

ARTICLE

Community-based, Experiential Learning for Second Year Neuroscience Undergraduates

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Service learning is becoming a keystone of the undergraduate learning experience. At Stonehill College, we implemented a service learning course, called a Learning Community, in Neuroscience. This course was created to complement the basic research available to Stonehill Neuroscience majors with experience in a more applied and “clinical” setting. The Neuroscience Learning Community is designed to promote a deep understanding of Neuroscience by combining traditional classroom instruction with clinical perspectives and real-life experiences. This Neuroscience Learning Community helps students translate abstract concepts within the context of neurodevelopment by providing students with

contextual experience in a real-life, unscripted setting. The experiential learning outside of the classroom enabled students to participate in informed discussions in the classroom, especially with regard to neurodevelopmental disorders. We believe that all students taking this course gain an understanding of the importance of basic and applied Neuroscience as it relates to the individual and the community. Students also have used this concrete, learning-by-doing experience to make informed decisions about career paths and choice of major.

Key words: Learning Community; Service Learning; Neuroscience education; undergraduate Neuroscience curriculum; experiential learning; clinical experiences

INTRODUCTION

The popularity of service learning is on the rise and is quickly becoming a norm across undergraduate education from large research institutions to small liberal arts colleges. This trend has impacted Neuroscience curricula. For example, Tulane University and Denison University (Murray 1997; Mead and Kennedy, 2012) offer service learning as a component of their Neuroscience programs. A unique feature of service learning is that it allows students to leave the traditional college environment and participate in real-world challenges in a meaningful way. When students leave their campus and serve the surrounding community, they learn how to apply what they are learning in class to real-life settings.

The Stonehill College Cornerstone curriculum requires that all students enroll in a “Learning Community,” typically during their sophomore year. In summary, Learning Communities (LCs) are two classes taken during the same academic term that enroll the same cohort of students. The two classes are united around an interdisciplinary theme and emphasize critical thinking, problem solving, and experiential learning. Learning Communities exemplify Stonehill's commitment to create a student-centered climate that promotes academic challenge, cooperative learning, and authentic community. (Visit the Stonehill College LC website for more information on learning communities offered. <http://www.stonehill.edu/offices-services/community-based-learning/current-courses/>)

Meeting the needs of a growing Neuroscience program with limited resources:

Amid the increasing role that service learning plays in undergraduate curricula across the country, there is also an increase in the popularity of an undergraduate Neuroscience degree (Ramos et al., 2011). The Neuroscience major at Stonehill College was established in

2006. Since then, the number of declared Neuroscience majors at Stonehill rose rapidly and reached a peak in 2010. Since then the popularity of the Neuroscience major has remained high with only a slight decline (Figure 1). We surmise that the slight drop in majors is due to the addition of two more semesters of chemistry that were added to the curriculum in 2011.

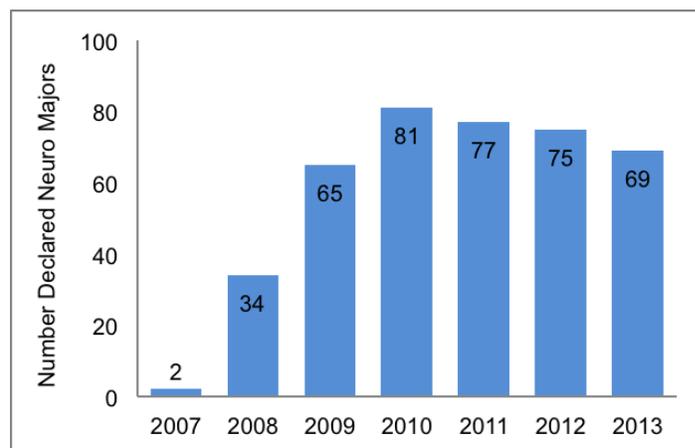


Figure 1. The number of declared Neuroscience majors has increased since the Neuroscience Program began in 2006. These data represent a snapshot of declared Neuroscience majors in the fall semester of each year shown.

The number of students majoring in Neuroscience increased at Stonehill due to several factors, including innovative initiatives in the Chemistry department, the opening of a new state-of-the-art Shields Science Center in 2010, and the addition of another faculty member. Understandably, the increasing demand for Neuroscience (and other sciences), combined with the finite resources such as faculty appointments, grants, and competitive

research opportunities limited our ability to provide students opportunities to participate in basic laboratory science. Besides these limitations, we realized that many of our majors seek more applied, real-world experiences in addition to traditional lab bench Neuroscience. In response to limited resources and the need to provide additional opportunities for our Neuroscience majors, we developed our own *Learning Community* course.

