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Assessing heart rate variability biofeedback as an adjunct to college recovery housing programs

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ABSTRACT

Heart rate variability biofeedback (HRV BFB) shows promise as an adjunct intervention for individuals receiving treatment for substance use disorder (SUD), potentially due to its capacity to reduce craving and negative affect. The present study sought to examine the utility of integrating HRV biofeedback into a college recovery housing program and gauging its ability to reduce craving and negative affect in young adults in remission from SUD. Forty-six residents of an SUD recovery house at a public university in the northeastern United States took part in a non-randomized controlled trial. The active intervention was 12 weeks of HRV BFB performed over a college semester. The control intervention was a semester-long, waitlist condition. Changes in craving, perceived stress, anxiety, and depressive symptoms were measured across time during the active HRV BFB intervention and compared to changes that occurred during the waitlist period using piecewise regression analyses. Significant reductions in craving were noted during HRV BFB, but not during the waitlist control condition; however, the difference in slopes between conditions was not statistically significant. Levels of self-reported craving, stress, anxiety, and depression varied substantially between participants and across time. The results suggest that use of HRV BFB in the college recovery setting as a tool to help reduce craving warrants further examination, particularly among individuals with elevated craving. Added value of HRV BFB comes from the fact that it can be easily and affordably implemented in everyday life.

1. Introduction

Lapses during recovery from substance use disorder (SUD) typically arise in-the-moment from interactions between emotional states, difficulty regulating affect, and cues and stressors that elicit craving and urges to use (Brown, Vik, Patterson, Grant, & Schuckit, 1995; Marlatt, 1996; Shiffman, 2009; Sinha, 2007). These high-risk interactions are potent contributors to lapses and relapse even among individuals in sustained recovery (Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Koob & Le Moal, 1997; Sinha, 2007). The college environment is particularly laden with these high-risk contextual features, with up to half of college students believed to experience marked levels of stress that may contribute to symptoms of anxiety and depression (Regehr, Glancy, & Pitts, 2013). Moreover, substance use is prevalent (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2015; O'Malley & Johnston, 2002) and considered socially normative in this setting (McAlaney et al., 2015; Sanders, Stogner, Seibert, & Miller, 2014). Alcohol use, in particular, often takes a center stage in the social activities of college students. Thus, a young adult in SUD recovery seeking a college education often grapples with conflicts between advancing their education and insulating themselves from the high-risk college campus environment.

1.1. University-based recovery houses

Several models of university-based recovery programs exist across the United States (Bell et al., 2009; Laudet, Harris, Kimball, Winters, & Moberg, 2014). One compelling model is the university-sponsored 'recovery house', an on-campus living community that offers a substance-free environment, a social network of peers in recovery, extracurricular activities throughout the year, and access to substance use and mental health resources (e.g., counselors, mutual-support meetings) for approximately the same cost of standard on-campus housing. Recovery houses offer a great deal of psychosocial support to residents, but are not SUD treatment programs per se.

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1.2. Heart rate variability biofeedback

Heart rate variability biofeedback (HRV BFB; Lehrer, Vaschillo, & Vaschillo, 2000) is a breathing-based intervention that takes advantage of the respiratory sinus arrhythmia that links heart rate with the respiratory cycle and the baroreflex that regulates blood pressure (Benarroch, 2008). When an individual breathes at ~0.1 Hz (equivalent to ~6 breaths per minute), heart rate increases and decreases in phase with respiration, and in doing so normalizes autonomic output. These dynamic changes in heart rate then effect phasic changes in vascular tone and blood pressure via the baroreflex mechanism (Vaschillo, Vaschillo, Buckman, Pandina, & Bates, 2011). HRV BFB has demonstrated utility to reduce negative affect in major depression (Karavidas et al., 2007; Siepmann, Aykac, Unterdorfer, Petrowski, & Mueck-Weymann, 2008) and PTSD (Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011; Zucker, Samuelson, Muench, Greenberg, & Gevirtz, 2009). It also may reduce craving during SUD treatment (Eddie, Kim, Lehrer, Deneke, & Bates, 2014; Penzlin, Siepmann, Illigens, Weidner, & Siepmann, 2015).

Once learned, HRV BFB can be implemented at will using one of several available smartphone applications (apps) or portable HRV BFB devices. Moreover, once trained in HRV BFB, individuals can approximate ~0.1 Hz paced breathing using breathing pacer apps or by counting the breath. Thus, it can be easily used by college students in SUD recovery as they navigate the broader college environment. Accordingly, this study taught students in recovery housing HRV BFB, and using a non-randomized controlled trial design with a wait list condition, explored its ability to lower craving, stress, anxiety, and depression.

