AULA versus d2 Test of Attention: Convergent validity and applicability of virtual reality in the study of reading disorders.

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Background

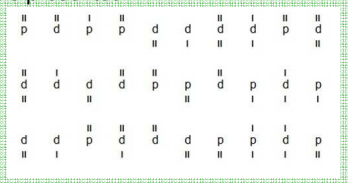
AULA is a Virtual Reality based neuropsychological test which measures attention processes and motor activity in children between 6 and 16 years-old on a CPT based paradigm with different tasks and distracting conditions, presented in a virtual scenario of a school classroom (Climent & Banterla, 2011). Mainly used for support in ADHD diagnosis (Diaz-Orueta et al. 2012, 2013; Zulueta et al., 2013), and with normative data for general population from 6 to 16 years old (Iriarte et al., 2012), its application to assess reading disorders remained so far unexplored.

AULA is composed by 2 main exercises:

- A No-X paradigm based exercise: “Press the button when you DO NOT see or hear apple”.
- An X paradigm based exercise: “Press the button whenever you DO see or hear seven”.

Stimuli are presented both on a visual (appearing in the classroom’ blackboard) and auditory basis (the patient hears them with the earphones), and, at the same time, previously randomized visual, auditory or combined distractors of ecological nature (i.e. equal to those that may appear in a real classroom environment), are presented.

AULA



d2

Objective

The objective of the current study is to show convergent validity between AULA, a Virtual Reality test to measure attention, and d2 Attention Test, a paper-and-pencil visual cancellation test; and to show AULA’s preliminary results in detecting attention problems and information processing patterns in children with reading disorders.

Sample and Method

- Sample was composed by 60 children (42% female) who were derived for psychological or educational treatment due to reduced school performance.
- Age: 6 to 17 years-old (mean age = 10.20, SD = 2.68).
- Sixty-eight percent of the group presents some type of learning disorders.
- AULA and d2 tests were administered in an alternative order to each half of the sample.
- AULA concentration index was calculated based on d2 measures (correct answers minus commission errors), in order to perform further convergent validity analyses.

Measures

AULA Variables	Description
Correct answers	Number of elements for which a correct answer is provided.
Omission errors	Patient do not press the button when he should have to do it. Measured per task, per sensorial modality (visual versus auditory), presence vs. absence of distractors
Commission errors	Patient presses the button when he should NOT have to do it Measured per task, per sensorial modality (visual versus auditory), presence vs. absence of distractors
Reaction time	Measured for correct answers and commission errors
Variability in reaction time	Changes in reaction time patterns during the test
Motor activity	Head movement, tracked with a movement sensor placed in the 3D glasses
Quality of attention focus	Number of errors performed by the subject when he/she has the blackboard in his/her viewing angle.

D2 Variables	Description
TR (nº of total answers)	Total number of elements (i.e. letters) that have been tried in each line.
TA (nº of total correct answers)	Number of elements for which a correct answer is provided. It relates to focalized attention or ability to attend task demands.
O (Omission errors)	Target letters which have not been marked and thus, have been omitted.
C (Commission errors):	Irrelevant letters marked by the patient as if they were correct.
TOT (Total effectiveness of the test):	A composite score obtained from subtracting errors from the number of total answers (TOT = TR – (O+C)).
CON (Concentration index):	An index obtained from subtracting commission errors from the number of total correct answers (CON = TA – C).
VAR (Difference or Variation Index)	Variability or sustained attention, that is, it evaluates whether with the progress throughout the test performance, the patients has committed more, less or a similar amount of errors.

Results

No statistical differences were attributable to test administration sequence. AULA distinguished better than d2 between children with and without reading-writing difficulties (Correct visual answers and visual errors: both $U = 166$, $z = -2.08$, $p<.05$), and convergent validity analyses showed adequate values for correct answers (cos = .944) and concentration indexes (cos = .929), while errors seemed to be measured differently in both tests.

Differences between groups with reading-writing problems versus group with no problems

	d2_ CON	d2_ TA	d2_ O	d2_ C	d2_ Errors	AULA_ CON	AULA_ Correct visual answers	AULA_ visual errors	AULA_ visual omissions	AULA_ visual commissions
Mann-Whitney U	261.5	268	222.5	227	224	180.5	166	166	179	209.5
Z	-.181	-.043	-1.013	-.926	-.981	-1.762	-2.080	-2.080	-1.795	-1.130
Sig.	.856	.966	.311	.354	.327	.078	.038*	.038*	.073	.258

*p<.05

AULA – d2 convergent validity analysis results

	d2- Correct	d2 – Errors	d2 – Commissions	d2 – Omissions	d2 – CON
AULA – Visual correct answers	.944				
AULA – Visual errors		.566			
AULA – Visual Commissions			.460		
AULA – Visual Omissions				.332	
AULA – CON					.929

Conclusion

Compared to d2, 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.

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