Translational Neuroscience Education:

The Neuroscience Learning Community (LC) was designed primarily for Neuroscience majors. This LC pairs a traditional course, *Brain and Behavior*, with a seminar in more advanced topics: *The Neurological Basis of Behavior*. *Brain and Behavior* provides students with a comprehensive overview of the nervous system while *The Neurological Basis of Behavior* takes a more clinical and applied approach to Neuroscience. In addition to these two more traditional learning formats, students are also required to volunteer on the weekends at the Yawkey House of Possibilities (HOPE House), a local non-profit organization that serves children with developmental disabilities.

The HOPE House is a place for the children to gather and gain social skills while participating in recreational activities. Another function of the HOPE House is to provide respite for primary caregivers of those with developmental disabilities in the community. More than half the children at the HOPE House (ages ranging from about 6 to 18 years of age) have been diagnosed with an autism spectrum disorder, which includes autism, Asperger syndrome, pervasive developmental disorder not otherwise specified (PDD-NOS), childhood disintegrative disorder, and Rett syndrome. Other children have been diagnosed with Down's syndrome, Angelman syndrome, language aphasia, among others.

According to the 16th Edition of Family TIES of Massachusetts, the HOPE House is one of two "in-house" respite homes in the state. Furthermore, it is the only "in-house" respite home located on a college campus in the United States, according to the House of Possibilities website. Because the facility is on the Stonehill campus, the college is in a unique position to offer the HOPE House as a service-learning site. Because the HOPE House's proximity is an advantage for students at Stonehill, similar programs could be implemented at other colleges and universities by partnering with such facilities (Mead and Kennedy, 2012). Thus, students learn about the nervous system in the classroom during the week and devote part of their weekends to helping children at the HOPE House develop social skills. What ties the weekend experience to Neuroscience is that students in the Neuroscience LC are expected to apply concepts learned in the classroom to their service learning experience at the HOPE House. (To learn more about the HOPE House, visit <http://www.houseofpossibilities.org>.)

After completing the Neuroscience LC students should possess an advanced understanding of the nervous system in the normal state and in abnormal conditions such as Down's syndrome and autism. Because this LC

approaches Neuroscience from both a basic research approach as well as from an applied perspective, we believe this combination helps each student attribute greater meaning to their learning experiences. Based on individual feedback and journal entries, we have found that students invest in learning Neuroscience from all perspectives and value Neuroscience research as it relates to the world. An additional benefit of the LC is that it helps students formulate career paths based on their unique interests.

COURSE DESCRIPTION

The description for the Neuroscience Learning Community is as follows:

LC 282A Neuroscience: Mind, Body, Community

What makes us who we are? Is it our experiences? Is it our memory of our experiences? Is it our relationships with others? Is it our ability to know our loved ones? Neuroscientists have shown that brain disorders can selectively destroy each of these aspects of who we are. This LC combines aspects of biology (The Neurological Basis of Behavior) and psychology (Brain and Behavior) with a truly unique and exciting experience in that students will participate in community-based service learning at the Yawkey House of Possibilities, a facility on the Stonehill campus that provides care for children with neurodevelopmental illness. By combining these three experiences students will gain a deep and integrative insight into neurodevelopment from a psychological, biological and personal perspective.

Learning Outcomes for the Neuroscience LC are to:

- *Describe differences in individuals with the same "diagnosis."*
- *Without having complete information, make genuine, important decisions that have consequences.*
- *Describe how developmental disorders impact a family, as a whole.*
- *Relate class material to real situations in two ways: (i) by connecting concepts from class with experience and then reflecting on the connection to gain deeper understanding and (ii) by understanding, in general, the relevance of academia to the real world.*
- *Take initiative to get things done with an underrepresented population.*
- *Assess the impact of respite care on child and family.*
- *Discriminate between motor, cognitive and behavioral problems and describe within the context of the brain.*

Course Mechanics

The rationale for taking a Learning Community in the sophomore year is that students have the initial preparation from freshman introductory courses such as *Introductory Biology I and II* and *General Psychology*, needed to participate in the applied topics seminar's deeper discussions of the biological basis of normal and pathological behavior. All students at Stonehill College must declare a major by the end of their sophomore year. Thus, one important benefit of taking the LC in the

sophomore year is that students are afforded an opportunity to explore a field of study in enough depth to make an informed decision about their major.

