# Startle Response and Anxiety Sensitivity: Mismatch between Sub-Cortical and Peripheral Measures of Fear

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## Introduction

- A strong relationship exists between high anxiety sensitivity (AS) and anxiety disorder diagnoses.
- Anxiety disorder research has increasingly focused on the biological mechanisms which differentiate between persons with and without an anxiety disorder.
- The eye-blink startle response (EBSR) and prepulse inhibition (PPI) paradigms represent state-of-the-art, sub-cortical methods for examining arousal.
- The EBSR paradigm involves presenting participants with brief, intense bursts of white noise to elicit a startle response reaction. The PPI paradigm involves presenting a relatively weak startle stimulus (prepulse) prior to the startle pulse, resulting in a decrement in responding.
- Individuals with anxiety disorder diagnoses frequently demonstrate enhanced sub-cortical arousal as evidenced by an exaggerated startle response to unexpected, aversive stimuli, and deficient prepulse inhibition (PPI).
- It is essential that the relationship between AS, startle response, and PPI be examined without the confounding factor of anxiety disorder diagnoses.
- As such, the current investigation examined the impact of AS on acoustic startle response magnitude and PPI in a non-clinical sample.

## Methods

- AS was conceptualized as taxonic (normative versus high-risk) based on a wealth of contemporary research.
- AS taxon membership was identified using the Anxiety Sensitivity Index – III, and cut-off scores identified by Bernstein and colleagues (2010).
- Participants from each taxon ($n$ = 25; $n_{total}$ = 50) were identified out of a pool of 267 undergraduates.
- Sub-cortical arousal was measured via the eyeblink startle response and PPI using electrodes place under the left eye. Peripheral measures of arousal included respiration, heart rate, and blood oxygenation, which were measured in the 10 sec following each startle trial.
- Startle responses were elicited by presenting participants with 105dB, 50msec bursts of white noise (P-alone trials) Prepulses were 70dB for 25 msec duration presented 120msec before the startle pulse (PP-Trial).
- Session was divided into four blocks, each containing 10 P-alone and 10 PP-trials.
- Startle responses were examined for peak EMG response 21-200 msec following stimulus onset.
- Hypotheses: (1) High-risk participants would demonstrate enhanced startle response, and (2) reduced PPI. No hypotheses were made regarding peripheral measures.

## Results

### SUB-CORTICAL ANALYSES

- Hypothesis 1: A directional ANOVA was used to examine differences in mean startle response at Block 1 (Figure 1). Participants in the high-risk taxon ($M$ = 113.05 mV, $SD$ = 46.19) demonstrated a significantly stronger startle response compared to individuals in the normative taxon ($M$ = 81.95 mV, $SD$ = 39.37; $F$ [1, 49] = 6.57, $p$ = .007 [one-tailed], eta squared = 0.12).
- Hypothesis 2: A directional $t$-Test was used to examine differences in mean PPI at Block 1 (Figure 2). Participants in the high-risk taxon ($M$ = - 0.45, $SD$ = 0.31) demonstrated a significantly less PPI compared to individuals in the normative taxon ($M$ = - 0.60, $SD$ = 0.19; $t$ [39.88] = -1.99, $p$ = .027 [one-tailed], eta squared = 0.08).

### PERIPHERAL ANALYSES

- A mixed-design ANOVA was conducted for both the heart rate and respiration measures. No differences between the taxons were observed for either heart rate, $F$ (1, 47) = 0.04, $p$ = .853, $\eta_p^2$ = 0.001, or respiration, $F$ (1, 47) = 1.18, $p$ = .283, $\eta_p^2$ = 0.03.
- Due to data limitation, blood $O^2$was evaluated using an ANOVA. No significant differences were found, $F$ (1, 46) = 0.74, $p$ = .393.

## Discussion

- High-risk taxon demonstrated enhanced startle and reduced PPI. There were no differences in peripheral measures.
- PPI is generally regarded as a measure of sensorimotor gating. Deficits in PPI among high risk AS individuals suggest the possibility that deficits in sensorimotor gating may in part underlie the development of AS in that it may lead to a heightened awareness of naturally-occurring physiological sensations.
- The EBSR is a defensive reflex and can be viewed as a measure of fearful responding. As such the EBSR paradigm allows for an evaluation of the "fear circuitry" underlying unconscious fear-based appraisals of arousal.
- Most prior research demonstrates that those with high and low AS do not differ in actual physiological arousal; instead, differences exist in their perceptions of arousal .
- The current investigation represents an exception to these findings, in that while individuals high in AS do not appear to differ in overt measures of peripheral arousal, they do appear to demonstrate more active "fear circuitry", which may, in conjunction with the effects of reduced PPI, represent unconscious processes that may lead to fear-based appraisals of arousal and help to explain their propensity towards anxiety-related psychopathology
- In short, the current finding may be reflective of the physiological substrate underlying elevated AS.

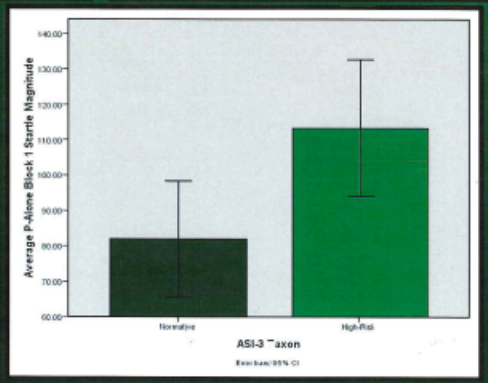


*Figure 1*. Average block 1 P-alone startle magnitude (mV). A significant difference was found between the taxons using a directional ANOVA. Error bars represent 95% between-subjects confidence intervals.

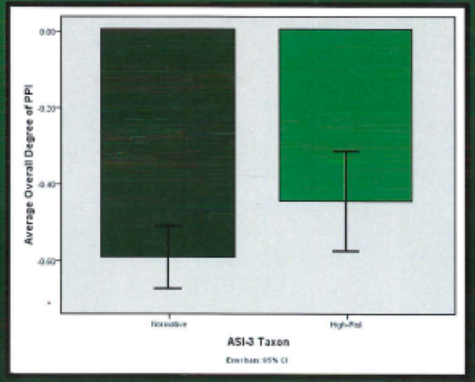


*Figure 2*. Average PPI throughout the experimental session. A significant difference was found between the taxons using a directional $t$-test. Error bars represent 95% between-subjects confidence intervals.

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