2017 AAPB CONFERENCE ABSTRACTS

Student Presentations

The 48th Annual Scientific Meeting of the Association for Applied Psychophysiology and Biofeedback (AAPB) was held at the Loews Chicago O’Hare Hotel on March 15–18, 2017. The theme of the meeting was “The Science of Self-Regulation: Established and Emerging Evidence.” The meeting included diverse program offerings consisting of oral and poster presentations, symposia, invited keynote and special addresses, a distinguished scientist address, the presidential address, and workshops.

Abstracts for the several student oral presentations featured at the 2017 event follow. AAPB will continue to support student research and clinical applications in our ever broadening field. A key way to do that is to encourage the interest and application of work by students, which will lead to further demonstration of the efficacy of biofeedback techniques.

Breathing Effort May Not Reduce Heart Rate Variability When Respiration Rate Is Controlled


Clinical lore that breathing effort reduces heart rate variability (HRV) may conflate effort with respiration rate. The challenges in testing this belief were operationalizing breathing effort and preventing confounding by respiration rate. Breathing effort was operationally defined as the degree of abdominal excursion (i.e., the range of respirometer movement during each breathing cycle). An animated pacer kept respiration rate constant. This experiment examined whether greater excursion decreases HRV when participants breathe at a constant rate. Subjects were 36 healthy undergraduates (16 men and 20 women, ages 18–26). A Thought Technology ProComp™ Infiniti system (Thought Technology, Ltd., Montreal, Canada) monitored ECG, respiration, skin conductance level, and hand temperature. Active ECG electrodes were located on the lower torso. Skin conductance sensors were placed on the index and middle fingers, and a thermistor was placed on the web dorsum of the left hand. A respirometer was positioned over the navel to measure excursion and respiration rate. Subjects were randomly assigned to one of two treatment orders separated by a 3-min resting buffer period: normal excursion-high excursion or high excursion-normal excursion. For each 5-min condition, subjects sat upright with eyes open and followed a 6 breaths per minute animated pacer without feedback. In the normal excursion (NE) condition, subjects were instructed to breathe effortlessly; in the high-excitation (HE) condition, subjects were instructed to allow their abdomen to deeply expand and contract. A natural log transformation normalized the data distribution. After manual artifacting, researchers compared the two excursion conditions using a general linear model repeated measures analysis of variance. Depth of excursion was successfully manipulated since abdominal excursion was greater in the HE condition, $F(1, 34) = 45.33$, $p = .001$, $\eta^2 = .57$, $d = 2.3$. Respiration rate was identical in both conditions. Excursion did not affect skin conductance or temperature. Contrary to clinical lore, HR Max – HR Min was greater in the HE condition, $F(1, 34) = 10.02$, $p = .003$, $\eta^2 = .23$, $d = 1.09$, and increased excursion did not adversely affect HRV frequency domain, time domain, or nonlinear HRV indices. Future research should replicate these findings with clinical populations and convergent operational definitions of breathing effort.

Abstracts submitted by Zachary M. Meehan, Undergraduate, Lab Manager, and Fredric Shaffer, PhD, BCB, Professor of Psychology and Director, Center for Applied Psychophysiology, Truman State University, email: fredricshaffer@gmail.com.

Ultra-Short-Term HRV Measurements Can Achieve Strong Concurrent Validity

S. Shearman, Z. Meehan, & F. Shaffer

This within-subjects study investigated whether artifacted resting ultra-short-term (UST) HRV values can achieve strong concurrent validity for time domain, frequency domain, and nonlinear measurements in healthy undergraduates when compared to 5-min resting baseline values. Concurrent validity is the degree to which values obtained from proposed and established measurement procedures are correlated. A Thought Technology ProComp™ Infiniti system monitored ECG and respiration. Active ECG electrodes were located on the lower torso. A respirometer was positioned over the navel to measure abdominal excursion and respiration rate. Subjects were stabilized for 5 min and then monitored for 7 min sitting upright, with
eyes open, no feedback, and instructions to breathe normally. The investigators extracted 10-, 20-, 30-, 60-, 90-, 120-, 180-, and 240-s segments from 5-min resting ECG recordings of 38 healthy undergraduates (20 men and 18 women, ages 18–23). Concurrent validity between the UST and 5-min measurements were measured using a Pearson product-moment correlation coefficient. A conservative criterion ($r = .90$) was selected because the calculation of UST and 5-min measurements from the same data set should be expected to inflate correlation values. This cut-off ensured that UST values would account for at least 81% of the variability in 5-min values. Resting UST measurements achieved strong concurrent validity for all but one of the 5-min HRV metrics examined in this study. A 10-s segment successfully estimated heart rate. A 60-s segment estimated SDNN, RMSSD, NN50, and pNN50. A 90-s segment estimated TINN, LF power, SD1, and SD2. A 120-s segment estimated HRV triangular index and DFA $\alpha1$. A 180-s segment estimated LFnu, HF power, HFnu, LF/HF power, SampEn, DFA $\alpha2$, and DET. A 240-s segment estimated ShanEn. No UST measurement successfully estimated correlation dimension. Based on these findings, resting baselines as brief as 1 min should be sufficient to measure heart rate, SDNN, and RMSSD for individuals who resemble Truman State University undergraduates as long as the data are carefully artifacted. The authors encourage further research employing this study’s rigorous concurrent validity criterion to determine minimum sample lengths for major demographic groups.

