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Client Experiences of a Brief Heart Rate Variability Biofeedback Protocol

Sheilagh Fox

A dissertation submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

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ABSTRACT

Client Experiences of a Brief Heart Rate Variability Biofeedback Protocol

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This study investigated the experiences of clients who completed a brief heart rate variability biofeedback protocol. The purposes of this study were to (1) learn about client experiences of biofeedback because almost no previous research has done so and (2) explore the potential role of common factors in biofeedback.

Fifteen clients were interviewed and their data analyzed according to the methods of Consensual Qualitative Research (CQR; Hill, 2012). CQR relies on the use of group consensus to construct representations of participant experiences and categorize themes within the data.

The results showed that participants generally experienced the HRVB+ protocol as helpful. They typically expressed that the intervention helped them with their anxiety or stress and that it increased their self-efficacy concerning their ability to manage anxiety or stress. Several domains emerged that captured data about the biofeedback therapist. Though more research is undoubtedly needed, the findings of this study provide some preliminary support for the idea that common factors could play a role in biofeedback interventions.

Keywords: biofeedback, heart rate variability biofeedback, common factors

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Client Experiences of a Brief Heart Rate Variability Biofeedback Protocol

Biofeedback techniques are used to help people manage a variety of mental health problems, including depression and anxiety (Lehrer & Gevirtz, 2018). Biofeedback is defined as any technique in which some aspect of a person's physiology ("bio") is monitored and displayed back to them ("feedback") for the purpose of bringing the physiology under conscious control (Schwartz, Collura, Kamiya, & Schwartz, 2016). One common type of biofeedback is called heart rate variability biofeedback (HRVB, also called respiratory sinus arrhythmia biofeedback or resonant frequency biofeedback in other studies; Lehrer & Gevirtz, 2014). Heart rate variability (HRV) refers to the variability in the duration of time between a person's heartbeats. When used in the context of intervention, the ultimate purpose of HRVB is to assist clients in learning how to deliberately engage in behavior that activates the body's relaxation response.

In a typical HRVB intervention, activation of the body's relaxation response is achieved by providing clients with breathing training. While breathing training without HRVB is generally beneficial, particularly when a breathing pacer is used to slow the breathing down (Vaschillo, Vaschillo, & Lehrer, 2006), the addition of HRVB provides data that the clinician can use to help clients to optimize their breathing. Notably, the data can be used to help determine the client's resonant frequency (RF), the breathing rate at which a client can achieve the greatest benefit (Steffen, Austin, DeBarros, & Brown, 2017).

A moderate amount is known about the physiological processes that are responsible for HRV and the efficacy of HRVB interventions for a variety of mental and physical health outcomes. However, very little is known about how clients experience HRVB. Even relatively straightforward and obviously important components of experience, such as satisfaction with HRVB, are rarely studied. This lack of information is problematic because it would be helpful to

know how HRVB administration could be optimized from the client's perspective. In addition, there may be aspects of HRVB interventions that affect clients in ways that are unknown because potentially relevant variables have simply not been measured in any quantitative study.

One purpose of the current study was to address this deficit of information about client experiences and satisfaction with HRVB by systematically analyzing the reported experiences of clients who have received a brief, two-session HRVB-focused intervention at Brigham Young University Counseling and Psychological Services (BYU CAPS). The intervention is called the HRVB+ protocol because electromyography (EMG; measures muscle tension), skin conductance (SC; measures sweat gland activity), and hand temperature (HT; measures hand temperature) biofeedback modalities are used in conjunction with HRVB. This is for two reasons. First, providing multiple kinds of feedback may assist clients in developing broader interoceptive awareness, which in turn may help clients to recognize their stress symptoms before they become intense. Second, it allows the biofeedback clinician to better assess what other types of biofeedback might be most useful for clients who are interested in doing EMG-, SC-, or HT-focused biofeedback after the HRVB+ protocol is completed. Thus, this brief protocol is intended to help clients increase awareness of their physiological responses to stress and learn skills that will help them to downregulate their physiological response.

Heart Rate Variability Biofeedback

HRV. Heart rate variability is primarily due to the interplay of the sympathetic and parasympathetic influences of the autonomic nervous system on the heart's pacemaking cells (Acharya, Joseph, Kannathal, Lim, & Suri, 2006; Stzajzel, 2004). The sympathetic nervous system innervates the heart via cardiopulmonary nerves that extend from the sympathetic trunk of the spinal cord (Brodal, 2010), which increase the rate of action potentials in the pacemaking

cells of the heart (Stzajzel, 2004). Conversely, the parasympathetic nervous system innervates the heart via the cardiopulmonary branches of the vagus nerve (Hanna et al., 2017), which slows down heart rate by decreasing the rate of action potentials in the pacemaking cells (Irisawa, Brown, & Giles, 1993). HRV is the integrated result of these excitatory and inhibitory signals. Higher HRV is indicative of better physical and mental health than low HRV because low HRV is the result of reduced parasympathetic output (Chalmers, Quintana, Abbott, & Kemp, 2014; Lehrer & Gevirtz, 2014). Lower HRV is associated with anxiety disorders (Chalmers et al., 2014) and depression (Caldwell & Steffen, 2018).

Physiological mechanisms of action. Thus far, almost all proposed mechanisms of action for HRVB are physiological. Lehrer and Gevirtz (2014) suggested that the psychologically beneficial effects of biofeedback are due to two pathways: (1) strengthening of the baroreflex, and (2) increases in vagal afferent activity independent of the baroreflex. They also speculated about other possible physiological mechanisms, such as increased vagal efferent activity and increased gas exchange efficiency. They also suggested that distraction from worries during breathing may be a mechanism of action, but the role of distraction has likewise not yet been investigated empirically.

Strengthening the baroreflex. The baroreflex is essentially a negative feedback system that helps the body regulate arterial blood pressure from moment to moment (Benarroch, 2008; Heesch, 1999). It causes the heart rate to increase when blood pressure decreases and vice versa. Baroreceptors—a type of sensory neuron embedded in the walls of the aorta and carotid artery—detect blood pressure by stretching when blood pressure increases (Heesch, 1999). When the baroreceptors are stretched, they cause stimulation of afferent nerves that transmit signals to the brain. The brain then inhibits the efferent preganglionic sympathetic neurons, which causes

vasodilation (opening of blood vessels) in some of the body's muscles and visceral organs, causing a decrease in blood pressure (Benarroch, 2008). When the baroreceptor is not stretched, the preganglionic sympathetic neurons are not inhibited which causes vasoconstriction (closing of blood vessels), increasing the blood pressure. This back and forth activity of the baroreflex results in a heart rate oscillation.

The baroreflex is one of many interactive processes that affect heart rate. Respiration is also an important influence on heart rate via its influence on the sinoatrial node (Lehrer & Gevirtz, 2014), one of the heart's "pacemakers." Exhalation causes an increase in parasympathetic activity in the vagus nerve, which decreases heart rate. Thus, as with the baroreflex, inhalation and exhalation result in a heart rate oscillation. When a person is breathing in a typical way (meaning at a variable rate between 9-24 breaths per minute), the heart rate speeds up during mid-inhalation and slows down mid-exhalation. At a certain rate of breathing, however, a person's heart rate speeds up at the beginning of inhalation and slows down at the beginning of exhalation (Lehrer & Gevirtz, 2014). This pace is called the resonant frequency, which falls between 4.5 and 7.0 breaths per minute for most people (Steffen et al., 2017). More specifically, in their sample of 56 healthy and asthmatic adults between the ages of 18 to 65, Vaschillo and colleagues (2006) found a mean resonant frequency of 5.56 breaths per minute with a standard deviation of 0.41 breaths per minute.

When a person is breathing at a variable rate between 9-24 breaths per minute, a plot of their heart rate over time produces a complex, chaotic-appearing wave due to many overlapping oscillations. When their respiration rate is slowed down at a constant pace, however, the combined oscillations of the baroreflex and respiration combine to form a sinusoidal wave. Additionally, they form a positive feedback loop (Lehrer & Gevirtz, 2014; Lehrer & Gevirtz,

2018). This is because the inhalation causes heart rate to rise higher than usual, which causes the blood pressure to fall lower than usual. The opposite is true for exhalation, which causes heart rate to drop and blood pressure to rise higher than usual. In other words, when a person breathes at resonant frequency, the baroreflex is maximally stimulated (Lehrer & Gevirtz, 2018) and the plot of heart rate over time results in higher-amplitude sinusoidal waves relative to slowed breathing not at resonant frequency.

Research on the exact nature of the relationship between the baroreflex and its psychological and neurological correlates is still in its early stages. Broadly speaking, it is fairly well-accepted that there is a relationship between the activity of the cardiovascular system and emotion, particularly with regard to blood pressure and emotional dampening (McCubbin et al., 2011). The role of the baroreflex is less clear, but it appears that increased baroreflex sensitivity (the amount of stretch on baroreceptors required to trigger the baroreflex), which is reflected in HRV (Swenne, 2013), appears to have inhibitory effects on many central nervous system structures, including the amygdala (Delgado, Vila, & Reyes del Paso, 2014). In their review, Lehrer and Gevirtz (2014) suggested that the influence of the baroreflex on the amygdala could be the mechanism by which HRVB helps to treat anxiety and depression.

Vagal afferent activity independent of the baroreflex. According to Lehrer and Gevirtz (2014), another physiological mechanism of action for HRVB may be that HRVB stimulates the vagus nerve in a similar way to direct electrical stimulation. Citing previous research on the effects of yoga, Brown, Gerbarg, and Muench (2013) claimed in their review that slow breathing changes the interoceptive signals that the brain receives in a way that leads to enhancement of emotion regulation and cognitive function by inhibiting overactivity in the amygdala.

Efficacy of HRVB for Psychological Stress. A growing body of research provides some support for using HRVB to treat psychological stress in both clinical and non-clinical populations. A recent meta-analytic study examined the effect of HRVB in a wide range of populations from borderline personality disorder to people without a psychological disorder addressing concerns such as performance anxiety (Goessl, Curtiss, & Hofmann, 2017). The researchers excluded studies in which HRVB was used along with other interventions (e.g., psychotherapy, progressive muscle relaxation, etc.). They found a within-groups pre-post effect size of $g=.81$ [95% CI .55-1.06] and a pre-post between-groups effect size of $g=.83$ [95% CI .34-1.33] when biofeedback was compared with conditions such as progressive muscle relaxation, meditation, or sham biofeedback. Both effect sizes were large and statistically significant. The fail-safe N s were $N=1858$ for the within-group estimate and $N=243$ for the between-groups estimate, suggesting that the study's results are not simply a result of the file-drawer problem. Furthermore, the researchers judged that the effect size estimates were unlikely to result from publication bias of selecting studies with large effect sizes according to the funnel plot trim-and-fill method or the number of studies according to Egger's regression intercept. While the researchers stated that HRVB is a promising treatment for stress and anxiety, they reported that greater rigor in future HRVB studies is needed regarding disclosing and improving randomization procedures and the handling of missing data in order to further strengthen the overall body of evidence.

Efficacy of HRVB as an adjunct to psychotherapy. Few published studies to date have directly investigated whether there is any incremental value in adding HRVB to psychotherapy. One of these studies investigated whether HRVB is a beneficial adjunct to psychotherapy for clients with depression (Caldwell & Steffen, 2018). The treatment sample was composed of

females with major depressive disorder between the ages of 18-25 at BYU CAPS. They were divided into three groups: a treatment-as-usual (TAU) group ($n=10$) that received only psychotherapy, a TAU-plus-HRVB group ($n=10$), and a control group comprised of non-depressed individuals ($n=10$). All participants took the Beck Depression Inventory-II and had their HRV measured six weeks apart. In the intervening six weeks, the psychotherapy-only group received treatment as usual at the counseling center; the psychotherapy plus HRVB group received treatment as usual plus a five-session HRVB protocol in which they were taught diaphragmatic breathing, had their optimal breathing rate (resonant frequency) measured, were given time to practice breathing at their optimal breathing rate, and were instructed to practice breathing for 15-20 minutes, 4-5 times per week; and the control group received no treatment. They found that participants in the psychotherapy plus HRV group demonstrated an improvement in depressive symptoms ($\eta^2 = 0.30$) and HRV ($\eta^2 = 0.36$) compared to the psychotherapy only group. The low n of the study limits the generalizability of the findings beyond the sample due to the possibility of sampling error. Another important limitation of the study was that the TAU-plus-HRVB group and TAU group received the same amount of individual psychotherapy, meaning the TAU-plus-HRVB group received a greater amount of treatment time. Though the time in biofeedback training was not psychotherapy per se, the time in biofeedback was spent in the presence of a human being who was trying to help them with their problems, providing some explanation for their symptoms, teaching them skills consistent with that explanation, and interpreting the feedback with them (Y. Caldwell, personal communication, December 28, 2018). Thus, time receiving treatment is a probable confounding variable. However, if the results of this study were to replicate in other studies that increased the

amount of TAU received by the TAU group, it would suggest that HRVB can be a very useful addition to psychotherapy.

Another study investigated whether HRVB is a beneficial adjunct treatment to psychotherapy for post-traumatic stress disorder (PTSD) and depression (Lande, Williams, Francis, Gagnani, & Morin, 2010). In this study, active duty service members deployed to combat areas were alternately assigned to a treatment as usual (TAU) group or TAU-plus-HRVB group. TAU consisted of outpatient individual psychotherapy, group psychotherapy, medication management, art therapy, and recreation therapy for eight hours per day, five days per week. The TAU-plus-HRVB group received as part of their treatment a five-minute explanation of how to use a simple HRVB intervention followed by 20 minutes of HRVB twice per week. Two measures, the Zung Self-Rating Depression Scale and the PTSD Checklist Military version, were given before treatment and after three weeks of treatment to measure outcome. At the conclusion, both groups showed statistically significant improvement but were not significantly different from each other. Thus, biofeedback did not appear to add incremental benefit.

A number of unpublished studies have also attempted to determine the value of adding HRVB to psychotherapy. In an unpublished dissertation, Wheeler (2017) compared the outcomes of 40 psychotherapy clients also from BYU CAPS who were evenly divided into a biofeedback group and a control group. The HRVB group received 6 sessions of HRVB training over a period of about 6 weeks in a lab setting and the controls watched nature videos in the same setting. At the conclusion of the intervention, the HRVB group had a statistically significantly lower LF/HF ratio relative to the control group, indicating higher physiological relaxation. However, the effect size is unknown because there were not standard deviations available to calculate effect sizes. There was no statistically significant difference between the groups with regard to OQ-45 scores

(see Lambert et al., 2013), heart rate, blood pressure, or on measures of HRV other than LF/HF. Overall, Wheeler concluded that the intervention was not an effective adjunct to psychotherapy because the participants' HRV did not change over time. However, she suggested that conclusions about HRVB efficacy should be interpreted cautiously due to methodological limitations including significant attrition, lack of practice adherence, and infrequent psychotherapy. Another major limitation in this study is that the biofeedback portion of the intervention was conducted almost entirely by undergraduate and first-year graduate research assistants with very limited clinical experience.

In an unpublished study presented at an American Psychological Association conference, Morrell et al. (2013) studied the impact of biofeedback training as an adjunct to psychotherapy on outcome as measured by the OQ-45. They studied a total of 6804 psychotherapy clients at BYU CAPS over a period of four years (2009-2012). Of these, 315 clients received at least two sessions and 369 clients received one session of biofeedback training. The majority of these participants received HRVB as part of their biofeedback training (B. Morrell, personal communication, November 16, 2018), though it was unfortunately not possible for their team to distinguish between types of biofeedback used in session. They found that, independent of initial distress, clients who received two or more sessions of biofeedback training improved an average of three more points on the OQ-45 compared to clients who had one or fewer sessions of biofeedback. No standard deviations were provided so that an effect size could be calculated. In a secondary analysis examining data from 1996-2012, they found that number of biofeedback sessions received was associated with significantly more rapid improvement on outcome, though standard deviations that would allow for an effect size to be calculated were not provided on the poster that they presented. Their results suggest that biofeedback training can be a potentially

useful adjunct to psychotherapy, though without effect sizes it is not possible to gauge clinical significance. Additionally, similar to the study by Caldwell and Steffen (2018), the total number of sessions received by people who did biofeedback versus people who did not do biofeedback were not controlled for.

In summary, the existing information that would help to answer the question of whether biofeedback adds incremental value to psychotherapy for treating stress and anxiety is limited in its utility. The relevant studies identified either featured small sample sizes, did not report effect sizes (or information that would allow for their calculation), or had significant methodological limitations. Overall, more research is needed to verify whether HRVB adds anything above and beyond the benefits that can be achieved in psychotherapy for clients with specific psychological disorders or significant psychological distress.

Client Experiences of Biofeedback

Client experience is a relatively neglected aspect of research investigating the use of HRVB (or any kind of biofeedback) for psychological and psychosomatic symptoms. However, two unpublished studies on this topic have been completed. In one of them (Leavitt, Rice, Morrell, Bawden, & Fife, 2016), researchers interviewed 23 clients who received HRVB from clinicians who had no previous experience in using biofeedback. They used EmWave, a basic HRVB program that provides feedback that includes a delayed time by heart rate graph and an index of coherence (EmWave defines coherence as “a highly efficient physiological state in which the nervous system, cardiovascular, hormonal, and immune systems are working efficiently and harmoniously” and equate it with “less stress”; Quantum Intech, 2006, p. 7). EmWave was chosen because of its relatively low price and ease of use compared to other biofeedback systems. The researchers used the “Kvale method” (see Kvale, 2009) to interview

and clients who participated in the study and analyze their data. They found that the participants liked using EmWave, found it relevant and helpful for increasing feelings of calmness, and that they continued to use the breathing strategies that they learned to help manage feelings of stress and anxiety.

The second study described the experiences of clients who belonged to “Mind-Body Self-Regulation” groups for patients with chronic and life-threatening illnesses (Esty, 1995). The group used “behavioral medicine techniques”—HT biofeedback and breathing training in addition to autogenic training, visualization, imagery, and music—in a family systems framework. The behavioral medicine techniques were taught as self-regulation skills. Five group members from a number of different groups were interviewed about their experiences using open-ended questions. For each interviewee, Esty reported on their responses concerning their feelings about the group experience, feelings about their illnesses, feelings about the other group members, changes in their family relationships, impact of the group on their quality of life, the role of the group leader, the skills that they learned, and how their life has changed as a result of their group experience.

As a group, the participants appeared to value the self-regulation skills they learned. Four of the five participants continued with self-regulation activities. Esty concluded that the participants benefitted at least in part because self-regulation skills help to counteract the loss of control experienced as a result of physical illness. She noted that diaphragmatic breathing was not mentioned as frequently as she expected and suggested that the reason for this was that diaphragmatic breathing became so automatic for the group members that they did not think to mention it during the interviews. While the author reported that “implicit in the interviews was an understanding of the physiological mechanisms of . . . biofeedback,” (p. 330) only one of the

participants' direct experiences with biofeedback was reported. Specifically, HT biofeedback helped the participant to enter "a deeply relaxed state."