Brain and Behavior, The Neurological Basis of Behavior, and the integrative seminar component of the LC equal nine credit hours (the equivalent of three standard courses). Thus, students are fully immersed in learning Neuroscience on a variety of levels during the semester. In addition to working with the children on Saturdays, the students take *Brain and Behavior* and *The Neurological Basis of Behavior*. *Brain and Behavior* is an introductory course covering the “nuts and bolts” of the nervous system, including development, and is taught by a Stonehill Psychology professor. In contrast, *The Neurological Basis of Behavior* is team-taught. Three lecturers are Stonehill College professors, while two lecturers are neurologists from Boston’s top teaching and research hospitals. Due to the variety of expertise in this team-taught course, students also gain a clinical perspective in *The Neurological Basis of Behavior*. For both *The Neurological Basis of Behavior* and the integrative seminar (LC 282A), students are required to read and prepare synopses or critiques of primary literature. We provide the students with a selection of peer-reviewed Neuroscience articles and reviews pertinent to the children with whom they are working, and the students select which articles to read and review. (See syllabi for more information.) Below are two examples of reviews from last year’s class:

Baird AD, Scheffer IE, Wilson SJ (2011). Mirror neuron system involvement in empathy: a critical look at the evidence. *Social Neuroscience* 6:327-35.

Rizzolatti G, Fabbri-Destro M (2010). Mirror neurons: from discovery to Autism. *Exp Brain Res* 200:223-37.

From their observations at the HOPE House, the students learn that children with autism exhibit deficits in the ability to imitate others’ behaviors, as well as display deficits in their ability to understand others’ intentions and emotions. From the research articles, such as those cited above, and from lectures given by the team of neurologists and professors, the students learn that imitation is often used as a proxy for empathy (though they also learn that the actual evidence for this connection is rather weak). Students learn about mirror neurons, their location in the brain, and their purported function in mediating imitation and empathy. The students review the current state of evidence with regard to the hypothesis that deficits in imitation and empathy may be mediated by dysfunction of the mirror neuron system in children with autism.

The community-based learning component of the LC is coordinated with the administrators of the HOPE House. Studies have shown that social skills intervention programs such as the one provided at the HOPE House help children with autism spectrum disorders and other developmental disorders in multifaceted ways (Krasny et al., 2003; Tse et al., 2007; McMahon et al., 2012). At the HOPE House, children with developmental disabilities engage in recreational activities that focus on skill practice with peers.

The goal of the activities is to develop self-confidence and self-esteem.

During the semester that they are enrolled in the LC, students are required to commit their Saturdays to spending the day with the children at the HOPE House. While the students are not provided with formal training that is required of developmental specialists, the students are given an introductory seminar led by the director of the HOPE House. This seminar involves introducing the students to the organizational structure and professional staff of the HOPE House, as well as providing a review of general safety precautions and protocols. To the extent possible, each student is then paired with a specific child for the duration of the semester. Students work with their matched child at each visit to the HOPE House. Interactions may involve conversation, playing board games, creating art projects, performing in plays, or participating in sports. The children at the HOPE House gain confidence and learn social skills, while the students observe first-hand the challenges that developmental disorders present.

As mentioned previously, the implementation of this LC is facilitated by the fact that the HOPE House is located on Stonehill’s property and only a short walk from the center of campus. Most other LCs offered at Stonehill necessitate travel to off-campus locations. Because all learning communities at Stonehill have the college’s support in the form of General Education or Academic Enrichment funds, if travel were necessary, monetary assistance would be provided. This assistance extends beyond simply traveling to and from the LC sites. For example, recently the HOPE House has begun to take the children to local events such as apple picking or on excursions to places such as Franklin Park Zoo in Boston. The funds that Stonehill generously provides to the LC cover the cost of admission tickets and transportation for the students enrolled.

