

## ARTICLE

# The Establishment of an On-Campus Neurotraining Center at a Small University: Internship Experience Using Neuropsychological Techniques

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In 2015, Wilkes University's Neuroscience Program and Psychology Department established a unique training and learning center on a small liberal arts undergraduate campus - *The NeuroTraining & Research Center*. This paper shares the purpose of the Center, as a learning tool for Neuroscience majors who engage in internships and research opportunities, and as a means of promoting well-being on the campus by offering training in techniques such as Neurofeedback, Biofeedback and Audio-Visual

Entrainment to the college community. The role that the center plays in connecting real world applications to concepts in Neuroscience, and the approach that the authors have taken to assess student learning is presented in this article.

Key words: neuroscience internship; neuroscience education; experiential learning; applied clinical neuroscience

Since the addition of a new B.S. in Neuroscience in the fall of 2015, Wilkes University has been inspired to create unique learning opportunities for its new majors. Beyond taking the rigorous science foundation courses, and specific Neuroscience courses, Neuroscience majors are required to conduct research in a senior capstone course. Furthermore, the application of some of the Behavioral Neuroscience coursework is being accomplished through a hands-on internship experience that has been developed in the past year. Specifically, a new on-campus facility called the NeuroTraining & Research Center (NTRC) provides internship experience in which interns learn how to use techniques such as Neurofeedback, Biofeedback and Audio-Visual Entrainment (AVE). The interns at the NTRC subsequently employ these techniques to help Wilkes students, staff, and faculty achieve personal goals in the areas of attention, focus, stress management, athletic, artistic and academic performance, and overall well-being. In essence, the internship program at the NTRC gives students hands-on experience with these techniques as they work one-on-one with "clients." Students also have research opportunities in these neurotraining techniques through the NTRC.

## BACKGROUND

In the fall of 2015, Wilkes University opened the doors to a new *NeuroTraining & Research Center* (NTRC). The present authors serve as the co-directors of the center. Dr. Bohlander is a Professor of Psychology at Wilkes University, and is a Pennsylvania-Licensed Psychologist in private working with children and adults with disabilities, using psychotherapy, biofeedback and neurofeedback. Dr. Bohlander is Board Certified in Neurofeedback with the Biofeedback Certification International Alliance (BCIA). Dr. Schicatano is an Associate Professor of Psychology at Wilkes University and is the Coordinator for the Neuroscience Program and the Department of Psychology at Wilkes University. Dr. Schicatano has also received training in neurofeedback with BCIA. In deciding on a

name for the new center, the co-directors used the term "neurotraining" to reflect the notion that clients are not receiving therapy, but instead are exposed to various techniques that ultimately train the brain towards obtaining a positive goal. Within a one year period, the co-directors proposed the center to the administration, received internal funding, and were given space to house the facility. The center now sits in a five-room suite in Breiseth Hall, centrally located on the Wilkes University campus.

Numerous studies have been conducted on the techniques that are employed at the NTRC. A description of these techniques is provided below in the Appendix. The techniques that interns are trained on have been shown to enhance academic, athletic and artistic performance, as well as promote better health and well-being by reducing stress. For instance, neurofeedback can improve music performance, creativity, attentional focus, sports performance, and decrease stress in general (Egner and Gruzelier, 2003; Gruzelier, 2009; Levesque et al., 2006; Perry et al., 2011; Pacheco, 2016). In these instances, clients were trained to increase or decrease the specific EEG waveform parameters associated with improvement in either focus or stress reduction. Biofeedback has also shown significant efficacy for reducing stress and improving athletic performance (Sutarto et al., 2010; Dupee and Werthner, 2011; Perry et al., 2011). Lastly, audio-visual entrainment (AVE) has been studied less, but Siever (2012) reported improvements in stress reduction and enhanced focus after college students were exposed to an AVE procedure. Further research using AVE will be conducted at the NTRC, to reinforce and expand on the findings of Siever (2012).

The NTRC provides services at no charge to all of its clients. It should be noted that the NTRC does not treat any disorders, but instead asks "clients" to identify at least two positive goals (e.g., stress reduction or improved focus/concentration), at which point, the co-directors assign the appropriate training modality for the client. A

student intern then sets up an appointment with the client, and subsequently works with the client to train him/her. Thus, the interns at the NTRC get firsthand experience working with clients in “clinical” type of setting.

