ASSOCIATIONS BETWEEN DAILY PHYSICAL ACTIVITY AND COGNTIVE FUNCTIONING: EVIDENCE FROM STIMULUS- AND RESPONSE-LOCKED EVENT RELATED POTENTIALS

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INTRODUCTION

•There is extensive research that supports a positive correlation between higher cognitive functioning and regular physical activity.[1,2,3]

•However, it remains unclear if this relationship is primarily a result of increases in physical activity or decreases in sedentary behaviors.

•Examining direct neural activity via EEG can help better understand the associations between cognitive functioning and level of daily physical activity.

•Event-related potentials (ERPs) such as the stimulus-locked P300 and response-locked Error Positivity (Pe) are reliable markers of cognitive processes such as attention allocation that can be utilized to examine this question.

•Additionally, these ERP components are theorized to overlap in terms of functionality[4]. However, they have never been simultaneously examined in relation to physical activity.

Objective: Examine the associations of daily physical activity and daily sedentary time simultaneously in relationship to neural measures of cognitive function. Additionally, examine if these neural measures overlap in terms of their associations with physical activity.

Methods

•A total of 145 undergraduate students (*mean age* = 19.01, *SD* = 1.25, 63% female) were recruited from Florida State University.

•The participants were asked to complete a survey regarding their daily habits in the last week. More specifically, participants answered the average amount of time they spent being sedentary (i.e., sitting, napping, etc.) as well as time spent completing exercise (running, gym, sports, etc.) each day.

•EEG signals were recorded while participants completed the fast-paced flanker task requiring the participants to quickly respond to the direction of a middle arrow that was surrounded by flanking arrows

•**P300:** this ERP component was quantified as the mean amplitude occurring 300 ms to 600 ms after flanker stimulus onset at electrode site Pz.

•**Pe:** this ERP component was quantified as the mean amplitude occurring 150 ms to 400 ms after a participant made an error response at electrode site Pz.

RESULTS

Table 1 : Zero-order correlations between study variables (n = 145)

	Mean (SD)	1.	2.	3.	4.
1. Daily Exercise (hours)	0.90 (0.74)	-			
2. Daily Sedentary (hours)	6.05 (4.48)	-.11	-		
3. P300 (µV)	10.41 (5.02)	.17*	.14	-	
4. Pe (µV)	14.43 (6.88)	.17*	.02	.68**	-

Note. * p < .05, ** p < .001

Figure 1 : Stimulus-locked waveforms and head maps based on a median split; high daily exercise (n = 73) and low daily exercise (n = 72)

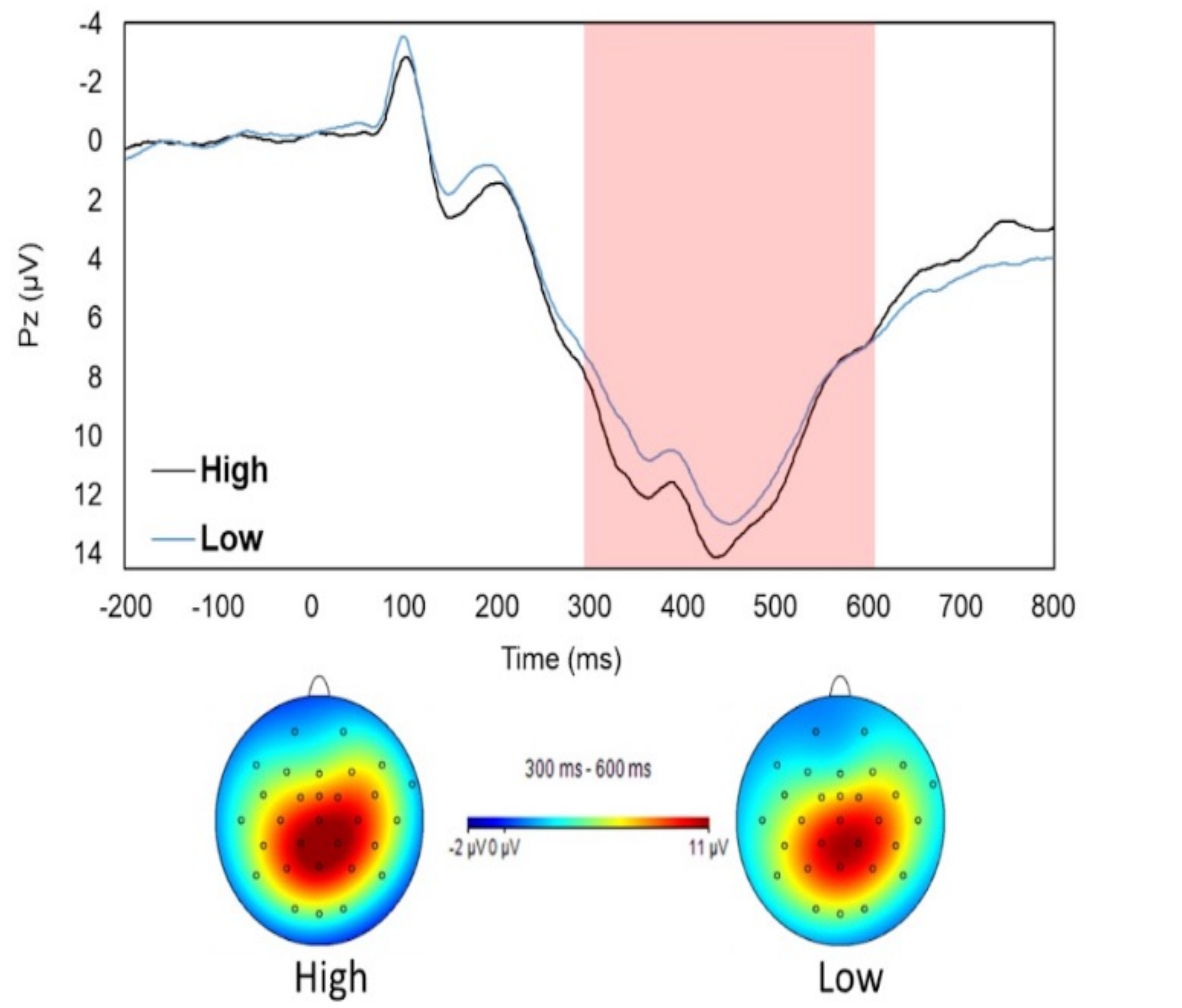

Figure 2: Error response-locked waveforms and head maps based on a median split; high daily exercise (n = 73) and low daily exercise (n – 72)

