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Intentional Excellence in the Baldwin Wallace University Neuroscience Program

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The Society for Neuroscience recognized Baldwin Wallace University's (BWU) undergraduate Neuroscience program as their *Program of the Year* for 2012. This award acknowledged the "accomplishments of a neuroscience department or program for excellence in educating neuroscientists and providing innovative models to which other programs can aspire." The Neuroscience program grew out of students interested in studying the biological basis of behavior. BWU's neuroscience major is research-intensive, and all students are required to produce an empirically-based senior thesis. This requirement challenges program resources, and the demand for faculty attention is high. Thus, we developed an intentional 3-step peer mentoring system that encourages our students to collaborate with and learn from, not only faculty, but each

other. Peer mentoring occurs in the curriculum, faculty research labs, and as students complete their senior theses. As the program has grown with over 80 current majors, we have developed a new Neuroscience Methods course to train students on the safety, ethics, and practice of research in the neuroscience laboratory space. Students in this course leave with the skills and knowledge to assist senior level students with their theses and to begin the process of developing their own projects in the laboratory. Further, our students indicate that their "peer mentorship was excellent," "helped them gain confidence," and "allowed them to be more successful in their research."

Key words: peer mentoring; best practices; Baldwin Wallace University

History of BWU Neuroscience Program:

The waning years of the twentieth century saw a tremendous increase nationally in collegiate programming and professional development for budding neuroscientists (Ramos, 2011). Students began designing their own major, pulling from courses in Baldwin Wallace's well-established Departments of Chemistry, Psychology, and Biology. A logical evolution was for the University to follow suit, sanctioning the creation of a neuroscience major in 1999.

The path leading to the program's fruition began in 1993, with the selection of Dr. G. Andrew Mickley. Tasked with the formation of a new program, he oversaw the administration, organization, and critical funding essential in the development of any fledgling program. The curriculum quickly gained traction from students and staff, as well as early financial support from National Science Foundation grants including Instrumentation and Laboratory Improvement (ILI) and Research in Undergraduate Institutions (RUI) awards. Later on the program was boosted by NIMH Academic Research Enhancement Awards (AREA; (R15).

Within the time span of six years, inception became implementation. Laboratories carved from repurposed spaces evolved into a well-equipped, dedicated neuroscience laboratory. Equipment and supplies were gathered, accelerating the evolution of the program from that of a minor to a major. Additional staff and faculty were hired, including Dr. Brian Thomas in 2001 and Dr. Jacqueline Morris in 2004, contributing new areas of research and expertise to the curriculum, in addition to ensuing administrative oversight.

Physical, professional, and financial expansion continued, as the abilities of students and staff followed



Figure 1. BWU neuroscience students, alumni and faculty receiving the 2012 Society for Neuroscience Program of the Year award at the 42nd Society for Neuroscience meeting. (Picture *Front row:* Ben Brown, Joe Luchsinger, Diana Slawski, Kara Gawelek; *Second row:* Morgan Rogers, Taylor Shreve, Logan Sirline, Janace Gifford, Rachel Zacharias, Marissa Ruddy, Jenny Remus, Gina Wilson; *Back Row:* G. Andrew Mickley, Sean Anderson, Chris Turner, Armand DeAsis.

suit. The Interdisciplinary Neuroscience Society (i.e., the student neuroscience club) began meeting on campus grounds in 2002. In 2007, the first chapter of *Nu Rho Psi*, the National Honor Society in neuroscience, was established on our campus with the induction of two faculty and 14 student members. *Nu Rho Psi* was founded by the Faculty for Undergraduate Neuroscience under the leadership of Andy Mickley, who is currently serving as the Executive Director. A most significant affirmation of the University's confidence in the program came in 2010, with

the renovation, enlargement, and rededication of the Neuroscience program lab space.

