Oculomotor speed and control as markers of cognitive ability in Malawian adolescent population

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Aims of the study

Processing speed and response control are fundamental properties of brain function and potential markers of cognitive ability.

Objectives

We examined whether eye tracking measures of saccadic reaction time and saccadic control are associated with an established cognitive ability test, Raven's coloured progressive matrices (CPM) among rural Malawian adolescents

Methods

Estimates of mean prosaccadic reaction time ($_pSRT_m$), antisaccade error rate (PE) and CPM were obtained for 760 (76%), 621 (62%) and 997 (99%) 13-year-old adolescents. We used Pearson correlation and linear regression to evaluate the association of the tasks.

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Results

Faster $_pSRT_m$ and lower PE were very weakly associated with higher CPM score (*r*s -0.12 and -0.11, p<.01). $_pSRT_m$ was associated with CPM (unadjusted and adjusted coef -0.02, 95%CI (-.03 - -.007), p=.005; -0.01, 95%CI (-.03- -.002), p=.03) but PE was not after adjustments (Table 1). The intercorrelations between pro- and antisaccadic tasks were mainly very weak (Table 2). Posthoc-analyses suggested that $_pSRT_m$ and PE are more strongly associated with CPM in children with more schooling (years in school below median <4.5, *r*s between $_pSRT_m$ and CPM -0.05, between PE and CPM -0.01; or above median >4.5, *r*s -0.21 and -0.39).

Conclusions

Saccadic reaction time was associated with traditional cognitive ability test performance; however, weaker than expected. Schooling is a potential moderator of the association between eye-tracking tests and CPM.

Table 1. Association between eye-tracking results and Raven's coloured progressive matrices scores

			CPM score								
Regressor	N		Unadjusted model Coef. (95% CI)	P-value	Adjusted R-squared / RMSE	LR test	N	Adjusted model[a] Coef (95% CI)	P-value	Adjusted R-squared / RMSE	LR test
SRT_m	579		-0.02 (-0.04 - -0.005)	0.012	0.01 / 3.7		567	-0.016 (-0.032 - - 0.001)	0.025	0.12 / 3.4	
SRT_m and PE	579	SRT_m	-0.02 (-0.04 - -0.006)	0.008	0.02 / 3.7	0.004	567	-0.017 (-0.03- -0.002)	0.031	0.12 / 3.4	0.203
		PE	-1.47 (-2.46- -0.48)	0.004				-0.63 (-1.60 - 0.33)	0.199		

SRT_m= Mean prosaccadic reaction time, PE = percentage of errors
[a]adjusted for participant age, sex, HAZ at 13 years, head circumference, schooling, and maternal education, the intervention during pregnancy and socioeconomic status at 13 years
Analysis is done including the maximal amount of the participants (with available the data required for the testing)

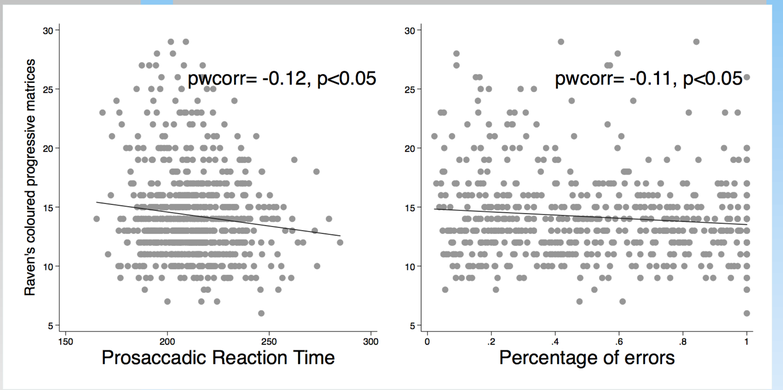

Table 2. Correlation coefficients among 7 different eye-tracking tasks (left side) and Raven's coloured progressive matrices score (right side) in preadolescence

SRT_{sd}	PE	LA_m	LA_{sd}	LE_m	LE_{sd}		CPM
0.61**	-0.04	0.11*	0.06	0.23**	0.12*	SRT_m	-0.12*
	-0.07	0.02	0.08	0.14**	0.08	SRT_{sd}	-0.03
		-0.13*	-0.10*	-0.19**	-0.19**	PE	-0.11*
			0.47**	0.32**	0.27**	LA_m	-0.06
				0.20**	0.20**	LA_{sd}	-0.01
					0.84**	LE_m	-0.05
						LE_{sd}	-0.00

SRT_m= Prosaccadic reaction time, mean, SRT_{sd}= Reaction time, standard deviation, PE = percentage of errors, LA_m=mean latency of accurate eye movement, LA_{sd}=standard deviation of accurate eye movement, LE_m=mean latency of error movement, LE_{sd}=standard deviationof error eye movement, CPM=Raven's coloured progressive matrices
N varies from 489 to 757, all the participants with data from each measurement included in the analysis.
*p<0.05
**p<0.001