**INTRODUCTION**

It has long been recognized in humans and animals that heart rate deceleration (HRD) following the presentation of a new stimulus is a component of the orienting response. It is an important adaptive function that facilitates attention to the external environment and heightens sensory receptivity toward stimuli. This response diminishes as the stimulus repeats and becomes familiar. Comparing to neutral and positive stimuli, negative emotional stimuli in general elicit greater HRD due to their higher salience, however variation exists among individuals. For example, highly fearful participants and patients with post-traumatic stress disorder (PTSD) responded to aversive stimuli with less HRD or even an acceleration, which indicates a fear/defense rather than orienting response.

Despite the many psychophysiological investigations, few have explored the relationship of orienting HRD to brain systems involved in attention shifts between externally- and internally-focused processing. The default mode network (DMN) is a group of brain regions with increased activity during awake but non-attentive states. Activity in the DMN is suppressed (deactivation) during tasks that require attention into the environment. It is worth noticing that alteration in DMN functioning has also been reported in patients with PTSD.

Here we aim to examine the relationships of orienting HRD to 1) healthy participants’ fear/defense behavior while responding to aversive emotional stimuli, and to 2) deactivation in the DMN during emotion processing. We hypothesized that:

1) **Participants with less fear/defense behavioral response during an interview session will show greater orienting HRD in a later recording session;**

2) **Within each participant, greater orienting HRD will be associated with greater DMN deactivation during emotion processing.**

**EXPERIMENT PROCEDURES**

32 healthy participants (18 males, average age 21.1 years) were recruited.

:: **One-on-one emotion-induction interview:**

Participants viewed narratives about real people. 10 positive narratives depicted amazing feats of virtuosity, designed to elicit admiration for skill (AS); 10 negative narratives depicted painful injury associated with a mishap, designed to elicit compassion for physical pain (CPP). Processing of both categories of narratives require externally-focused attention. Because body damage stimuli have been shown to more markedly differentiate responses in highly fearful and non-fearful participants, we coded participant’s degree of fear/defense behavior responses to CPP narratives to capture the individual differences.

:: **Neuroimaging with simultaneously ECG recording:**

Participants viewed 5-second reminders of the same narratives, and were instructed to "pay attention to the narrative, reflect upon it and become as emotional as possible".

**RESULTS**

1) **Participants who showed less fear/defense behavioral response to CPP narratives during the pre-scan emotion induction interview showed greater average orienting HRD during CPP in the scanner.**

To test Hypothesis 1), HRD was measured on the average heart rate response curve during CPP for each participant. To test Hypothesis 2), HRD was measured on each individual trial.

:: **Modeling BOLD activity**

The 5-second video presentation of each trial was modeled as a boxcar and convolved with standard hemodynamic response function. Magnitude of HRD was used as a parametric modulator.

:: **ANALYSES**

HRD was defined as the lowest peak within the 8-second window after stimulus onset relative to pre-trial fixation baseline, taking into consideration of the temporal delay of heart rate response.

**DISCUSSION**

In the current study, we demonstrated that 1) greater orienting HRD to CPP stimuli was associated with less fear/defensive behavior while responding to the same stimuli in a separate session; and 2) greater orienting HRD predicted greater deactivation in the DMN regions during emotion processing.

To our knowledge, this is the first study linking HRD and DMN activity. This finding provides insight into the neural processing that supports the attention facilitating effect of HRD, and may shed light on the neural mechanism of altered emotion processing in patients with affective disorders, such as PTSD.

**References**