Client satisfaction with biofeedback interventions. Another way that researchers have already attempted to understand the subjective experience of clients who receive biofeedback is by measuring their treatment satisfaction. Unfortunately, this has not been done on a large scale. Additionally, important details—such as measures, methods, or any quantitative or qualitative data - are unclear in many studies that have reported client satisfaction with biofeedback interventions (Doerksen, 1997; Ebert, 2012; Henriques, Koffer, Abrahamson, & Horst, 2011; Kleen & Reitsma, 2011; Lande et al., 2010; Long et al., 2011; Stern, Guiles, & Gevirtz, 2014). Only a handful of studies provide useful information about treatment satisfaction with types of biofeedback that are used in the HRVB+ protocol.

Of these few, only a single study featured HRVB. Twelve children with cancer received a four-session HRVB intervention to help with relaxation immediately prior to painful medical procedures (Shockey et al., 2013). There was not a control group. The sessions lasted 60 minutes each, with 20-45 minutes devoted to respiration training or HRVB in every session. Over the course of the four sessions, the children received basic psychoeducation about stress, an introduction to diaphragmatic breathing, and practiced with EmWave software. Eleven of the children (91.7% of the total sample) took the satisfaction survey at the conclusion of the intervention. The survey was developed by the researchers specifically for the study. It was a four-item survey with each question delivered in a five-point Likert scale format. The items asked the children whether they felt the diaphragmatic breathing or HRVB were helpful. It also asked them whether the combination of breathing and HRVB was helpful toward the end of helping children to feel "more in charge of their bodies" and whether they would use the

diaphragmatic breathing in future stressful situations. They found that diaphragmatic breathing helped 63% of the children to feel less scared, HRVB helped 45% feel less scared, and 81% felt the intervention as a whole helped them to feel more “in charge of their bodies” before the medical procedures. Results were not reported concerning the item that asked whether the children thought they would use diaphragmatic breathing in future stressful situations.

Information about client satisfaction with types of biofeedback other than HRVB is also relevant to discuss because, though HRVB is featured in the HRVB+ protocol, all clients are exposed to EMG, SC, and HT biofeedback with the hope that it will help to build client awareness. Additionally, some clients who complete the HRVB+ protocol go on to do EMG, SC, and HT-based biofeedback. And lastly, all kinds of biofeedback have significant commonalities such as being hooked up to biofeedback equipment, seeing feedback, and body-based intervention strategies. These similarities suggest that the experiences of participants who receive one kind of biofeedback (e.g., EMG) could potentially be relevant to participants who receive another kind of biofeedback (e.g., HRV).

One study treated patients with neck and shoulder pain with an EMGB-based tele-treatment that lasted for four weeks (Huis in 't Veld et al., 2010). The patients ($n=82$) wore a garment under their shirt that vibrated if the patients were insufficiently relaxed. The garment also sent data to therapists who consulted with the participants via telephone on a weekly basis. Of the participants who began treatment, 37% dropped out due to problems with the equipment or personal circumstances. A significant decrease in pain ($g=.49$, $p<.001$) and improvement in functioning in various life domains (e.g., home responsibilities, recreation, etc.; $g=.46$, $p=.002$) were experienced by the conclusion of the study. Forty-five of the participants completed the treatment satisfaction measure, which was defined as fulfillment of expectations about

intervention ease of use and usefulness for helping with problems. The measure was created specifically for the study and based on the technology acceptance model described by Hu, Sheng, and Tam (1999). The measure comprised two questions about the intervention's ease of use and usefulness. The researchers conceptualized satisfaction as a lack of discrepancy between expectations of ease of use and usefulness before the intervention to experience of ease and usefulness after the intervention. The researchers found a significant correlation ($r=.47, p=.0004$) between experiences and expectations for ease of use but not for experiences and expectations of usefulness ($r=.22, p=.151$). Unfortunately, these indicators of satisfaction are difficult to interpret because there was no control group.

Another study (Glombiewski, Hartwich-Tersek, & Rief, 2010) examined outcomes for patients with chronic back pain. They compared a cognitive-behavioral therapy (CBT) condition, a CBT-plus-biofeedback (mostly electromyography biofeedback [EMGB], but with infrequent use of "respiratory" biofeedback and SCB) condition, and a waitlist control group. Of the participants who began the CBT-plus-EMGB condition ($n=62$), 14% dropped out. Of the participants who began the CBT-only condition ($n=54$), 19% dropped out. Treatment satisfaction was evaluated with two items on a five-point Likert scale: "Therapy was helpful for [the problem]" and "I would recommend this treatment to a friend." The two responses indicating highest satisfaction ("yes" and "probably") were grouped and the three lowest responses ("undecided", "not really", and "no, not at all") were grouped to create a binary variable. A chi-square test of significance comparing the satisfaction with the CBT condition and CBT-plus-EMGB condition found no statistically significant differences.

A similar study examining outcomes for patients with tinnitus compared a CBT-plus-EMGB group with a wait-list control group (Weise, Heinecke, & Rief, 2008). Participants

($n=130$) received 12 one-hour sessions and reported a statistically significant decrease in distress and difficulties with auditory perception. Only 12% of the participants dropped out of treatment. Those who completed reported high treatment satisfaction (an average of 5.16 on a 6-point scale, with higher numbers indicating greater satisfaction) on a scale designed specifically for the study. The scale consisted of 19 questions and demonstrated high internal consistency ($\alpha=.91$). Items included items such as “I would recommend this treatment to a friend with a similar disorder.” Unfortunately, the study’s structure does not allow for distinguishing between the satisfaction due to CBT and the satisfaction due to EMGB. Furthermore, the study used a wait-list control group and evaluated satisfaction in both groups at the end of their treatment, preventing satisfaction with treatment from being compared with satisfaction with another condition.

A study that examined outcomes for patients with temporomandibular joint (TMJ) pain compared an EMGB-plus-CBT condition ($n=29$) with an occlusal splint (dental procedure) condition ($n=29$; Shedden Mora, Weber, Neff, & Rief, 2013). The completion rate for the EMGB-plus-CBT group was 96.3% while the completion rate for the occlusal splint group was 88.9%. Participants in both conditions demonstrated improvement but did not differ significantly from each other. EMGB-plus-CBT group reported significantly higher satisfaction ($g=1.48$, $p<.001$). Satisfaction was measured using a modified version of the scale used by Weise et al. (2008) in their study investigating an intervention for tinnitus. Unfortunately, the study’s structure does not allow for distinguishing between the satisfaction due to CBT and the satisfaction due to EMGB.

Lastly, an unpublished dissertation (Fragedakis, 2014) found that participants ($n=10$) reported high satisfaction with a treatment protocol that included HRVB, skin temperature

biofeedback, skin conductance, and neurofeedback. However, their satisfaction was measured using a modified version of the Treatment Satisfaction Index (a subscale of the Global Appraisal of Individual Needs: Dennis, 1999; Tetzlaff et al., 2005). This was problematic because many of the items on the questionnaire arguably measured the therapeutic alliance (the client and therapist “agreed on what [the client’s] problems were”, and the client and therapist “agreed on what [the client was] to do about [the] presenting problem”) rather than overall satisfaction with treatment.

Overall, previous research on client satisfaction with biofeedback has been limited in its depth. It appears that many clients are satisfied with their biofeedback experiences. However, this conclusion must remain tentative because of the variety of methodological issues present across these studies. Additionally, many of the articles that have provided methodological data concerning satisfaction with biofeedback have focused on populations in medical settings, which limits the generalizability of the findings to mental health clinics or counseling centers. Lastly, client satisfaction does not adequately represent the richness of client experiences in biofeedback.

Common Factors in Biofeedback

One of the potential benefits of researching client experiences of biofeedback is enrichment of the theory that guides biofeedback research and practice. A recent paper authored by two leading biofeedback researchers, Lehrer and Gevirtz (2014), explained “how and why” biofeedback works—including for emotional concerns—almost exclusively in terms of physiological mechanisms (the one exception being their suggestion that distraction from worries may play a role). This explanation as articulated in their article is consistent with the medical model as outlined by Wampold and Imel (2015). Wampold and Imel stated that there are five

components to the medical model that are particularly relevant from a psychotherapy perspective (pp. 7-9): (1) illness, which is defined as a deviation from normal functioning; (2) biological explanation, which means that symptoms are assumed to have a physical basis; (3) mechanism of change, which refers to a process that rectifies the illness; (4) therapeutic procedure, which is defined as an intervention consistent with the illness, explanation, and mechanism of change; and (5) specificity, which means that the intervention works because of the specified mechanism of change and not because of other processes.

The medical model as it applies to psychotherapy can be contrasted with the contextual model of psychotherapy (Wampold & Imel, 2015). The contextual model is characterized by three pathways for change (Wampold & Imel, 2015, pp. 54-61): (1) the “real relationship”, which refers to a genuine interpersonal connection (attachment, belongingness, social connection) between the therapist and the client; (2) “creation of expectation through explanation and some form of treatment”; and (3) specific ingredients, or therapeutic actions designed to target specific psychological problems. The prerequisite to the operation of the three pathways is the therapeutic alliance, which is defined as agreement on the goals and tasks of therapy as well as the initial bond of trust between therapist and client. The real relationship and creation of expectation contribute to increased quality of life while creation of expectation and specific ingredients contribute to symptom reduction. The contextual model differs from the medical model in that it explicitly acknowledges and accounts for the roles of common factors in psychotherapy (Wampold & Imel, 2015). Common factors can be contrasted with the “specific ingredients” pathway of the contextual model. Essentially, common factors are non-specific therapeutic factors common across different varieties of psychotherapy (Tschacher, Junghan, & Pfammatter, 2014).

Lehrer and Gevirtz's (2014) article about "how and why" HRVB works is not a treatment manual and does not capture their clinical approach to administering biofeedback, which they use as an adjunct to psychotherapy (P. Steffen, personal communication, April 21, 2020). However, researchers and clinicians from outside the biofeedback community reading their article could easily get the impression that biofeedback researchers and practitioners do not acknowledge the role of common factors. Indeed, Tschacher and colleagues (2014) found that, on average, expert psychotherapy researchers with a variety of allegiances (mostly cognitive-behavioral, psychodynamic, and eclectic, and most of whom were active as clinicians) rated biofeedback training techniques as being negatively associated with common factors (including affective experiencing, desensitization, and twenty others). For example, they found that the study participants believed that the "therapeutic alliance . . . would be counteracted by the application of biofeedback training" (p. 92). However, it seems implausible that clients benefit from biofeedback in spite of its techniques being incompatible with common factors (or, indeed, that clients who receive biofeedback techniques impart all of their benefit through means other than common factors).

In summary, further theoretical work in the biofeedback literature is indicated in order to articulate the most useful metatheoretical assumptions for researchers and clinicians of biofeedback to operate from. For example, if the therapeutic relationship between the clinician and client in biofeedback contributes to outcome, it should be taken into account when designing a study or during treatment. While individual biofeedback practitioners may believe common factors are important in biofeedback, this is not reflected in the research literature. Additionally, if common factors do play a role in biofeedback outcomes, further research could aid

biofeedback clinicians in better understanding how to make use of common factors when treating clients to maximize benefits.

Rationale for Present Study

Levitt (2015) suggested that qualitative methods might be “ideal for the development of principles to guide psychotherapy.” Consistent with this idea, investigating the experiences of the client is a reasonable starting point to begin remedying this theoretical vacuum because it is difficult to know what aspects of biofeedback impact clients without asking them. Once clients’ experiences are known, they can be compared with the predictions of the extant theory (Stiles, 2015). Thus, if clients endorse only that they feel physiologically and psychologically calmer when doing biofeedback, then perhaps the reigning dominant paradigm really is sufficient to account for how and why biofeedback works. However, if the clients communicate that other factors played a role in their treatment, such as the relationship with the clinician or feeling increased hope, then the need for further theoretical and empirical work is indicated.

Additionally, no matter what client experiences of HRVB the present study brings to light, analogous studies of client experiences of individual therapy have been generally fruitful in helping clinicians understand how traditional individual psychotherapy helps to support clients in their healing (Levitt, Pomerville, & Surace, 2016).

Qualitative methods of inquiry are useful tools for understanding experiences of events in great depth and will therefore be utilized in the present study. However, quantitative methods are the dominant approach in clinical psychology research (Levitt, 2015), which means that the methods of this study methods go contrary to what is expected and potentially what is valued within the discipline. It is true that qualitative research does not have the same potential to aid researchers in understanding cause and effect relationships as quantitative research. However, its

methods typically solicit information in a more open-ended way, which means that more detailed and nuanced information can be collected from each participant. Additionally, the participants are not limited to sharing only the information that the questionnaires in a quantitative study ask about. Predicting the findings of a qualitative study beforehand (such as in hypothesis testing) is discouraged because of the possibility that the predictions could bias the results (Hill, 2012b). Instead, it is recommended to simply present the research question: How do clients experience the HRVB+ protocol?

Methods

This study used a consensual qualitative research (CQR; Hill, 2012a) approach to investigate client experiences of the HRVB+ protocol. Studies that use CQR feature a small sample of participants who have experienced a phenomenon of interest. The data are collected in semi-structured interviews (Burkard, Knox, & Hill, 2012). After the recorded interviews have been transcribed, a primary research team of at least three people code the transcripts to find themes (Thompson, Vivino, & Hill, 2012) and to categorize the data within themes (Ladany, Thompson, & Hill, 2012).

The defining feature of CQR is that the primary team must do everything by consensus throughout the coding and categorizing processes. To aid the primary team, an auditor or auditing team provides feedback on the work of the primary team at least twice during the analysis. Having multiple people interviewing, analyzing the data, and auditing the analysis is helpful because it can dilute the effect of expectations and biases of any one member on the results, particularly when the research team members have diverse characteristics and experiences (Sim, Huang, & Hill, 2012). Lastly, it is important in CQR to address the effects of

expectations and biases explicitly to facilitate a high degree of transparency about how the research team may have affected the data.

Clinical Procedure

Before the first biofeedback appointment, clients filled out the BYU CAPS intake and consent form and the biofeedback intake and consent form. Before the second biofeedback appointment, clients filled out the returning biofeedback appointment form (see Appendix #). Participants were invited to fill out the Outcome Questionnaire-45.2 (OQ-45) before each session of biofeedback as part of regular BYU CAPS operations. The OQ-45 total score measures general symptoms of psychological distress. The OQ-45 also contains three subscales (symptomatic distress, interpersonal relations, and social role functioning). However, factor analysis has not supported this structure (Lambert et al., 2013) and so we will not report them. The OQ-45 has demonstrated acceptable reliability and validity in undergraduate students (Lambert et al., 2013). The internal reliability appears to be high ($\alpha=.93$), test-retest reliability appears to be acceptable (.84 for a two-week interval and .66 for a ten-week interval), and it shows good convergent validity with a variety of anxiety and depression measures.

HRVB+ Protocol. The HRVB+ protocol is a brief, two-session protocol structured to maximize the number of clients that can benefit from biofeedback services at BYU CAPS without sacrificing quality of treatment. Clients that receive biofeedback services at BYU CAPS receive this brief HRVB intervention before receiving other types of biofeedback. It is a flexible protocol, though deviation from the two-session format is not typical. The general purposes of the protocol are to help clients to gain awareness of their own idiosyncratic stress response, learn diaphragmatic breathing, determine their RF, and assess whether they are likely to benefit from additional biofeedback intervention beyond HRVB.

The objective of the first session of the HRVB+ protocol is to create a “stress profile” (Khazan, 2013, pp. 37-46) and introduce diaphragmatic breathing. After a brief initial introduction and interview about the presenting problems, the stress profile is conducted for the purpose of learning about clients’ idiosyncratic responses to and recovery from psychological stress. It consists of HRV, EMG, SC, HT, and respiration data over a baseline period, one or more stressors (depending on time constraints and the presenting problem), and a recovery period. The most typical stressors are a thinking stressor in which participants are asked to think about something stressful, and a talking stressor in which they are asked to talk about something stressful. After the stress profile, diaphragmatic breathing is introduced and practiced while the data continues to be gathered. At the conclusion of the first session, biofeedback clinicians review the data with clients and collaborate with them to create personal “awareness goals” and a “practice goals” to work on before the second session. The awareness goals vary depending on the results of the stress profile but tend to involve periodic self-evaluation of a specific stress symptom. The practice goal is to practice diaphragmatic breathing, with or without a pacer, for at least 30 minutes per week. The clinician provides a rationale for the stress profile and diaphragmatic breathing throughout the session.

The objective of the second session of the HRVB+ protocol is to determine the client’s RF. After the clinician follows up about the goals made in the first session, clients breathe diaphragmatically according to a breathing pacer. The clients breathe from 4.5-7.0 breaths per minute at every 0.5 breath per minute interval. Clinicians provide additional instruction about diaphragmatic breathing as needed, such as when the client is feeling lightheaded, sleepy, or is having some other difficulty with breathing. After the RF is determined by the clinician, the client is instructed to practice breathing at the RF rate for at least 30 minutes per week. Similar to

the first session, the clinician provides a rationale for the diaphragmatic breathing at resonant frequency throughout the second session.

Four out of six of the BYU CAPS biofeedback therapists who administered the HRVB+ protocol are doctoral students in either clinical or counseling psychology. The other two clinicians were licensed counseling psychologists and provided biofeedback services on a less frequent basis than the graduate students. The graduate students were supervised by a licensed counseling psychologist who is certified by the Biofeedback Certification International Alliance (BCIA) as an approved mentor. Thus, all of the clinicians administering the protocol were considered competent to do so.

Fidelity check. For both the stress profile session and the resonant frequency session, clinicians were required to review an outline of the session's content and indicate whether any deviations were made as part of their regular session note (see Appendix A for the stress profile template and Appendix B for the resonant frequency session template).

Participants

The 15 participants in the study were BYU CAPS clients who were also receiving, or were scheduled to receive, individual psychotherapy. Only clients who agreed to be contacted about research opportunities in the general BYU CAPS intake form and the biofeedback-specific intake form were invited to participate. Eligible participants were contacted in one of three ways: (1) clients saw flyers advertising this study and emailed the author of this dissertation; (2) the author of this dissertation emailed the client after their second session of biofeedback to see if they would be interested in participating, or (3) the biofeedback clinicians asked if the client was interested in participating at the conclusion of the HRVB+ protocol. Clients who were not

available for an interview within approximately two weeks of finishing the HRVB+ protocol were not interviewed.

Eleven of the participants (73%) were female and four of the participants (27%) were male. The mean age of participants at the time of interview was 22.3 years with a standard deviation of 2.3 years, the median age was 22.0 years, and the participant ages ranged from 18.8 to 28.9 years. Fourteen of the participants (93%) identified as white and one participant (7%) identified as Hispanic/Latino/a. Thirteen participants (87%) reported that the United States as their country of origin and two participants (13%) reported that they were international students. Eleven participants (73%) identified as heterosexual, one participant (7%) identified as bisexual, and three (20%) participants did not disclose any information about their sexual orientation.

It is worth noting that six participants (40%) had received additional biofeedback sessions beyond the stress profile and resonant frequency sessions prior to their interview. One of these participants had three sessions between the stress profile and resonant frequency due to illness (and potentially other unknown factors) that prevented her from successfully engaging in the resonant frequency session. Another six participants (40%) had not yet received an additional biofeedback appointment but had one scheduled for after the interview or indicated in the interview that they were planning on scheduling another appointment after the interview.