## PHYSICAL FACILITY

The NTRC occupies a 1,200 square foot space on the campus of Wilkes University, consisting of a main reception and waiting area, and four individual training rooms.

1. *Waiting Area* with four chairs, and two desks/chairs with three major filing cabinets. A computer with office management program for scheduling clients for receptionist, and table/lamp, telephone and printer are the main pieces of equipment in this area. A CCTV system monitors all rooms and trainees from reception area.
2. *Two Neurofeedback/Biofeedback Rooms* with desk and chair for a technician, desktop computer in each room, reclining chair for client, with 30-inch screen on table right in front of the client. This Nexus 4™ in one room, Nexus 10™ in a second room. The Nexus devices are multichannel biofeedback and neurofeedback hardware units that utilize Biotrace™ software for real-time analysis of biological signals.
3. *Biofeedback Room (HeartMath™ for stress-reduction)* with reclining chair for client, two desks with one desktop and one laptop computer. This room is also used as a research room.
4. *Audio-Visual Entrainment (AVE) Room* divided into three sections with two portable dividers. Two reclining chairs for clients receiving AVE training, and a chair/desk, computer for clients to receive either Heartmath™ training, or to assess attention using the IVA test. Future research using the IVA will determine the efficacy of some of the aforementioned procedures.

## DAILY REQUIREMENTS FOR RUNNING THE CENTER

Both co-directors of the NTRC possess expertise in the areas of Neurofeedback and Biofeedback, and donate their time and knowledge to help create the center and oversee its operation. At least two student assistants (intern or volunteer) are needed to be on duty at any time for the center to be open, one as a receptionist to oversee the operation of the center (schedule appointments, check-in clients, etc.) and the other as a technician working directly with clients. Students work at the center as interns, volunteers or in the future - possibly as paid work-study students. During the first semester (fall of 2015), the center was open for 18-20 hours with five interns, during the following semester the center was open for 25-30 hours a week, with six interns and two volunteers managing the center.

Clients come to the center having been either referred by academic or athletic advisors, or self-referred based upon on-campus marketing of the Center’s services, or “word-of-mouth.” The co-directors have given several presentations to inform the campus about the benefits of the services. The NTRC webpage ([www.wilkes.edu/ntrc](http://www.wilkes.edu/ntrc))

serves as a basic informational page that provides clients with an intake form that they can submit to schedule an appointment. Once a client has set up an appointment, they sit down in a comfortable waiting room until a student trainer (intern) is ready to train them. A client session at the center typically lasts up to 30 minutes. The center is available to the Wilkes University community during both fall and spring semesters. The number of client appointments and the specific training is shown in Table 1. Since only 12 new clients were seen in the fall semester (the first semester that the NTRC was open), these data have not been included. In the near future, the center could potentially be open during the summer months, allowing for more internships and the ability to serve the personal and research needs of students, staff, and faculty who are on campus during this time.

NeuroTraining Center Clients Spring 2016 Semester	
Service	Number of Apts.
Neurofeedback Room 1	56
Neurofeedback Room 2	16
Heartmath	36
Audiovisual Entrainment	53
Station 1	
Audiovisual Entrainment	7
Station 2	
<b>Total</b>	168
No Shows	44
Total Number of Clients	33

Table 1. The number of appointments (Apts.) completed for each of the training techniques at the NTRC during one semester (14 weeks). The number of no shows and total number of different clients in one semester are also shown.

## FINANCIAL CONSIDERATIONS

The costs for the establishment and ongoing support of the NTRC have been low because of the availability of the two co-directors to offer, *pro bono*, their time and expertise in the training of staff and oversight of the center. The co-directors' role in developing and maintaining the NTRC is considered to be valuable service to the University and to the department. In the near future, a lab manager will be hired for 30-40 hours a semester to handle detailed training of interns, and any troubleshooting and ordering of equipment. The entire cost for the setup of the NTRC was approximately \$29,000, half of which provided by the University Provost, and the rest provided by the Wilkes University Student Government Association. A yearly budget of approximately \$3-4,000 maintains the basic upkeep of the center.

