



## **D5.2 – Independent Report on the performance of AULA on Latam population**



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VRMIND (GA 133901)

## 1. EXECUTIVE SUMMARY

VRMIND-AULA is a neuropsychological test for attention in children from 6 to 16 years old. It is a Continuous Performance Test (CPT) designed to evaluate attentional processes and support the diagnosis of attention disorders, it analyses the child's behavior within a classroom. It is also valuable in other kind of disorders where attentional processes are essential like generalized developmental disorders. VRMIND-AULA offers scores about: sustained attention, divided attention (visual and auditory); impulsivity; excessive motor activity (hyperactivity); tendency to distraction, processing speed, focus on the task, attentional difference between visual and audio stimuli and between more and less stimulating tasks, sterile movement, motor activity and fatigue for tasks. Also distinguishes the tendencies to the internal or external distraction. The normative study of AULA with general population of Spain was published in Journal of Attention Disorders (Iriarte et al., 2012), and the convergent validity with Conners' Continuous Performance Test, the market leading test, has been recently published in Child Neuropsychology journal (Díaz et al., 2014).

This product was launched to the market on 2011 and it has been sold to more than 350 customers in 22 countries. From 2011 up to now both the professionals from Nesplora and also our customers have made different investigations with this tool.

Even though to continue researching with VRMIND-AULA it is always useful since these studies increase the visibility of the tool and its clinical value. This is the reason why it was planned to perform clinical studies with AULA in different countries at the beginning of the VRMIND Project.

This deliverable describes the contacts with potential collaborators made in section 3. The studies which were finally carried out are specified in section 4 while the main conclusions are drawn up in section 5.

## 2. RELATION WITH OTHER WPS AND DELIVERABLES

This deliverable is closely related with D5.1 (Independent report on the performance of AULA on European population) and D5.3 (Independent

report on the performance of AULA on N. American population). In fact, since several collaborators in the three regions have used the same evaluation protocol in their studies we plan to publish their results in the same paper.

### 3. COLLABORATOR’S STUDIES

A total of contacts were made basically with different experts in the ADHD (Attention Deficit Hyperactivity Disorder) field and also with current clients of VRMIND-AULA. All of them were contacted by mail and telephone and with some of them we could schedule a telco for giving more information. However, with some of them were not possible to reach an agreement for the reasons specified in the table below.

Table 1. Contacts done but not signed *(for confidentiality reasons, the columns including the name of the centers has been deleted in this version)*

CITY	REASON FOR NOT PARTICIPATING
México	No feedback after first contact
México	Contact lost after exchanging basic Project information
México	Contact lost after exchanging basic Project information
El Salvador	Problems to carry out the collaboration in the time requested
Chile	Contact lost after several Exchange of information about the collaboration process
Venezuela	Contact lost after exchanging basic Project information
Spain	Contact lost after exchanging basic Project information
Mexico	Contact lost after exchanging basic Project information

As one of the main collaborators’ complaints was to have the evaluations done by the deadline of the deliverable, we decided to offer the collaborators to participate with us and to share with us as much data as possible by month 2 of the project in order to be able to finish the deliverable by month 3, as expected in the DoA, and to continue collecting and exchanging data with us until they complete the total required sample.

With this more flexible criterion, we were able to get three collaborators on board, as described below.

### 3.1 University of Rio de Janeiro

Collaborator's description: Sergio L. Schmidt is a researcher and professor at the University of Rio de Janeiro since 1989. He is author of more than 45 articles. Besides other topics, his research has been focus on neuropsychological assessment, cognition disorders and neurodegeneration.

Location: R o de Janeiro (Brasil)

At the beginning, this collaborator was interested in AULA and he planned to evaluate 600 children between 6 and 16 years old without pathology starting on September 2017. However, when we talked to him about Nesplora Aula School, he told us that this tool is more interested for him. So he decided to wait a little bit for this new tool and started collecting data with this tool. Specifically, he is going to collaborate in a clinical study of the Nesplora Aula School. He is going to recruit 600 children from the schools and the objective is to compare the scores of Nesplora Aula School with the academic results. The final aim is to know the prediction power of the attentional processes in the educational performance.

The results of this collaborator will be described in D5.14 - Independent Report on the Performance of AULA School on Latam population (M19).

### 3.2 INECO - Institute of Cognitive Neurology

Collaborator's description: INECO was created with the aim of improving the living conditions of patients suffering neurologic and psychiatric disorders, their relatives and the population in general. It is a well-recognized institution in Argentina which promotes the research in new advances for neuropsychological measures. For the Nesplora AULA clinical study, the adolescents and children department, directed by Andrea Abadi, carried out the research.

