS

En el estudio piloto que se ha realizado sobre la prueba mencionada, se han obtenido dos tipos de resultados: por una parte, la usabilidad de la prueba, el escenario, las instrucciones, etc; y por otra parte, el funcionamiento de los ítems. En los primeros resultados obtenidos, se ha observado que los índices de dificultad de las tareas son superiores a 0,9 por lo que las tareas se consideraron demasiado fáciles y se han realizado modificaciones. También se modificaron las instrucciones y el escenario.

## CONCLUSIONES

Tras los cambios realizados, la prueba es percibida como más atractiva y ecológica. Es adecuada para medir la atención sin interferir con factores motivacionales. Actualmente, la prueba se encuentra en una fase más desarrollada en la que se han realizado más modificaciones dependiendo de los índices de dificultad obtenidos en los análisis estadísticos. La prueba consta de tres tareas diferentes; una de ellas es un paradigma AX y las otras dos son tipo Xno dual. El tiempo aproximado de la prueba es de 18 minutos. Tras un pilotaje realizado con más de 200 sujetos, la prueba se encuentra en proceso de baremación.

## REFERENCIAS BIBLIOGRÁFICAS

Petersson, R., Söderström, S., & Nilsson, K. W. (2015). Diagnosing ADHD in Adults An Examination of the Discriminative Validity of Neuropsychological Tests and Diagnostic Assessment Instruments. *Journal of attention disorders*, 1-13. doi: 0.1177/1087054715618788.



**ANNEX X – POSTER PRESENTED AT  
THE 6<sup>TH</sup> WORLD CONFERENCE ON  
ADHD**

VRMIND (CA 733901)

# COMPARISON BETWEEN PROCESSING SPEED OF WISC-IV AND RESPONSE TIME OF THE CPT NESPLORA AULA IN CHILDREN WITH ADHD

Miguel Mejías<sup>(1)</sup>, Maria Feliciano González<sup>(1)</sup>, Maite Redondo<sup>(1)</sup>, Andrea Abadi<sup>(2)</sup>, Sofia Lalor<sup>(2)</sup>, Ivan Dario<sup>(3)</sup>

(1) Nesplora Technology & Behavior. R&D Department. San Sebastián, Spain.

(2) INECO. Departamento Infantojuvenil. Buenos Aires, Argentina.

(3) Instituto Randall. Asunción, Paraguay.

**Contact information:**  
(1) psychology@nesplora.com  
(2) info@ineco.org.ar  
(3) ivandelgado11@gmail.com

## OBJECTIVES

One of the findings of the studies is that children with ADHD score worse on WISC Processing Speed Index (PSI) than children undiagnosed. Alterations in temporal processing may represent a primary cause of key symptoms in ADHD<sup>(1)</sup>. Reaction times in go/no\_go tasks, seem also a variable with positive predictive value for ADHD diagnosis<sup>(2)</sup>. Reaction time on the correct answers in CPT tasks is also believed to reflect processing speed<sup>(3)</sup>. However, none of the tools use the same parameters to calculate the processing speed. The objective of this study is to compare the PSI scores with Response Time (RT) of a CPT in a clinical sample.

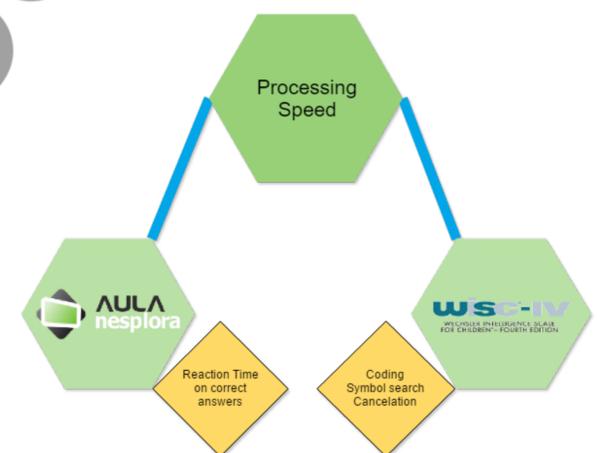
## METHODS

AULA Nesplora<sup>(5)</sup> is a virtual reality CPT which measures attentional processes and motor activity with two tasks (X-No and X task) using visual and auditory stimuli and presenting distractors.

WISC-IV<sup>(4)</sup> is a widely used IQ test which provides, among others, a processing time measure using two core subtest (Coding and Symbol search) and one supplementary subtest (Cancellation).

35 children diagnosed with ADHD participated (74.3 % male), with an age range from 6 to 16 years old (M = 9.89, SD = 3.18).

Due to the distribution of the sample non-parametric analysis were carried out (Spearman correlation).



## RESULTS

There is not significant relationship between the WISC-IV processing speed and the total mean value of response time on Nesplora AULA. There is not significant relationship between the WISC-IV processing speed and the total response time mean value of the visual stimuli.

There is a significant inverse relationship between the WISC-IV processing speed and the total mean value of response time in the auditory stimuli.

		Correlations		
		Reaction Time - AULA (total)	Reaction Time - AULA (visual)	Reaction Time - AULA (auditory)
Rho de Spearman	Processing Speed - WISC-IV	-0,226	-0,193	-0,400*
		0,193	0,266	0,017
		35	35	35

## CONCLUSIONS

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. After analyzing the results of children in PSI of WISC and RT of AULA Nesplora we can conclude that there is not any relationship between the two tests, except between PSI and RT in auditory stimulus, which is expected due higher score on RT represents an slower reaction to the stimuli.

