Assessing the Correlation Between Parent-Child Relationships and Brain Development and Cognitive Functioning in Early Adolescents

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Introduction

- Executive functions (EF) are a crucial set of cognitive processes that control behavioral regulation and metacognition (Schroeder & Kelley, 2009)
- Adverse childhood experiences represent risk factors associated with the development of negative outcomes (Whittle et al., 2014)
- Social relationships and experiences have been shown to correlate with neurocognitive development (Sosic-Vasic et al., 2017)

Methods

Data Collection

- All data in dataset is de-identified and anonymous, obtained through Professor Kirby
- Dataset includes 5 assessments of parent relationship and 5 cognitive skill measures
- Participants include 10 year olds from 10 different international countries

Data Analysis

- Used SPSS software program
- Pearson's Correlation Coefficient table used to note the r and r^2 values
- Linear regression performed on specific variables of interest
- Multivariate multiple regression model run for predictions of multiple correlated variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
c3mroaff	1290	1.0000000	4.0000000	3.56148025	.496264866
c3mrohos	1290	1.0000000	4.0000000	1.34609819	.464621868
c3mroneg	1290	1.0000000	3.57142857	1.48936508	.485805959
c3mrorej	1290	1.0000000	3.75000000	1.24198966	.411312120
c3mrocon	1290	1.0000000	4.0000000	2.88462532	.562952401
c3froaff	1215	1.0000000	4.0000000	3.48531256	.559825595
c3frohos	1215	1.0000000	3.5000000	1.30994513	.428215134
c3froneg	1215	1.0000000	3.42857143	1.51185773	.505966585
c3frorej	1215	1.0000000	4.0000000	1.20192044	.384631742
c3frocon	1215	1.0000000	4.0000000	2.75631001	.608235220
y3Fluency.Avg	937	.000000000	23.5000000	8.88758449	3.59878617
y3DigitSpanB_Highest	940	0	7	4.08	1.167
y3SWM.Final.Span	939	2	8	4.38	1.487
y3Stroop.RT.Eqlnc	935	588.958333	1324.75000	961.438736	117.164809
y3WASI.Tscore	933	20	70	48.02	11.338
Valid N (listwise)	853				

Research Question:

Is there a correlation between parent-child relationships and brain development and function, and if so, which relationship has the greatest magnitude of association?

Correlations

		c3mroaff	c3mrohos	c3mroneg	c3mrorej	c3mrocon	c3froaff	c3frohos	c3froneg	c3frorej	c3frocon
y3Fluency.Avg	Pearson Correlation	.195**	−.140**	−.209**	−.117**	−.024	.232**	−.181**	−.262**	−.210**	−.008
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.457	<.001	<.001	<.001	<.001	.807
	N	928	928	928	928	928	874	874	874	874	874
y3DigitSpanB_Highest	Pearson Correlation	−.016	−.006	−.071*	−.070*	−.065*	−.024	−.008	−.047	−.098**	−.027
	Sig. (2-tailed)	.623	.859	.029	.033	.048	.483	.808	.164	.004	.425
	N	931	931	931	931	931	876	876	876	876	876
y3SWM.Final.Span	Pearson Correlation	.115**	−.119**	−.125**	−.142**	.011	.099**	−.126**	−.126**	−.179**	.013
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.738	.003	<.001	<.001	<.001	.692
	N	930	930	930	930	930	876	876	876	876	876
y3Stroop.RT.Eqlnc	Pearson Correlation	−.026	.086**	.034	.095**	−.049	−.085*	.130**	.073*	.140**	−.003
	Sig. (2-tailed)	.434	.009	.304	.004	.135	.012	<.001	.031	<.001	.923
	N	926	926	926	926	926	872	872	872	872	872
y3WASI.Tscore	Pearson Correlation	.140**	−.113**	−.133**	−.139**	−.105**	.086*	−.126**	−.160**	−.155**	−.099**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.001	.011	<.001	<.001	<.001	.003
	N	924	924	924	924	924	869	869	869	869	869

