

Introduction

Inhibitory control (IC) is defined as the ability to suppress thoughts or responses when they are inappropriate or no longer relevant¹. Preadolescence (age 8-11) is a dynamic developmental period during which changes in inhibitory and attentional processes take place. It is during this time that many children present to clinical settings due to attention and behavior problems at school.

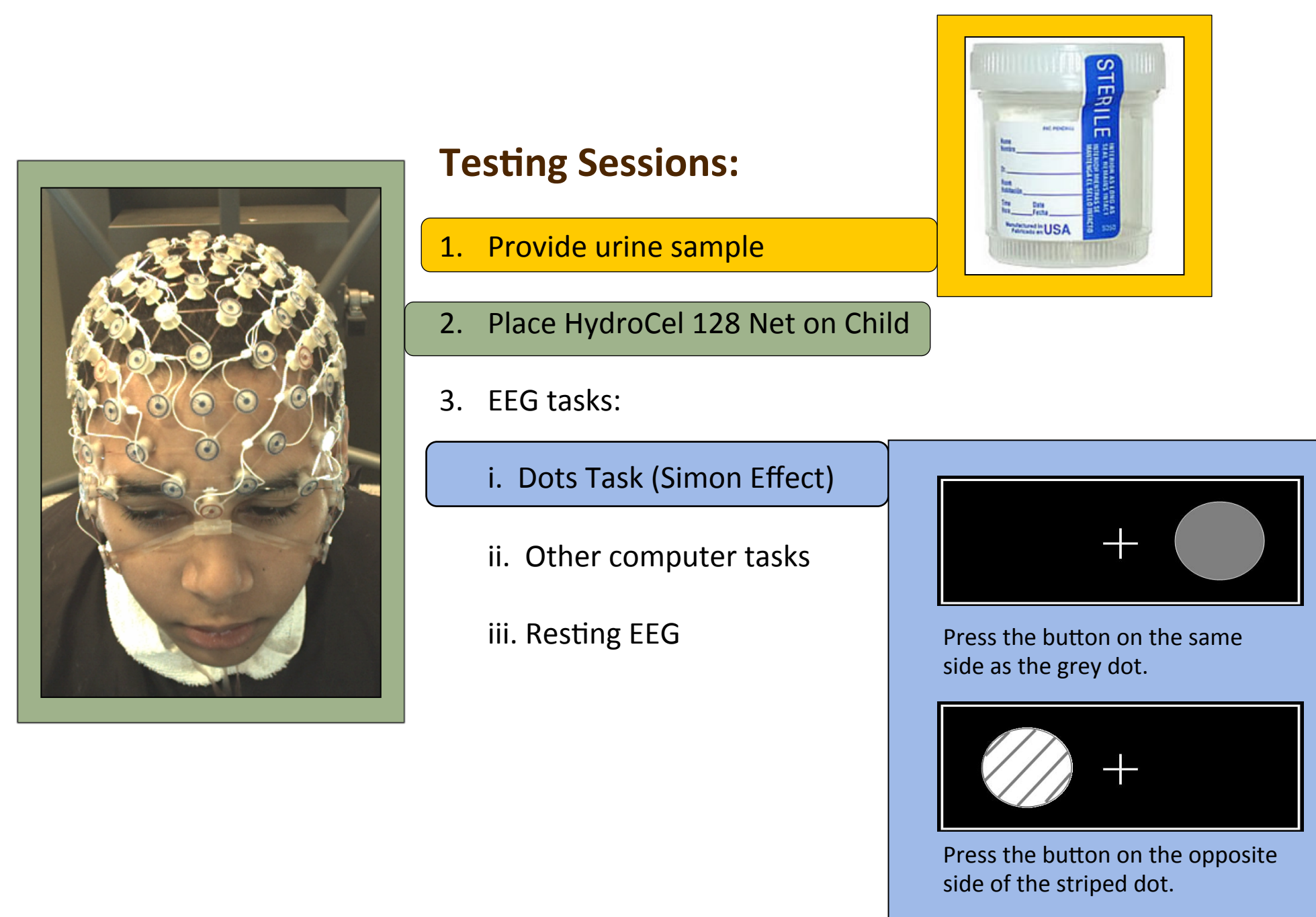
Previous studies demonstrate that IC is a predictor for a student's performance in educational settings², demonstrating a strong connection to math and reading skills at practically every stage of schooling². This study seeks to examine changes in inhibitory control and associated event-related potentials (ERPs) in this age group using a modified Simon-effect paradigm² called the Dots task.