2. Materials and methods

2.1. Participants

Forty-six female and male residents of a university recovery house were recruited for participation over the course of 7 semesters. To be eligible for recovery housing, students were required to be enrolled in the university, have received an SUD diagnosis from a health care provider, provide evidence of successful completion of an addiction treatment program (typically inpatient or intensive outpatient), and be free of alcohol and other drug use for at least 90 days. Recovery housing students were required to attend a minimum of two mutual-support meetings (e.g., AA, SMART Recovery) meetings per week and have a sponsor. The recovery house accommodated approximately 40 students, with an average of 5 new students joining per semester. Study exclusion criteria were previous HRV BFB training, current cardiovascular problems (e.g., cardiac arrhythmia, hypertension), medications directly influencing heart rate and blood pressure (e.g., alpha- or beta-blockers), psychotic disorders (e.g., schizophrenia), or serious neurological conditions (e.g., epilepsy). Antidepressant (e.g., SSRIs, bupropion, n = 13) and/or mood stabilizing (e.g., lithium, quetiapine; n = 15) medications were allowed, although participants were asked to not make medication changes mid-study, unless instructed by their doctor. Sample characteristics are presented in Table 1.

Participants were recruited every Spring and Fall semester from Spring 2012 to Spring 2015. Any participants who left the recovery house during the study were invited to remain in the study as long as they continued to be enrolled as students at the university. Eight participants withdrew (1 during the waitlist period and 7 during HRV BFB) due to feeling too busy (n = 6) and leaving the university (n = 2).

2.2. Procedures

This study was a non-randomized controlled trial with a waitlist condition. Both the active (HRV BFB) and control (waitlist) conditions lasted for one semester. The waitlist condition occurred prior to the HRV BFB condition except when volunteers were not able to participate for two semesters due to personal time constraints or upcoming graduation; these participants completed the HRV BFB condition only. In other words, all participants were first assigned to the waitlist condition, when possible. The non-randomized design was selected in collaboration with the recovery housing clinical staff based on their aim to provide all interested residents with access to the active intervention, as well as the small census of the recovery house, and the lack of access to parallel recruitment sites. All study procedures were approved by the university's institutional review board. Participation was voluntary and did not affect students' access to other services provided by the recovery house or the university more broadly. Volunteers provided written, informed consent and understood they were free to withdraw from the study at any time without penalty.

Table 1
Sample characteristics at study entry.

Variable	
Age (years)	23.6 (5.0)[a]
Sex (% female)	28%
Ethnicity (% Hispanic)	11%
Race	
Asian	2%
White/European	91%
Other	7%
Employment	
Full–time	7%
Part–time	44%
University standing	
Freshman	10%
Sophomore	27%
Junior	33%
Senior	20%
Graduate	10%
Years of abstinence	2.5 (1.9)[a]
Perceived Stress (PSS)	13.8 (6.1)[a]
Craving (PACS-M)	5.4 (4.9)[a]
Anxiety Symptoms (BAI)	12.4 (8.8)[a]
Depressive Symptoms (BDI)	8.4 (6.0)[a]

Possible ranges: Perceived Stress Scale (PSS), 0–40; Penn Alcohol Craving Scale - modified (PACS-M), 0–35; Beck Anxiety Inventory (BAI), 0–63; Beck Depression Inventory (BDI), 0–63.
[a] Means and standard deviations (in parentheses).

The waitlist condition involved the completion of questionnaires four times during the semester; no home practice or experimental sessions occurred. The active HRV BFB condition included 8 experimental sessions over 12 weeks. The first 7 sessions occurred weekly starting at the beginning of the semester. The final session was conducted at the end of the semester (approximately 4 weeks after session 7). Each session included the completion of questionnaires and review of the daily home practice logs followed by an HRV BFB session, as described below.

2.2.1. Heart rate variability biofeedback training

Participants were trained to perform HRV BFB as detailed in Lehrer et al. (2000) and briefly described below. At each HRV BFB session, after completion of questionnaires, dermal electrocardiogram (ECG) electrodes were placed laterally below the deltoid muscles on the right and left arms, as well as in a lateral position above the left ankle, and a respiration belt was placed across the chest to capture thoracic breathing (Thought Technology, Montreal, PQ, Canada).

At Session 1, participants were introduced to an EZ-Air Plus visual breathing pacer (Biofeedback Foundation of Europe, Montreal, PQ, Canada) to guide the pace of inhalation and exhalation. They were asked to breathe along with the pacer set at a 6-breaths per minute rate for 5 min. They then breathed for 2 min at five different breathing frequencies (4.5, 5.0, 5.5, 6.0, & 6.5 breaths per minute) to identify their resonance frequency, which was determined based on optimal