Respiratory sinus arrhythmia: A marker of positive functioning in children with autism spectrum disorders

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Introduction
- Children with autism spectrum disorders (ASD) have difficulties modulating social behavior, including eye-to-eye gaze, vocalizations, and facial affect (DSM-IV-TR; American Psychiatric Association, 2000).
- Physiologically, children with ASD have less cardiac vagal tone relative to their typically developing peers (Bal et al., 2010; Van Hecke et al., 2009).
- Polyvagal Theory: suggests a neurobehavioral link between poor vagal regulation and social engagement deficits. The theory defines three neural circuits that provide adaptive responses to safe (social) interactions, danger, and life threat:
  - Social Engagement System (mechanisms to self-sooth and calm via social interactions)
  - Autonomic nervous system (ANS): myelinated vagus
  - Lower motor neurons: nucleus ambiguous
  - Mobilization (active avoidance)
    - ANS: sympathetic-adrenal system
    - Lower motor neurons: spinal cord
  - Immobilization (passive avoidance, death feigning)
    - ANS: unmyelinated vagus
    - Lower motor neurons: dorsal motor nucleus of the vagus
- Social Engagement System: phylogenetically most recent circuit supporting social communication.
- Respiratory sinus arrhythmia (RSA): is a measure of myelinated vagal influence of the heart; thus, the social engagement system can be monitored by quantifying RSA.
- ASD & RSA: higher RSA related to better functioning (Van Hecke et al., 2009) and social engagement (Bal et al., 2010).

Hypotheses:
- Higher RSA will be related to more joint attention
- Higher RSA will be related to higher cognitive functioning

Methodology
- Social Interaction Coding Scale (SICS; Bazhenova, 2006): joint attention was coded via the SICS. Joint attention was defined as sharing information, emotion, interest.
- Peabody Picture Vocabulary Test (PPVT-III; Dunn & Dunn, 1997): measured receptive language skills by presenting a stimulus words with a set of pictures to the participant.
- Data analysis: Heart period (HP) data were edited with CardioEdit and CardioBatch (Brain-Body Center, University of Illinois at Chicago; Porges, 1985). Data were analyzed to generate measures of RSA as a functional index of the myelinated vagus.
- LifeShirt®: an ambulatory physiology monitor used to measure heart rate (HR) and heart period (HP). The LifeShirt® is considered an accurate measure of R-R intervals and R-waves, both necessary in the calculation of HR and HP (Heilman & Porges, 2007).
- Procedure:
  - Baseline (3 minutes)
  - SICS (10 minutes)
  - Higher RSA was significantly correlated with higher cognitive functioning, \( r = .44, p = .04 \)
  - Higher RSA was significantly correlated with increased joint attention, \( r = .48, p = .03 \)
  - Heart period (HP), exhibited a trend with cognitive functioning, \( r = .36, p = .09 \), but was unrelated to joint attention, \( r = .17, p = .47 \)

Conclusions
- Higher RSA was related to better social and cognitive functioning as assessed by increased joint attention and higher receptive vocabulary skills, but HP was not.
- The findings suggest that RSA, as an index of myelinated vagus activity and the functional competence of the Social Engagement System, reflects a unique neurophysiological portal into social and cognitive functioning.
- These results provide further evidence that vagal regulation of the heart, via myelinated pathways, is a marker for positive social and cognitive functioning in children with ASD.

Participants
- N = 23, 4-7 years old (\( M = 5.72, SD = 1.17 \))
- Autistic Disorder (\( n = 12 \)), Asperger’s (\( n = 10 \)), PDD-NOS (\( n = 1 \))