After nearly two decades at the helm of the department, Dr. Mickley retired from his position as Program Director, handing the reins to the faculty he was so instrumental in bringing together. From its nebulous beginnings in the early '90s to the acclaim of being awarded the 2012 Program of the Year (Figure 1), neurosciences at BWU have continued to be current and consistent in its drive for excellence.

Curriculum:

Neuroscience students graduate with two majors. All major in neuroscience and then also major in one of three more-traditional disciplines: biology, chemistry, or psychology. Students begin courses in chemistry, biology, and psychology to build a foundation for the interdisciplinary study of neuroscience. A new addition to the curriculum is a course introducing students to laboratory practices in neuroscience. They then complete courses in anatomy, physiology, statistics, research methods, and the foundation course for the neuroscience major, Principles of Neuroscience. Upper level curriculum varies for each student dependent upon their second major. Many students complete courses such as Organic Chemistry, Biochemistry, Genetics, Sensation and Perception, Biochemistry, Learning and Memory, or Developmental Biology. Required upper-level courses for neuroscience majors include Physiological Psychology and Neuropharmacology. The capstone course for the major is a guided research project with a faculty mentor. Most students begin with a faculty-directed reading of the literature in the spring semester of their junior year. Once the research plan has been developed, students conduct their laboratory research in the neuroscience laboratory or at an off campus location arranged through the Neuroscience Program director. Students at Baldwin Wallace have conducted thesis research at the Cleveland Clinic and NASA Glenn Research Center as well as NSF REU sites across the nation. The senior thesis capstone culminates in a research paper graded by two faculty mentors from separate disciplines and a public presentation.

With over 80 current students, neuroscience is very popular at the University. Since the inception of the program in 1999, the interest and numbers of students has steadily risen with a peak in growth between 2006 and 2008 (Figure 2). In order to maintain the research intensive environment for all students we have utilized and adapted the peer mentoring approach previously described (Mickley et al., 2003).

Peer Mentoring as a Tool to Support Research Training:

It is widely accepted that teaching a skill to someone enhances the teacher's skill as well. Yet, peer mentoring in higher education is often relegated to assisting student adjustment to college or academic tutoring - not usually to enhance research skills. As neuroscience undergoes growth worldwide, undergraduates are seeking laboratory

experiences in which they become full partners with their peers and faculty in the design, conduct, and documentation of experiments that are publication worthy.

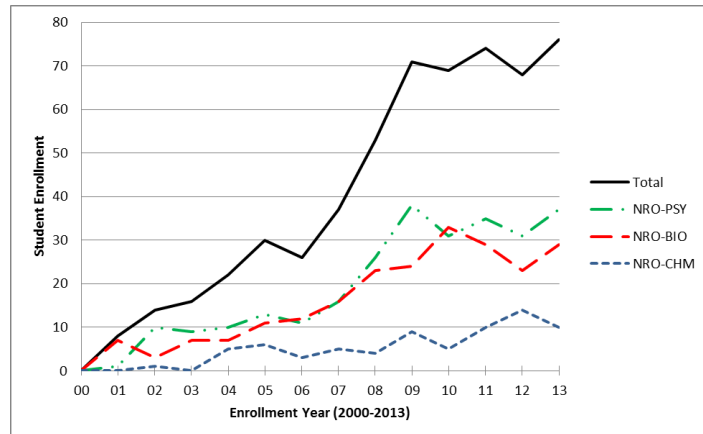


Figure 2. The number of students enrolled in the Neuroscience program at Baldwin Wallace University has grown substantially since its inception in 2000 (black). The breakdown into each double major shows that the growth is across all three Neuroscience majors in Biology (red), Chemistry (blue) and Psychology (green). Enrollment data were collected each fall.

We have *intentionally* developed a **3-step peer mentoring system** that encourages our students to collaborate and learn from, not only faculty, but each other.