These results indicate that the PSI of the WISC and RT of AULA do not measure the same construct. These results, may contradict the extended interpretation of reaction time as a reliable measure of processing speed. Therefore, more studies with more participants are required in order to test this hypothesis.

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**ANNEX XI - ORAL COMMUNICATION  
PRESENTED AT THE 3<sup>RD</sup> NATIONAL  
CONGRESS ON PSYCHOLOGY**

VRMIND (GA 733901)



III Congreso Nacional  
de Psicología  
3 al 7 Julio 2017 · Oviedo · Asturias

# Certificado

El Consejo General de Colegios Oficiales de Psicólogos de España (COP) certifica que

**Maria Feliciano Gonzalez Perez**

ha presentado la siguiente Comunicación Oral en el III Congreso Nacional de Psicología:

**Evolución de los procesos atencionales en función de la edad, medidos a través de una herramienta en realidad virtual**

Maria Feliciano González, Maite Redondo Zaballos, Miguel Mejias, Amaia Aierbe y Marta Moreno

III Congreso Nacional de Psicología

3 al 7 Julio 2017 · Oviedo · Asturias · España

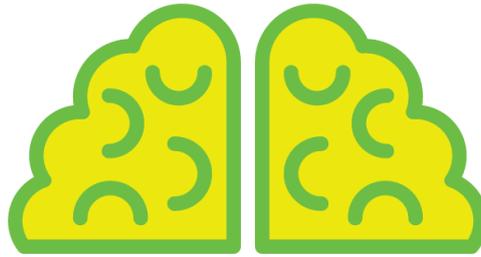
*Francisco Santolaya Ochando*

Presidente del Consejo General de Colegios Oficiales de Psicólogos

*José Muñoz Fernández*

Presidente del Comité Científico

**ANNEX XII – ORAL COMMUNICATION  
PRESENTED AT THE 6<sup>TH</sup> SCIENTIFIC  
MEETING OF THE FEDERATION OF  
THE EUROPEAN SOCIETIES OF  
NEUROPSYCHOLOGY**



**FESN 2017**

## **Certificate of Attendance**

I hereby declare that

**Marta Moreno - Oyarzabal**

has participated in **FESN 2017** held from 13 to 15 September 2017 at Maastricht University in Maastricht, The Netherlands.

**Presentation:**

'Attention assessment in adults through virtual reality'

**Co-authors:**

Miguel Mejías, Mari Feli González, Maite Redondo, Amaia Aierbe, Marta Moreno and Javier Guinea.

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**Prof. dr. B. Schmand**

**President of the Dutch Neuropsychological Society  
Program chair of FESN 2017**

Date: 21 September 2017

**ANNEX XIII – POSTER PRESENTED  
AT XI SENEP ANNUAL MEETING**

VRMIND (GA 733901)



## [Efecto diferencial del metilfenidato y la lisdexanfetamina en la ejecución del Test neuropsicológico AULA Nesplora en niños/as en tratamiento para TDAH]

[Manuel Fernandez Fernandez<sup>1</sup>, Maite Redondo Zaballos<sup>2</sup>, Miguel Mejias<sup>2</sup>, M.<sup>a</sup> Feliciano Gonzalez Perez<sup>2</sup>, Unai Diaz Orueta<sup>3</sup>]

[<sup>1</sup> Instituto Andaluz de Neurología Pediátrica. España] [<sup>2</sup> Nesplora, Techonoly & Behavior. España] [<sup>3</sup> Dublin City University. Ireland]

## Introducción y Objetivos

El objetivo de este estudio es evaluar el efecto diferencial del metilfenidato y la lisdexanfetamina en la mejora sintomática conductual y cognitiva del TDAH medida a través del Test AULA Nesplora de realidad virtual.

## Material y Método

La muestra está compuesta por 123 sujetos (76,4% niños) de entre 5 y 20 años. Todos tenían un diagnóstico de TDAH según los criterios diagnósticos del DSM - 5. Se ha llevado a cabo un diseño cuasi-experimental con dos grupos.

- Un grupo fue sometido a un tratamiento farmacológico con Metilfenidato de liberación prolongada (n=35)
- Otro grupo a un tratamiento con lisdexanfetamina (LDX) (n=88)

Se evaluó el rendimiento atencional y motor antes y después del tratamiento en ambos grupos.

A todos los participantes se les aplicó el test AULA Nesplora antes de comenzar con el tratamiento farmacológico y después.

Se realizaron análisis no paramétricos U de man-Whitney para muestras independientes .



## Resultados

No se encontraron diferencias significativas en las puntuaciones obtenidas en el Test AULA entre ambos grupos antes de comenzar con el tratamiento.

Se compararon las puntuaciones post de ambos grupos y se observó que existía diferencias significativas en las puntuaciones de Actividad Motora cuando están presentes los distractores y en la Tarea Xno, observándose menor Actividad en el grupo con Tratamiento de Metilfenidato.

## Conclusiones

Se observa una menor Actividad Motora en algunas circunstancias (Con distractores y en la Tarea Xno) con el tratamiento de metilfenidato que con la LDX. Sin embargo es necesario equiparar las muestras y comprobar si estas diferencias también se dan en otras variables.