This study aims to:

- determine the test-retest reliability of the N200 ERP signature over 4-6 weeks of time
- establish age effects on accuracy and response latency of the Dots task, and
- determine whether urinary epinephrine levels correlate with performance measures during the Dots task.

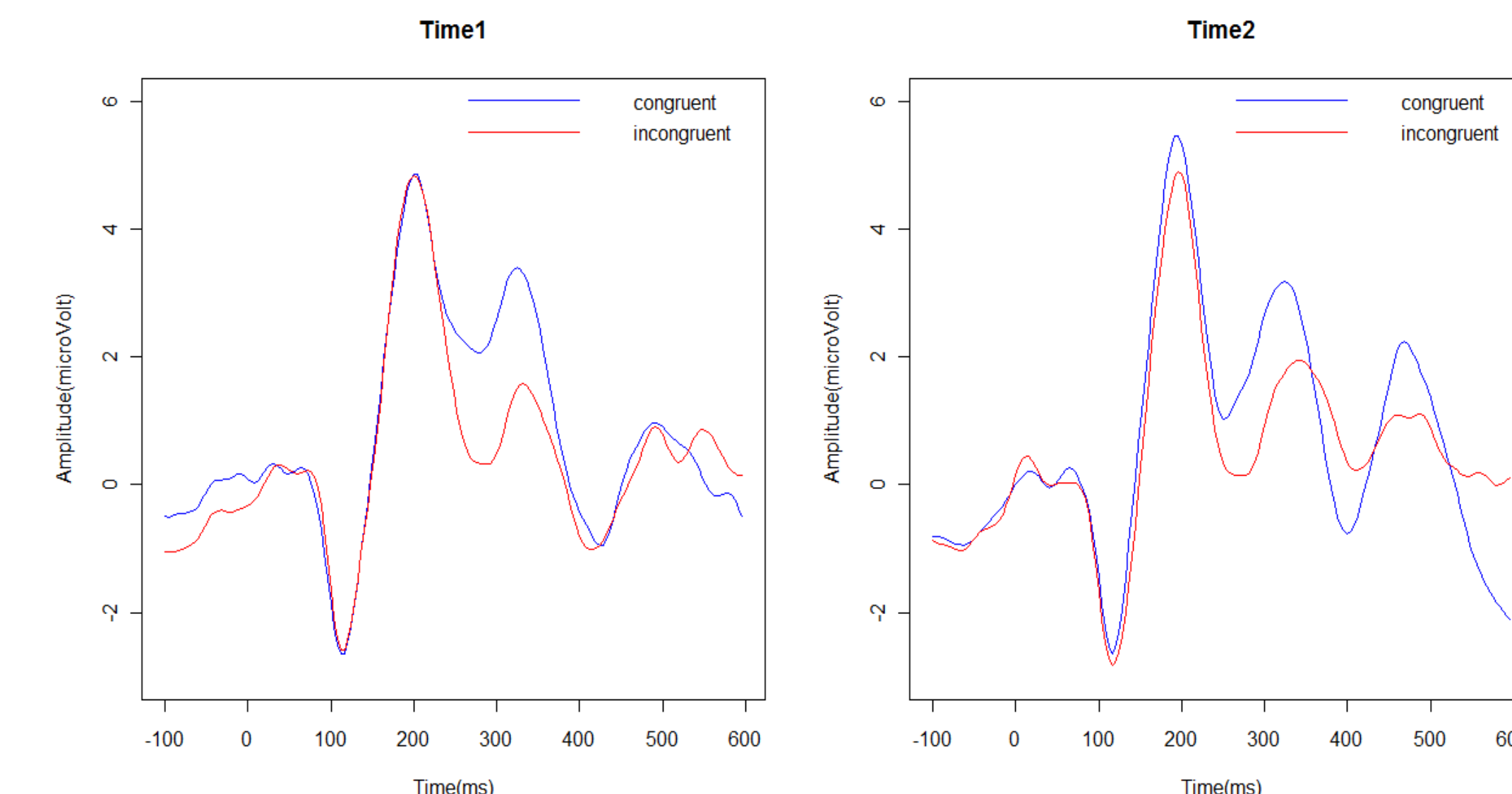
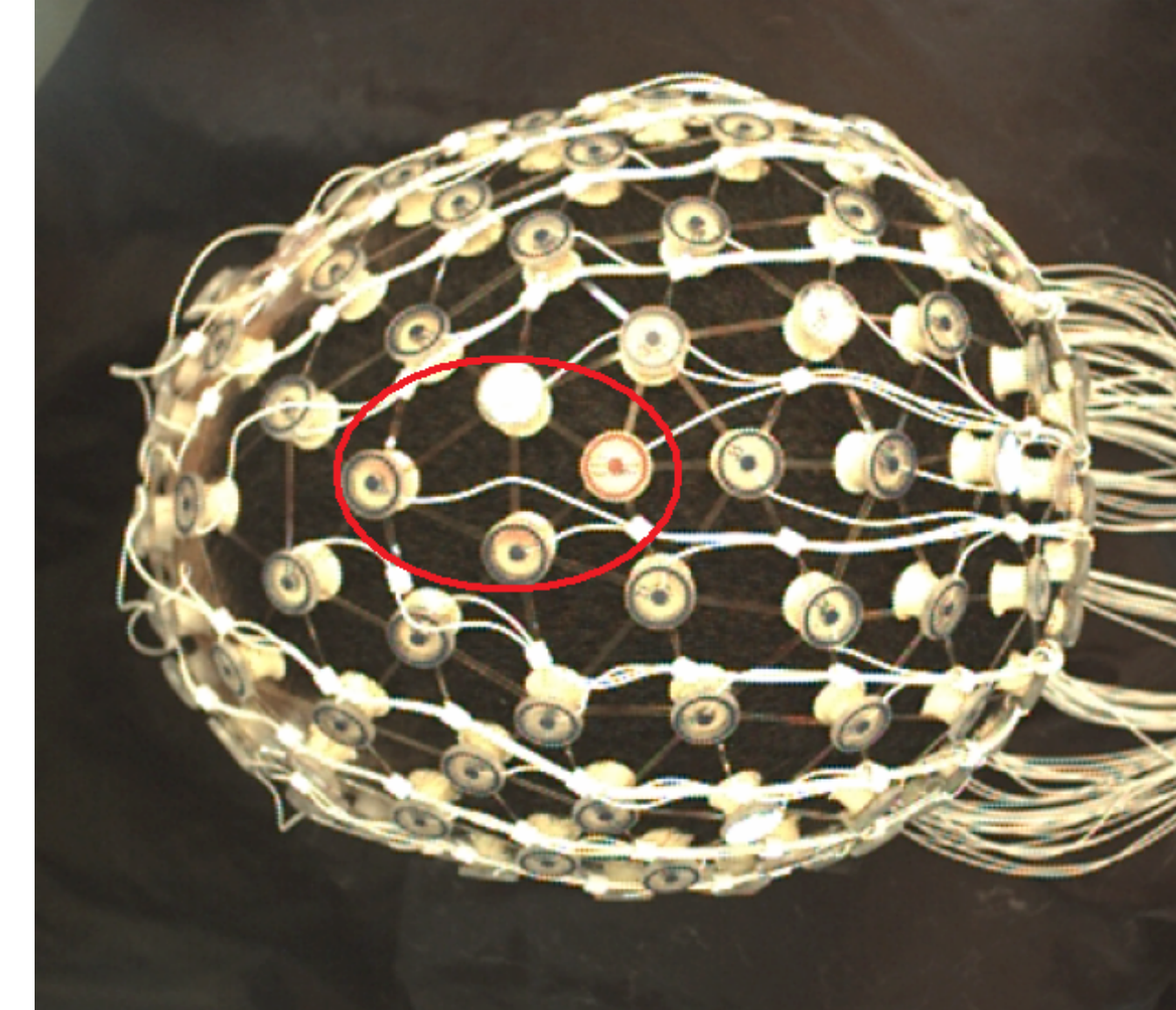
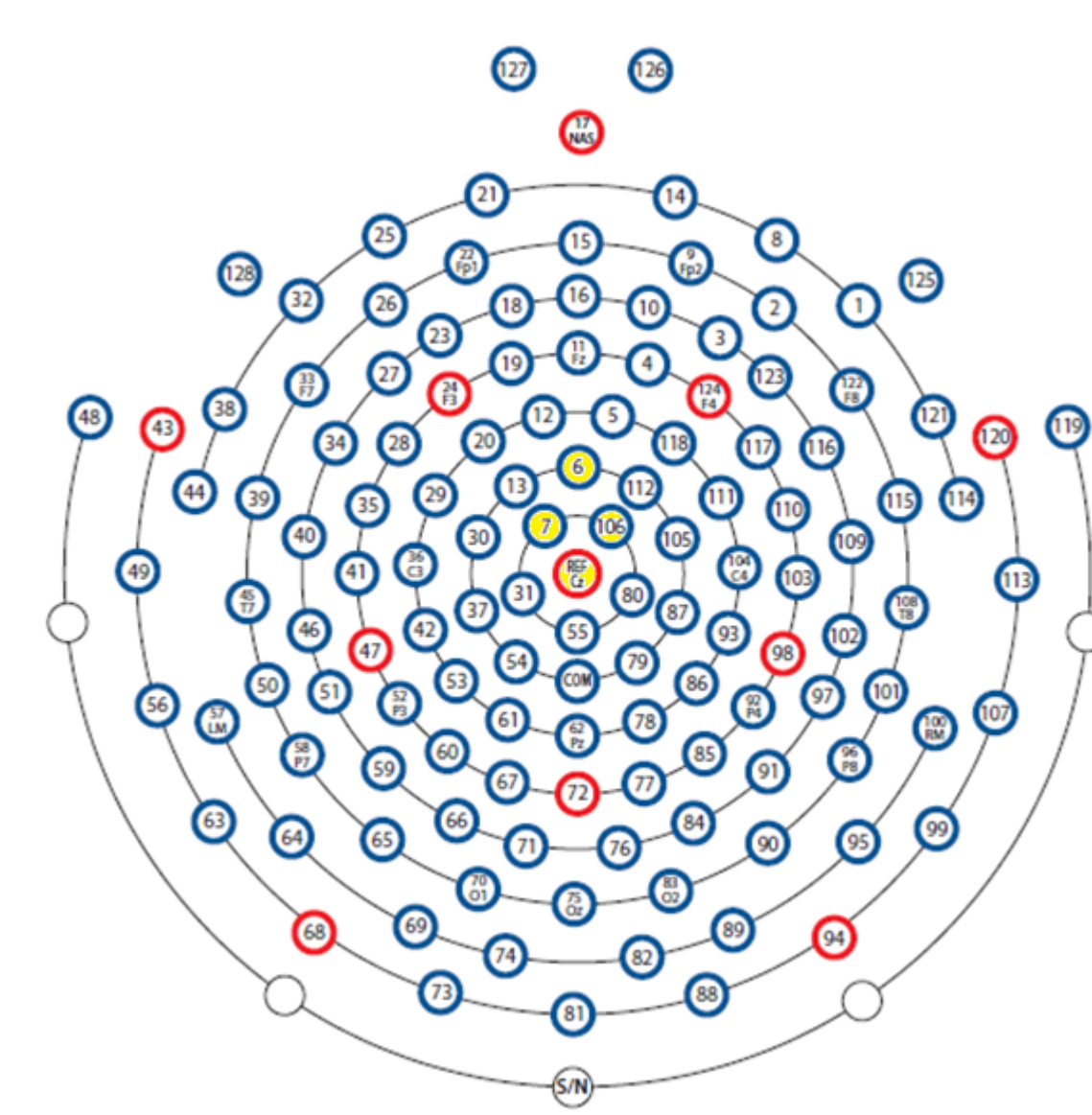
Methods

