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CHAPTER 1

AIM 3

1.1 Abstract

1.2 Introduction

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1.3.1 EEG Acquisition and Processing

EEG measures electrical activity from the brain via electrodes placed on the scalp. As cortical regions are active, extracellular current creates inhibitory and excitatory post synaptic potentials which are detected by the scalp electrodes [51]. Subjects will be fitted with a standard 58-channel EEG cap (*Electrocap, Eaton, OH*) with a sampling rate of 1000 Hz *Synamps 2, Neuroscan, Charlotte, NC, USA*). Brain activity will be measured during the performance of the Probabilistic Choice Reaction Task (PCRT, described below) by responding to images on the screen on a custom built, two button keypad (*Arduino Uno, www.arduino.cc*). Eye blinks and movement artifacts will be recorded using electrooculographic (EOG) activity and subtracted from the data offline. Data will initially be analyzed by examining changes in the event-related potentials (ERP) compared across each condition but also over time. This allows for investigation into specific sensory and cognitive responses to on-screen stimuli and movement generation.

The raw, continuous EEG was leaded into EEG lab [52] for subsequent post-processing and analysis. All data was first high-pass filtered at 0.5 Hz and low-pass filtered at 50 Hz. Bad channels (those with maximum), bad channels were identified, rejected and interpolated. Data was then epoched from 100 ms pre- stimulus onset to 500 ms post-stimulus for all 945 stimuli presentations with baseline correction from 100 to 0 msec, to provide epochs

for subsequent event-related potential (ERP) analysis. An independent component analysis (ICA) was then conducted, utilizing EEGLABs runica algorithm, to assist in removal of blink and other stereotypical movement artifact components. Selection of components for removal was based on visual inspection of scalp map localization, unusual spectral frequency patterns and irregular ERP-image activity. An average of 7 of 58 components per participant was selected for subtraction. After removal of artifact components, data was segmented into 27 separate datasets, one for each block. A separate dipole fitting analysis was then conducted, utilizing EEGLABs DIPFIT plugin [21], for every block for each subject. Dipole localization was determined utilizing the Talairach Client application [22]. After pre-processing, all datasets were loaded into a STUDY structure for group analysis.

1.4 Results

1.5 Discussion

1.6 Conclusion

Appendices

APPENDIX A

SUMMARY TABLE OF STUDIES WITH DEHYDRATION AND COGNITION

Authors	n	%BM Loss	HYPO Method / Control	Cognitive Functions	Reported Effects of HYPO
Wittbrodt et al. [24]	12 M	-1.5	EHS / EHS + Fluids	Information Processing	—
				Attention	—
				Executive Function	—
				Working Memory	—
Weber et al. [35]	32 M	-2.4, 4.8	FR + Exercise / Rest	Simple Reaction Time	—
				Concussion Protocol	—
Armstrong et al. [53]	25 F	$\sim$1	Exercise / Exercise + Fluids	Reaction Time	
				Working Memory	—
				Logical Reasoning	—
				Learning	—
				Attention	Increased False Alarms ($p < 0.05$)
Ganio et al. [54]	26 M	$\sim$1	Exercise / Exercise + Fluids	Reaction Time	—
				Working Memory	Increased Errors ($p < 0.05$)
				Logical Reasoning	—
				Learning	—
				Attention	Increased False Alarms ($p < 0.05$)
Baker et al. [55]	11 M	1,2,3,4	FR & EHS / EHS + Fluids	Attention	Decreased vigilance ($p < 0.001$)
Sharma et al. [6]	8 M	1-3	EHS + FR / EHS + Fluids	Motor Coordination	Decreased Score at 2% BM
				Information Processing	Fewer Correct Scores $\geq$ -2% BM
				Working Memory	Fewer Correct Responses at $\geq$ -2% BM
Patel et al. [32]	24 M	2.5	FR & Exercise / Rest	Reaction time	—
				Information Processing	—
				Working memory	Deteriorated Memory ($p < 0.001$)
				Motor Coordination	—
Cian et al. [33]	8 M	2.8	Heat, EHS / Exercise + Fluids	Long term memory	Shorter String Recall ($p < 0.05$)
				Reaction Time	—
				Information Processing	Increased Reaction Time ($p < 0.05$)
				Short Term Memory	Shorter String Recall ($p < 0.05$)
				Motor Coordination	Elevated Deviation ($p < 0.05$)

