AULA Virtual Reality based attention test: factorial validity and convergent validity with EDAH scale and DSM criteria

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Background

AULA is a Virtual Reality based neuropsychological test for evaluating attention and support ADHD diagnosis in children between 6 and 16 years-old (Diaz-Orueta et al. 2012, 2014; Zulueta et al., 2013), with high test-rest reliability (Fernández-Fernández et al., 2012), sensitivity and specificity (Rufo et al., 2012). It is a test based on a CPT paradigm with different tasks and distracting conditions, presented in a virtual scenario of a school classroom (Climent & Banterla, 2011).

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

Objective

The objective of the current study was to study the factorial validity of AULA and its convergent validity with EDAH scale and DSM-IV criteria.

Sample and Method

Two exploratory factorial analyses of the 18 main variables of AULA were performed with 2074 children from different Spanish schools and clinical centres. Both a 1-dimensional structure and a 3-dimensional structure (accounting for aspects of inattention, impulsivity and hyperactivity –see table) were explored, by means of ULS (Unweighted Least Squares) extraction method.

For the convergent validity analysis with EDAH and DSM-IV, ADHD subsamples of 188 and 360 children were respectively analyzed, performing cosine similarity analyses.

AULA main indexes	Description	Related to…
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	Inattention
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	Impulsivity
Reaction time	Measured for correct answers and commission errors	Processing speed
Variability in reaction time	Changes in reaction time patterns during the test	Sustained attention, surveillance
Motor activity	Head movement, tracked with a movement sensor placed in the 3D glasses	Hyperactivity
Quality of attention focus	Number of errors performed by the subject when he/she has the blackboard in his/her viewing angle.	Inattention

Results

Part I: Factorial Validity Analysis

Eighteen studied variables tend to saturate a single factor (F-values from .527 to .946). When three factors are extracted, 2 of them clearly appear as residual dimensions. The adequacy of the variables correlation matrix was analyzed in order to perform the factorial analysis (Barlett = 55505.0, p<.000001; Kaiser-Meyer-Okin = 0.89), indicating a good data adjustment (RMSEA = 0.071; GFI = .98; alpha = .98), with a total explained variance of 66% for the single dimension.

Task	Main variables in AULA	F1	F2	F3	1-Single factor
NO-X TASK 	NO-X omission errors	.550			.818
	NO-X Commission errors	.858			.819
	NO-X Average reaction time for correct answers	.924			.867
	NO-X Deviation of reaction time for correct answers	.898			.946
	NO-X Average reaction time for commission errors	.923			.821
	NO-X Deviation of reaction time for commission errors	.846			.868
	NO-X Motor activity	.431	.510		.786
	NO-X deviation from the focus		.941		.627
	NO-X number of errors while watching the blackboard	.725			.860
X TASK 	X omission errors	.400	.386		.834
	X Commission errors			.990	.527
	X Average reaction time for correct answers	1.025			.847
	X Deviation of reaction time for correct answers	.878			.882
	X Average reaction time for commission errors	.494			.825
	X Deviation of reaction time for commission errors	.580			.865
	X Motor activity	.626			.835
	X deviation from the focus		.913		.639
	X number of errors while watching the blackboard			.950	.667

Part II: Convergent validity with EDAH and DSM

Results show low to moderate correlations between AULA and EDAH, being the highest correlations for inattention (from .406 to .544); between AULA and DSM-IV, the highest correlation values are also for inattention (from .379 to .473)

Conclusion

Results support the structure of AULA of one single factor that comprises the cognitive variables correlating with ADHD in any of its subtypes.

With regards to convergent validity, different nature of AULA as an objective cognitive measure and EDAH and DSM-IV as observational scales suggest they target different aspects or dimensions of patients’ behaviour and, hence, they may complement each other in the increase of ADHD diagnosis accuracy. Future analysis of the data will require to establish a relationship between AULA indexes and EDAH and DSM IV items one by one, in order to establish more accurate relationships between objective and observational data.

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