Location: Buenos Aires (Argentina)

Sample: 80 children with ADHD

Sociodemographic data

	Number	Age average	Years of education (average)
<b>Male</b>	38	10.92	5.58
<b>Female</b>	20	11.40	6.15
<b>Total</b>	58	11.09	5.78

Finally INECO was not able to recruit the 80 children agreed at the beginning, but they were able to recruit 58.

The diagnostic of the children were:

Diagnostic	Frequency	Percentage
ADHD	45	77.6
Anxiety	3	5.2
Dyslexia	2	3.4
Specific Language Impairment	1	1.7
Autism Spectrum Disorder	1	1.7
Child Behaviour Disorder	2	3.4
Social Anxiety	1	1.7
Learning Disabilities	1	1.7
Tourette Syndrome	1	1.7
No specific diagnostic	1	1.7
<b>TOTAL</b>	<b>58</b>	<b>100</b>

### Measurements:

- Nesplora AULA:** AULA (Climent & Banterla, 2010) is a continuous performance test that takes place in a virtual scenario, very similar to a school classroom. During 20 minutes, the child is situated in a virtual context, shown through a head-mounted display with movement sensors and earphones and a single-button switch. Perspective places the child in one of the desks, facing the blackboard, where the stimuli appear. Stimuli are presented both on a visual and auditory basis, and, at the same time, previously randomized distractors of ecological nature appear progressively. The core of AULA is composed by two main exercises: (a) a NO-X paradigm-based exercise (i.e., “Press the button when you DO NOT perceive the target stimulus”) and (b) an X paradigm-based exercise (i.e., “Press the button when you perceive the target stimulus”).
- WISC-V: Wechsler Intelligence Scale for Children®-Fifth Edition** (Wechsler et al., 2003): It is the latest version of the most proven trusted cognitive ability measure ever. It has been redesigned to give you a truly comprehensive picture of a child's abilities and it includes notable improvements to make identifying the issues—and finding the solutions—faster and easier.

### Descriptive data:

WISC IV	
Description	Mean ± Standard Deviation
Verbal Comprehension Index	92.26 ± 15.486
Similarities	9.03 ± 2.232
Vocabulary	8.59 ± 3.185
Comprehension	8.09 ± 3.430
Information	8.54 ± 3.289

Perceptual Reasoning Index	93.09 ± 13.869
Block Design	8.05 ± 2.958
Picture Concepts	9.09 ± 2.843
Matrix Reasoning	9.26 ± 2.794
Working Memory Index	83.86 ± 15.380
Digit Span	7.58 ± 2.630
Letter-Number Sequencing	6.98 ± 3.357
Arithmetic	6.84 ± 2.963
Processing Speed Index	90.29 ± 11.286
Coding	7.62 ± 2.477
Symbol Search	8.83 ± 2.479
CI_TOTAL	89.05 ± 13.723
<b>Nesplora AULA</b>	
<b>Description</b>	<b>Mean ± Standard Deviation</b>
Total omissions	61.57 ± 9.548
Total commissions	56.12 ± 11.611
Average reaction time on correct answers	49.48 ± 12.372
Variability of reaction time on correct answers	58.66 ± 11.611
Motor activity	65.03 ± 11.696
Deviation from attentional focus	64.78 ± 7.760

### Objectives of the study

The aim of this study is to provide better understanding of the children's cognitive profile, mainly children with ADHD, exploring Nesplora AULA's scores correlations with WISC IV intelligence scale.

### Hypotheses study

Correlation between the variables of both tests would provide complementary data about the cognitive profiles on children with an ADHD diagnose. Negative correlation between reaction time in Nesplora AULA and

processing time in WISC IV are expected in ADHD participants as CPT reaction time has been considered as a measure of processing speed.

## Results

Significant correlations could be observed between some of the variables of both tests. The absence of significant correlation between processing speed in the WISC IV and the reaction time in Nesplora AULA suggest that, contrary to what is assumed, could not be considered as a reliable measure of processing speed in ADHD subjects. In those cases, reaction time would be related to impulsivity. Different studies carried by Walg et al. (Walg, Hapfelmeier, Hapfelmeier & Prior, 2017) or Jimenez-Figueroa et al. (Jiménez-Figueroa, Ardila-Duarte, Pineda, Acosta-López, Cervantes-Henríquez, Pineda-Alhucema et al., 2017) support this hypothesis.