Research Procedure

Interview. The interviews were conducted by a clinical psychology graduate student and recorded over the telephone. The graduate student was not a biofeedback clinician at BYU CAPS. Prior to asking the interview questions, he introduced himself, informed the participants about what will happen to the interviews to ensure confidentiality, and confirmed that the participant would be compensated with a \$20 Amazon gift certificate or \$20 in cash. As a part of

his introduction, he disclosed that he is a clinical psychology doctoral student who has experience doing psychotherapy. He also informed the participant that he has not been specifically trained in biofeedback. The intent of his disclosure was to maximize the participant's comfort with sharing relevant information that they might be unwilling to share with someone who has a strong opinion about the value of biofeedback as an intervention or who does not have intensive clinical training.

In the semi-structured interview, all of the participants were asked the exact same questions. Depending on their responses, the interviewer probed for more details with non-leading prompts (“tell me more about that” instead of “what did you appreciate about that?”) to aid the participant in articulating their experience as fully as possible. The interview protocol questions were:

1. *What did you expect biofeedback would be like before the first session?*
2. *What were your impressions of the first biofeedback session?*
3. *What were your impressions of the second biofeedback session?*
4. *What were your impressions of the biofeedback practice assignments?*
5. *What was your biofeedback therapist like?*
6. *What concerns originally brought you to biofeedback?*
7. *Was your biofeedback experience useful to you?*
8. *Would you recommend biofeedback to other people with similar concerns?*
9. *Is there anything else important about your experience that hasn't come up yet in our interview?*

Though Burkard et al. (2012) suggested that an eight- to ten-question interview lasts about one hour, all of the interviews were under 40 minutes. No changes were made to the interview questions after the process of interviewing clients had started.

Transcription. After completion of the interviews, the interviews were transcribed by either undergraduate students or the author of this dissertation. The transcripts transcribed by undergraduate students were double-checked by the author of this dissertation. One error that could potentially impact a participant's meaning was detected and the coding team was alerted immediately to make the correction. There were no other significant errors.

Domains. After the recorded interviews were transcribed, a coding team comprised of six undergraduates coded the data per the coding process outlined by Thompson, Vivino, and Hill (2012). They identified meaningful topics that appeared in the text ("domains") by independently identifying potential domains and then coming together to discuss them until they reached a consensus on what domains were represented in the transcripts. During the process of identifying domains, the coding team met for about four hours per week. Over the course of the meetings, the list of domains evolved to fit the growing body of data. When the domain list was completed, it was sent to the auditing team. The auditing team reviewed the list and provided feedback regarding whether the domains were clear and specific enough to capture discrete and meaningful themes within the data. The coding team and the auditing team went back and forth until they agreed on the domain list.

Once the domain list was finalized, members of the coding team reviewed all of the text and assigned domains to small sections of text ("blocks") within the transcripts. The length of blocks varied because block length was determined by how long it took the participant to convey an idea. The shortest blocks were portions of a sentence, and the longest blocks were long

paragraphs. For each block, a summary called a “core idea” was written. If disagreements about the domain assignments or core ideas arose between the members of the coding team, they were discussed until the team reached a consensus.

Once all of the blocks were assigned domains and summarized into core ideas, the coded transcripts and core ideas were sent to the auditing team, who provided feedback and recommended changes to the domains or core ideas. The primary team then reviewed the feedback and made the changes based on consensus between themselves.

Cross-analysis. After the coding team came to consensus regarding changes to the block assignments and core ideas, the coding team plus the author of this dissertation (a member of the auditing team) completed a cross-analysis (Ladany et al., 2012). It is necessary for primary investigators to be present during the cross-analysis even if they were not a member of the coding team. The purpose of the cross-analysis is to categorize the data within each domain. The cross-analysis team (comprised of the coding team plus the author of this dissertation) grouped together similar core ideas within domains and tentatively labeled the categories. As with all steps in the process, the cross-analysis team carried out these tasks consensually. If a core idea was unclear, they went back to the original transcripts to clarify. Core ideas that did not fit in with any of the other core ideas in a domain were placed in an “Other” category.

After cross-analysis was performed on all of the domains, the author of this dissertation reviewed the results in detail and finalized category labels as she wrote the results section of this dissertation. If any core ideas were reassigned at this time, both members of the auditing team discussed the changes and came to consensus. Categories were considered “general” if all or all but one participant has data within that category, “typical” if more than one-half of participants

have data within that category, “variant” if up to half of the participants have data within that category.

Physiological data analysis. All HRV data that was analyzed was gathered using J & J Engineering’s Physioblab by the biofeedback clinicians as part of their routine practice. The inter-beat interval data was exported from Physioblab and analyzed in Kubios version 3.3. Within Kubios, the default settings were used with artifact correction set to medium.

Disclosure of Information about Research Team Members

The research team is of great importance in CQR because they are the “instruments” by which the raw data are obtained, organized, and ultimately interpreted. Thus, they are an important potential source of bias and it is beneficial to share information about their connection with the phenomenon of interest (in this case of this study, biofeedback). The research team in this study consisted of the interviewer, the coding team, the auditing team, and an additional transcriber.

Interviewer. The interviewer was a third-year graduate student in clinical psychology. As mentioned in the interview section, he is a graduate clinical psychology student who is not a biofeedback clinician at BYU CAPS. He helped to administer HRVB research protocols for a study for a total of four months in his first year but does not have any ongoing clinical or research interest in biofeedback.

Coding team. The six members of the coding team were undergraduate psychology majors. They were recruited from a research team interested in psychotherapy research and, as of prior to data collection, had no prior experience with biofeedback of any kind. One of the coding team members also assisted in transcribing the interviews.

Auditing team. The auditing team was comprised of two members. The first member of the team is a third-year graduate student in clinical psychology and the author of this dissertation. She has been involved with researching HRV, HRVB, and related phenomena for over three years. In addition to administering HRVB research protocols, she also fulfilled many lab manager duties, which included contacting participants, evaluating participant eligibility, training other research assistants, and tracking the overall progress of data collection. She worked at BYU CAPS from September 2018 to April 2019 administering the HRVB+ protocol and other types of biofeedback sessions to clients. She is curious about whether the benefits of HRVB are largely due to common therapeutic factors, such as instillation of hope, empathy, psychoeducation, and so on. In addition, she assisted in transcribing the interviews.

The second member of the auditing team is a licensed counseling psychologist and the chair of this dissertation. Her academic interests include psychotherapy research and she is experienced with the CQR method. She does not have any experience in administering biofeedback and she has not been involved in any previous research investigating biofeedback or psychophysiology.

Transcriber. One of the transcribers did not have any other involvement with the study other than transcribing. She was an undergraduate assistant who provided basic biofeedback services on a walk-in basis at BYU CAPS.

Results

Sample

Eighty percent of our participants received (or planned to receive) biofeedback sessions in addition to the HRVB+ protocol. It is likely that the participants' evaluations of the overall impact of the intervention, the perceived impact of the interventions that they had received,

comments that they made about their biofeedback therapist, and comments they made about the biofeedback equipment were influenced by sessions other than the stress profile session and resonant frequency session in imperceptible ways. In a few cases, the information participants shared with the interviewer was clearly likely to have been influenced by the additional sessions. In these instances, the likely influence of the other sessions is clearly noted in the results section. However, because the influence is likely to be impossible to clearly identify much of the time, and because one of the purposes of the HRVB+ protocol is to assess participant needs for potential future biofeedback sessions, we did not attempt to scrub the data of the influence of the additional sessions.

Descriptive data. Some descriptive data is provided in Table 1 to provide context for the qualitative data. Participants varied broadly in terms of their baseline physiological data. The physiological data for Participant 3 was invalid due to technical issues. The physiological data for Participant 7 could not be located after an extensive search, suggesting that it was probably deleted or misnamed in the database.

Participants varied broadly in terms of their distress scores on or around the days of their stress profile and resonant frequency sessions. For participants who did not take the OQ-45 on the exact day of their session, the closest administration of the OQ-45 (within up to one week before or after the session) was used. Participant 8 took the OQ-45 two times on the administration date closest to her stress profile session and so both scores are reported. Participant 5 did not have an OQ-45 score available within one week before or after the stress profile session. Participants 1 and 6 did not have an OQ-45 score available within one week before or after the resonant frequency session.

Table 1

Descriptive Data by Participant

Participant	OQ-45 SP	OQ-45 RF	Sample (min)	Mean HR (bpm)	Min HR (bpm)	Max HR (bpm)	SDNN (ms)	RMSSD (ms)	VLF Power (ms ²)	LF Power (ms ²)	HF Power (ms ²)	LF/HF
1	58	—	2:02	80	71	95	75.2	35.4	31	4198	254	16.497
2	98	56	2:02	63	58	78	93.2	92.7	205	5039	3598	1.4
3	68	70	—	—	—	—	—	—	—	—	—	—
4	76	74	2:01	72	61	87	77.2	52.9	111	5924	847	6.994
5	—	63	1:59	57	53	67	61.7	77.6	30	2711	1471	1.842
6	79	—	1:52	73	70	83	36.8	41.8	8	217	869	0.25
7	89	79	—	—	—	—	—	—	—	—	—	—
8	63/53	50	1:59	55	49	59	96.8	110.3	13	7100	6124	1.159
9	37	40	7:32	73	63	90	75.1	85.2	96	2922	2360	1.238
10	96	92	2:00	78	65	89	68.1	60.6	61	3684	1907	1.932
11	84	77	2:00	68	65	77	35.2	38.1	42	481	442	1.087
12	44	17	1:41	83	64	97	88.6	44.8	789	6498	617	10.536
13	97	82	4:37	74	64	91	42.9	48.1	66	1031	930	1.108
14	58	57	2:03	91	83	100	24.5	19	60	389	223	1.741
15	34	46	2:03	57	53	61	67	93.5	50	818	2075	0.394

Note. OQ-45 SP/RF = OQ-45 score closest to stress profile or resonant frequency session. Sample (min) = length of sample in minutes. HR (bpm) = heart rate in beats per minute. SDNN (ms) = standard deviation of NN intervals in milliseconds. RMSSD (ms) = root mean square of successive differences in milliseconds. VLF/LF/HF Power (ms²) = very low frequency/low frequency/high frequency power in milliseconds squared. LF/HF = low frequency to high frequency ratio.

Deviations from protocol. Participant 2 only breathed at paces between 7.0 and 5.5 breaths per minute during the resonant frequency session because she was late and became sleepy (it is not possible to determine resonant frequency if a client is too sleepy). Participant 3 had a mindfulness meditation exercise incorporated into the stress profile session. Her biofeedback therapist also had to use EmWave instead of Physiolab to record data from the stress profile session due to technical difficulties. Participant 4 used an audio pacer instead of a visual pacer during the resonant frequency session. Additionally, though all paces between 7.0 and 4.5 breaths per minute were tested, the note indicated that the readings from 5.0 and on needed to be redone, though no reason was given. Participant 6 had muscle tension measured on the jaw rather than the forehead during the resonant frequency session due to jaw pain. Additionally, the 4.5 breaths per minute pace was not attempted with no reason given in the note. Participant 7 had three sessions between the stress profile and resonant frequency due to illness and potentially other factors interfering with breathing. One of the sessions was a mindful breathing training. Another session appeared to consist of a relaxation profile, an exercise in which participants try many relaxation exercises while being monitored by biofeedback equipment to see which relaxation exercises they respond to best (Khazan, 2013). What the remaining intermediate session consisted of is unknown. In the resonant frequency session, she breathed at paces between 7.5 and 5.5 breaths per minute with no reason given for the deviation. Participant 12 breathed at 4.0 breaths per minute in addition to paces between 7.0 and 4.5 breaths per minute. Though no reason was given, the additional pace was likely added because the resonant frequency was 4.5 and the biofeedback therapist wanted to ensure it was not lower. Participant 15 did not have practice or awareness goals set at the end of the stress profile session because the session was cut short.

List of Domains

The data analysis process resulted in the emergence of 15 domains. More specific results will be presented by domain according to the order and structure presented in Table 2.

Table 2

List of Domains

Number	Name
1	Reasons for Client Participation in Biofeedback
2	Expectations for Biofeedback Intervention
	<i>Biofeedback Sessions</i>
3.1	Evaluation of Stress Profile Session
3.2	Evaluation of Resonant Frequency Session
	<i>Out-of-Session Activities</i>
4.1	Out-of-Session Activities Assigned or Completed
4.2	Evaluation of Out-of-Session Activities
	<i>Overall Intervention</i>
5.1	Evaluation of Overall Intervention
5.2	Perceived Impact of Intervention
5.3	Willingness to Recommend Biofeedback to Others
5.4	Suggestions for Intervention
	<i>Biofeedback Therapist</i>
6.1	Evaluation of Biofeedback Therapist
6.2	Specific Non-Protocol Biofeedback Therapist Behaviors
6.3	Perceived Impact of Interaction with Biofeedback Therapist
7	Evaluation of Biofeedback Equipment
8	Other

Domain 1: Reasons for Client Participation

The majority of the findings in this domain were derived from the participants' responses to the interview question: *What concerns originally brought you to biofeedback?* Three types of categories emerged in the cross-analysis: (1) referral sources, (2) symptoms, and (3) other motivations.

Table 3

Findings for Domain 1: Reasons for Client Participation

Category	Frequency	Illustrative Core Ideas/Excerpts
<i>Referral Sources</i>		
A. Referred by Individual Therapist	T (11)	Individual therapist
B. Referred by Someone Other than Individual Therapist	V (5)	Professor; student development class; on-call after hours therapist
<i>Symptoms</i>		
C. Physical Symptoms	T (11)	Muscle tension; headache; pain; fatigue; sweating; heart pounding; poor circulation
D. Anxiety	T (10)	Feeling "high strung"; social anxiety; unspecified anxiety
E. Stress	V (3)	Experiencing large stressors; desire to learn stress management techniques
F. Sleep Difficulties	V (3)	Falling asleep; staying asleep
G. Panic	V (2)	Panic attacks
<i>Other Motivations</i>		
H. Curiosity about Biofeedback	V (2)	Curious; intrigued
I. Desire to Increase Self-Awareness	V (3)	Not confident about own emotions; better understand self

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Referral sources. Two categories pertaining to referral sources emerged in the cross-analysis: (A) Referred by Individual Therapist and (B) Referred by Someone Other than Individual Therapist. (A) Referred by Individual Therapist was a *typical* category while (B) Referred by Someone Other than Individual Therapist was a *variant* category.

Within (A) Referred by Individual Therapist, all eleven of the clients reported being referred by their individual therapist.

Within (B) Referred by Someone Other than Individual Therapist, one participant reported that a teacher personally referred her to biofeedback, another reported being referred by the after-hours crisis on-call therapist, another reported that she had “heard a little bit around campus about biofeedback”, and another reported hearing about biofeedback from a class:

So I had a student development class here at BYU that was kind of like a test preparation class. And in that we talked about stress and stuff, and so he [the teacher] kind of went over a lot of different resources that were found on campus and he went over the biofeedback and I found that interesting and then I kind of just signed up for it.

It is worth noting that there was considerable overlap between the two categories. Three of the four participants who reported information that was categorized within (B) Other Referred were also referred by their individual therapist.

Lastly, one core idea pertaining to referral sources was classified as Other. One participant reported that he self-referred to biofeedback after seeing signs advertising biofeedback in the counseling center.

Symptoms. Several categories emerged that pertained to symptoms: (C) Physical Symptoms, (D) Anxiety, (E) Stress, (F) Sleep Difficulties, and (G) Panic. (C) Physical Symptoms and (D) Anxiety were *typical* categories while (E) Stress, (F) Sleep Difficulties, and (G) Panic were *variant* categories.

Within (C) Physical Symptoms, eight participants reported muscle tension, five reported headaches, three reported concerns about breathing (e.g., shortness of breath or rapid breathing), and three reported heart pounding. Fewer numbers of participants reported experiencing physical symptoms such as restlessness, fatigue, pain, sweating, stomach issues, poor circulation, or non-specified physical symptoms.

Within (D) Anxiety, three participants specifically mentioned social anxiety and the remainder did not specify a certain type of anxiety. The participants often simply reported having anxiety (e.g., “A lot of times I have a lot of anxiety towards the end of the day”). One client described her anxiety as being particularly intense: “I was just always feeling out of my mind, like I was ready to spontaneously combust, just that on edge.” Additionally, two participants stated that they were, or were feeling, “high strung.”

Within (E) Stress, two participants reported that they went to biofeedback to learn stress management techniques. However, one participant reported dealing with specific stresses without explicitly mentioning that she went to learn how to manage stress. She stated:

I’m getting married in a few days, so obviously that’s a stress . . . but then [also] financial stresses because I’m broke. Well, not exactly broke, but I feel like I am . . . And with getting married, there’s a lot of expenses with that.

Within (F) Sleep Difficulties, two participants mentioned difficulty falling asleep on a regular basis, one participant mentioned a specific instance in which he could not fall asleep, and one participant reported difficulty staying asleep.

Lastly, within (G) Panic, one participant reported having panic attacks about a variety of concerns and another participant reported having a “week-long panic attack.”

Lastly, three core ideas pertaining to symptoms were classified as Other. One participant reported that post-traumatic stress disorder (PTSD) was her presenting concern. Another

participant reported that comorbid obsessive-compulsive disorder (OCD) and attention-deficit/hyperactivity disorder was her presenting concern and that she “wanted a better way to manage all of the noise in [her] head.” Lastly, another participant reported that she sought biofeedback because of difficulty concentrating without referencing a specific psychological disorder as the cause.

Other motivations. Lastly, two *variant* categories captured motivations for participation unrelated to referral or symptoms: (H) Curiosity About Biofeedback and (I) Desire to Increase Self-Awareness.

Within (H) Curiosity, one of the participants stated that they thought “it [biofeedback] would be kind of interesting”, another reported that she was “intrigued” when she read a description of it on the website, and another stated explicitly that he became curious due after seeing biofeedback signs in BYU CAPS for about nine months.

Within (I) Desire to Increase Self-Awareness, one participant specifically stated wanting to gain more emotional self-awareness: “part of the reason that I’m going into the biofeedback and counseling and stuff is because I’m not always super confident, even with my own emotions.” The other participant stated that she wanted to gain more self-awareness specifically as it pertained to PTSD:

The more I can figure it out, the more I am able to take action, and so . . . they got me into biofeedback and also a counselor to work on that. So that’s really why I came, to just better understand myself and stuff . . . so I can take action, so I don’t just let it affect me.

Lastly, two core ideas pertaining to other motivations were classified as Other. One participant reported that one of the reasons why she wanted to try biofeedback was because it was a free service. The other participant reported that she wanted to attend biofeedback because she was not benefitting from current therapy or prior relaxation training that she had received:

I was just having pretty much a week-long panic attack. And I was doing meditation and I was doing mindfulness and I was doing deep breathing and like paced breathing the way that I understood it, and none of it was helping. Like I was just like always feeling just out of my mind like I was ready to spontaneously combust, just that on edge. So I tried to talk to the therapist and they weren't helping as much so they suggested going to the biofeedback to see like where my stress level was and what in particular was causing me the most stress. I was just wanting to try anything, honestly.

Domain 2: Expectations for Biofeedback Intervention

Many of the findings in this domain were derived from the participants' responses to the interview question: *What did you expect biofeedback would be like before the first session?*

However, expectations that participants had about the resonant frequency session after participating in the stress profile session were also coded in this domain. Three types of categories emerged in the cross-analysis: (1) expectations about process, (2) expectations about outcome, and (3) expectations compared to experience.