Three-step peer mentoring system:

1. Peer Mentoring and the curriculum.

Neuroscience Methods Course

In order to address the growing number of students entering the program and streamline training for students, we started a new course (1 credit hour) in the fall 2014 for students in their first year at Baldwin Wallace (a course syllabus is available on the FUN website in the syllabus folder). The idea is not unique to Baldwin Wallace University as Dr. Eric Wiertelak, Professor of Neuroscience, has taught a similar course at Macalester College for neuroscience students. Dr. Wiertelak describes his course as a boot camp introduction to laboratory practices (Eric Wiertelak personal communication).

In the first year of our course, 27 students enrolled (22 first-year and five transfer students). The goal of the course was to familiarize students with the neuroscience laboratory including safety procedures, faculty and staff, as well as opportunities to conduct research. The course allows us to train students prior to entering the laboratory so that they have a more standard foundation for equipment operation and safety procedures. Additionally, this saves time for the faculty to train the students in basic laboratory safety. With four faculty members, two staff, and 40-50 students conducting research, attending labs and working in the neuroscience laboratory space each semester, we benefitted from streamlining standard lab practices. In the evaluations at the end of the term, most

students felt that the laboratory safety, animal handling and equipment tutorials were important skills learned during the course. Another outcome from the course was that six students decided not to pursue a neuroscience major. Many students enter a neuroscience major without a complete understanding of the reality of conducting research and laboratory practices. During this course, students were immersed in the neuroscience lab and techniques which allowed them to make an informed decision about their future early in their college experience. Another goal in this course was to explore career opportunities in neuroscience using the Society for Neuroscience website. Students watched the videos of neuroscientists in a variety of careers and then reflected on their own future career in neuroscience. Many students see neuroscience as a pathway to medicine or research, but not teaching, policy advocacy, science writing or work in the pharmaceutical industry - to name a few. Neuroscience students were excited to learn about the variety of careers open to them and enjoyed taking the time to analyze how their strengths and weaknesses would match a variety of career paths.

“It [Neuroscience Methods course] has exposed me to peers with similar interest as well as given me a peek at what actually happens in the lab. It’s one thing to see data; it’s another to know where the data come from and how to obtain it.” Anonymous first year Neuroscience major on course evaluation in Fall 2014

Additionally, this course encouraged students to strengthen their math skills. We used lab math worksheets (available online <http://www.bio-link.org/GMP/math.htm>) to test their skills in calculating proportions, molarity, and dilutions. Students with difficulties in lab math had time to build their skills and receive coaching by peer mentors to develop their abilities. Overall, we expect that this new course will reinforce the peer mentoring aspect of the program. Having acquired baseline knowledge and safety skills in this course, many of the students have entered faculty labs and/or work with senior students as junior researchers within their first or second semester at BWU.

Supplemental Learning

Peer mentors serve as course assistants in all Neuroscience courses. The upper-level students prepare review sessions, read and edit papers, and tutor to assist students with little background in the sciences and math to develop the competencies needed to succeed. Also, in order to conduct research-intensive experiences in the laboratories, peer mentors assist the faculty by demonstrating techniques and guiding students during their first experiences with animal handling and operating behavioral equipment. These opportunities support students as they learn and they also provide occasions when more-senior students can teach their younger peers.

2. Peer Mentoring and work in faculty labs.

Students at BWU frequently start laboratory internships as freshmen or sophomores and enter a faculty and peer

mentoring system where they are trained in a structured, progressive manner. Students are given the Neuroscience Lab Manual with standard operating procedures for all techniques used in the laboratory.

“The fact that we are encouraged to mentor others has given me the belief that I can develop leadership skills even before my career matures. I also have realized the importance of being patient and paying meticulous attention to detail, and that mistakes by new students provide teachable moments that help my mentoring skills grow.” Morgan Rogers, a BWU Neuroscience and Psychology graduate now pursuing a Ph.D. in Behavioral Neuroscience at Boston College

As new techniques are used, students work with faculty to add these protocols to the manual. They first observe the particular task they wish to learn (this could be in the first year Neuroscience Methods course or shadowing another student, faculty or staff). Once they have watched this skill for the first time, they have a faculty member, staff, or a peer mentor verify this by signing on the '*observation*' line of a checklist. Students next *perform* the skill under supervision, and finally are *tested* on the skill. Once this process is complete, students are then qualified to perform this particular task on their own (Mickley et al., 2003). We have found that this method of initial observation, training and testing has been *instrumental in maintaining quality control* in the laboratory.