Correlations between some variables of both tests can be observed in the following table. Results should be explored in order to provide further explanations about cognitive processes on these kids:

		Nesplora AULA						
		Total omissions	Total commissions	Reaction time on correct answers	Variability of reaction time on correct answers	Reaction time on commissions	Variability of reaction time on commissions	Motor activity
WISC IV	Comprehension	.071	-.242	.219	-.345	-.103	-.465*	-.010
	Information	-.207	.039	-.171	-.319	-.390	-.500*	-.146
	Digit Span	-.165	-.492*	.020	-.396	-.097	-.421	-.526*
	Letter-Number Sequencing	-.171	0.050	-.055	-.247	-.018	-.426	-.243
	Perceptual Reasoning Index	-.046	-.123	.092	-.312	-.118	-.528*	-.090

	<b>Working Memory Index</b>	-0.180	-0.249	-0.099	-0.263	-0.041	-0.358	-0.508*
	<b>Processing Speed Index</b>	-0.055	-0.024	-0.051	.007	-0.126	-0.037	.063
	<b>IC_TOTAL</b>	-0.101	-0.277	.071	-0.346	-0.162	-0.478*	-0.150

Dissemination

Results obtained with part of this sample have been partially presented as a poster publication in the 6th World Congress of ADHD at Vancouver (April 2017):



The conclusion of this poster is that: Reaction Time (RT) is a reliable measure of the time taken to respond to a stimulus, while the Processing Speed Index (PSI) corresponds to the time taken to complete a task. After analyzing the results of children in Processing Speed Index of WISC and Reaction Time 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 to higher score on RT represents a 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.

Further analysis on the data obtained would be carried out in order to disseminate these results.

### 3.3 Autonomous University of La Asunción / Randall Institute

Collaborator's description: Ivan Dario Delgado Mejía is a Neuropsychologist working with neurodevelopment disorders at the Randall Institute. He is also professor of the child neuropsychology master degree at the Autonomous University of La Asunción. He actively participates in numerous neuroscience congresses. His research activity is focused on ADHD assessment and treatment.

Location: Asunción (Paraguay)

Sample: 60 children between 6 and 16 years-old with ADHD

Sociodemographic data

	Number	Age average
<b>Male</b>	42	11.31
<b>Female</b>	10	11.30
<b>Total</b>	52	11.31

The final sample has been composed of 52 children, 8 children less than the initial sample agreed.

The diagnostic of the children were:

Diagnostic	Frequency	Percentage
ADHD	34	65.4
ODD	1	1.9
GAD	4	7.7

AED	2	3.8
Depression	1	1.9
OCD	1	1.9
PLD	6	12
Intellectual disability	1	1.9
Without clinical condition	2	3.8
TOTAL	52	100

Measurements:

- Nesplora AULA:** AULA (Climent & Banterla, 2010) is a continuous performance test that takes place in a virtual scenario, very similar to a school classroom. During 20 minutes, the child is situated in a virtual context, shown through a head-mounted display with movement sensors and earphones and a single-button switch. Perspective places the child in one of the desks, facing the blackboard, where the stimuli appear. Stimuli are presented both on a visual and auditory basis, and, at the same time, previously randomized distractors of ecological nature appear progressively. The core of AULA is composed by two main exercises: (a) a NO-X paradigm-based exercise (i.e., “Press the button when you DO NOT perceive the target stimulus”) and (b) an X paradigm-based exercise (i.e., “Press the button when you perceive the target stimulus”).
- WISC-V: Wechsler Intelligence Scale for Children®-Fifth Edition** (Wechsler et al., 2003): It is the latest version of the most proven trusted cognitive ability measure ever. It has been redesigned to give you a truly comprehensive picture of a child's abilities and it includes notable improvements to make identifying the issues—and finding the solutions—faster and easier.

Descriptive data:

<b>WISC IV</b>	
<b>Description</b>	<b>Mean ± Standard Deviation</b>
Verbal Comprehension Index	65.37 ± 30.679
Similarities	11.38 ± 3.075
Vocabulary	11.29 ± 2.718
Comprehension	11.65 ± 3.860
Word Reasoning	34.40 ± 8.997
Perceptual Reasoning Index	30.54 ± 5.539
Block Design	10.04 ± 2.835
Picture Concepts	10.29 ± 2.718
Matrix Reasoning	10.17 ± 2.307
Working Memory Index	31.13 ± 22.709
Digit Span	8.10 ± 2.378
Letter-Number Sequencing	7.33 ± 2.662
Processing Speed Index	15.90 ± 4.385
Symbol Search	8.58 ± 2.803
<b>Nesplora AULA</b>	
<b>Description</b>	<b>Mean ± Standard Deviation</b>
Total omissions	29.02 ± 23.693
Total commissions	22.79 ± 28.277
Average reaction time on correct answers	868.63 ± 184.142
Variability of reaction time on correct answers	432.981 ± 72.76
Motor activity	1.099 ± 1.05
Deviation from attentional focus	18871 ± 32120.22