Table 4

Findings for Domain 2: Expectations for Biofeedback Intervention

Category	Frequency	Illustrative Core Ideas/Excerpts
<i>Expectations about Process</i>		
A. Neutral Expectations about Process	T (12)	Expected being hooked up to equipment; having stress response measured; focus on sympathetic/parasympathetic nervous systems
B. Vague Expectations about Process	T (9)	“No clue what it was”; unsure of what would happen in second session; did not have in-depth explanation beforehand
<i>Expectations about Outcome</i>		
C. Positive Expectations about Outcome	T (10)	Expected biofeedback would help with anxiety; excited about second session because first session had helped
D. Negative Expectations about Outcome	V (2)	“I didn’t think it was going to actually help me”; “I was a little bit skeptical of it at first”
<i>Expectations Did Not Match Experience</i>		
E. Expectations Did Not Match Experience in a Positive Way	V (6)	Setting more peaceful than expected; intervention better than expected
F. Expectations Did Not Match Experience in a Neutral Way	V (3)	Intervention less like therapy than expected; intervention did not result in diagnosis
G. Expectations Did Not Match Experience in a Negative Way	V (2)	Intervention less customized than expected; equipment more unpleasant than expected

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Expectations about process. Two categories pertaining to expectations about process emerged: (A) Neutral Expectations about Process and (B) Vague Expectations about Process. Both (A) Neutral Expectations and (B) Vague Expectations about Process were *typical* categories.

Within (A) Neutral Expectations about Process, participants reported expectations about processes without clearly indicating whether the expectations were positive or negative. Many of the participants reported expectations about the process that did match the protocol, such as having their physiological response to stress measured, having their physiological response to stress explained to them, having their breathing monitored, and being taught about how breathing affects the stress response.

Within (B) Vague Expectations, participants indicated that they did not know much about the process. All but one of the participants are also represented in (A) Neutral Expectations about Process. These participants typically expressed that they did not know much about what would happen but then stated what they expect. The participant who only reported vague expectations about process stated: “Honestly, I had no clue what it was, other than my counselor suggested it for my anxiety.”

Lastly, one core idea pertaining to expectations about process was classified as Other. One participant reported having negative expectations about process. More specifically, she stated:

It was a more calm environment and very peaceful setting [sic] than what I thought it was going to be. I thought it was going to be just a bunch of people measuring how stressed I am all the time.

Expectations about outcome. Two categories pertaining to expectations about outcome emerged: (C) Positive Expectations about Outcome and (D) Negative Expectations about Outcome. (C) Positive Expectations about Outcome was a *typical* category while (D) Negative Expectations about Outcome was a *variant* category.

Within (C) Positive Expectations about Outcome, five participants reported or implied that, at the beginning of biofeedback, they expected biofeedback to help with their anxiety or

stress. For example, one participant went into some detail explaining the expectations imparted to her by her therapist:

[My therapist] told me he thought it would be a good idea because biofeedback helps to tell the client where their stress is located and to relax the body so that your stress will be lessened, almost. [Inaudible] your body won't be as stressed and you can focus more and stuff like that. So, I don't know, just basically talked more about the benefits of it, that a lot of his patients that have gone over to biofeedback, they've noticed a lot more relief in their body as far as stress goes when they're stressed.

In contrast, one participant reported more vague expectations that had been imparted to him by his therapist: "My therapist just said, 'It's a way of assessing and dealing with the physical symptoms of anxiety and how they deal with that.' But that's about it."

Two participants reported that they expected to gain a better understanding of how stress affects the body without going into detail. And one participant simply stated: "I didn't really have an expectation other than they said that it would help me when I didn't have counseling."

Two participants specifically mentioned having positive expectations going into the second session because they felt that the first session was helpful. One of them stated: "I was really excited to go there because I knew that the first session had actually helped in a real-life scenario."

Lastly, one participant reported that she had positive expectations about the out-of-session practice assignments because she "had the experience already of sitting down and being able to get to a better mental place through these exercises."

Within (D) Negative Expectations, two participants reported that, at the beginning of biofeedback, they were skeptical of its ability to benefit them. One of these participants reported: "I was a little bit skeptical at first about how measuring my breathing would help me in stressful situations." The other participant made a similar statement: "I think I was a little bit skeptical of it at first that it would actually make that much of a difference."

Expectations did not match experience. Two categories captured data in which clients compared their expectations of biofeedback to their actual experiences: (E) Expectations Did Not Match Experience in a Positive Way, (F) Expectations Did Not Match Experience in a Neutral Way, and (G) Expectations Did Not Match Experience in a Negative Way. All of these categories were *variant*.

Within (E) Expectations Did Not Match Experience in a Positive Way, participants indicated a variety of reasons that their biofeedback experience exceeded their expectations. As mentioned previously, one participant explicitly expected a stressful experience and was pleasantly surprised: “I thought it was going to be just a bunch of people measuring how stressed I am all the time, but it was way more calm.”

Additionally, both participants who were initially skeptical of the ability of biofeedback to help them both reported that biofeedback was more helpful than they initially expected. While discussing the first session, one participant reported: “As it went on, I realized that the breathing exercises and mindfulness exercises . . . helped me to calm down in that moment, and that I could maybe replicate that when I was more stressful [sic] afterwards.” The other participant had a similar experience in the first session:

I was a little bit skeptical of it at first that it would actually make that much of a difference, but then we did some exercises and they showed me on the monitor that it was changing my stress response, and then I felt a lot better too after I left that day.

Three participants reported that they did not expect to get so much information from the intervention. For example, one participant stated:

I knew I carried stress in my back just because I always have back tension but she told me my headaches were part of it and my circulation—because I have poor circulation in my hands and feet—could be part of it. And I don’t know, it was very eye-opening that I didn’t even think I could get from something like that. So just really helpful for me, so that’s why it was better [than expected].

Lastly, one participant reported that the intervention was helpful despite it being different than what he first expected. He stated:

It went in a direction I wasn't expecting it to go but it was a good direction because it turned into something that was based on breathing and managing stress through different breathing exercises. And so I would say that I learned a lot and I found it interesting and I found it helpful.

Within (F) Expectations Did Not Match Experience in a Neutral Way, two of the participants reported they had expected the biofeedback to be more like individual psychotherapy. One of these participants stated:

I sort of assumed it would be similar to counseling, which is a lot of discussion and reflecting on what you're doing. And I also think that a lot of helping mental health comes from my own thoughts and my own feelings and my own responses to things, and so a lot of times I think that's where all of the help is going to come from. So I didn't really think that there would be a lot of data that they were giving to me, because I thought it would all be coming from myself.

The other participant who expected biofeedback to be more like individual psychotherapy had a slightly different idea: "I thought that it would be like a therapy session and they would measure my heart rate when I talked about things and maybe my breathing and stuff like that."

Lastly, another participant reported that they expected to get a "complete, very distinctive diagnosis." This same participant also anticipated that the procedure would be more "complicated . . . technology-wise" and that the exercises would include a focus on reducing muscle tension.

Within (G) Expectation Did Not Match Experience in a Negative Way, one of the participants reported that she had hoped the intervention would be geared more towards her presenting concern than it was. The other participant reported: "I was surprised how many wires were hooked up to me. Honestly, that was my first impression . . . I felt a little bit like Frankenstein for one second."

Domain 3.1: Evaluation of Stress Profile Session

The majority of the findings in this domain were derived from the participants' responses to the interview question: *What were your impressions of the first biofeedback session?*

Table 5

Findings for Domain 3.1: Evaluation of Stress Profile Session

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Helpful	T (10)	Beneficial; led to improvement; personalized to specific needs
B. Unhelpful	V (3)	Participant did not need the skills offered; already knew breathing techniques
C. Engaging	V (5)	Interesting; enjoyable
D. Good (vague)	V (2)	“Really good”; “It went by really fast, so it was good.”

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Four categories emerged in the domain: (A) Helpful, (B) Unhelpful, (C) Engaging, and (D) Good (vague). (A) Helpful was *typical* while categories (B) Unhelpful, (C) Engaging, and (D) Good (vague) were *variant*.

Within (A) Helpful, some participants described the stress profile session as being generally helpful. For example, one participant stated: “As soon as I got into my first session it was really, really helpful and I really enjoyed the experience and so I definitely wanted to go back.”

Other participants gave more specific reasons. Four participants reported that seeing the feedback was helpful. One participant stated the feedback was helpful because he was able to see that his behavior impacted his body. He noted: “It was much more effective . . . than someone just telling me, ‘Hey, breathing will help you feel better’.” Another participant stated that it was

helpful to see the difference between her own physiological baseline compared to “the normal level.”

One participant reported that the session helped her because of a concept that she learned: “I didn’t realize that your breathing has an effect on the rest of your body and that by controlling your breathing you can help your stress and anxiety, so that was really helpful.”

Within (B) Unhelpful, two participants reported that they had not learned much in the stress profile session. For example, one participant stated: “I have done some relaxation in the past, so it wasn’t anything really new to me that they were saying just to breathe . . . it wasn’t revolutionary to me.” In contrast, another participant stated that she improved at breathing but did not learn something pertinent to her concerns:

I walked out very relaxed, but I didn’t feel like it equipped me to . . . I didn’t feel like it gave me the tools I needed necessarily. Because I came out knowing how to breathe better, but I didn’t feel like that was necessarily what I needed, if that makes any sense?

Within (C) Engaging, all five participants reported that the stress profile session, or some aspect of it, was interesting. One of the participants did not elaborate on what aspect of the session was interesting. However, four of the participants represented in (C) Engaging commented on the visual feedback that showed how their behaviors impacted their physiology. For example, one participant reported:

It was interesting to be able to see how much effect that I had over my stress and how much I’m able to control my stress levels, my own breathing, and my heart rate and things like that just by being a little bit more mindful and conscious.

Lastly, one of the participants reported that the session was engaging in the sense that she “really enjoyed the experience.”

In (D) Good (vague), data that contained positive words but were too vague to be interpreted with certainty were captured. Only participants who are not represented in other

positive categories within this domain are captured in this category. One participant reported that the first biofeedback session was “really good” and immediately transitioned to talking about her reasons for trying biofeedback. Another participant was somewhat contradictory. He said that “[t]he first one [the stress profile session] was good”, but immediately followed with, “I didn’t learn a ton of stuff on the first one.”

Domain 3.2: Evaluation of Resonant Frequency Session

The majority of the findings in this domain were derived from the participants’ responses to the interview question: *What were your impressions of the second biofeedback session?*

Table 6

Findings for Domain 3.2: Evaluation of Resonant Frequency Session

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Helpful	T (9)	Personalized to specific needs; provided helpful feedback
B. Unhelpful	V (5)	Not personalized to specific needs; redundant; less helpful than sessions completed after protocol
C. Good (vague)	V (2)	“Really nice”; “It was good.”

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Three categories emerged in the domain: (A) Helpful, (B) Unhelpful, and (C) Good (vague). (A) Helpful was a *typical* category while (B) Unhelpful and (C) Good (vague) were *variant*.

Within (A) Helpful, all eight participants provided a reason for evaluating the second session as “helpful” or “useful.” Three of these participants felt that finding their optimal breathing rates helped to personalize the intervention. For example, one of these participants commented: “It wasn’t a general thing, it was finding out what works exactly best for me, which

I really liked.” Another participant stated: “I felt like the second session was more like how to handle my stress personally now that she had the results, which obviously was very helpful.”

Three of the participants reported that the resonant frequency session was helpful because they were able to get feedback regarding their progress. One of these participants stated:

I really liked the second one . . . because I was actually able to see results from the first session, and so then when I came back she said, “Wow, look! This is the data that shows that you’re progressing and you’re helping yourself become less anxious when you do these breathing exercises” and stuff like that.

Two of the participants reported that the second session was helpful because it provided them with a useful skill. For example, one of them reported: “It’s something I can and have used since then. It’s like how I should be breathing to calm myself.”

One participant felt that the session was helpful because the purpose of it was clear:

When I got there it was very organized and it was well planned out and it was overall a really good experience, just because we had a goal that we were going for which was finding out what the optimum breathing rate for oxygen levels and for staying calm and relaxed.

Lastly, one participant reported that, though the second session was helpful, it was not as helpful as the first session: “I don’t know if it was as helpful as the very first time, but it was good to know what rate I responded to the best so I could practice that.”

Within (B) Unhelpful, three participants reported that the second session was redundant with the first session and that it was not as good as the first session. One of these participants had an overall negative view of the second session:

The first time . . . [t]hey taught me my pace of breathing. And then the next time I came, [the biofeedback therapist] was like, “I think breathing is going to really help you.” And so we spent an hour doing it again. So it was stressful because it was more focused on something I’ve already done and she wasn’t really listening.

One of the two participants who didn’t evaluate the second session negatively overall but still reported that it was unhelpful due to redundancy explained in more detail:

I felt it was kind of a continuation of the first one. At the first one they told me “Okay, we’re going to have you practice breathing” and then I came back and we just worked on breathing again, like I didn’t really learn anything new.

Two of the participants reported that the second session was not specifically matched to their needs. One of the participants reported that, though finding her optimal breathing was helpful, the lack of focus on one of her presenting concerns that day was unhelpful. Furthermore, she also reported that the second session was less helpful than the first:

I think that day I went in and had a bunch of jaw tension and so I kind of wanted to work on that. I think we found my optimal breathing rate that day. And then he was trying to help me relax my jaw as I breathed. I didn’t feel like it was as helpful that time as when I went back again the third time [an additional session beyond the protocol to specifically work on muscle tension].

The other participant who felt the second protocol was not matched to her needs reported: “I expected them to gear it towards what I needed and it wasn’t.” She did not state that the second session was less helpful than the first session, however, as she was one of the participants who reported that the first session was unhelpful.

Within (C) Good (vague), data that contained positive words but were too vague to be interpreted with certainty were captured. Only participants who are not represented in other positive categories within this domain are captured in this category. Both of the participants represented in this category reported that the first session was less helpful than the second session. For example, one of them stated:

It was a little bit redundant. And we did some of the same exercises that I did in my first session that I already knew about . . . It was a little bit less helpful than the first one, but it was nice too.

Lastly, one core idea was classified as Other. A participant reported that the resonant frequency session was disorganized: “The second appointment, it was not as much of . . . a set up appointment. Like where this is the things that are going to happen, and this order and stuff.”

Domain 4.1: Evaluation of Out-of-Session Activities

The majority of the findings in this domain were derived from the participants' responses to the interview question: *What were your impressions of the biofeedback practice assignments?* However, some participants evaluated activities related to the biofeedback intervention that they did not explicitly state were formally assigned to them. These data were also captured in this domain.

Table 7

Findings for Domain 4.1: Evaluation of Out-of-Session Activities

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Helpful	G (14)	“Super helpful”; “super beneficial”; practical; “could feel the difference”
B. Challenging	V (7)	Difficult; hard to remember to do it; hard to be consistent; hard to take the time to do it

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Two categories emerged in the domain: (A) Helpful and (B) Challenging. (A) Helpful was a *typical* category while (B) Challenging was a *variant* category.

Within (A) Helpful, 14 participants reported that the out-of-session activities were helpful. Even one participant who would have preferred a muscle tension-focused intervention rather than a breathing intervention reported that the breathing practice assignments were helpful: “I’m sure it does help me and that it’s a good tool to have—the breathing thing and all that.” In addition to this participant, five other participants also indicated only that the activities were helpful. They did not give specific information about why. For example, another participant stated simply: “I could feel the difference that it was making when I would use it and so it was encouraging to try and do it every day.”

Nine participants mentioned that the out-of-session activities were helpful specifically because the assignments helped to reduce stress or anxiety. One participant reported:

It was actually very effective for me. And at first it was strange when I first started doing it because it was something new and I wasn't quite used to it, but I could tell it definitely helped with dealing with my stress.

Another participant reported that the out-of-session activities were helpful for reducing anxiety, though not quite as helpful as the in-session session activities:

I noticed I started using the breathing exercises that we practice when I'm feeling anxious, like in everyday situations. And it wasn't quite as helpful as it was in the room when we were going through the meditation and I got . . . really relaxed. But it did help a little bit, that I was able to calm my body down enough to be able to kind of focus on what I needed to do at work or whatever I was doing at the time.

Four of the participants reported that the out-of-session activities were helpful specifically because they helped with sleep. For example, one participant stated: "There was one night I couldn't sleep . . . I was just super tense and high strung . . . so I just did the breathing exercises and fell asleep . . . Usually I'm up for like an hour when that happens, so that was helpful." Similarly, another participant reported: "I was having these anxious thoughts before I went to bed and . . . I tried to mimic what we did in biofeedback and it was very helpful to me."

One participant reported that she was given a customized practice assignment that felt helpful in part because it was customized to her interests:

The whole writing assignment thing was personally just for me. She said she that she doesn't normally give that but just because I am a writer she thought that that would be appropriate for me to vent my stresses into paper because that's what I do anyway. I don't know, yeah, everything was more centered on me than necessarily the general broad diagnosis.

Lastly, one participant reported that the practice activities were helpful because "it was good to have to focus on [her]self and [her] mental health throughout the week."

Within (B) Challenging, four participants reported that the out-of-session activities were challenging because it was hard to remember to do them. Two participants specifically denied that the exercises themselves were difficult. One of these two participants stated the experience succinctly: “I think the only challenge of them wasn’t the assignments themselves, it was just remembering to do the assignments.”

Two participants who had difficulty remembering to do some of the out-of-session activities elaborated about why it was so difficult to remember. The first participant suggested that stress or anxiety made it more difficult to remember to do the activities. The second participant reported:

In the beginning it was hard to be consistent. Especially because the exercises that they gave me were more generalized because they hadn’t had time to narrow it down to what would work for me specifically. So like the first week they said, “We just want you to practice breathing for like 3-5 minutes”, and that was pretty much impossible because I just forgot. But as the weeks have gone on and we’ve tried out different things and gotten more specific in figuring out what actually helps me, I’ve become a lot more consistent.

Similarly, two participants reported it was difficult to take the time to do the out-of-session activities even though they did not feel that the practice assignments themselves were difficult. One of these participants reported:

I think it was just remembering to do it. Just in general, things are pretty busy right now and I think that there were moments where I would sit down and think about it or try to sort of, [inaudible] for my anxiety, but it wasn’t . . . I wasn’t consistently every day saying, “Okay, now I’m going to do my 3 minutes of breathing,” or whatever because I just didn’t really think about it in those terms.

Three core ideas were categorized as Other. One participant was vaguely positive in his evaluation of the out-of-session activities without offering further comments concerning them in his interview. Another participant reported that the out-of-session activities were enjoyable and that “they didn’t take too long, so [he] was definitely willing to do them.”

Domain 4.2: Out-of-Session Activities Assigned to or Completed by Participants

The majority of the findings in this domain were derived from the participants' responses to the interview question: *What were your impressions of the biofeedback practice assignments?* However, some participants reported out-of-session activities that they did not explicitly state were formally assigned to them. These data were also captured in this domain.