3. Peer Mentoring and Senior Theses.

“I entered the Neuroscience Lab during my sophomore year as an assistant to a senior working on her thesis. Through this experience, I learned a vast array of lab techniques and developed a strong interest in neuroscience research. I interned in the laboratory shortly thereafter. Research has enhanced and expanded my education experience at Baldwin Wallace, and I encourage other students to pursue their own research interests. I look forward to bringing on other students to work on my own senior thesis project in the hopes of sparking a similar passion.” Kara Gawelek, A BWU neuroscience, chemistry and biology graduate pursuing an M.D. at Case Western Reserve University

Once students have completed the Neuroscience Methods course they are ready to assist upper level students in their Senior Thesis. This portion of the program is student-driven and was started and organized by students in our *Nu Rho Psi* chapter and Interdisciplinary Neuroscience Society (INS). During honor society or INS meetings, students describe their research plan, then students interested in working with them sign up to help. The senior student contacts student trainees, selects individuals to help, and organizes the schedule for completion of the project. During the experimentation phase of the thesis, the senior students serve as project managers organizing undergraduate assistants in the collection of data, for example, mounting brain sections, counting neurons and assisting in surgical procedures. This win-win paradigm provides students performing their senior theses with the

help they need on their projects while the mentees learn new lab techniques that will be utilized when they complete their own senior theses. Many times the mentee will continue the research started by the senior student, this continuity in projects allows students and faculty to move forward towards the goals of publication and grant proposal preparation.

Demonstrated Success of the Program

Success in student satisfaction

During the summer of 2012 Neuroscience majors at Baldwin Wallace University were encouraged to complete an anonymous online survey about peer mentoring at the University. Participants (N=23) strongly agreed that the peer mentoring program increased their lab skills, communication skills and research skills. Additionally the survey demonstrated student satisfaction that peer mentoring provided opportunities to obtain their career goals and learn more about Neuroscience. For a copy of the survey contact Dr. Jacqueline K. Morris the corresponding author.

Success in advanced training:

Our student's acceptance rate in graduate, medical, dental, and veterinary schools stands close to 100% for the students who apply for these programs. Of the 64 students who have graduated from the program 65% have earned or are enrolled in programs for advanced degrees in neuroscience research or medicine. The remaining individuals are working in the research or healthcare field with degrees in counseling, anesthesiology assistant, and physician assistants or working in research laboratories. The emphasis of undergraduate research combined with a foundation in the liberal arts has been a recipe for success in the BWU Neuroscience program.

Success for the University and beyond:

Institutional: Neuroscience peer mentors are recognized as enthusiastic ambassadors that are used by our undergraduate research office to go into classrooms to inform students about research opportunities on the BWU campus. As a result, student recruitment and interest in science has grown consistently since it began in 2000 (Figure 1) and graduation rates are near 100% in these peer mentors.

Community: Neuroscience students are active in community outreach events such as Brain Awareness Week activities. For example, during the last academic year, high school students were invited into our labs where they learned basic neuroscience techniques such as neurohistology from our peer mentors. Neuroscience student mentors also taught elementary school children about autism and educated them about the basic mechanisms of sensation.

Summary:

BWU's award-winning Neuroscience program has thrived, in no small part, due to its use of peer mentoring techniques. The program produces strong neuroscience students who are research-active, often published as undergraduates, and successful in life and career. Peer mentoring encourages cooperative learning and teamwork that prepares students for collaborative research projects throughout their careers. Peer mentoring provides an efficient method to supplement faculty mentoring in the laboratory. BWU's Neuroscience program encourages student to become engaged in their own learning and as mentors and that, it turns out, is satisfying for students and faculty alike.

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