

# Poor Error Monitoring Response is Related to Lack of Empathy

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## Introduction

**Background:** Empathy is a multidimensional construct involving cognitive and affective processes. High empathic ability has been related to prosocial behavior whereas low empathic ability has been associated with self-centeredness, alienation of others and psychopathy. Several neural imaging studies have found that trait empathy and experiencing others' pain is associated with activation of the ventromedial, orbitofrontal and anterior cingulate cortices (ACC)<sup>1,2,3,4</sup>. No studies have examined the electrophysiological correlates of empathy and, in particular its relation to response monitoring. Response monitoring has been measured using the error-related negativity (ERN), an ERP component thought to reflect activity of the anterior cingulate cortex<sup>5,6</sup>. The ERN has been conceptualized as indexing error detection or response conflict and may be sensitive to affective responses to errors. Most notably, reduced ERNs has been associated with low socialization in adults<sup>7</sup> and children<sup>8</sup> while the amplitude of the ERN varied with motivation level for individuals low on conscientiousness<sup>9</sup>. These results suggest that the ERN may be influenced by the extent to which individuals care about the outcome of their behaviors and reflect poor reinforcement learning.

**Purpose:** To examine the ERN in relation to empathy.

## Method

### Participants:

- 37 unselected 18- to 19-year-old males
- Right-handed, free of head injury

### Self-report measures:

- Empathy Quotient (EQ)<sup>10</sup>: a 60-item scale assessing an individual's beliefs about his/her own empathic traits such as social sensitivity and sensitive communication
- Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) Questionnaire<sup>11</sup>: a 48-item scale assessing worry about threats of punishment or failure and the extent to which individuals do things to obtain rewards

### ERP Flanker task:

- Four computer generated visual displays of 5 letters, displayed 250 ms each with an ISI of 1000 ms
- Target letter (S or H) flanked by either congruent (SSSSS, HHHHH) or incongruent (SSHSS, HSHHH) letters, target letter required key press

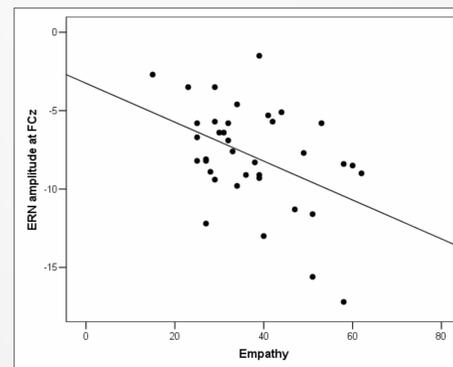
### Electrophysiological measurements:

- 4 midline scalp sites scored: Fz, FCz, Cz, Pz
- ERPs were averaged time-locked to error responses starting 200 ms prior and continuing 800 ms post response
- Pre-response baseline 200 to 0 ms

## Results

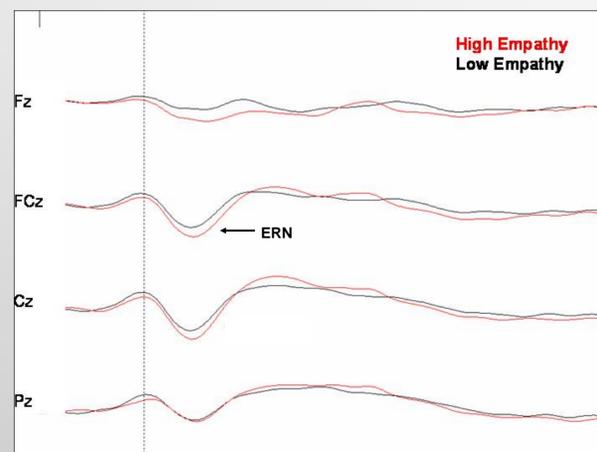
- Pearson correlations revealed no relations between empathy and response time, accuracy or post-error slowing on incongruent flanker trials
- Empathy was related to the ERN at FCz,  $r = -.36$ ,  $p = .03$ , see Figure 1

Figure 1 – Scatter plot of empathy and ERN amplitude at FCz.



- Independent t-tests showed that those low on empathy had a significantly smaller ERNs at FCz,  $t(35) = 2.4$ ,  $p = .02$ , see Figure 2

Figure 2 – Average response-locked ERP waveforms for error trials for high (red) and low (black) empathy groups.



### Additional Analyses

- SP was negatively related to Empathy ( $r = -.42$ ,  $p = .01$ ) and non-significantly related to the ERN ( $r = .26$ ,  $p = .07$ )
- A simultaneous regression analysis showed substantial overlap between SP and EQ in accounting for variance in the ERN, see Table 1

Table 1 – Results from a simultaneous regression predicting ERN amplitude at FCz from EQ and SP scores.

Variable	B	SE B	sr <sup>2</sup>	p
Empathy Quotient	.09	.11	.06	.43
Sensitivity to Punishment	-.07	.05	.09	.15

Note. R<sup>2</sup> = .13

## Conclusions

1. Results provide support for the role of the ACC in empathy.
2. The ERN may be influenced by the extent to which individuals are concerned with the outcome of events. Low empathic individuals may display poor error monitoring and diminished affective reactions to errors.
3. The present study may also provide insight into more general reinforcement learning deficits (diminished sensitivity to punishment) that may contribute to the development of maladaptive social behaviors in individuals with low empathic ability.

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**Acknowledgements:** This research was supported by a grant from NSERC Canada awarded to SJS. Please address all correspondence to either DLS (dsantesso@hotmail.com) or SJS (sid.segalowitz@brocku.ca).

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Presented at the 46<sup>th</sup> Annual Meeting for the Society for Psychophysiological Research, Vancouver, B.C., Canada, October 25-29, 2006.