Table 8

Findings for Domain 4.2: Out-of-Session Activities Assigned to or Completed by Participants

Category	Frequency	Illustrative Core Ideas/Excerpts
<i>Types of Out-of-Session Activities Assigned or Completed</i>		
A. Paced breathing	V (6)	Completed paced breathing with app and musical pacer; assigned to do paced breathing
B. Mindful breathing	V (2)	Took a few minutes every couple hours to “breathe and be more mindful”; sometimes focused on breathing
C. Unspecified breathing assignment	V (2)	Completed “breathing exercises”; assigned to do “deep breathing” three times per day
D. Guided Exercises	V (5)	Cycling through various recordings; encouraged to practice meditation
E. Used Mobile Phone Application	V (4)	Assignment to use Headspace app; applications to help with assigned breathing exercises

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Six categories pertaining to types of out-of-session activities assigned or completed by participants emerged: (D) Paced Breathing, (E) Mindful Breathing, (F) Unspecified Breathing Assignment, (G) Meditation or Guided Exercises, and (H) Phone Application. All five categories were *variant*.

Within (D) Paced Breathing, six participants reported doing paced breathing activities outside of the biofeedback sessions. Participants reported using a variety of methods to pace their breathing, including using a visual pacer, using an audio pacer, and counting.

Within (E) Mindful Breathing, two participants reported doing mindful breathing exercises. One of these participants described her assignment and how she did the practice in detail:

They told me, especially when I'm feeling very stressed, to just get everything out of my mind. And when stressful thoughts came into my mind . . . I just could focus just on my breathing . . . sometimes I'm even walking in the street having thoughts and then I just try to focus on my breathing and try to mimic again what I did in biofeedback.

Within (F) Unspecified Breathing Assignment, participants described doing a breathing exercise outside of session without specifying what type of breathing exercise it was. Only data from participants who did not specify the type of out-of-session breathing exercise anywhere in their interview were captured in this category. For example, one participant simply stated: "We discussed doing breathing exercises once a day for a week."

Within (G) Guided Relaxation Exercises, participants reported being assigned, or engaging in, guided relaxation exercises outside of the biofeedback session. Four participants reported being assigned or engaging in guided meditations. In addition, one participant stated that she did many types of guided relaxation exercises:

Usually I'll find one that I feel like is a really good fit and it will work for a couple days and then I kind of acclimate to it and so have to find another one. It's almost like I just stop hearing them after a few days. I recognize that I'm hearing them but I'm not really processing them. So I cycle through several different ones.

Within (H) Used Phone Application, four participants reported using mobile phone applications to aid their practice. Two participants mentioned that they used Headspace, one participant reported using an unnamed application that helped her to pace her breathing, and one

participant reported that she was recommended several unnamed applications to help her “practice the breathing exercises and all the small practical things that [she] could do at home.”

Four core ideas were categorized as Other. One participant reported that she was encouraged to meditate without indicating that she used guided meditations. Another participant reported that she completed “some worksheets to change [her] mindset about things when [she was] stressed.” Another participant reported that part of her out-of-session activities included “remembering to relax [her] body and to not build up a bunch of tension.” Another participant reported that he obtained guided exercises from a website. The last participant simply stated that he was given “little homework assignments” without providing more details.

Domain 5.1: Evaluation of Overall Intervention

The majority of the findings in this domain were derived from the participants’ responses to the interview question: *Was your biofeedback experience useful to you?* Additionally, some findings were derived from participant responses to the interview question: *Would you recommend biofeedback to other people with similar concerns?*

Table 9

Findings for Domain 5.1: Evaluation of Overall Intervention

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Helpful	G (15)	Useful; helped even though “I already thought that I knew what I was doing”
B. Engaging	V (3)	“Cool”; interesting; fun

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Two categories emerged in this domain: (A) Helpful, and (B) Engaging. (A) Helpful was a *general* category while (B) Engaging was *variant*.

Within (A) Helpful, all participants reported that the intervention was helpful to at least some degree. The intervention impacted participants in a variety of helpful ways that are explored in detail in Domain 5.2: Perceived Impact of Intervention. One participant gave several reasons why biofeedback is helpful without discussing the actual impact of the intervention:

I think that often we don't know how to deal with our problems; we may recognize that we have a problem and, if we do try to deal with it, we're not sure if we're going about it in the right way. And to have a professional help us and guide us along can help correct any wrong things that we're doing or can help us know if we're doing things right . . . And also to have somebody that you're accountable to can help you remember to do things.

Another participant explained why biofeedback was helpful above and beyond doing relaxation in regular individual psychotherapy:

I feel like my [individual] therapist wasn't able to gauge the type of breathing needs that I had. We would do guided meditation and we would do deep breathing with recordings but it wasn't to the pace that I needed, whereas in biofeedback we went through all the different paces and found the one that gave me the best results, like this is where you have the best results at. I felt like it improved my techniques more than just working on the techniques themselves. Like my [individual] therapist, we would do this, think about this, feel this with your body type of thing. But having somebody say, "This is numerically most effective for you," they're right, it honestly was.

Lastly, another participant reported that the biofeedback intervention was helpful to her because it is action-oriented:

Biofeedback has been nice because it's a little bit more hands-on, like it's more tactile and so it kind of sticks in my brain better . . . Biofeedback has been really helpful because instead of just getting hypothetical things that you can do, instead of just the cognitive side of things, you go home and you practice breathing.

Within (B) Engaging, two participants reported that the intervention was interesting. For example, one of them stated: "it was cool to understand what your body is doing." One participant reported that biofeedback is "fun."

One core idea was classified as Other. Though the participant reported that her experience in biofeedback was useful to her because "it was very relaxing . . . and . . . it gave

[her] tools that [she] use[s]”, she indicated that the intervention was unhelpful in meeting her specific needs.

Domain 5.2: Perceived Impact of Intervention

The majority of the findings in this domain were derived from participant responses to the interview question: *Was your biofeedback experience useful to you?* Four types of categories emerged in the cross-analysis: (1) symptoms, (2) behavior, (3) self-perception, and (4) affect.

Table 10

Findings for Domain 5.2: Perceived Impact of Intervention

Category	Frequency	Illustrative Core Ideas/Excerpts
<i>Symptoms</i>		
A. Helped with Anxiety and/or Stress	T (10)	Able to calm down quickly; can get body out of state of fear
B. Helped with Sleep	V (6)	Helped fall asleep quickly; “better night’s rest”
C. Helped with Panic	V (4)	Learned to prevent panic attacks; can get body out of state of panic
D. Helped with Physical Symptoms	V (3)	Reduced muscle tension; helped with unspecified physical concerns
E. Helped with Cognitive Regulation	V (2)	Helped increase ability to focus; helped “get rid” of stressful thoughts
<i>Behavior</i>		
F. Developed Ongoing Regular Practice of Skills Learned	V (3)	Developed “good habits”; continues to use exercises worked on in biofeedback
G. Increased Mindfulness	V (2)	“Brings me into the present”
<i>Self-Concept</i>		
H. Increased Self-Efficacy	T (12)	Confidence in ability to manage anxiety; able to control stress levels
I. Sense of Validation	V (4)	“It’s not just in my head”; “I wasn’t just making things up”

Learning

J. Increased Breathing Skills	V (7)	Get pacing to correct level; learned how to “breathe better”
K. Increased Self-Awareness	V (7)	Physical indicators; when stress is present
L. Increased Knowledge	V (5)	Learned about how everything is “so interconnected”; learned “a lot”

Affect

M. Relaxation	V (5)	Left session feeling more relaxed; “felt better” that day
N. Increased Stress	V (2)	Session was stressful; left session feeling stressed

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Symptoms. Five categories pertaining to symptoms emerged in the cross-analysis: (A) Helped with Anxiety and/or Stress, (B) Helped with Sleep, (C) Helped with Panic, (D) Helped with Physical Concerns, and (E) Helped with Cognitive Regulation. (A) Helped with Anxiety and/or Stress was a *typical* category while (B) Helped with Sleep, (C) Helped with Panic, (D) Helped with Physical Symptoms, and (E) Helped with Cognitive Regulation were *variant*.

Within (A) Helped with Anxiety and/or Stress, participants reported that biofeedback helped them learn to manage anxiety and sometimes gave illustrative examples. For example, one participant reported that “by going to biofeedback [she] was able to learn how to control or manage the anxiety better to prevent anxiety attacks.” She also recounted:

Last week was super stressful, I had lots of not-so-hot things happen with school . . . I had to withdraw from one of my classes because I missed a test because of testing hours and instead of getting very anxious I was able to breathe, kind of separate myself from the situation, think things through, and then had almost no anxiety over the issue. Instead I just kind of recognized the consequences of what happened and took action from there rather than deal with the stress of what happened.

Another participant acknowledged that, though her experience in biofeedback did not fix everything, her experience in biofeedback provided her with helpful strategies to deal with anxiety:

Of course it didn't take away all of the problems, but I felt like I learned a little bit of how to use the breathing exercises was helpful, so I could get my body back to enough of—instead of being the fight or flight response—just getting it back to normal a little bit.

Within (B) Helped with Sleep, participants reported that their experience in biofeedback helped them with sleep. Five participants indicated it helped them to fall asleep. For example, one participant stated that he “learned different exercises to put [his] body into sleep mode.” Additionally, one participant reported that “[her] sleep has been more restful, which is really nice because [she] almost never sleep[s] well.”

Within (C) Helped with Panic, participants reported that their experience in biofeedback helped them to manage symptoms of panic. One participant reported: “Most of the time, if I'm not super about to have a panic attack, I can usually catch it now. I'm like, ‘Wait, I can feel my heart pounding a little bit more.’ So I try to take a moment and calm down.” Another reported:

And if I just take some deep breaths and am able to just calm down then I can help my body go back to normal. Just by realizing it and by taking these deep breaths I can help my body get out of that state of fear and panic.

Within (D) Helped with Physical Symptoms, three participants (all of whom had received an additional session of biofeedback between the resonant frequency profile and their interviews) reported that biofeedback helped them with physical symptoms. Two participants reported that their experience in biofeedback helped them with muscle tension. For example, one of the participants stated: “I feel like [biofeedback] helped me a lot. Especially with the muscle tension, that's just bugged me for a long time. I feel like it was very practical, very useful.” One participant reported that it helped her with her physical concerns in general.

Within (E) Helped with Cognitive Regulation, one participant reported that her experience in biofeedback helped her learn to reduce her anxiety “enough to be able to focus on what [she] needed to do at work or whatever [she] was doing at the time.” The other participant stated that some of the skills she learned helped to “get rid of some thoughts that [she] was having that were causing [her] stress and that were causing [her] not being able to fall asleep.”

One core idea pertaining to symptoms was categorized as Other. This participant reported that her symptoms before biofeedback were so severe that her experience in biofeedback substantially improved her quality of life.

Behavior. Two categories pertaining to behavior emerged in the cross-analysis: (F) Developed Ongoing Regular Practice of Skills Learned and (G) Increased Mindfulness. Both (F) Developed Ongoing Regular Practice of Skills Learned and (G) Increased Mindfulness were *variant* categories.

Within (F) Developed Ongoing Regular Practice of Skills Learned, participants indicated that, as of the time of their interviews, they were still using some of the skills they learned in biofeedback. One stated: “I would say I haven’t implemented everything, but definitely a number of things have become more regular for me now.” Another participant reported that his experience in biofeedback helped him to develop “good habits.”

Within (G) Increased Mindfulness, participants reported that their experience in biofeedback contributed to their practice of mindfulness. One participant reported:

My biofeedback therapist recommended some sorts of meditation and listening to meditation videos before I go to sleep to help me fall asleep, and that’s been really useful as well because it’s nice for me to think about my physical self and where I am right now while I’m trying to fall asleep rather than thinking about a thousand things that are going to happen tomorrow.

Self-concept. Two categories pertaining to self-concept emerged in the cross-analysis: (H) Increased Self-Efficacy and (I) Sense of Validation. (H) Increased Self-Efficacy was a *typical* category while (I) Sense of Validation was *variant*.

Within (H) Increased Self-Efficacy, participants indicated that biofeedback helped increase their sense of control. One participant simply stated that it “gave [her] tools” and another participant stated that “it’s something [she] can use in order to better cope with situations.” Other participants went into greater detail about how they felt empowered. For example, one participant stated:

It was interesting to be able to see how much effect that I had over my stress and how much I’m able to control my stress levels, my own breathing, and my heart rate and things like that just by being a little bit more mindful and conscious.

Another participant reflected: “I think a lot of the changes are coming from inside of me, which is really empowering as well as useful.” Lastly, another participant reported:

It helped me feel better just doing that whenever I had trouble sleeping, just realizing even if I have all the stressors if I just did this deep breathing it will force my body to relax, and then I probably will be able to sleep. Just knowing that like no matter what was going on in my head, if I could just take control of my body’s symptoms that that would help me.

Within (I) Sense of Validation, participants reported that they felt biofeedback helped them to validate their own experiences as legitimate. For example, one participant reported: “It was just helpful to know that I’m not making up my symptoms, that they’re real.” Another participant stated:

It was validating to be [sic] “Oh, I am a very tense person” but at the same time I have control over it and it’s not something that is a physical problem, it’s just something that’s a mental problem. I mentally have to relax and to allow my body to relax.

Two core ideas pertaining to self-concept were categorized as Other. One participant reported that her experience in biofeedback helped her to develop self-compassion:

For me, biofeedback has been really helpful in me just being more compassionate to myself. And part of that, I think, is the fact that you have to calm down and it gives you a chance to distance yourself a little bit from your thoughts and to realize where maybe you're being less compassionate than you should be.

The same participant also reported that her experience in biofeedback helped her to feel more trusting of her body in general:

I think the first time I met with [my biofeedback therapist], she said something about how, "Your body knows how much air you need, so if you just stop forcing it to do what you think it should do, it will naturally do what it should." And it sounds like . . . It's kind of a dumb thing because it seems pretty intuitive, but it was kind of a turning point for me to realize that's true, and it's not just true of breathing, but your body knows how to exist in any setting. You know, like, you don't have to be worried about it, you don't have to force it to do anything, you can just relax and not be worried about that.

Learning. Three categories pertaining to learning emerged in the cross-analysis: (J) Increased Breathing Skills, (K) Increased Self-Awareness, and (L) Increased Knowledge. All three categories were *variant*.

Within (J) Increased Breathing Skills, participants explicitly reported that they learned breathing skills or reported an instance that demonstrated they effectively used the breathing skills in a setting outside of biofeedback. For example, one participant reported: "Any time I notice I might be breathing a little faster than normal or might be uncomfortable then I start slowing my breathing down to that pace." Notably, one person reported that biofeedback helped them improve on their pre-existing breathing skills:

I did a lot of meditation and diaphragmatic breathing and paced breathing at home before [doing the biofeedback intervention], but it wasn't nearly as effective as it was after my first session. Like before I thought I was doing it right, and I did it mostly right, but I didn't get the pacing down to the right level that was best for me . . . I went from being kind of all over the place and not quite where it should be to perfect just within a couple weeks of me working on the techniques that they showed me . . . absolutely crazy improvement. Just by following the things that they were telling me that I thought I was already doing but I just needed a little help in getting it all the way.

Within (K) Increased Self-Awareness, participants reported that their experience in biofeedback contributed to developing greater self-awareness. Five participants specifically mentioned gaining greater awareness of how their body reacts to stressors and relaxation. One participant explained that increased self-awareness is one of the most important benefits of biofeedback:

People just get so caught up in the situation that they don't know what's happening to their body. If they can take a step out and focus on what's happening to their body and physiology, they can know what needs to work on to calm themselves down even when they can't calm the situation down . . . biofeedback makes you recognize what's going on.

Another participant commented that biofeedback helped increase her awareness of what proper technique and relaxation feel like: "It just helped me realize what I should be doing at home and what it feels like to be doing the right thing."

Two participants reported that biofeedback helped them with cognitive aspects of stress. One of the participants reported: "I'm able to recognize when I am stressed. Not that I necessarily couldn't before, but I'm able to process my stress, if that makes sense. To think, 'Okay, why am I stressed? Why am I stressed about this thing?'" Another participant stated:

It has been guiding me through managing anxiety, being able to have a healthier relationship and be able to stop myself when I can feel myself getting in thought processes that just get worse and worse. Because I think it's helped me just in general to just sort of think about it differently.

Lastly, one participant reported gaining greater awareness of her own behavior prior to the intervention. She reported: "It was kind of eye-opening because I realized that I had habits that I needed to break."

Within (L) Increased Knowledge, participants reported that their experience in biofeedback helped them to learn new information. For example, one participant stated simply:

“I didn’t know how powerful breathing was.” Similarly, another reported: “I learned a lot.” One participant went into greater detail:

It was very educational, I would say, to get a better understanding how everything is so interconnected. I’ve learned in psychology courses that things are connected, but I didn’t quite understand to what degree. So it was really interesting to actually find out and be able to visualize it.

Affect. Two categories pertaining to affect emerged in the cross-analysis: (M) Relaxation and (N) Increased Stress. Both (M) Relaxation and (N) Increased Stress were *variant* categories.

Within (M) Relaxation, three participants reported feeling better immediately after a biofeedback session. For example, one participant reported: “The first time especially I left feeling a lot more relaxed and like a really positive attitude, like I had really good day after that.”

In contrast, within (N) Increased Stress, two participants reported leaving a biofeedback session feeling more stressed than when they started. One participant reported the stress was due to her perception that the biofeedback therapist “wasn’t really listening” and the redundancy of the second session. The other participant reported that she “left [the session] kind of stressed” after receiving corrective feedback from the biofeedback therapist:

He told me whenever I stopped doing the breathing exercises [i.e., during the intervals between different breathing paces in the resonant frequency session] my breathing would get really shallow and I would tense up and he was talking about how maybe I was worried about what I was going to say, and then I just got really self-conscious.

Domain 5.3: Willingness to Recommend Biofeedback to Others

The majority of the findings in this domain derived from participant responses to the interview question: *Would you recommend biofeedback to other people with similar concerns?*

Table 11

Findings for Domain 5.3: Willingness to Recommend Biofeedback to Others

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Participant Would Recommend Biofeedback to Others in General	T (8)	Anyone; “anyone who feels like they are suffering from some kind of stress in their life”
B. Participant Would Recommend Biofeedback to Some People	V (7)	People with anxiety; people with psychosomatic symptoms
C. Participant Would Recommend or has Already Recommended Biofeedback to Specific People	V (4)	Referred brother; friend; roommate

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Three categories emerged in this domain: (A) Participant Would Recommend Biofeedback to Others in General, (B) Participant Would Recommend Biofeedback to Some People, and (C) Participant Would Recommend or has Already Recommended Biofeedback to Specific People. (A) Participant Would Recommend Biofeedback to Others in General was a *typical* category while (B) Participant Would Recommend Biofeedback to Some People and (C) Participant Would Recommend or has Already Recommended Biofeedback to Specific People were *variant*.

Within (A) Participant Would Recommend Biofeedback to Others in General, participants reported that they believed anyone could benefit from biofeedback. For example, one participant reported: “I would recommend it to anyone who feels like they’re suffering from some kind of stress in their life.” Another participant stated:

Naturally, when something is good for you, you want to share that with other people . . . I don’t know, especially when it comes to sleep and just stress in general if you can have a better night’s rest or if you can tone your stress down a little bit, then that’s definitely

something that everybody needs and everybody wants. So I would definitely recommend biofeedback for that.

