



The Relationship between Self-reported Effortful Control and Electrophysiological Error Processing

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background

The ability to detect and respond to errors is a key component of self-regulation (Eisenberg et al., 2010). This ability is reflected in two well-established electrophysiological components: (1) The Error-Related Negativity (ERN) which is a negative deflection occurring ~50–100 ms after an error, associated with automatic error monitoring (Gehring et al., 1993) and (2) Error Positivity (Pe), a long positive waveform appearing ~200–500 ms after an error, associated with conscious error awareness and evaluation (Overbeek et al., 2005). The literature associates temperamental self-regulation, also known as effortful control (EC) with error processing (Bridgett et al., 2013; Zhou et al., 2012). EC includes three core components: Inhibitory Control, Effortful Attention, and Activation Control (Bridgett et al., 2013). The aim of the current study was to examine the unique relations between each EC component and error processing.

method

Sample:

- 20 neurotypical mothers.
- *M*_{age} = 36.46 years (*SD* = 4.61 years , Range = 28.96 – 42.86)
- *M*_{education} = 16.8 years (*SD* = 1.91 years, Range = 12 – 20)

Measures:

Error Processing (ERN / Pe):

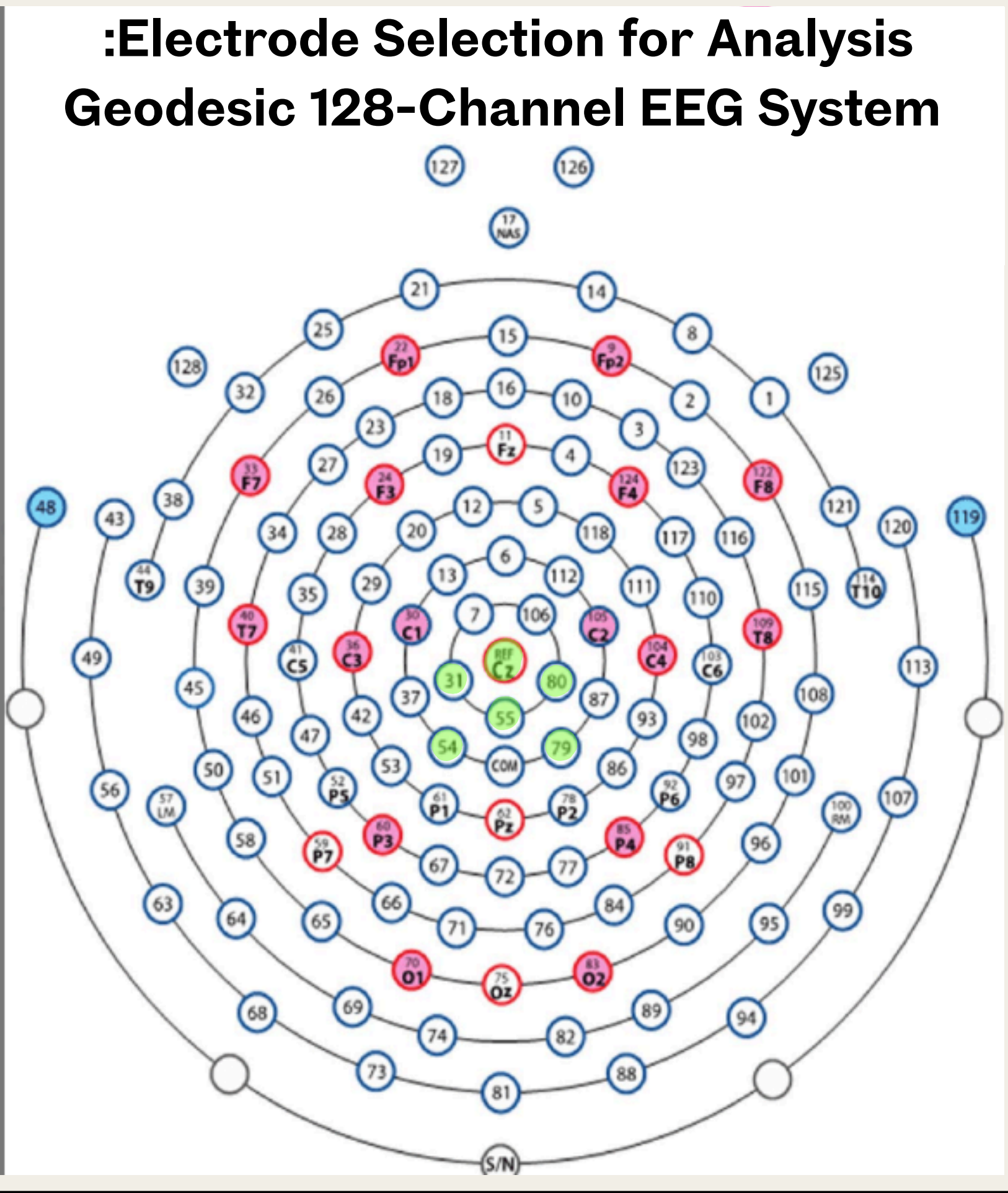
- Measured using the Emotion-Induction Go/NoGo task: Three blocks, manipulating the mother's emotions by rating in a fake competition (Farbiash, 2014).
- Only failed No-Go responses were analyzed.
- Minimum trials: *N* = 8.
- EEG Recording and Preprocessing:
 - 128 scalp sites, sampling rate of 250 Hz.
 - Filtering, Segmentation, Manual Artifact Removal, ICA, and Trial by Trial interpolation (TBT).