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.416	119.367[b]	5.000	838.000	<.001
	Wilks' Lambda	.584	119.367[b]	5.000	838.000	<.001
	Hotelling's Trace	.712	119.367[b]	5.000	838.000	<.001
	Roy's Largest Root	.712	119.367[b]	5.000	838.000	<.001
c3mroaff	Pillai's Trace	.030	5.245[b]	5.000	838.000	<.001
	Wilks' Lambda	.970	5.245[b]	5.000	838.000	<.001
	Hotelling's Trace	.031	5.245[b]	5.000	838.000	<.001
	Roy's Largest Root	.031	5.245[b]	5.000	838.000	<.001
c3mrohos	Pillai's Trace	.006	.999[b]	5.000	838.000	.417
	Wilks' Lambda	.994	.999[b]	5.000	838.000	.417
	Hotelling's Trace	.006	.999[b]	5.000	838.000	.417
	Roy's Largest Root	.006	.999[b]	5.000	838.000	.417
c3mroneg	Pillai's Trace	.011	1.944[b]	5.000	838.000	.085
	Wilks' Lambda	.989	1.944[b]	5.000	838.000	.085
	Hotelling's Trace	.012	1.944[b]	5.000	838.000	.085
	Roy's Largest Root	.012	1.944[b]	5.000	838.000	.085
c3mrorej	Pillai's Trace	.007	1.183[b]	5.000	838.000	.316
	Wilks' Lambda	.993	1.183[b]	5.000	838.000	.316
	Hotelling's Trace	.007	1.183[b]	5.000	838.000	.316
	Roy's Largest Root	.007	1.183[b]	5.000	838.000	.316
c3mrocon	Pillai's Trace	.014	2.348[b]	5.000	838.000	.039
	Wilks' Lambda	.986	2.348[b]	5.000	838.000	.039
	Hotelling's Trace	.014	2.348[b]	5.000	838.000	.039
	Roy's Largest Root	.014	2.348[b]	5.000	838.000	.039
c3froaff	Pillai's Trace	.018	3.042[b]	5.000	838.000	.010
	Wilks' Lambda	.982	3.042[b]	5.000	838.000	.010
	Hotelling's Trace	.018	3.042[b]	5.000	838.000	.010
	Roy's Largest Root	.018	3.042[b]	5.000	838.000	.010
c3frohos	Pillai's Trace	.003	.486[b]	5.000	838.000	.787
	Wilks' Lambda	.997	.486[b]	5.000	838.000	.787
	Hotelling's Trace	.003	.486[b]	5.000	838.000	.787
	Roy's Largest Root	.003	.486[b]	5.000	838.000	.787
c3froneg	Pillai's Trace	.013	2.151[b]	5.000	838.000	.058
	Wilks' Lambda	.987	2.151[b]	5.000	838.000	.058
	Hotelling's Trace	.013	2.151[b]	5.000	838.000	.058
	Roy's Largest Root	.013	2.151[b]	5.000	838.000	.058
c3frorej	Pillai's Trace	.014	2.320[b]	5.000	838.000	.042
	Wilks' Lambda	.986	2.320[b]	5.000	838.000	.042
	Hotelling's Trace	.014	2.320[b]	5.000	838.000	.042
	Roy's Largest Root	.014	2.320[b]	5.000	838.000	.042
c3frocon	Pillai's Trace	.005	.873[b]	5.000	838.000	.498
	Wilks' Lambda	.995	.873[b]	5.000	838.000	.498
	Hotelling's Trace	.005	.873[b]	5.000	838.000	.498
	Roy's Largest Root	.005	.873[b]	5.000	838.000	.498

a. Design: Intercept + c3mroaff + c3mrohos + c3mroneg + c3mrorej + c3mrocon + c3froaff + c3frohos + c3froneg + c3frorej + c3frocon