Wong et al. [34]	19 (9M)	1.4 - 2	EHS / EHS + Fluids	Motor Coordination	Decreased Speed ($p < 0.05$)
				Information Processing	Decreased Accuracy ($p < 0.05$)
				Working Memory	—
				Short Term Memory	Decreased Accuracy ($p < 0.05$)
				Attention	Decreased Performance ($p < 0.05$)
Gopinathan et al. [5]	11 M	0,1,2,3,4	EHS EHS + Fluids	Mental Arithmetic	Decreased Correct at $\geq$ -2% BM
				Short-Term Memory	Decreased Performance at $\geq$ -2% BM
				Executive Function	Decreased Speed at $\geq$ -2% BM
Smith et al. [56]	7 M	-1.5	FR / Rest	Executive Function	Impaired Performance ($p < 0.001$)
Watson et al. [25]	11 M	1.1	FR / Rest	Attention	Increased Errors after 30 min ($p < 0.05$)
Barroso et al. [57]	12 M	1.8	EHS / Rest	Reaction Time	Impaired Reaction Time ($p < 0.05$)
Cian et al. [58]	7M	2.8	FR, EHS / Exercise + Fluids	Long Term Memory	
				Reaction Time	ND
				Short Term Memory	
				Information Processing	

APPENDIX B

SUPPLEMENTAL FIGURES

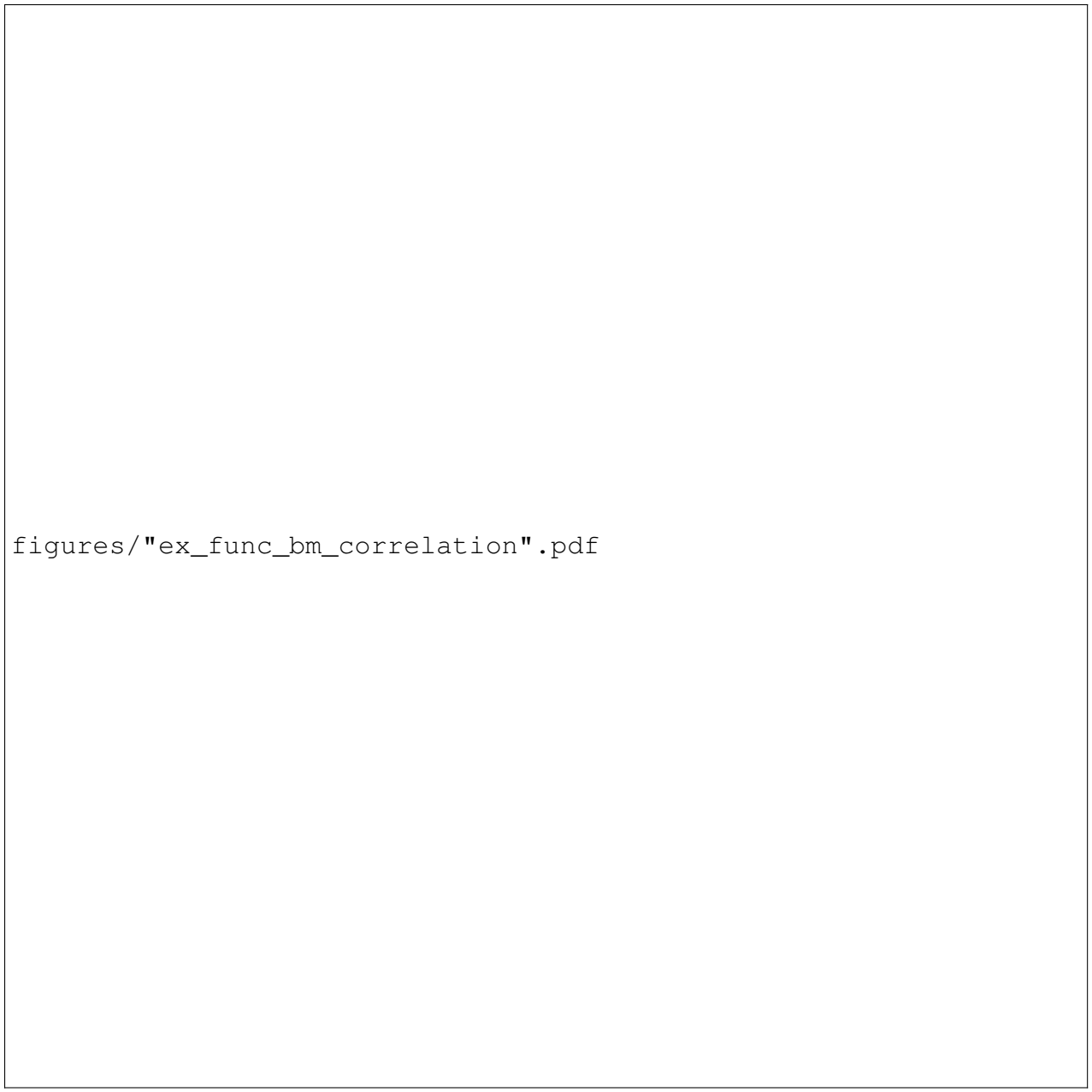

Figure B.1: Meta Regression analysis of body mass loss compared to the mean study effect size in studies examining executive functioning.

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