We recruited typically-developing boys, ages 8-11 from the community. Currently, 22 subjects have completed their first session and 20 subjects have completed their second session, with approximately six weeks between sessions ($\mu=49.75$ days). Dense-array (128 channels) electroencephalography was used to record ERPs while subject performed the Dots Task. The Dots Task uses the sidedness of stimuli presentation to induce a Stroop-like effect³. Each subject performed 36 trials of congruent and incongruent conditions where congruent trials were defined as all responses on the same side of the gray dot while the incongruent trials were all the responses on the opposite side of the striped dot (or vice versa)³. Urine samples were also collected at each session and analyzed for epinephrine levels.



Results

1. Dots Task ERP Data:



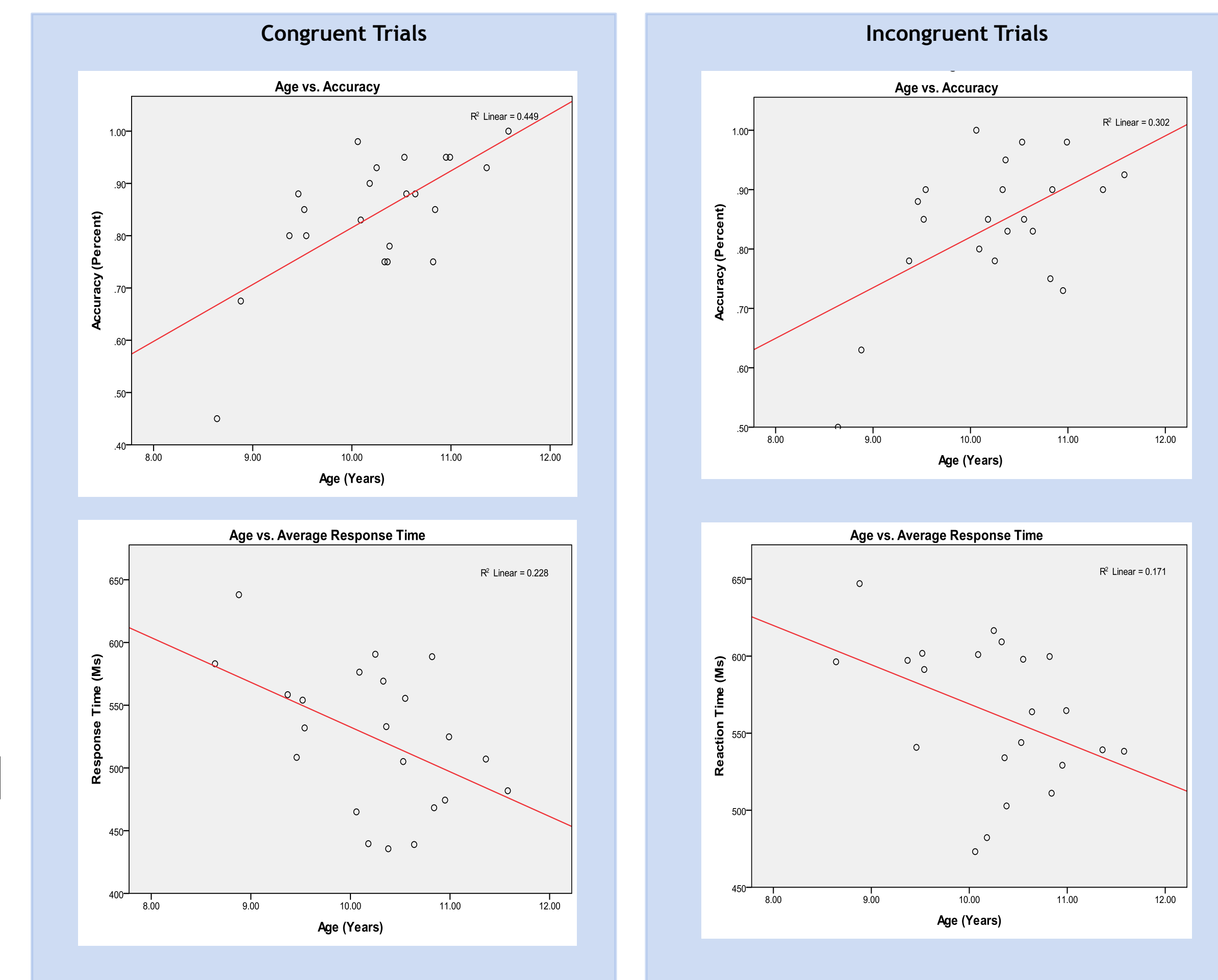
General Linear Model Univariate Test with Greenhouse-Geisser Correction (N=18)						
Source	df	Error df	F	Sig.	Partial Eta Squared	Observed Power
Time * Condition	1	17	0.764	0.394	0.043	0.131
Amplitude	1	17	2.017	0.174	0.106	0.268
Latency	1	17				