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A 1:2 Inhalation-to-Exhalation Ratio Does Not Increase Heart Rate Variability During 6-BPM Breathing


A controversy continues as to whether a 1:2 inhalation-to-exhalation (I/E) ratio produces greater heart rate variability (HRV) than a 1:1 I/E ratio. An I/E ratio is the proportion of the breathing cycle during which subjects inhale and exhale. The present within-subjects randomized controlled trial (RCT) replicated a previous RCT that found no advantage for a 1:2 I/E ratio on time domain and frequency domain measures. Sixteen undergraduates (8 men and 8 women, ages 18–22) participated in this study. A Thought Technology ProComp Infiniti™ system monitored ECG, respiration, temperature, and skin conductance. Active ECG electrodes were located on the lower torso. A respirometer was positioned over the naval in order to measure abdominal excursion and respiration rate. Skin conductance sensors were placed on the index and middle fingers, and a thermistor was placed on the web dorsum of the left hand. Investigators randomly assigned subjects to begin with one of two 5-min I/E ratio conditions (either 1:1 or 1:2) and then cross over to the other condition. In each I/E ratio condition, participants sat upright while effortlessly breathing at 6 breaths per minute (bpm) guided by a visual pacer. A 3-min buffer period between conditions minimized carryover by instructing participants to sit quietly without breathing instructions or feedback. The investigators monitored compliance with respiration rate and I/E ratio instructions during each experimental condition. The researchers analyzed data using a general linear model. Participants successfully followed the visual pacer and breathed at 6 bpm in both I/E ratio conditions. Breathing ratio did not affect autonomic (heart rate, skin conductance, temperature), HRV time domain (HR Max − HR Min, NN50, pNN50, RMSSD), frequency domain (LFnu, HFnu), or nonlinear measurements (DFalpha1, SampEn). The authors recommend that clinicians select the I/E ratio that their clients prefer since this parameter did not affect HRV when participants breathed at 6 bpm. Future research should replicate these findings at each individual’s resonance frequency, instead of a fixed 6 bpm, and with clinical populations.

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Ventral Index and Middle Finger Sites Are Warmer than Homologous Dorsal Sites


This within-subjects parametric study compared skin temperatures obtained from thermistors for two dorsal and ventral finger placements on each hand. This methodological issue has not been previously addressed in published studies and could influence temperature measurements. Forty-nine subjects (29 women and 20 men, ages 18–26) participated in this study. A Thought
Technology ProComp™ Infiniti system monitored hand temperature using thermistors placed on the dorsal and ventral aspects of the index and middle fingers of both hands. Investigators stabilized subjects for 10 min in a 74°F room. Subjects sat upright without breathing instructions or temperature feedback for two successive 5-min measurement periods. Researchers monitored temperature from dorsal and ventral sites on the left hand and then assessed the corresponding sites on the right hand after repositioning the thermistors. Data were analyzed using a general linear model repeated measures analysis of variance. On the left hand, the ventral aspect of the index finger was warmer (82.0°F) than the dorsal surface (80.0°F), $F(1, 48) = 20.34, p = .003, \eta^2 = .130, d = 0.77$. The ventral aspect of the middle finger was warmer (82.7°F) than the dorsal surface (81.1°F), $F(1, 48) = 22.85, p = .001, \eta^2 = .32, d = 1.37$. On the right hand, the ventral aspect of the index finger was warmer (81.5°F) than the dorsal surface (80.4°F), $F(1, 48) = 9.65, p = .003, \eta^2 = .17, d = 0.91$. The ventral aspect of the middle finger was warmer (84.6°F) than the dorsal surface (82.8°F), $F(1, 48) = 26.66, p = .001, \eta^2 = .36, d = 1.5$. These findings replicate previous results from this laboratory obtained using an infrared thermometer. Both experiments demonstrate that large-scale (about 1–2°F) dorsal-ventral temperature differences can be found on both hands and encourage standardization of thermistor placements to reduce measurement variability. Future research should utilize thermistors to measure the dorsal and ventral temperatures of the remaining recording sites on the hand.

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