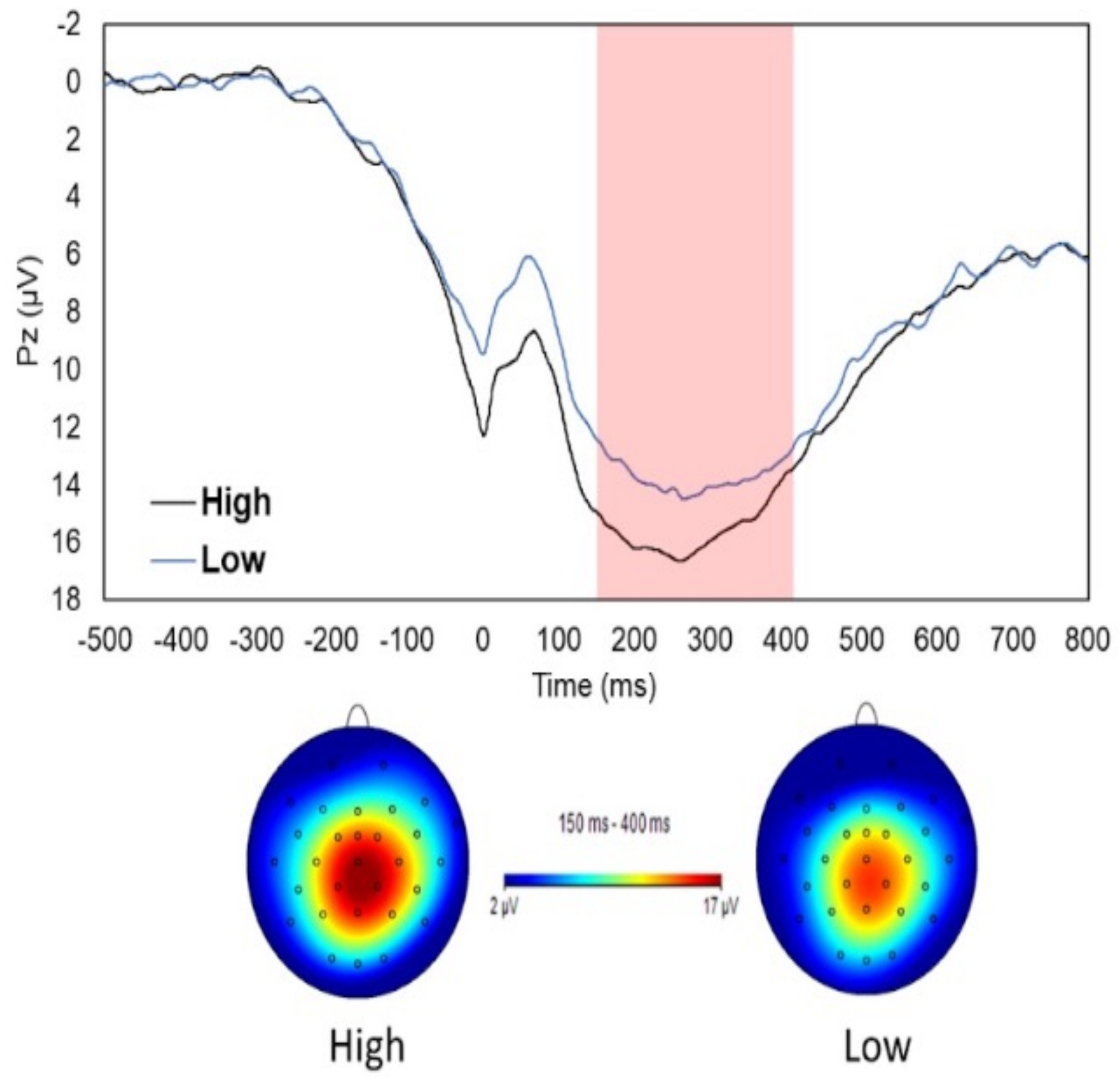

Table 2: Multiple linear regression predicting daily exercise (n = 145)

	Model Fit (R^2)	b	t-value	p-value	CI (95%)
Predictors	.045				
Intercept		0.56	3.63	<.001	0.26 ,0.87
P300 (µV)		0.03	1.60	.112	-0.01, 0.06
Pe (µV)		0.00	0.37	.714	-0.02, 0.03

DISCUSSION

•Individuals who reported more hours of daily exercise exhibited a greater P300 response to the flanker stimuli as well as greater Pe response to committing errors.

•Interestingly, sedentary activity did not significantly relate to either ERP component suggesting that the relationship of physical activity and better cognitive function is not associated to potential decreases in sedentary activity.

•The P300 and Pe were also shown to be highly correlated with one another potentially suggesting shared functional significance.

•This overlap was further demonstrated by results from the multiple linear regression model which suggest that neither ERP uniquely related to physical activity; they shared the same variance in physical activity.

•Further longitudinal research is needed to better understand the causal relationships between cognitive functioning, daily physical activity, and daily sedentary time.

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