Effortful Control (Evans & Rothbart, 2007):

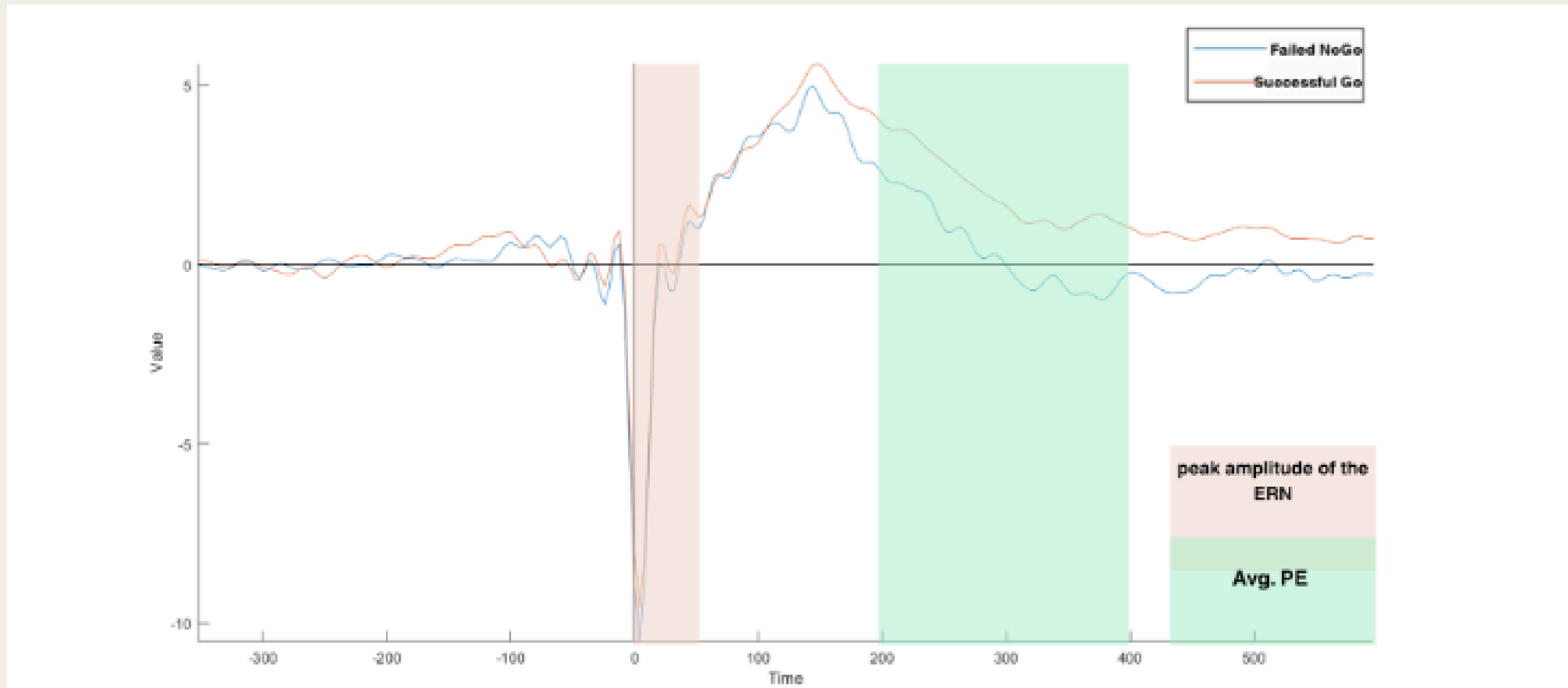
Inhibitory Control's (IC) $\alpha = .46$

Activation Control's (AC) $\alpha = .66$

Effortful Attention's (EA) $\alpha = .77$



Stimulus Locked ERP



Results

Linear Regression ERN Explaining Amplitude by EC sub-scales

Variables	ERN β (SE)	<i>p</i> value	95% CI
Inhibitory Control	.11 (.16)	.499	[-.23, .46]
Activation Control	-.89 (.19)	<.001	[-1.30, -.48]
Effortful Attention	.39 (.19)	.064	[-.03, .81]
<i>F</i> (3, 16)	7.61	.002	
<i>R</i> ²	.588		

Linear Regression Explaining Pe Amplitude by EC sub-scales

Variables	Pe β (SE)	<i>p</i> value	95% CI
Inhibitory Control	-.35 (.23)	.177	[-.94, .23]
Activation Control	-.16 (.28)	.497	[-.68, .35]
Effortful Attention	-.08 (.28)	.951	[-.74, .60]
<i>F</i> (3, 17)	.91	.417	
<i>R</i> ²	.149		

Discussion

In the current study, it was found that **Activation Control (AC)** was uniquely related to **ERN amplitude**, even after controlling for the other EC sub-scales. This may indicate that individuals with high AC—the ability to initiate goal-directed behavior despite low internal motivation—are more sensitive to early and automatic error detection processes.

In contrast, **none of the EC sub-scales were significantly related to Pe amplitude**. This dissociation between ERN and Pe may suggest that AC is more closely tied to early, automatic stages of error processing, whereas later stages involving conscious evaluation may rely on different mechanisms.

However, the interpretation of these results should be done with caution: First, since **the sample size was very small**, limiting statistical power and generalizability. Second, since **the internal reliability of the EC sub-scales—particularly Inhibitory Control—was low**, which could reduce the sensitivity to detect true associations.

Future studies with larger samples, more error trials, and more reliable EC measures may clarify the distinct roles of EC components in different stages of error processing.

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