## TRAINING OPPORTUNITIES AT THE NTRC FOR STUDENTS

The NTRC provides an opportunity for Wilkes students to obtain valuable training and experience in applied human

neuroscience techniques as part of internship experiences or work-study. These students also acquire office management skills by working the reception area and doing client intake and documentation of sessions. In the past, many of our students who have either minored in Neuroscience or majored in Psychology have continued their education in clinically-based graduate programs in health-related fields (e.g., Counseling Psychology, Physical Therapy, Occupational Therapy, and Medical school). With the addition of a new Neuroscience major, which has 19 freshmen enrolled in the fall of 2016, we envision that this hands-on experience at the NTRC will likely provide opportunities typically not available at other small universities. In addition to learning techniques, interns also gain client interaction skills while developing a professional demeanor, e.g., to be respectful and considerate of the client's needs when working at the center. Likewise, interns quickly become aware of the importance of practicing strict confidentiality when working with clients, as is expected in any health-related field.

## INTERNSHIP QUALIFICATIONS

Three credit internships are available to students who either are pursuing a Neuroscience minor or major, and possess an overall GPA of 3.0 or higher (out of 4.0). Interns must hold a junior/senior status, and are always selected during a screening process held the semester before they conduct their internship. Students are chosen for internships after completion of either a Behavioral Neuroscience or Neuropsychology course at Wilkes. Students are then interviewed by both co-directors to determine if they will be given an internship position.

## SPECIFIC INTERN TRAINING

Interns who work at the NTRC receive hands on experiential learning by training with cutting-edge equipment in the field of Neuroscience and Psychology. For example, every intern is well trained to use Neurofeedback, Biofeedback and AVE with clients. At this point in time, these are the three major training modalities employed at the NTRC. One week before, and during the first week of the semester, interns are trained for approximately 6-8 hours on the Neurofeedback equipment. For the first several weeks of the semester, interns are required to serve as a Neurofeedback client and to practice working in both a client and trainer role to gain expertise with this technique. The co-directors supervise all interns to ensure that they are sufficiently skilled at using the techniques offered. Specific training in Neurofeedback involves:

- Orientation to basic concepts of Neurofeedback in which interns learn how operant conditioning of EEGs can be used as a means for training or changing brain activity in clients.
- Basic understanding of the neurophysiology of the EEG. Readings are assigned from Demos (2005).
- Demonstration and training in use of Neurofeedback software controlling Nexus 10 and Nexus 4 Biofeedback/Neurofeedback equipment.

- Learning client setup for single channel EEG recording and training at Cz, located at the vertex, equidistant from the top of each earlobe (10-20 system). This includes how to attach sensors and test integrity of electrophysiological connections.
- Learning to use software for EEG amplitude and client waveform training and how to troubleshoot if needed.

Interns are also trained for at least two hours during the first week of the semester in using Heartmath™, which is a simpler technique than Neurofeedback for improving heart rate variability (HRV) using operant conditioning to achieve optimal HRV in clients. HRV is the change in time intervals between adjacent heartbeats, and serves as a good indicator of stress levels (Sutarto et al., 2010). A short two-hour training session followed by practice using the technique on fellow interns is sufficient to achieve a reasonable skill level necessary for working with clients. In addition, interns receive approximately two hours of training to use AVE to entrain the brain with flashing lights (presented through goggles) and isochronic auditory tones (presented through headphones). A description of the specific training process for AVE is not included in the present paper (see Siever, 2003; Siever, 2012).

Since interns spend many hours working face to face with clients using the techniques, they are also trained in two separate didactic sessions with the co-directors, covering client confidentiality, informed consent and debriefing. Interns also practice administering informed consent and debriefing information to fellow interns as a means of demonstrating their understanding of these processes.

## INTERNSHIP ASSESSMENT

Interns receive a grade at the end of the semester. Each intern's final grade is based on several factors:

1. Intellectual understanding of the techniques is objectively measured on a test given at the end of the semester. Specifically, interns are required to complete readings about the techniques and their applications (Demos, 2005), and then are given a test on the reading material. Their test score contributes to the grade that they receive at the end of the semester for their internship. This test accounts for 15% of their grade.
2. Interns are required to submit a weekly, one-page reflection paper about their experiences at the NTRC. This reflection typically is based on what techniques they learned and used with clients, and any novel interactions or information learned when working with clients. Reflection papers account for 35% of their grade.
3. At the end of the semester, interns are required to write a 6-10 page paper integrating what they learned during their internship at the NTRC with related fundamental concepts in Neuroscience and Psychology. All papers are graded and contribute to the final internship grade. For example, interns often write about EEG and Neurofeedback techniques, relating these techniques to states of consciousness such as high or low focus/concentration, or high or low brain arousal states,

and abnormalities shown to exist in specific populations such as ADHD or anxiety disorders. For instance, individuals with ADHD/inattentive subtype show a low beta/theta wave frequency. Neurofeedback can improve this ratio in this population, and thus improve focus (La Marca and O'Connor, 2016). This has been one topic often included in interns' papers. The final paper accounts for 25% of their grade.