Within (B) Participant Would Recommend Biofeedback to Some People, participants reported that they felt biofeedback would be helpful to people with specific problems. For example, six participants reported that they would recommend biofeedback to people who are anxious. For example, one participant stated: “Biofeedback I think would be a good support for people who are trying to learn how to relax.” Another participant stated:

I know a lot of people with anxiety issues, and a lot of them kind of were just like me where we just kind of truck through it and try not to think about the anxiety but just deal with it as it comes. And so going to biofeedback they can recognize they can stop it before it comes and kind of control their mind and their body so that they don't have the panic attacks that come. So I would definitely recommend it to someone else if it prevents more pain in the process. Because if you're going to have stress, might as well just deal with the stress and not anything extra.

Two participants reported that they would recommend biofeedback to people who experience psychosomatic symptoms. For example, one person specifically mentioned that it could be useful to people experiencing “stomach problems . . . really bad headaches, or stress . . . muscle tension . . . [a]nd . . . panic attacks.” And one participant reported that she would recommend biofeedback to some people but did not specify whom.

One participant reported that she would recommend biofeedback to many people but speculated that several characteristics might make someone a poor candidate for biofeedback:

I feel like there's a lot of people . . . that maybe are not ready to be like, “Oh this is actually going to help me.” Or that don't feel stressed, or that feel stressed but are able to by themselves manage the situation way better than by doing this kind of exercises [sic]. There are people that just breathing and being still for such a long period of time . . . might even cause them more anxiety and more stress than . . . going for a run or stuff like that . . . [and] are willing . . . to stay still, to be patient with yourself, with your breathing, [and] with your thoughts.

Within (C) Participant Would Recommend or has Already Recommended Biofeedback to Specific People, four participants stated that they were going to recommend, or had already

recommended, biofeedback to a specific person that they knew. Two participants reported that the person they had recommended, or considered recommending, biofeedback to a friend. One of these participants stated:

I actually have a friend who I'm going to suggest go to biofeedback because . . . she struggles in a variety of areas, and she's done counseling and therapy with multiple people for over a long period of time. And it's definitely been helpful, but I can see places where she would be really benefited by the more kinesthetic, tangible ways to get peace of mind than just the theoretical.

Another participant reported that she had recommended biofeedback to a roommate and friend: "I already recommended my roommate because . . . my roommate is someone I adore, and I know she's struggling with similar things . . . if it helped me, then it can most definitely help her."

Lastly, one participant reported recommending biofeedback to a family member who had trouble with sleep:

I recommended it to my brother and he's trying it out . . . He has a lot of trouble falling asleep at night. And that's one of the things that has helped me is to just focus on my breathing at night and focus on relaxing my body and I thought it might help him.

Domain 5.4: Client Suggestions for Intervention

The findings in this domain were derived from a variety of questions in the interview.

Table 12

Findings for Domain 5.4: Client Suggestions for Intervention

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Allow More Flexibility	V (3)	Something more than deep breathing; wanted to try all of the machines
B. Provide More Information about Biofeedback	V (2)	More introduction to protocol; list of other biofeedback interventions

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Two categories emerged in this domain: (A) Allow More Flexibility and (B) Provide Introduction to Biofeedback. Both (A) Allow More Flexibility and (B) Provide Introduction to Biofeedback were *variant* categories.

Within (A) Allow More Flexibility, participants reported that they wanted more flexibility in the intervention. One participant stated: “I get that there are a couple introductory sessions you have to go through before they can address things. But I wish it had been more geared towards [my specific concerns].” Another mentioned that he wished the intervention included “something more than just deep breathing.” Similarly, another participant also mentioned that he wanted:

More results. They just talked about what they do and the broad spectrum of things that they could do there. And I wanted to be tested on all of the machines and see more results. And so, I don’t know, just the little piece that I got made me want to have more.

Within (B) Provide Introduction to Biofeedback, participants reported that they wished they had more information about the intervention or about biofeedback in general. One participant stated: “I feel like it would have been helpful to me just to have a better idea going in of what exactly would happen, like what we would be doing.” Another participant reported that, in addition to greater flexibility: “One thing that I would’ve liked out of biofeedback . . . [is] to have known earlier is the broad spectrum of things that they can do at biofeedback but that they don’t really tell you.”

Five core ideas derived from data from a single participant were classified as Other. Firstly, the participant wished that he had received more in-depth information:

I wish they would’ve maybe talked a little bit more about the physiology of it. Or how it’s actually affecting my body instead of just say, “Okay, try deep breathing three times a day.” It would have helped me more to understand more what that was doing to my body, how that would help my body relax better.

He also suggested that the following also would have been helpful: being asked to keep a journal to record events that precede feelings of stress, having his regular therapist also as his biofeedback therapist (he also acknowledged that may not be plausible), having a re-assessment of his response to

stress (similar to the stress profile) after practicing for a few weeks to compare progress, receiving reminders to practice, and having more weeks between sessions.

Domain 6.1: Evaluation of Biofeedback Therapist (BT)

The majority of the findings in this domain derived from participant responses to the interview question: *What was your biofeedback therapist like?*

Table 13

Findings for Domain 6.1: Evaluation of BT

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Pleasant	T (13)	Kind; “super nice”; supportive; sweet
B. Competent	T (8)	“Knew exactly everything that she was doing”; BT did tasks well
C. Professional	V (2)	Not “too involved”; “sincere and nice at the same time as research-based”
D. Relatable	V (2)	Client felt BT was similar to self; could relate to BT on “personal level”
E. Insightful	V (2)	Able to pick up on when client is “surface-level”; “very aware” of things that cause anxiety
F. Compassionate	V (2)	Eager to help; actively wanted to help
G. Inexperienced	V (3)	“Maybe she lacked a bit of experience”; reported that one BT was less experienced than another

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Seven categories emerged in this domain: (A) Pleasant, (B) Competent, (C) Professional, (D) Relatable, (E) Insightful, (F) Compassionate, and (G) Inexperienced. (A) Kind and (B) Competent were *typical* categories while (C) Professional, (D) Relatable, (E) Insightful, (F) Compassionate, and (G) Inexperienced were *variant*.

Within (A) Pleasant, participants indicated that they experienced their biofeedback therapist as being generally pleasant. Nine participants used the exact phrase “really nice” and three used the exact phrase “super nice” to describe their therapist. Two participants reported that their biofeedback therapist was “sweet.” Two participants reported that their biofeedback therapist was “kind.” One participant reported that her biofeedback therapist was “very supportive.” Lastly, one participant reported that her biofeedback therapist was “so cute” (clearly not in reference to the biofeedback therapist’s attractiveness).

Within (B) Competent, participants reported that they perceived their biofeedback therapist as being capable. Five participants explicitly reported that they perceived their biofeedback therapist as being generally competent. For example, one participant reported that “it seemed like [the biofeedback therapists] always knew what they were doing” and another reported: “I felt like I was in really good hands.”

More commonly, participants described a specific way in which their biofeedback therapist was competent. Four participants reported that their biofeedback therapist was knowledgeable. For example, one participant described her biofeedback therapist as “a fountain of knowledge.” Another participant reported:

I could tell she knew exactly everything that she was doing, and that she has done it before . . . she knew in her mind everything that was going to happen in the appointment. And she had ready all the things that she wanted me to do. Or all the apps that I could download on my phone, and she had all this knowledge.

Three participants described their biofeedback therapist as being good at listening. For example, one of these participants reported: “[My biofeedback therapist was] really good at paying attention to information that you give her and then working with that.” One participant reported that her biofeedback therapist was “good at explaining things and simplifying.” Another

participant reported that her biofeedback therapist was “good at asking questions to dig down deeper into what you’re thinking.”

Lastly, one participant reported that one thing that made his biofeedback therapist competent was that she referred him to a more experienced provider, who was even more competent:

[My first biofeedback therapist] was really helpful, seemed very competent . . . It was helpful. In the second one, she couldn’t quite understand why my body was reacting and so she recommended meeting with a professor who had a little more experience. And that was really valuable, the professor had some really valuable feedback and in terms of a lot of stuff . . . I think they portrayed confidence in the whole process . . . they had . . . [knowledge of] a wide variety of medical issues in the past and so the professor, after hearing about all sorts of different things, was able to recommend a lot of useful resources and recommended some people to see on campus.

Within (C) Professional, two participants commented on the professionalism of their biofeedback therapists. One participant reported that her biofeedback therapist was “very professional” and did “not get . . . too involved.” The other participant stated: “[My biofeedback therapist] was respectful about my PTSD . . . I could tell she wasn’t prying. It was also sincere and nice at the same time as research-based.”

Within (D) Relatable, two participants reported that they felt that their biofeedback therapists were similar to themselves. One of the participants simply stated: “I felt like I could really relate to both of [my biofeedback therapists] on a personal level.” The other participant reported: “[My biofeedback therapist] and I actually are quite similar, so it was really nice to feel like I was understood.”

Within (E) Insightful, participants reported that they felt that their biofeedback therapists were very insightful or perceptive. One of the participants reported:

[My biofeedback therapist] had some really insightful things to say that I felt affected me really personally... That second session, she just intuitively saw my behavior and then she pointed out a bunch of things that were true about me that not very many people

notice . . . without even having known me previously, she was like, “You feel a lot of pressure from trying to take care of people, right?” And I was like, “Yeah!” Just things that most people . . . have to take time to be around me to know.

The other participant reported a similar experience but with a different presenting problem. She described the insightfulness of her biofeedback therapist, with whom she did both the stress profile and resonant frequency sessions, in the context of their third session together:

We were doing a little meditation that was supposed to help muscle tension . . . it was where you tightened up your muscles and then you relaxed them as much as you can [progressive muscle relaxation] . . . And ordinarily, that would kind of make me anxious, because I’m like “Well, what if I scrunch up my shoulders and I look really ridiculous and then the person next to me glances over randomly?” And almost no one would recognize that, but she totally did. She was like, “Well I’m going to be turned all the way around and I’m not going to look back, so you can do whatever you want.” And she just seemed very aware of things, really small things, that cause stress in people with anxiety.

Within (F) Compassionate, two participants described their biofeedback therapists as being earnest in their desire to help them. For example, one of the participants reported:

I really truly when I went in there, I knew she was there and she was actively wanting to help me, it wasn’t, “Oh, this is just part of my job.” It was where she saw me as an individual, she remembered my name and she remembered who I was and she wanted to help me work through stresses. I wasn’t just another thing on her checklist.

Within (G) Inexperienced, three participants either reported that their biofeedback therapist was inexperienced or less experienced than another biofeedback therapist. One participant observed:

Maybe [my biofeedback therapist] lacked a bit of experience. I don’t think she’d been doing [biofeedback] for a super long time and so sometimes I’d ask her questions and she didn’t necessarily know the answer and she would be like, “Oh, maybe I can ask one of the other people that maybe knows a little bit more, has a little bit more experience.” But overall for her time that she spent there I think she did a really good job, and that she was able to really respond to the most part of my questions and the most part of my concerns very well.

Two of the participants who had multiple biofeedback therapists reported that one of their biofeedback therapists had less experience than another. One of the participants stated:

Maybe you could tell that [the second session biofeedback therapists] hadn't done [biofeedback] as many times as the first [biofeedback therapist] that was in the first appointment. It was . . . A little bit less organized . . . but it was more focused on me and what I wanted to do and what I needed.

One core idea was categorized as Other. One participant noted that her biofeedback therapist was “really calm.”

Domain 6.2: Notable BT Behaviors

The majority of the findings in this domain derived from participant responses to the interview question: *What was your biofeedback therapist like?*

Table 14

Findings for Domain 6.2: Specific Non-Protocol BT Behaviors

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Listened to Client	V (6)	About potential problems with the intervention; about participant's history
B. Therapist Customized Protocol to Client	V (3)	Left the script; incorporated jaw relaxation into resonant frequency breathing
C. Asked Client Questions About How Client is Doing in the Moment	V (4)	Checked in with the client about current experience; asked clients about their thoughts
D. Did Not Ask Client Questions about How Client is Doing in the Moment	V (2)	Rarely checked in with clients about current experience; not much probing
E. Explained Procedure to Client	V (3)	Told the client what each wire was for; told client about second session beforehand
F. Used Humor	V (2)	Used humor; joked around
G. Used Calm Voice	V (2)	Soft-spoken; calmer voice
H. Chatted with Client	V (2)	Asked how participant's week was; talked about “a lot of stuff”
I. Was Emotionally Responsive to Client	V (2)	Asked client questions without prying; demonstrated appropriate empathy

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Ten categories emerged in this domain: (A) Listened to Client, (B) Therapist Customized Protocol to Client, (C) Asked Client Questions About How Client is Doing in the Moment, (D) Did Not Ask Client Questions About How Client is Doing in the Moment, (E) Explained Procedure to Client, (F) Used Humor, (G) Used Calm Voice, (H) Chatted with Client, and (I) Was Emotionally Responsive to Client. All of the categories were *variant*. Most clients indicated that the biofeedback therapists' behaviors were helpful, though there were some exceptions.

Within (A) Listened to Client, participants mentioned that their biofeedback therapist listened to them. For example, one participant reported: “[My biofeedback therapist] listened really well, and made sure she understood my background before she just went ahead and tried to figure out what to do.” All of the participants indicated that their experience of being listened to was positive.

Within (B) Therapist Customized Protocol to Client, participants reported that the biofeedback therapist tailored the intervention in response to their individual concerns and needs. One participant indicated that their experience of the customization of the protocol was positive. She reported: “[My biofeedback therapist] is not afraid to leave the script and address what you're really concerned about.”

Two participants did not indicate whether or not their experience of the customization of the protocol was positive or negative. One participant reported that, during the resonant frequency session, her biofeedback therapist asked her to think of something stressful before starting each pace of breathing. The second participant reported that her biofeedback therapist tried to incorporate a jaw relaxation exercise into the resonant frequency session because jaw pain was one of her presenting concerns. Though the second participant did not say that incorporating the jaw relaxation exercise was a positive or negative experience, she did indicate that her overall experience of that session was negative elsewhere in the interview.

Within (C) Asked Client Questions About How Client is Doing in the Moment, participants reported that their therapists frequently checked in with them about their experience. All of the participants indicated that their experience of this therapist behavior was positive. For example, one participant reported: “[My biofeedback therapists] were like, ‘Does this work for you, does this not work for you, how can we make you more comfortable? We want you to feel very comfortable.’” This participant also indicated that this behavior contributed to her perception that “[the biofeedback therapists] care[d] a lot about what specific needs [she had].” Another participant stated:

[My biofeedback therapist] would always ask, “Do you have any questions? How do you feel about this?” And she would always try to include me in the session instead of just hooking a bunch of wires and letting me go, so that was nice.

Within (D) Did Not Ask Client Questions About How Client is Doing in the Moment, two participants reported that their biofeedback therapists did not check in with them about their experience. One participant indicated that her experience of the therapist not checking in with her was negative and one indicated her experience was neutral. The participant who reported having a negative experience stated: “[My biofeedback therapist] didn’t let me say what I was thinking.” The participant who had a neutral experience reported:

[Compared to my second biofeedback therapist, my first biofeedback therapist was] maybe a little less, like, “Okay, what works best for you at this time, or okay for you, is this breathing exercise okay for you?” she didn’t ask this question. Which again, because it was a first appointment I didn’t know if she could ask them. I was like “Okay, so that’s fine.”

Within (E) Explained Procedure to Client, three participants reported that their therapist explained the protocol or the equipment to them. Two participants indicated that having the protocol explained to them was a positive experience while one participant did not indicate whether the experience was positive or negative. The two participants who reported a positive experience both stated that the procedure and the equipment were explained to them. One of these participants commented: “[My biofeedback therapist] had me sit down and talk through me [sic] what was going to happen. And

then she told me what each of the wires were for. So I felt very informed of what was going on.” One participant did not indicate if having the procedure explained to them was positive or negative.

Within (F) Used Humor, two participants reported that their therapist used humor in their interaction. Both participants indicated that the therapist’s use of humor was a positive experience. For example, one participant similarly reported that her therapist “joking around” helped her to feel more relaxed.

Within (G) Used Calm Voice, two participants reported that their biofeedback therapists used a calm voice. Both participants indicated that their biofeedback therapists’ use of a calm voice was a positive experience. For example, one participant stated that her biofeedback therapist’s “calmer voice” contributed to her relaxation. The other participant reported: “[My biofeedback therapist] . . . showed me some of the videos that calm people down . . . and she kind of spoke like one of those people . . . it was really sweet.”

Within (H) Chatted with Client, two participants reported that their biofeedback therapist engaged with them in conversations not related to biofeedback. Both participants indicated that their therapist engaging them in conversations unrelated to biofeedback was a positive experience for them. One participant reported that her therapist “joking around and asking how my week was” contributed to her relaxation. The other participant reported it helped her to feel more connected to her biofeedback therapists: “We talked about a lot of stuff. And I just felt like I could really relate to both of [my biofeedback therapists] on a personal level.”

Within (I) Was Emotionally Responsive to Client, participants reported clear instances of their biofeedback therapists showing appropriate emotional responsiveness towards them. Both participants indicated that their experience of the therapist showing emotional responsiveness was positive. One participant reported:

I've had therapists previously that sometimes are really heavy on, "Oh, that sounds really hard." Which is helpful when people are empathetic in most terms but sometimes it feels exhausting. I felt like I just came in and it was, they sort of left out, and then they told me a lot of different approaches with it, where we're just here focusing on the body and how it functions on sort of a less of an emotional level . . . so that was almost kind of refreshing in some ways. It's like, "Let's figure out this mechanical issue and how to troubleshoot that . . . [it was] refreshing to get that less emotional approach."

Six core ideas were categorized as Other with one participant providing data that yielded two of these core ideas. This participant stated that her biofeedback therapist "didn't really listen . . . [and] talked too much." She also reported that the biofeedback therapist did not customize the session to her needs: "It was more task-based than help me-based."

One participant noted that his biofeedback therapist "didn't talk too much while she was hooking [him] up to [the equipment]. She explained what [the equipment was] but didn't chat that much, which [he] felt was unusual but not super uncomfortable or anything." Another participant noted that her biofeedback therapist remembered her name, which helped contribute to her sense that her biofeedback therapist was genuinely invested in helping her. A participant who reported that one of her presenting concerns was social anxiety stated that her therapist made a helpful self-disclosure ("at church I get really nervous sometimes"). Lastly, one participant reported a negative experience during the talking stressor in which his biofeedback therapists did not show appropriate empathy: "They're like, 'Okay tell us, basically just talk about what's stressing you out,' and then they're just like, 'Wow, I'm sorry, that's hard.' And then they kind of moved on from it. It was an odd experience."

Domain 6.3: Impact of Interaction with BT

The majority of the findings in this domain derived from participant responses to the interview question: *What was your biofeedback therapist like?*

Table 15

Findings for Domain 6.3: Impact of Interaction with BT

Category	Frequency	Illustrative Core Ideas/Excerpts
A. Client Put at Ease	V (7)	Felt like they were “in really good hands”; BT created safe space
B. Client Made Uneasy	V (5)	Guarded because of lack of relationship with BT; felt self-conscious having BT see physiological data
C. Client Felt Understood	V (4)	BT disclosed similar problem; felt that BT understood their problems
D. Client Buy-In Increased	V (2)	BT’s expertise helped client feel intervention was important; BT’s feedback gave credibility to physiological data

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Four categories emerged in this domain: (A) Client Put at Ease, (B) Client Made Uneasy, (C) Client Felt Understood, and (D) Client Buy-In Increased. All of the categories were *variant*.