2. Dots Task Behavioral Data:

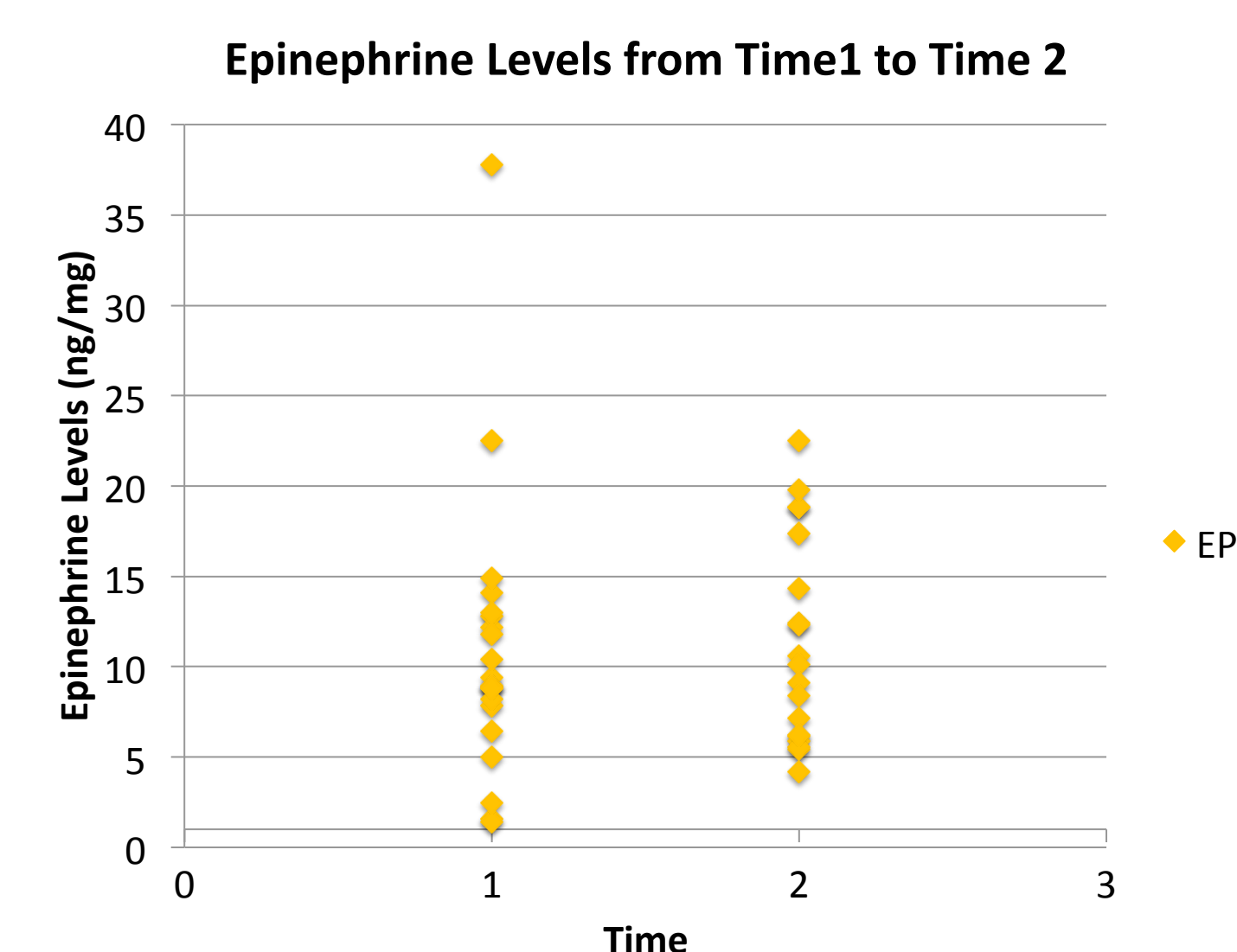
Time 1 Correlations between Age and Performance (N=22)					
Age	Pearson Correlation	Cong. Accuracy	Incong. Accuracy	Cong. Response Time	Incong. Response Time
		0.67	0.55	-0.478	-0.414
P-Value		0.001	0.008	0.025	0.056