During the first week of the semester, interns are exposed to informed consent, debriefing, office management/organizational skills, and direct client interaction. Although interns are not tested on this material, they are informally assessed to ensure that they will be able to provide a professional practitioner/client relationship. This informal assessment is performed throughout the semester by both co-directors. Professionalism and observations of intern's skills account for 25% of their grade, and is subjectively assessed independently by both co-directors.

## RESEARCH OPPORTUNITIES AT THE NTRC

The center also possesses resources for empirical research conducted by students and faculty within the Neuroscience and Psychology fields. The equipment available is somewhat specialized, and offers an opportunity for research in the cutting-edge fields of Biofeedback and Neurofeedback. With approximately 150 Psychology majors, 36 Neuroscience majors, and 31 Neuroscience minors, there is a need for hands-on experience with applied technologies for these students. In the past, a high percentage of Neuroscience minors have continued their education in graduate programs. When students apply to graduate schools, research experience at the NTRC will likely be appealing for prospective graduate school admission in the future.

During the first year of operation, two students completed their senior capstone research requirement at the NTRC. One student used the AVE technology in his research to examine the effects of AVE on short term memory, while the other student used EEG as a basic measure of cortical arousal in response to chocolate consumption. These students proposed the research in a Psychology "Research Methods" course, and then during the next semester, collected the data, performed the statistical analyses, and presented the findings in both a poster session, and in a departmental PowerPoint presentation. Independent research opportunities available at the NTRC also allow Neuroscience and Psychology undergraduate majors and Neuroscience minors to work one-on-one with one of the co-directors to propose and test hypotheses in the field. Technologies used in current and future research include; EEG, Galvanic Skin Response, Biofeedback and Neurofeedback.

## DISCUSSION

The internship experience at the NTRC serves as a powerful tool for training students in applied human neuropsychological techniques, enabling them to learn about and apply the techniques, and relate this learning to

a deeper understanding of basic Neuroscience and Psychology concepts.

The co-directors typically give the interns numerous research articles (some articles from the present paper) to help them relate the techniques to Neuroscience and Psychology concepts. As a result, the interns gain an in-depth understanding of the neural substrates involved in EEG, attention, arousal, and stress from these readings. In the future, we will likely administer a test at the end of the internship based on the basic concepts related to the techniques and their application – beyond what is currently given. The results of this test will contribute to the final internship grade.

As mentioned and cited above, there is a considerable research demonstrating the efficacy of Neurofeedback and other Biofeedback techniques in improving attention, school performance, athletic performance, and enhancing psychological well-being by reducing stress. Student interns employ these techniques towards helping clients achieve positive outcomes. At this point in development of the NTRC, no data has been collected regarding the efficacy of the techniques provided at the NTRC. Future research will investigate the effects of neurofeedback, biofeedback, and AVE on client stress reduction, improvements in focus/attention, and psychological well-being. Clients who choose to use the center may benefit in the following ways:

**Decreased stress** – An obvious decrease in stress using these procedures could lead to overall better health and well-being. Effective stress management can improve sleep; test-taking performance as well as individual athletic and creative performances. (For examples of research paradigms and findings, see Hoedlmoser et al., 2008; Ros et al., 2009). Decreased stress also is reported to boost the immune system, and as a result, decrease illnesses (Segerstrom and Miller, 2004).

**Increased concentration and executive functioning** - The training procedures that are employed have been shown to enhance attentional focus and improve decision-making and what is called "self-regulation" (Ros et al., 2009; Hoedlmoser et al., 2008). Thus, training may optimize student's test taking ability (logically leading to improved student performance and potentially increased retention rates) and also enhance the performance of athletes and creative artists.

We think that students (who are clients) exposed to the training offered in the center will see improvements in their academic performance because of decreased stress levels and better focus. These are key factors for helping students stay in college and have a more productive and enriched college experience (Zajacova et al., 2005).