Within (A) Client Put at Ease, participants indicated that their interactions with their biofeedback therapists had the effect of putting them at ease in some way. Two participants indicated that their therapist’s humor played a role in putting them at ease. For example, one participant reported that her biofeedback therapist’s “joking around [and] asking how [her] week was” helped her to not feel “self-conscious or judged.” Similarly, another participant commented that her biofeedback therapist “used humor to dissipate a lot of [her] anxiety and stress.”

Two participants commented that they felt understood by her biofeedback therapist and that feeling understood was important in helping them to feel at ease. For example, one participant reported:

It was really nice to feel like I was understood . . . I felt like I was in really good hands, that [my biofeedback therapist] was going to address the actual things that were bothering me . . . she . . . [used] the information that [I gave] her to construct a mental safe space

where I can relax and where I can step back and look at my thoughts a little bit more objectively.

The other participant stated:

I didn't feel like, "Oh, there's a person here that I don't know very well." It was very much like, "Oh, there's a person here who sort of understands where I am and who knows what's going on." And so that was a really good way to make the environment really calm.

One participant commented that her biofeedback therapist's own relaxation was important in helping her to feel more relaxed. She commented on the environment created by her biofeedback therapist and speculated about what it would be like to have a biofeedback therapist who was less relaxed:

It was . . . [a] very relaxed atmosphere, it wasn't uptight or it has to be a certain way. It was very just "accept how you are right now and we'll just work with where you're at right now." It was a very relaxing and accepting environment . . . I could easily see a biofeedback appointment being awkward, had it been someone else who's a little more uptight or less open to communication and easing the situation so it's not awkward or tense.

One participant who reported being uneasy at the beginning of the first session reported that her biofeedback therapist helped her feel more at ease by explaining the procedure to her: "I just felt really informed and like I knew what was going on and then after when I went the second time I knew what to expect, so it was nice." One participant reported that her perception of the biofeedback therapist's "expertise helped [her] feel relaxation." Lastly, one participant reported that her biofeedback therapist, whom she described as having "listened really well, and made sure she understood my background", contributed to her becoming "really relaxed" to the point where she "almost fell asleep."

Within (B) Client Made Uneasy, participants indicated that their interactions with their biofeedback therapists had the effect of making them uneasy in some way. Two participants

indicated that they felt uncomfortable disclosing information that their biofeedback therapists requested during the stress profile. For example, one of these participants reported:

I was definitely more guarded. And maybe if I would've had more previous [sic] relationship or another appointment with her, I would have been able to talk about the things that were actually stressing me out in that moment. But since I didn't, and it was just this random person that I just saw. And even though I wanted to learn techniques, I was not comfortable sharing my stressful situations with her.

The other participant who felt uncomfortable disclosing information also mentioned that his biofeedback therapist did not show appropriate empathy:

Even with a therapist, it takes a little bit to have some trust, have some confidence in a therapist before you tell them everything. And especially when I had told them nothing and they're like, "Okay tell us, basically just talk about what's stressing you out," and then they're just like, "Wow, I'm sorry, that's hard." And then they kind of moved on. That was kind of weird . . . I didn't feel super comfortable talking about everything with them.

One participant reported that receiving constructive feedback from her biofeedback therapist made her feel self-conscious:

He told me [that] whenever I stopped doing the breathing exercises, my breathing would get really shallow and I would tense up and he was talking about how maybe I was worried about what I was going to say, and then I just got really self-conscious . . . I don't think he was trying to make me feel self-conscious, I just was.

This same participant also indicated that she felt self-conscious simply by having the biofeedback therapist see her data, even though she felt the intervention was helpful: "I haven't been diagnosed with anxiety for very long so seeing how exactly it affected my body was at first a little uncomfortable with someone watching how my body was reacting."

One participant reported that he felt it was "unusual" that "the biofeedback lady didn't talk too much while she was hooking [him] up to [the equipment] . . . she explained what they were but didn't chat that much." Lastly, one participant with PTSD reported that she was made uneasy because her biofeedback therapist "didn't really listen" and didn't "give [her] a voice . . .

” or “opportunity for a voice.” This participant stated: “I was stressed out . . . so it was hard to focus on what she was saying.”

Within (C) Client Felt Understood, participants indicated that their interactions with their biofeedback therapist had the effect of helping them to feel understood. Four of these participants stated that they felt understood without giving specific details about their therapist’s behavior. For example, one of these participants stated: “It was . . . kind of an out-of-body experience actually, because I was so caught off guard by how well I felt like she understood how I see the world.” Another reported: “It seemed like they had a really good understanding of where I was coming from, my goals, and what I needed to improve.” One participant reported that her therapist’s anticipation of her in-session anxiety during an additional session of biofeedback helped her to feel understood. Another participant reported that her therapist’s self-disclosure helped her to feel understood:

She had been through something similar, I guess, because I have a little bit of social anxiety and that’s what I’d been talking about. And then she was like, “Oh yeah, I feel that sometimes too, like at church I get really nervous sometimes,” and it just felt good to know that there was somebody else that felt that too.

Within (D) Client Buy-In Increased, participants reported that their interaction with the biofeedback therapist helped them to feel more confident in the intervention. One participant reported that her perception of her biofeedback therapist’s expertise “validated the fact that relaxation is necessary and it’s an important thing . . . to do.” Another participant reported: “For [the biofeedback therapists] to say, ‘You are having a lower heart rate when you breathe slower’, I really appreciated that because then it helped me feel confident that that’s what was happening.”

Two core ideas were categorized as Other. One participant reported that an interaction with her biofeedback therapist in an additional session helped her to feel hopeful:

If I was the only person on the entire planet earth that worried about [being self-conscious during a muscle relaxation exercise], then she wouldn't have said anything because she couldn't have possibly known. But since she did know and since she made a point of clarifying, "Oh, just so you know, this will be happening, or you should lean back in your chair." Or these little things that could be stressors. It reminded me that there's other people that are working with the same things, and other people that have worked through the same things. And so, it was a good reminder that like there's other people even if no one else talks about it.

Another participant reported that her interaction with her biofeedback therapist helped her to change maladaptive patterns of thinking:

Every single time I've gone and I've had a conversation with her, she's had some insight that has like flipped a switch in my head and all of a sudden something just kind of clicks I don't know if she knows how helpful they are, but every time I feel like have come away with something that has helped me . . . ground myself instead of having these irrational beliefs about what I'm doing and who I'm with and how [other people] perceive me.

Domain 7: Evaluation of Biofeedback Equipment

The findings in this domain derived from participant responses to a variety of interview questions.

Table 16

Findings for Domain 7: Evaluation of Biofeedback Equipment

Category	Frequency	Illustrative Core Ideas/Excerpts
Helpful	V (7)	Informative; client appreciated "hard data"; client felt visual component was helpful
Strange	V (4)	Weird being "hooked up to the electronics, doodads, and whatnot"; client "felt like Frankenstein"
Interesting	V (2)	"Cool" to see results in real-time; "neat experience"

Note. N=15. G=General (14-15 participants), T=Typical (8-13 participants), V=Variant (2-7 participants).

Three categories emerged in this domain: (A) Helpful, (B) Strange, and (C) Interesting.

All three categories were *variant*.

Within (A) Helpful, participants reported that they experienced the biofeedback equipment as being helpful. All of the participants represented in this category indicated that the biofeedback equipment gave helpful information. One participant noted: “I felt like it was pretty informative.” Another stated: “I actually really appreciated the fact that there was hard data that they were giving to me.” Other participants went into greater detail. For example, one participant discussed her experience of seeing the feedback with her biofeedback therapist’s interpretation:

It was nice to be able to get more of a scientific approach, not just purely like . . . I mean, when I’ve done meditation in the past it’s been very much from a place of like, Buddhist Zen feeling type of thing, or like feelings and “let’s just feel these thoughts out” or whatever. And that’s nice in some ways, but it’s also nice to see, “Okay, scientifically speaking, when you do this, when you slow down your breath, this is what it’s doing to your body and that’s how it’s helping you.”

Similarly, another participant reported:

I’ve always known that breathing and that sort of thing helps calm you down but I think being able to sort of see it and see the response, having that sort of visual thing of just how much and how quickly breathing can slow down the heart and stuff was super useful for me.

Within (B) Strange, participants reported that they experienced the biofeedback equipment as strange in some way. One participant noted that, if not for her biofeedback therapist, the wires “would have been very unsettling.” Similarly, another participant reported that the wires made her feel “a little bit like Frankenstein for one second.” Another participant stated: “It was kind of weird just like going in and being hooked up to all the electronics, doodads, and whatnot.”

One participant reported that “at first it was really weird to see all [her] bodily responses to stress.” She elaborated:

I don’t think it was weird to be hooked up to it, but more to see what was going on on the screen because I haven’t been diagnosed with anxiety for very long so seeing how exactly it affected my body was at first a little uncomfortable with someone watching how my body was reacting.

Within (C) Interesting, participants reported that the biofeedback equipment was intriguing to them. One of the participants stated:

It was interesting, they had all these different charts and they kind of showed me, especially when I was thinking about it . . . that's when my heart rate was going the fastest, that's when my hands were perspiring and it was cool to look at the charts that they had and cool to actually see those results in real-time.

Similarly, the other participant reported:

I think there was probably 6 or 7 different monitors you're hooked up to. So I thought it was a really cool experience to be able to see immediate results of what's going on inside my body and to see things that I could potentially work on, areas that I was thriving in, and areas that maybe needed a little bit of improvement.

Two core ideas were classified as Other. One participant reported that the equipment itself was confusing and that the interpretation of the biofeedback therapist was therefore very helpful: "One of the biggest ways that [the biofeedback therapists] helped was that they interpreted all of the graphs for me, because I have absolutely no idea what all those weird lines mean."

Another participant reported that the biofeedback equipment was a source of physical discomfort for him:

Well for some of the machines . . . [I] had to hold my hands still, for example. Or they hook white electrodes up to your forehead and move them over your ears, so it's just sort of uncomfortable when all these wires and stuff were on and around me.

Domain 8: Other

Lastly, several core ideas did not fit into any domain because there were not enough similar ideas to create a domain. Additionally, some core ideas were not placed into a domain because they discussed the content of additional sessions of biofeedback not directly related to the HRVB+ protocol.

Core ideas without enough similar core ideas to create a domain. The content of core ideas that were too few to group together included the following categories of data:

Conceptualizations of biofeedback, the complementary nature of biofeedback and individual psychotherapy, evaluations of the biofeedback intervention as helpful because of the presence of the biofeedback therapist or other caring individuals, evaluations of the physical environment, discomfort due to initial uncertainty about what to expect, and discomfort with the biofeedback therapist because the biofeedback therapist was a new person.

Conceptualizations of biofeedback. One participant reported that he thought of biofeedback skills as a “life hack.” The second participant reported that the ultimate purpose of biofeedback is to “recogniz[e] the habits that you have, like with your mind/body awareness, that are not helping you.” She also elaborated on the nature of biofeedback skills: “It’s kind of like a skill, like in sports you start out and you’re not super good but you just keep working and eventually get better. It’s the same concept.” The third participant echoed the second:

Biofeedback makes you recognize what’s going on and then they give you things to fix it, and that’s what’s important. Not fix it, but deal with it even . . . So either resolve or deal with that situation so that you can feel better quicker.

Non-equivalence of biofeedback and individual psychotherapy. One of the participants went into detail:

When they put me in only [biofeedback], and I couldn’t go to counseling [because of the wait list], I still felt like there was a lot of things that I needed to figure out and [biofeedback] didn’t cover the mental side of it . . . It was all just body-focused, which is totally the point of it, so that’s great . . . I think it’s a good time-filler before meeting with a counselor, but I don’t think it’s enough to just not meet with a counselor after that for big problems, if that makes sense.

Evaluations of the biofeedback intervention as helpful because of the presence of the biofeedback therapist or other caring individuals. One of the participants stated:

Part of it is just [that] the extra time that you spend in the counseling office talking to someone during the biofeedback process is helpful. Because then, instead of like an hour of counseling and then you're done for the week, it's like an hour of counseling and then you go to biofeedback and you continue to work out whatever it is that's been bothering you but it's in a different way. So that has been nice, just the extended time period.

Evaluations of the physical environment. One participant commented:

I liked how it was kind of dark in there. There was music playing. There wasn't [sic] any distractions in there, I could just focus on trying to relax and on what he was telling me. There was only one person in there . . . Some of my anxiety is social anxiety, so I'm not as comfortable in bigger groups. So it's a lot easier to talk to one person.

The other participant stated:

The environment is really good. Even just sitting in the CAPS office is really helpful because it's quiet and it's peaceful and you can tell that there's people around that care about you, and so just being in an environment like that for a few hours a week I think really helps me.

Discomfort due to initial uncertainty about what to expect. One of these participants went into detail:

[The second session] was definitely more comfortable now that I was familiar with all the machines and where they went and what I'd have to do for them and how they felt being on me . . . I knew who I was meeting with and . . . all the machines she was going to hook me up on, and I knew the room and the whole environment and layout. So it was just a lot more familiar.

Discomfort with the biofeedback therapist because the biofeedback therapist was a new person. One participant noted that her ability to feel comfortable with her therapist was significant and hinted that she often feels uncomfortable with new people: "Being able to actually get to a relaxed state, even when I'm with someone new, was really important." Another person similarly noted that being with the biofeedback therapist was less comfortable than being with his individual therapist simply because he did not know the biofeedback therapist.

Content of additional biofeedback sessions. Seven participants indicated that they had, or were scheduled to have, additional biofeedback sessions that did not include components of

the stress profile session or resonant frequency session. One of these participants completed non-HRVB+ protocol biofeedback sessions between the stress profile and resonant frequency sessions.

Three participants reported that they had already had, or were going to have, an additional biofeedback session to focus specifically on muscle tension. Two participants appeared to report that they had completed a relaxation profile, an exercise in which participants try many relaxation exercises while being monitored by biofeedback equipment to determine which relaxation exercises they respond to best (Khazan, 2013). Another participant reported that he had completed an additional biofeedback session to focus specifically on sleep. The last participant reported that he simply hoped to work on “other things” in addition to further work on breathing.

Discussion

The present study investigated client experiences of the BYU CAPS HRVB+ protocol. The purposes of this study were to (1) learn about client experiences of biofeedback because almost no previous research has done so and (2) explore potential mechanisms of change contributing to biofeedback outcomes beyond physiology. Common factors were of particular interest because Tschacher and colleagues (2014) found that expert psychotherapy researchers with a variety of allegiances rated biofeedback training techniques as being negatively associated with common factors. However, it seems implausible that clients benefit from biofeedback in spite of its techniques being incompatible with common factors. In addition, this study gathered information that may be helpful to biofeedback services at BYU CAPS as they continue to refine their protocol. CQR, a qualitative research method defined by its use of group consensus in interpreting the meaning of words and categorizing ideas, was used to gather and analyze data.

Overview of Findings

Client expectations. It was typical for participants to have vague expectations about what the HRVB+ protocol would entail. For example, one participant reported that she had “no clue” what the biofeedback intervention was, only that her “counselor suggested it for [her] anxiety.” It was also somewhat common for participants to comment that the procedure did not match their expectations in some way. For example, two participants expected the biofeedback intervention to be more like traditional psychotherapy than it was. Another participant reported that the intervention was “more peaceful” than she originally anticipated. Overall, it appears that many participants did not know what to expect with some having incorrect ideas about what would happen.

This finding is notable, especially given that two participants discussed feeling more at ease during their second visit compared to the first because they knew what to expect. One of these participants stated it would have been helpful for him to receive an overview of the procedure before going through it. Practitioners of biofeedback may be able to alleviate some client anxiety by providing more information to clients prior to starting biofeedback procedures. Additionally, clients who are referred by their individual psychotherapists for biofeedback may benefit from receiving more information at the time of referral.

Participant expectations regarding treatment outcome were typically positive. This makes sense, as people with negative expectations would be unlikely to engage in the intervention. However, two participants did note that they were initially skeptical of biofeedback and that it helped them more than they thought it would. Unfortunately, they did not articulate any reasons for their skepticism. This is concerning because there are likely people who could benefit from biofeedback who never try it because they are skeptical about it. Further research should

investigate the prevalence of this skepticism among potential biofeedback clients and the reasons for it.

One possibility is that clients could be picking up on the skepticism of their individual psychotherapists. The attitudes of psychotherapists at BYU CAPS toward biofeedback have not been studied. However, Tschacher and colleagues (2014) found that expert psychotherapy researchers with a variety of allegiances rated biofeedback training techniques as being negatively associated with common factors on average. They tended to believe that the “therapeutic alliance . . . would be counteracted by the application of biofeedback training” (p. 92). This finding suggests that many psychotherapists might harbor some skepticism about biofeedback. And it is conceivable that even therapists who are skeptical of biofeedback might refer clients to biofeedback in a setting like BYU CAPS because of the extremely high demand for psychotherapy and need for alternatives. Further research concerning the attitudes of psychotherapists towards biofeedback may be beneficial.

Client evaluation of HRVB+ protocol. The participants generally found the HRVB+ protocol to be helpful. In addition, 80% of the participants had already attended, scheduled, or said they were going to schedule another session, suggesting that they felt biofeedback was worth their time. Though it is not possible to make any statistical inferences about the representativeness of our participants’ experiences, it appears that many BYU CAPS clients experience the HRVB+ protocol as helpful and biofeedback as worthwhile. This is consistent with previous research suggesting that participants are generally satisfied with the biofeedback interventions they receive (see Fragedakis, 2014; Glombiewski et al., 2010; Huis in ‘t Veld et al., 2010; Leavitt et al., 2016; Shedden Mora et al., 2013; Shockey et al., 2013; Weise et al., 2008).

The participants perceived that the HRVB+ protocol impacted them in a variety of helpful ways. They typically expressed that the intervention helped them with their anxiety and/or stress. They also typically expressed that the intervention increased their confidence or sense of control regarding their own ability to manage anxiety or stress. This finding that biofeedback enhanced the participants' sense of control echoes the findings of Esty (1995), who created a group plus biofeedback intervention for patients with chronic and life-threatening illnesses. She concluded that her participants benefitted from the intervention at least in part because self-regulation skills help to counteract the loss of control experienced as a result of physical illness. This similar finding expands on Esty's finding because the population consisted of college students instead of patients with chronic and life-threatening illnesses.

Participants expressed that biofeedback helped them with sleep, panic, psychosomatic symptoms (e.g., reduced muscle tension), and cognitive regulation. These findings are consistent with the notion that biofeedback works by increasing parasympathetic activation. Participants also commonly expressed that the intervention helped them increase their self-awareness (e.g., awareness of physical indicators of stress) and a few noted that it helped them validate their own experiences (e.g., "it's not just in my head"). While these findings are not likely to be surprising to biofeedback practitioners, they do merit further exploration in biofeedback research as potential mechanisms leading to decreased psychological distress or as outcomes in their own right.

Of the three components of the intervention (stress profile session, out-of-session activities, and resonant frequency session), only out-of-session activities were generally reported to be helpful. Almost all of the out-of-session activities were oriented around some kind of practice (e.g., paced breathing, guided meditations, etc.). Surprisingly, even though one

component of the HRVB+ protocol is an awareness assignment between sessions geared toward helping clients increase awareness of stress, only one participant mentioned anything that resembled a typical awareness assignment (“remembering to relax [her] body and to not build up a bunch of tension”). However, only one participant was documented as not receiving an awareness assignment. This suggests that the participants in the HRVB+ protocol may have forgotten their awareness assignments or may have found the awareness assignments to be unimportant.