Time 2 Correlations between Age and Performance (N=20)					
Age	Pearson Correlation	Cong. Accuracy	Incong. Accuracy	Cong. Response Time	Incong. Response Time
		0.606	0.4	-0.408	-0.399
P-Value		0.005	0.08	0.074	0.082

Scatter plots for Time 1



3. Urinary Epinephrine Levels :



Time 1 Correlations between Epinephrine and Performance (N=20)					
Epinephrine	Pearson Correlation	Cong. Accuracy	Incong. Accuracy	Cong. Response Time	Incong. Response Time
		-0.304	-0.353	0.457	0.346
P-Value		0.192	0.127	0.043	0.136

Time 2 Correlations between Epinephrine and Performance (N=19)					
Epinephrine	Pearson Correlation	Cong. Accuracy	Incong. Accuracy	Cong. Response Time	Incong. Response Time
		0.265	0.173	0.494	0.274
P-Value		0.272	0.479	0.032	0.257

Paired-Sample T test			
	t	df	Sig. (2-tailed)
Time 1 Epinephrine vs. Time 2 Epinephrine	-0.174	18	0.864

Conclusions

- When a general linear model univariate test was performed to compare the N200 wave from time 1 to time 2, there was not a significant change in the amplitude or the latency. Consequently, we conclude that the N200 wave showed good test-retest reliability between testing sessions.
- At Time 1, there is a strong relationship between age and performance on the Dots Task.
 - Age and accuracy in the congruent trials and incongruent trials were positively correlated.
 - Age and response time in the congruent trials were negatively correlated.
 - Age and response time on the incongruent trials were not yet significant.
- At Time 2, there is not a significant correlation between performance on conditions and age. This may be due to a learning effect, especially for younger participants.
- Epinephrine levels did not show any correlation with performance, accuracy or reaction time, on the dots task.

Overall, the data supports our hypothesis that this narrow age range represents a dynamic time with regard to inhibitory control.

References

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- Deák, G.O. & Narasimham, G. (2003). Is perseveration caused by inhibition failure? evidence from preschool children's inferences about word meanings. *Journal of Experimental Child Psychology* 86 (3), 194-222
- Davidson, M. C., Amso, D., Anderson, L. C., Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, 44 (11), 2037-2078

Acknowledgements

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