b. Exact statistic

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	y3Fluency.Avg	1109.318[a]	10	110.932	9.309	<.001
	y3DigitSpanB_Highest	38.264[b]	10	3.826	2.771	.002
	y3SWM.Final.Span	69.288[c]	10	6.929	3.284	<.001
	y3Stroop.RT.Eqlnc	365844.43[d]	10	36584.443	2.722	.003
	y3WASI.Tscore	7829.807[e]	10	782.981	6.219	<.001
Intercept	y3Fluency.Avg	426.713	1	426.713	35.807	<.001
	y3DigitSpanB_Highest	148.638	1	148.638	107.660	<.001
	y3SWM.Final.Span	127.949	1	127.949	60.640	<.001
	y3Stroop.RT.Eqlnc	3470154.41	1	3470154.41	258.201	<.001
	y3WASI.Tscore	14518.821	1	14518.821	115.326	<.001
c3mroaff	y3Fluency.Avg	15.885	1	15.885	1.333	.249
	y3DigitSpanB_Highest	.025	1	.025	.018	.892
	y3SWM.Final.Span	1.145	1	1.145	.543	.462
	y3Stroop.RT.Eqlnc	75228.369	1	75228.369	5.597	.018
	y3WASI.Tscore	1819.119	1	1819.119	14.450	<.001
c3mrohos	y3Fluency.Avg	9.344	1	9.344	.784	.376
	y3DigitSpanB_Highest	3.252	1	3.252	2.356	.125
	y3SWM.Final.Span	.749	1	.749	.355	.551
	y3Stroop.RT.Eqlnc	12030.035	1	12030.035	.895	.344
	y3WASI.Tscore	247.747	1	247.747	1.968	.161
c3mroneg	y3Fluency.Avg	77.861	1	77.861	6.534	.011
	y3DigitSpanB_Highest	4.572	1	4.572	3.311	.069
	y3SWM.Final.Span	2.942	1	2.942	1.394	.238
	y3Stroop.RT.Eqlnc	348.588	1	348.588	.026	.872
	y3WASI.Tscore	53.701	1	53.701	.427	.514
c3mrorej	y3Fluency.Avg	1.918	1	1.918	.161	.688
	y3DigitSpanB_Highest	4.584	1	4.584	3.320	.069
	y3SWM.Final.Span	1.693	1	1.693	.802	.371
	y3Stroop.RT.Eqlnc	7929.857	1	7929.857	.590	.443
	y3WASI.Tscore	175.426	1	175.426	1.393	.238
c3mrocon	y3Fluency.Avg	11.125	1	11.125	.934	.334
	y3DigitSpanB_Highest	4.696	1	4.696	3.401	.065
	y3SWM.Final.Span	.165	1	.165	.078	.780
	y3Stroop.RT.Eqlnc	42470.137	1	42470.137	3.160	.076
	y3WASI.Tscore	701.114	1	701.114	5.569	.019
c3froaff	y3Fluency.Avg	20.472	1	20.472	1.718	.190
	y3DigitSpanB_Highest	3.278	1	3.278	2.374	.124
	y3SWM.Final.Span	.856	1	.856	.406	.524
	y3Stroop.RT.Eqlnc	32505.605	1	32505.605	2.419	.120
	y3WASI.Tscore	685.994	1	685.994	5.449	.020
c3frohos	y3Fluency.Avg	.111	1	.111	.009	.923
	y3DigitSpanB_Highest	1.365	1	1.365	.988	.320
	y3SWM.Final.Span	.402	1	.402	.191	.662
	y3Stroop.RT.Eqlnc	10059.682	1	10059.682	.749	.387
	y3WASI.Tscore	10.481	1	10.481	.083	.773
c3froneg	y3Fluency.Avg	81.257	1	81.257	6.819	.009
	y3DigitSpanB_Highest	.128	1	.128	.093	.760
	y3SWM.Final.Span	.289	1	.289	.137	.712
	y3Stroop.RT.Eqlnc	3114.749	1	3114.749	.232	.630
	y3WASI.Tscore	563.920	1	563.920	4.479	.035
c3frorej	y3Fluency.Avg	51.980	1	51.980	4.362	.037
	y3DigitSpanB_Highest	8.708	1	8.708	6.307	.012
	y3SWM.Final.Span	14.860	1	14.860	7.043	.008
	y3Stroop.RT.Eqlnc	32839.455	1	32839.455	2.443	.118
	y3WASI.Tscore	368.700	1	368.700	2.929	.087
c3frocon	y3Fluency.Avg	1.228	1	1.228	.103	.748
	y3DigitSpanB_Highest	1.052	1	1.052	.762	.383
	y3SWM.Final.Span	.298	1	.298	.141	.707
	y3Stroop.RT.Eqlnc	9164.105	1	9164.105	.682	.409
	y3WASI.Tscore	151.371	1	151.371	1.202	.273

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.155[a]	.024	.023	11.378	1.387

a. Predictors: (Constant), c3frorej

b. Dependent Variable: y3WASI.Tscore

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2756.778	1	2756.778	21.296	<.001[b]
	Residual	112234.849	867	129.452		
	Total	114991.627	868			

a. Dependent Variable: y3WASI.Tscore

b. Predictors: (Constant), c3frorej

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	53.629	1.284		41.775	<.001		
	c3frorej	−4.710	1.021	−.155	−4.615	<.001	1.000	1.000