Students considering Neuroscience as a major often consider going to graduate school in Neuroscience or in the Health Sciences. These majors are eventually exposed to coursework representing the Cellular/Molecular and Behavioral subdivisions in the field of Neuroscience, as well as many foundational, basic science courses. Hands-on experience with clients/patients is crucial for students thinking about working in the Health Sciences in the future. The NTRC gives interns this type of experience.

Furthermore, an opportunity to apply information from Behavioral Neuroscience in a manner that directly and immediately helps other people is an exciting notion for our majors. Observing these benefits in clients, and connecting these results with the neurobehavioral processes that underlie the positive changes, is a powerful way for them to learn about Neuroscience.

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## APPENDIX

**Neurofeedback:** Neurofeedback is a brain training technique in which the trainee is rewarded with visual and auditory feedback for making changes to his/her EEG, brain wave patterns (Demos, 2005). It is based upon

operant conditioning principles, well-known in psychology. There are specific brain regions and EEG frequencies that can be trained to produce changes in physical and cognitive states, such as decreasing anxiety, increasing self-regulation, and improving focus and concentration. The type of training that we provide at the NTRC is based upon the client's goals. For example, alpha waves are associated with a "calm, peaceful" state of mind. If a client has a goal of wanting to be calmer, that client may be assigned to a protocol to increase alpha waves. In a neurofeedback session, that client would be provided immediate feedback whenever their brain produced a predetermined amplitude of alpha at a particular scalp site.

With practice, the changes in brain activity (i.e., desired EEG frequency) become easier to produce, and typically become habitual, as with any learned behavior. The research literature on the benefits of neurofeedback is extensive (see Demos, 2005; Levesque et al., 2006). Additionally, after examining the extant empirical literature, *The American Academy of Pediatrics*, in 2013, listed neurofeedback as a "Level 1 – Best Support" treatment for the symptoms of attention deficit disorder – difficulty maintaining focus and concentration. Neurofeedback has primarily been used at the NTRC as a tool for reducing stress, and/or improving focus/concentration. More information about neurofeedback can be obtained by visiting *The International Society for Neurofeedback and Research* ([www.isnr.net](http://www.isnr.net)) or *The Association for Applied Psychophysiology and Biofeedback* ([www.aapb.org](http://www.aapb.org)).

**Biofeedback:** Biofeedback involves the training of any of a number of physiological modalities, including heart rate, heart rate variability, the electrodermal response, respiration, and electromyographic activity. Similar to neurofeedback, an operant conditioning procedure is employed to increase or decrease a desired physiological process. By being provided with feedback (visual or auditory) about the status of a particular autonomic nervous system function, an individual can learn to alter that activity (see Sutarto et al., 2010).

The NTRC offers biofeedback in two ways. First, by targeting a physiological system over which the client wishes to gain some control (e.g., breathing, heart rate, etc.). This procedure enables monitoring and feedback of that system for the purpose of learning to exercise control over one's physiology. This type of control over one's physiology is conducive to reducing stress and increasing self-efficacy (Sutarto et al., 2010).

**HeartMath™:** The second way that biofeedback is being utilized at the NTRC is through use of HeartMath™. This particular biofeedback software provides a computer-based approach to stimulating the relaxation response, leading to decreased physiological arousal and greater sense of well-being. Using biofeedback principles based upon heart-rate-variability (enhancing the differential heart rate between the periods of inspiration and of expiration), this modality enhances calmness and reduces bodily and mental tension. More information about biofeedback can be obtained by visiting [www.isnr.net](http://www.isnr.net) or [www.aapb.org](http://www.aapb.org).

**Audio-Visual Entrainment (AVE):** This training modality involves the presentation of pulsing tones and flashing lights via headphones and goggles. The frequency and intensity of the stimuli can be specified in order to “entrain” brainwave rhythms to a faster or slower pace. This change in brain activity may be expected to produce varying effects, including improved focus and attention, or decreased stress and tension. The effects typically do not last more than a few hours following an AVE session. This modality has been used to create short-term improvements in cognitive performance and stress reduction. It is often used by athletes prior to a contest, and by students prior to an examination. (More information about the AVE procedure and research can be obtained at [www.MindAlive.com](http://www.MindAlive.com).)

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