Both the stress profile session and the resonant frequency session were typically reported to be helpful. A greater number of participants expressed that the stress profile session was engaging. All but one participant commented specifically on the visual feedback, suggesting that seeing the results of the stress profile was a highlight of the intervention for some participants. Additionally, a greater number of participants expressed that the resonant frequency session was unhelpful or less helpful than the stress profile session. Redundancy was the most commonly cited reason for the unfavorable evaluation of the resonant frequency session, followed by a desire to focus on muscle tension instead of breathing. Additionally, some of the participants who reported that the resonant frequency session was helpful attributed at least part of the helpfulness to being able to see their progress since the first session.

Overall, these results suggest that participants were often satisfied with the skills they learned as part of the stress profile session and found out-of-session practice to be helpful. While some participants did find breathing at their resonant frequency to be helpful, it appears that others did not perceive much added benefit to breathing at resonant frequency compared to breathing at six breaths per minute at the end of the stress profile session. This contrasts with the findings of a previous experimental study that found breathing at resonant frequency for 15

minutes resulted in statistically significantly higher mood compared to breathing one breath per minute faster than RF (Steffen et al., 2017). There are many possible reasons for this apparent discrepancy. The sample of the present study is small, and the experiences of these participants may be unique. Or participants in the present study may have happened to breathe at a rate close to their resonant frequency when introduced to paced breathing in the stress profile session, resulting in no room for improvement. Or resonant frequency breathing may result in statistically significant improvement of mood but result in no clinically significant impact outside of a laboratory setting. Overall, more research is needed to determine the added benefit of breathing at resonant frequency beyond slow paced breathing in a naturalistic clinical setting.

Client suggestions for HRVB+ protocol. Some participants offered suggestions to improve the HRVB+ protocol or wished that the HRVB+ had been different in a specific way. The most commonly desired change was greater flexibility to do other biofeedback activities if needed or desired. Additionally, a few participants mentioned that it would have been helpful for them to be given more information about the intervention or biofeedback in general. These findings make sense given that some participants felt the intervention did not meet their needs and that most participants did not know what to expect. They are also consistent with the finding that the majority of the participants received or planned to seek additional biofeedback services to address additional concerns.

Client explanations of how biofeedback works. Many participants commented on the impact of skills that they learned in biofeedback. However, some participants commented on more nebulous aspects of the intervention. For example, one participant reflected that “part of it is just the extra time that you spend in the counseling office talking to someone during the biofeedback process is helpful.” Similarly, another participant reported that “just sitting in the

CAPS office is really helpful because it's quiet and it's peaceful and you can tell that there's people around that care about you, and so just being in an environment like that for a few hours a week I think really helps me." One participant seemed to be discussing the interpersonal process between her and her biofeedback therapist: "Being able to actually get to a relaxed state, even when I'm with someone new, was really important." These statements further demonstrate a need for future research to determine to examine the role of non-specific therapeutic factors, such as the therapeutic relationship, on biofeedback outcomes.

Client experiences of the biofeedback therapist. Several domains emerged that captured data about the biofeedback therapist: Evaluation of Biofeedback Therapist, which captured general statements made about the biofeedback therapist; Specific Non-Protocol Biofeedback Therapist Behaviors, which captured descriptions of specific biofeedback therapist behaviors that were not mandated by the protocol; and Impact of Interaction with the Biofeedback Therapist, which captured participant reactions to interactions with the biofeedback therapist.

The first of these domains, Evaluation of Biofeedback Therapist, is of limited utility for making recommendations for practice because general statements about biofeedback therapists are not specific enough to generate actionable recommendations. However, the data do potentially provide information about what characteristics clients value in a biofeedback therapist. Participants typically noticed when their biofeedback therapists were pleasant and competent. Three clients who felt their therapists were inexperienced all mentioned positive characteristics and competencies of the biofeedback therapist, suggesting that a biofeedback therapist's familiarity with the procedure was not the most important thing to them. Interestingly,

two participants specifically mentioned that they felt the biofeedback therapist was relatable, suggesting that they valued having a personal connection with their biofeedback therapist.

The second and third domains, Impact of Interaction with Biofeedback Therapist and Specific Non-Protocol Biofeedback Therapist Behaviors, captured data that more readily lead to specific recommendations for biofeedback practitioners. They also had some overlap because several clients perceived their biofeedback therapists' non-protocol behaviors as impactful. All of the categories in these two domains were variant, which likely reflects that there were six biofeedback therapists with different interaction styles that were attempting to be responsive to their clients' specific needs.

Some participants reported that, at some point during the intervention, their interactions with their biofeedback therapists resulted in them feeling more at ease. For example, one person reported that her biofeedback therapist's use of humor contributed to an atmosphere of acceptance in which she did not feel pressure to perform. Other non-protocol therapist behaviors associated with putting clients at ease included listening, customizing the protocol, chatting with the client (i.e., about things other than the intervention), and explaining the procedure in advance of or while doing the procedure (e.g., telling the client what each wire is for when hooking them up to the equipment).

Participants indicated that they variously had positive experiences when their biofeedback therapist used a calm voice, asked about their experience in the moment (e.g., "are you comfortable?"), remembered their name, made an effective self-disclosure (e.g., "at church . . . I get really nervous sometimes"), or was emotionally responsive (e.g., one participant appeared to appreciate that his biofeedback therapists showed empathy, but not in an overly demonstrative manner). Some clients reported that their interactions with the biofeedback

therapist put them at ease without mentioning behaviors. Two participants who reported that they felt understood by their biofeedback therapist linked feeling understood to feeling safe. Other aspects of interactions with biofeedback therapists that helped participants to feel at ease included a perception that the biofeedback therapist had expertise and a sense that the biofeedback therapist was not “uptight.”

Additionally, a few clients reported being beneficially impacted in unique ways with their biofeedback therapists. Participants reported that their interactions with their biofeedback therapists variously had the effect of helping them (the participants) to feel more confident in the intervention, hopeful about their capacity to make progress, or change maladaptive patterns of thinking that extended beyond the obvious scope of biofeedback (i.e., reducing anxiety or psychosomatic symptoms).

In contrast, some other participants reported that their interactions with their biofeedback therapists resulted in them feeling uneasy at some point. Being hooked up to the biofeedback equipment and doing the talking stressor were both mentioned in connection with feelings of discomfort, suggesting that the participants are particularly vulnerable during these activities. One participant reported feeling self-conscious when her biofeedback therapist was looking at her biofeedback therapist and when he shared his observations about her breathing. Non-protocol biofeedback therapist behaviors associated with feelings of unease for clients included not listening, not customizing the protocol (e.g., “it was more task-based than help me-based”), not talking while hooking up the biofeedback equipment, and not showing appropriate empathy. The participant who reported that her biofeedback therapist did not listen or customize the protocol to her needs stated that her biofeedback therapist’s behavior was stressful for her. Furthermore, she

stated that the stress made it difficult for her to focus on what the biofeedback therapist was saying.

Lastly, the experiences of a few participants suggest that interpersonal processes could be important in biofeedback interventions. For example, one participant with PTSD spoke of her biofeedback therapist not giving her “a voice.” While the participant did not share any details about her PTSD, this may have been a particularly harmful interaction for her. Another participant who had social anxiety spoke about how being able to feel comfortable with her biofeedback therapist was “important”, suggesting that she could perhaps have benefitted from discussing that experience with the biofeedback therapist.

Overall, these results suggest that a client’s relationship with the biofeedback therapist matters. Interestingly, customizing the protocol stands out as being especially important for developing a positive relationship with the biofeedback therapist. The participant who spoke the most about difficulties with her biofeedback therapist complained specifically about her biofeedback therapist’s inflexibility. While this anecdote does not establish a causal relationship between customizing the protocol and the quality of the relationship between client and biofeedback therapists, it is intriguing.

Theoretical Implications

Leading biofeedback researchers Lehrer and Gevirtz (2014) explained in their article “how and why” HRVB works—including for emotional concerns—almost exclusively in terms of physiological mechanisms (the one exception being their suggestion that distraction from worries may play a role). The explanation in their article is consistent with what Wampold and Imel (2015) called the medical model. Some experiences reported by this study’s participants could definitely be accounted for by this model. For instance, increasing parasympathetic

activation using HRVB could account for participants experiencing a reduction in anxiety or stress.

However, some experiences reported by this study's participants are more consistent with the contextual model (Wampold & Imel, 2015). Additionally, some data suggested that several of Tschacher and colleagues' (2014) common factors were at play for participants. In particular, therapeutic alliance, provision of explanatory scheme, self-efficacy expectation, mastery experiences, and mindfulness stood out as being potentially important. Interestingly, one client experience appeared to map onto the common factor of cognitive restructuring. Though more research is needed to establish the roles of various common factors in biofeedback, these preliminary findings are of interest and indicate a need for further investigation.

Recommendations for Biofeedback Services at BYU CAPS

Though all participants found the HRVB+ protocol to be helpful in some way, a number of findings in this study suggest that certain changes that could be beneficial for biofeedback services at BYU CAPS.

More second session options for clients. Biofeedback services may wish to consider making the resonant frequency session optional. Multiple participants stated or implied that they would have appreciated greater flexibility in the protocol. Additionally, multiple participants reported that the resonant frequency session was redundant and appeared to be satisfied with the breathing training they received at the end of the stress profile session.

A helpful alternate option to a resonant frequency session could be an ergonomic assessment or a relaxation profile session. Multiple participants indicated that they wished they had worked on muscle tension instead of resonant frequency or that they would return for additional sessions to work on muscle tension. Providing a muscle tension-focused option could

help clients to feel that they have more say in their treatment. Additionally, it may help biofeedback services to reduce the overall number of sessions that each participant attends, providing more openings for more additional people to benefit from biofeedback.

Helping clients remember to practice. It was typical for clients to find the homework assignments challenging due to difficulty with remembering. It may be beneficial to set more specific behavioral goals with clients, such as specific times that they are going to practice. Additionally, it may be beneficial to brainstorm with clients about how they will remind themselves in advance of them leaving the session.

Training for graduate students conducting biofeedback. Biofeedback services may wish to consider training its student clinicians to be particularly mindful of clients' needs during hookup to the biofeedback equipment and the talking stressor. For hookup, it appears that friendliness and talking to the client while placing the electrodes and wires could help make the process more comfortable. For the talking stressor, it may be helpful to emphasize that the client does not have to share anything they do not want to. Additionally, it may be helpful to check in with the client after the relaxation period following the talking stressor to ensure they receive an appropriate reaction and are ready to move on.

Let clients know what to expect. Biofeedback services may wish to consider ways to educate clients about what they will experience in biofeedback beforehand. Two clients stated that they were much more comfortable in the second session compared to the first one because they knew what to expect. This is concerning given that it was typical for clients to not to know what to expect. It may be beneficial to provide training to the BYU CAPS faculty so that they can tell the clients that they refer what to expect. It may also be beneficial to provide flyers or posters near the biofeedback waiting area that outline the procedure.

Limitations

As with any study, this study has strengths and limitations that affect how it should be interpreted. I will use Maxwell's well-known and thorough examination of validity in qualitative studies (1992) as my framework for discussing these strengths and limitations.

Interpretive validity. An important strength of CQR lies in the domain of what Maxwell (1992) called interpretive validity: the ability to “comprehend phenomena not on the basis of the researcher's perspective and categories, but from those of the participants in the situations studied” (p. 289). Though no method can capture with absolute precision the meaning or intention of a participant when they said something, using group consensus can help dilute the bias of any one researcher. In the case of this study, decisions at all stage of the analysis were approved by at least two people and by as many as eight. Additionally, only undergraduate research assistants participated in the domain generation and writing of core ideas as part of the primary coding team, reducing the risk of power differentials within the group affecting interpretation.

Generalizability. Another advantage of this study is its relatively large sample size of 15 participants. Interviewing 15 participants allows for a wide variety of perspectives to be explored in the search for potential mechanisms of change in biofeedback, which is the purpose of the present study. (I readily acknowledge that interviewing 15 participants selected in a non-random fashion hardly leads to any kind of statistical generalizability regarding their experiences to a broader population of biofeedback users, which, fortunately, is *not* the purpose of the present study.)

However, some of the participant inclusion criteria should be taken into account while interpreting the data. First, only participants who completed both sessions of the HRVB+

protocol were allowed to participate. This means that we could not capture the experiences of people who did not complete a second session. Second, only participants who were also participating in (or were about to begin) individual psychotherapy were allowed to participate. This means that we could not capture the experiences of any biofeedback clients who were unable or unwilling to engage in psychotherapy, or the experiences of clients who simply did not need it.

Theoretical validity. Lastly, one important limitation concerns theoretical validity (Maxwell, 1992). Theoretical validity “refers to an account’s validity as a *theory* of some phenomenon” (Maxwell, p. 291) and comprises the validity of the concepts employed in a theory as well as the proposed relationships amongst them. Thus, theoretical validity contains elements of what Cook and Campbell (1979) called construct validity and internal validity.

Concepts. The coding process in CQR abstracts data when the data are being sorted into domains and categories, which (1) results in some reducing of the actual data and (2) requires labels to give clusters of data identified as similar. As with interpretive validity, the use of group consensus to categorize all of the data helped to increase the rigor of this process in this study.

Relationships between concepts. The purpose of the present study was done to explore possible mechanisms of change in biofeedback. It is intended to provide starting places for future research rather than provide definitive conclusions about the relationships between any concepts, such as cause and effect relationships.

Descriptive validity. Descriptive validity refers to the researcher’s accuracy in recording the actual events that occurred. In the case of this study, it refers to how well the transcripts being analyzed by the coding team actually captured the interview. Maxwell (1992) insisted that interview transcripts are more than a text because an interview is a social event that occurs

between an interviewer and an interviewee. To maximize the quality of interviews in this study, a clinical psychology graduate student with three years of clinical experience and no interest in biofeedback was selected to be the interviewer. He was trained to use therapeutic microskills, such as reflection, asking open-ended questions, and appropriate demonstration of empathy, to provide the safest interview experience possible for participants.

Regarding the accuracy of the transcripts, I checked or personally transcribed all of the transcripts and found that there were some minor errors. All but one of these errors had no effect on the meaning of what was stated. In the one case where an error could potentially change the meaning, I alerted the coding team and they re-analyzed the data.

Evaluative validity. Evaluative validity refers to any judgments that I might make about anything that was reported. In general, I aim to be descriptive rather than evaluative. However, my evaluations (and the evaluations of the research assistants) of certain events that participants reported are likely to “seep out” despite our best efforts. For example, one participant reported his biofeedback therapist did not demonstrate appropriate empathy. Such reports are likely to provoke an emotional response that could have affected our interpretation of it.

Recommendations for Further Research

Common factors in biofeedback. The results of this study provide some preliminary evidence that common factors may play a role in biofeedback outcomes. However, further studies are needed to better understand how common factors impact outcomes. For example, do certain common factors directly contribute to outcome or do they facilitate another factor that contributes to outcome? Mediation and moderation models may help determine the precise roles that different factors play. Then if a given common factor is identified as being important, biofeedback clinicians can be more intentional in making use of it in their interventions.

Additionally, having empirical evidence of common factors may help mental health professionals not in the biofeedback community better understand biofeedback.

As part of this line of research, process studies may be beneficial to help determine what clinician behaviors are most beneficial for biofeedback clients. They might also shed light how to make use of interpersonal process in biofeedback and the best ways to navigate client vulnerability resulting from biofeedback procedures.

Alternate biofeedback outcomes. Several participants reported experiencing outcomes other than reduction of stress or increased relaxation. Of note are reports that biofeedback helped participants to validate their own experiences and increase mindfulness. One participant even reported that the intervention helped her let go of needing to control her own body. These reports raise interesting possibilities for treating clients who struggle to validate their own experiences, are interested in alternate approaches to developing mindfulness skills, or who experience difficulties that involve a maladaptive desire to control one's body (e.g., panic symptoms, social anxiety, negative body image, etc.).

Incremental benefit of breathing at resonant frequency. Determination of resonant frequency appears to be a polarizing aspect of the HRVB+ protocol. Some participants reported that the process felt very personalized. One participant whose resonant frequency was 4.5 breaths per minute indicated that personalizing breathing coaching, including finding optimal rate of breathing, was helpful even though previous breathing and relaxation training was not. However, several clients reported that finding resonant frequency felt redundant because they had already practiced paced breathing or slow mindful breathing.

This finding raises several possibilities. Some participants may have breathed at a rate close to their resonant frequency when introduced to paced breathing in the stress profile session,

resulting in no room for improvement. Some participants may have simply failed to appreciate the difference of breathing at resonant frequency. It is also possible that resonant frequency breathing may result in statistically significant improvement of mood and physiology (see Steffen et al., 2017) but result in no clinically significant impact outside of a laboratory setting. Overall, more research is needed to determine the added benefit of breathing at resonant frequency beyond slow paced breathing in a naturalistic clinical setting.

Skepticism of biofeedback. Two participants reported initial skepticism about the ability of biofeedback to help them. This is concerning because there are likely people who could benefit from biofeedback who never try it because of their skepticism. Additionally, the results of the Tschacher and colleagues (2014) study indicates that many clinicians have skeptical attitudes toward biofeedback. Overall, these findings together suggest a need for further research about the attitudes towards biofeedback held by referring therapists and incoming clients.

Conclusion

This study investigated client experiences of the HRVB+ protocol at BYU CAPS to explore possible mechanisms of change beyond physiology. The results of the study provide some initial support for the idea that common factors could play a role in biofeedback. However, further research is needed to determine the impact of common factors on biofeedback outcomes. Additionally, if some aspect of the therapeutic relationship appears to predict outcome, further research should also investigate the role of biofeedback procedures on the therapeutic relationship. Doing so will help to ensure that biofeedback practitioners are not using procedures that could interfere with more important aspects of treatment. In conclusion, further research along the lines of the present study could help convince the broader mental health community that biofeedback is not at odds with common factors, including the therapeutic relationship.

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Appendix A

Stress Profile Note Template

A. Did you make any deviations from the protocol? Review before answering.

Preparation

1. Check biofeedback paperwork

Stress Profile

2. Record ECG, EMG (forehead), SC, and HT data
3. Provide a rationale for doing a stress profile
4. Have a baseline reading and least one stressor plus recovery period
5. Interpret the stress profile with the client

Introduction to diaphragmatic breathing:

1. Record ECG, EMG (forehead), SC, and HT data
2. Provide a rationale for teaching diaphragmatic breathing
3. Teach and practice diaphragmatic breathing (mindful, HRV training, pacer)
4. Provide the client with feedback about their breathing
5. Review the data gathered during breathing practice with the client

Goals

6. Set practice goal (30 min/week of paced breathing)
7. Set awareness goal

If yes, what was the deviation?

B. Client Note

Appendix B

Resonant Frequency Note Template

A. Did you make any deviations from the protocol? Review before answering.

Preparation

1. Review paperwork (including note from session 1)
2. Ask client about their goals from the week before

Resonant Frequency of Breathing

1. Record ECG, EMG (forehead), SC, and HT data
2. Provide a rationale for finding resonant frequency
3. Test all frequencies between 4.5 – 7 breaths per minute
4. Provide the client with feedback about their breathing
5. Review the data gathered during the protocol with the client

If yes, what was the deviation?

B. Client Note