a. Dependent Variable: y3WASI.Tscore

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
y3Fluency.Avg	Intercept	9.737	1.627	5.984	<.001	6.543	12.931
	c3mroaff	.441	.382	1.155	.249	−.308	1.189
	c3mrohos	.379	.429	.885	.376	−.462	1.221
	c3mroneg	−.843	.330	−2.556	.011	−1.490	−.196
	c3mrorej	.178	.443	.401	.688	−.693	1.048
	c3mrocon	−.279	.289	−.966	.334	−.845	.288
	c3froaff	.449	.343	1.311	.190	−.224	1.122
	c3frohos	−.042	.437	−.096	.923	−.901	.816
	c3froneg	−.873	.334	−2.611	.009	−1.530	−.217
	c3frorej	−.936	.448	−2.089	.037	−1.815	−.056
	c3frocon	−.085	.265	−.321	.748	−.604	.434
y3DigitSpanB_Highest	Intercept	5.747	.554	10.376	<.001	4.660	6.834
	c3mroaff	−.018	.130	−.136	.892	−.273	.237
	c3mrohos	.224	.146	1.535	.125	−.062	.510
	c3mroneg	−.204	.112	−1.820	.069	−.425	.016
	c3mrorej	−.275	.151	−1.822	.069	−.571	.021
	c3mrocon	−.181	.098	−1.844	.065	−.374	.012
	c3froaff	−.180	.117	−1.541	.124	−.409	.049
	c3frohos	.148	.149	.994	.320	−.144	.440
	c3froneg	−.035	.114	−.305	.760	−.258	.189
	c3frorej	−.383	.153	−2.511	.012	−.682	−.084
	c3frocon	.079	.090	.873	.383	−.098	.255
y3SWM.Final.Span	Intercept	5.332	.685	7.787	<.001	3.988	6.676
	c3mroaff	.118	.161	.737	.462	−.197	.433
	c3mrohos	.107	.180	.596	.551	−.246	.461
	c3mroneg	−.164	.139	−1.181	.238	−.436	.109
	c3mrorej	−.167	.187	−.896	.371	−.533	.199
	c3mrocon	−.034	.121	−.280	.780	−.272	.204
	c3froaff	−.092	.144	−.637	.524	−.375	.191
	c3frohos	−.080	.184	−.437	.662	−.442	.281
	c3froneg	−.052	.141	−.370	.712	−.328	.224
	c3frorej	−.500	.189	−2.654	.008	−.870	−.130
	c3frocon	.042	.111	.376	.707	−.177	.260
y3Stroop.RT.Eqlnc	Intercept	878.078	54.645	16.069	<.001	770.821	985.335
	c3mroaff	30.316	12.814	2.366	.018	5.165	55.467
	c3mrohos	13.617	14.392	.946	.344	−14.632	41.865
	c3mroneg	−1.784	11.075	−.161	.872	−23.521	19.954
	c3mrorej	11.440	14.893	.768	.443	−17.792	40.671
	c3mrocon	−17.223	9.689	−1.778	.076	−36.240	1.794
	c3froaff	−17.905	11.513	−1.555	.120	−40.502	4.693
	c3frohos	12.710	14.691	.865	.387	−16.125	41.545
	c3froneg	5.407	11.281	.479	.632	−16.730	27.545
	c3frorej	23.524	15.049	1.563	.118	−6.014	53.061
	c3frocon	7.337	8.885	.826	.409	−10.102	24.776
y3WASI.Tscore	Intercept	56.797	5.289	10.739	<.001	46.416	67.178
	c3mroaff	3.801	1.241	3.063	<.001	1.367	6.236
	c3mrohos	1.954	1.393	1.403	.161	−.780	4.688
	c3mroneg	−.700	1.072	−.653	.514	−2.804	1.404
	c3mrorej	−1.701	1.441	−1.180	.238	−4.531	1.128
	c3mrocon	−2.213	.938	−2.360	.019	−4.053	−.372
	c3froaff	−2.601	1.114	−2.334	.020	−4.788	−.414
	c3frohos	−.410	1.422	−.289	.773	−3.201	2.381
	c3froneg	−2.301	1.087	−2.116	.035	−4.434	−.167
	c3frorej	−2.493	1.456	−1.711	.087	−5.351	.366
	c3frocon	−.943	.860	−1.097	.273	−2.631	.745

Results and Discussion

Descriptive Statistics

- Out of the parent-child measures, father affection had the highest mean
- Most relationships had similar degrees of variation and standard deviations

Pearson's Correlation Coefficients

- Overall weak correlations, but mostly significant
- Negative correlations observed for multiple cognitive tests across all parent-child relationships

Linear Regression

- Model good fit of data
- Weak correlation, but father rejection does have a significant relationship with WASI score ($p<0.001$)

Multivariate Multiple Regression

- Multivariate Tests show good model and statistically significant
- Tests of Between-Subjects Effects display significant interactions – father rejection significant with 3 out of 5 cognitive tests
- Parameter Estimates show fluency and WASI tests most correlated with various relationships

Limitations

- Associations, not causal
- Preliminary multivariate analysis
- Confounding variables not accounted for

Conclusion

- Although correlations were weak and had low r values, most were statistically significant
- Father rejection may play a large role in affecting child brain development

Future Research

- Run multivariate regression after checking assumptions
- Look into differences across countries

References

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