A comparison of objective (Readalyzer) and subjective (DEM test) evaluation of ocular movements

Maria Vittoria Manzoli[1], Alessio Facchin[2,3],Roberto Pregliasco[4], Silvio Maffioletti[5]

[1] Optometry private practice, Ostiglia, MN, Italy.
[2] Department of psychology, University of Milano Bicocca, Italy.
[3] Department of psychology, University of Pavia, Italy.
[4] Optometry private practice, Genova, Italy.
[5] Degree course in Optics and Optometry, University of Padova, Italy.

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Introduction

The Developmental Eye Movement Test (DEM Test) is a clinical and screening test used to evaluate ocular motility skills and naming in developmental age using a visuo-verbal format.
The ReadAlyzer is an eye tracking that analyzes ocular motility skills during the execution of four different motility test and while the subject is reading a text integrated in ReadAlyzer software. It consists of two parts: an hardware that measures ocular movements recording the ocular reflex of an IR source directed to the ocular limbus and a software that automatically analyzes, records and reports some specific and characteristic parameters.

Hypothesis

The purpose of DEM test is to analyze ocular motility skills in a reading like condition. The DEM consists of two section: a vertical one (test A and B) that measures automaticity of naming and a horizontal one (test C) that require ocular motility to complete the subtest. There are several studies that report the validity of DEM Test as a psychometric test to assess oculomotor skills, but there are only two research (Ayton L. et al., 2009; Lack, 2005) that compare DEM test performance with explicit quantification of saccadic eye movements objectively measured with an eye tracking. The purpose of this study is to demonstrate that DEM test gives a valid evaluation of ocular movement skills and to find what are the objectives ocular movement parameters that are related.
During this evaluation we have also considered and analyzed DEM test reliability with test-retest procedure.

Subjects

111 children from 6 to 14 years from a local state primary school participated to the study (49♂ and 62♀). All subjects present a near visual acuity with or without refractive correction ≥ 0,8. Due to a problem with the ReadAlyzer software some data have been lost and not all the correlations analyze all subjects data. For this reason each graph reports the number of subjects analyzed.

Materials and Methods

The data-gathering was divided into two principal blocks. During the first session we selected the subjects administering: Near LEA Acuity Vision test, PPC, Push-up and Push-away, TNO and Butterfly Stereoacuity Test.
During second experimental session, the DEM test was completed using the procedure showed in manual (Richmman, 2009). The objective recording of ocular movement are performed using the test of ReadAlyzer: tracking test, numbers test and the C card of DEM test. Because ReadAlyzer records only horizontal eye movements, A and B cards of DEM were not included.

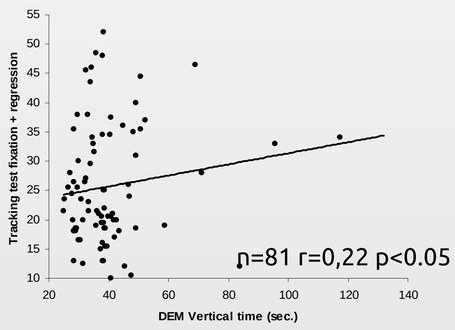
Procedures

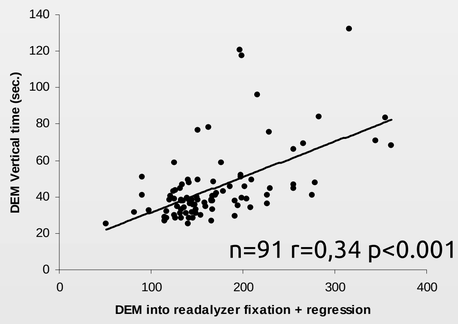
First of all, was completed the DEM test using the standard procedure described in user' s manual, and after 40-45 minutes we re-tested the C card of DEM test with ReadAlyzer and behavioral evaluation of time and errors. To obtain this parallel evaluation, the C card was incorporated in ReadAlyzer program.
During the 45 minutes between the standard execution of DEM Test and the retest with ReadAlyzer's assistance we execute the fixation, motility and tracking tests included in ReadAlyzer's software using the standard procedures described in the user's guide of the instruments.
During years the ocular movements in reading develops diminishing the numbers of fixation and regression. For these reason we have computed a synthetic value of ocular movement adding the mean of fixation and the mean of regression of the two eyes for the three test of ReadAlyzer (Tracking, Numbers and C card of DEM).

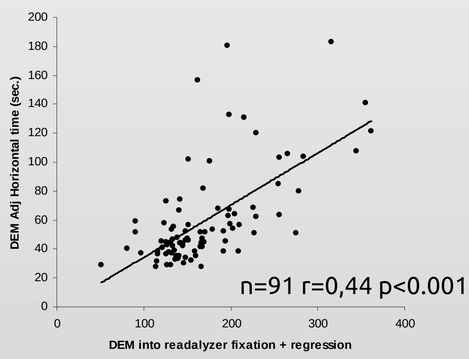
Results

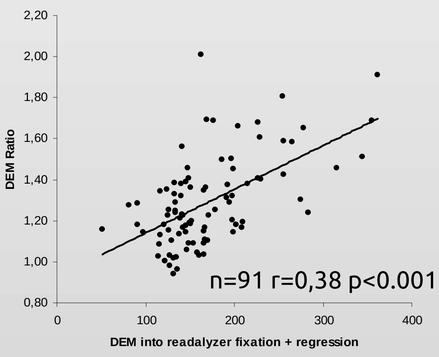
Since the variables are evaluated during developmental age, and normal Pearson correlation may return not real and higher value, we decide to perform **all correlation using partial correlation, corrected for age.**
The primary comparison are performed between DEM subtest and data obtained from ReadAlyzer using C card of DEM as stimuli. The results show several relationship; the higher are between AHT and number of regression and between ratio and number of regression. If we use the synthetic values:

	VT	*AHT*	*Ratio*	*Errors*
Number of fixation	0,30 p=0,004	*0,39 p=0,000*	*0,33 p=0,002*	0,16 p=0,127
Number of regression	0,36 p=0,001	*0,48 p=0,000*	*0,42 p=0,000*	*0,27 p=0,011*
Fixation duration	0,41 p=0,000	*0,36 p=0,001*	0,0126 p=0,90	*0,26 p=0,01*
Rate (numbers/min)	-0,43 p=0,000	*-0,45 p=0,000*	*-0,24 p=0,02*	*-0,23 p=0,03*
Regression ratio	0,23 p=,035	*0,31 p=,003*	*0,27 p=,010*	0,18 p=,083
Cross Correlation	-0,18 p=0,101	-0,13 p=0,240	0,03 p=0,770	0,02 p=0,878
Mean saccade in R.S.	0,14 p=0,18	0,12 p=0,26	0,02 p=0,80	0,04 p=0,69

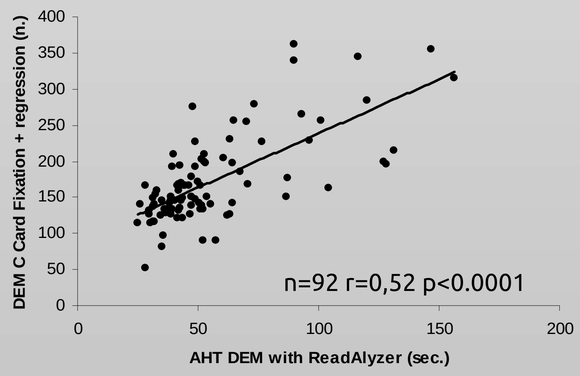


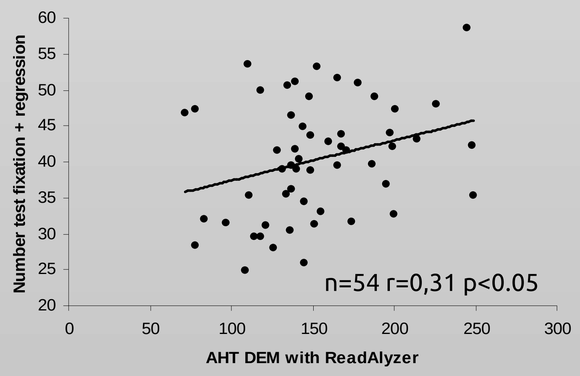




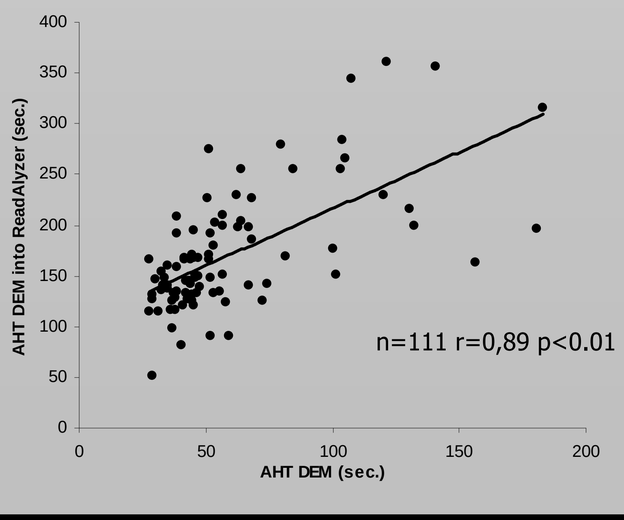


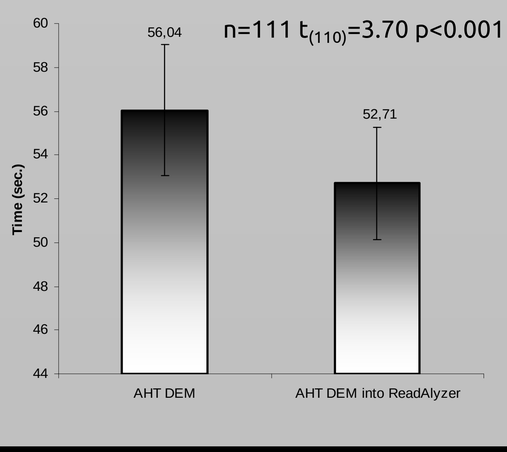
In the next evaluation is considered the relationship between synthetic parameters aforementioned of ReadAlyzer and AHT acquired simultaneously.





Finally we test the reliability of C card of DEM :





Conclusion

The convergence validity of DEM test with ReadAlyzer synthetic results is high if evaluated with the same stimuli. These results confirm the validity of DEM test to evaluate ocular motility in the developmental age. If we compare DEM test to other objective ocular motility assessment with ReadAlyzer, the correlation between the two tests decreases because the stimuli used are different and require differents skills. Finally, the repeatability of horizontal time of DEM test is very high if revaluated after a short time.

References

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@ mv.manzoli@gmail.com; alessio.facchin@unimib.it