### Objectives of the study

The aim of this study is to provide a better understanding of the children’s cognitive profile, mainly children with ADHD, exploring Nesplora AULA’s scores correlations with WISC IV intelligence scale.

### Hypotheses study

Correlation between the variables of both tests would provide complementary data about the cognitive profiles on children with an ADHD diagnose. Negative correlation between reaction time in Nesplora AULA and processing time in WISC IV are expected in ADHD participants as CPT reaction time has been considered as a measure of processing speed.

### Results

The analyses of the results provided by Randall Institute go in the same direction as the ones obtained by INECO. Significant correlations could be observed between some of the variables of both tests. The weak significant correlation between processing speed in the WISC IV and the reaction time in Nesplora AULA (two scores which theoretically measure the same construct) suggests that, contrary to what is assumed, could not be considered as a reliable measure of processing speed in ADHD subjects. In those cases, reaction time would be related to impulsivity. Different studies carried by Walg et al. (Walg et al., 2017) or Jimenez-Figueroa et al. (Jiménez-Figueroa et al., 2017) support this hypothesis.

		Nesplora AULA						
		Total omissions	Total commissions	Reaction time on correct answers	Variability of reaction time on correct answers	Reaction time on commissions	Motor activity	Deviation from attentional focus
WISC IV	Verbal Comprehension Index	-.266	0.087	-.374*	-.228	-.325*	-.014	-.155
	Perceptual Reasoning Index	-.233	.140	-.193	-.117	-.036	-.040	-.061
	Working Memory Index	-.455*	-.053	-.230	-.349*	-.284	-.293	-.370*
	Processing Speed Index	-.073	.042	-.083	-.177	-.198	-.041	-.057

Dissemination

Results obtained with part of this sample have been partially presented as a poster publication in the 6th World Congress of ADHD at Vancouver (April 2017):



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 a 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.

Further analysis on the data obtained would be carried out in order to disseminate these results.

#### 4. CONCLUSIONS

The aim of these validation clinical studies is to measure the accuracy, validity, sensibility and specificity, for the detection of pathologies, of the AULA test. From the commercial point of view, these tests are done in order

to give value to the test in front of the market so the studies can open new markets in foreign countries.

AULA was deployed into the market in 2011 and from that moment until now several studies have been carried out by the R+D department of Nesplora but also by independent experts, mainly our clients.

For this report we expected to make studies with a total sample of 300 subjects, and we have just been able to recruit 110 subjects. This reduction is due to the difficulties to find new collaborators to perform the studies in Latam. Even three collaborators were identified before the start of the project; they have not finally collaborated with us. So we have started from the beginning looking for collaborators. The ethical constraints and the deadline of the studies have been the main reasons to not collaborate with us.

Even though, we have been able to close three agreements with three collaborators in three different countries: Brazil, Argentina and Paraguay. With the Brazilian collaborator it has not been possible to start the study yet, and finally he will carry out his study with the Nesplora Aula tool. Anyway, as the virtual reality tool is the same, and just the report changes between the two tools, we can obtain data for both: Nesplora Aula and Nesplora Aula School. Even late for updating this deliverable, these data will help us also for carrying out a normative study which will help us to commercialize Nesplora Aula not only in Brazil but also in other Latin American countries.

The studies carried out by INECO and Autonomous University of La Asunción /Instituto Randall use a very similar approach since the characteristics of the sample and the evaluation protocol (AULA and WISC-IV) are the same. These studies have allowed us to participate in an International Congress (6th ADHD World Congress) which has opened us new contacts in USA and Canada. Some of these contacts are interested in collaborating with us in the studies of the VRMIND Project, and others are interested in buying VRMIND products. In Spain we also have a collaborator called INPAULA (this collaboration is detailed in D5.1) with the same evaluation protocol and with

some ADHD patients. Currently, INECO and Randall Institute have agreed to share their data with INPAULA who is currently analyzing the data in deep with the aim of publishing a multicenter study. The data have been shared following the ethical principles.

## 5. REFERENCES

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