ASSESSMENT OF STUDENT LEARNING

Students receive three separate standard letter grades, one for the *Brain and Behavior* course, one for *The Neurological Basis of Behavior* course and one for the integrative seminar component (LC 282A). The letter grade for *Brain and Behavior* is based mostly on exams. The letter grade for *The Neurological Basis of Behavior* is based on three equally weighted exams (25% each), a homework assignment (5%), and two short written summaries/reviews of scientific journal articles (10% each). The letter grade for the community-based learning is based on attendance at the HOPE House, feedback from HOPE House administrators, and a reflective journal submitted by each student detailing his or her experience and thoughts. (See supplemental materials for examples of syllabi for each LC component.)

Community learning enhances motivation and real-time problem solving

In this LC, students honed their observational skills while working with the children at the HOPE House. As referred to above, students were required to keep a weekly journal that recorded, in both an objective format and a reflective

format, their observations of the children. The students' journals often included proposed strategies to help bring a child "out of his or her shell" since some of the children at the HOPE House can be very shy or nonverbal. Some students reported in their journals that over the course of a semester they managed to develop a relationship with a child. Often students wrote about the progress they made with their "matched" child.

While the development of a relationship with a child at the HOPE House may appear to indicate success from the perspective of the student, it actually indicates the development of problem solving skills, which is one important concrete goal of the LC. Students in this LC are not trained therapists and they are not expected to treat the children at the HOPE House. However, in reading each student's journal we look for signs of keen observation, planning of appropriate games, and evaluation of their own strategies to help the child gain confidence and social skills. Part of the challenge in this LC is that the student is put in a mildly uncomfortable and unfamiliar setting, and with limited structure, the student must observe and assess potential challenges and then solve problems in real-time. For example, a quote from one student's journal included:

"...his running was constant and at some point it seemed like a game to him...during the movie he sat on my lap and in order to keep him from running I kept my arms or legs always moving to keep him from becoming agitated."

Children with developmental disorders may be hyperactive and internalizing (Macintosh and Dissanayake, 2006) and thus can often be difficult to work with. This is especially true when children are nonverbal and there is a paucity of reciprocity such as eye contact and facial expressions (American Psychiatric Association, 1994). In order to insure that they focused on some of the difficult behavior patterns, students in the LC were instructed to include in their journals such objective observations as hand wringing, lack of eye contact, etc. Additionally, because of the inherent challenges faced when working with children who have developmental disorders, the LC students were also expected to include in their weekly journals a section of personal thoughts and reflections. Eyer, Giles, and Schmiede (1996) suggest that an opportunity to reflect on community work enhances the critical thinking skills of students and provides an opportunity to examine values. This subjective outlet provided the students in the LC with an opportunity to reflect on their feelings. As one student wrote,

"Working at the HOPE House was an amazing experience. It took me out of my comfort zone and forced me to present to a much different audience."

In the reflective portion of the journal we found that sometimes students would express their frustration with their lack of progress with their paired child. Other students expressed pride in the children and themselves when some progress was made or a goal was met.

Learning Communities help students make informed decisions about choice of major

Because of the exposure to the applied aspect of the Neuroscience field, students complete the Neuroscience LC with a better understanding of what field of study they want to pursue. Therefore, another effect of this course is a "weeding out", but not in the traditional sense. For example, students enter this course having a general idea of what they want to do when they graduate. The majority of students enrolled in the Neuroscience LC are Neuroscience majors (54%), although another substantial percentage comes from other related majors such as Psychology (18%) and Biology (11%) (Figure 2A). One possible reason why students in other majors such as Psychology select the Neuroscience LC may be that they need or desire to have clinical experiences.

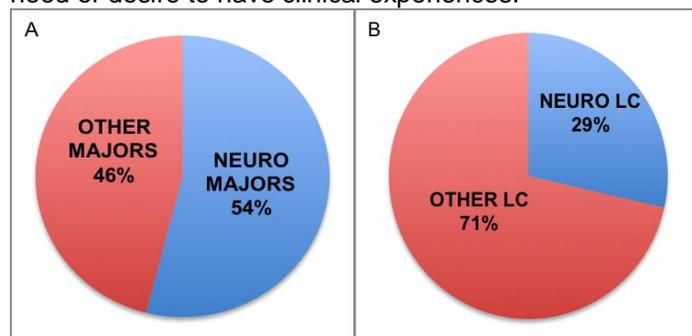


Figure 2. A) Percent enrollment in Neuroscience Learning Community from 2009-2012 by major. NEURO = Neuroscience, OTHER = Psychology (18%), Biology (11%), Criminology (2%), Economics (2%), Healthcare Administration (2%), Interdisciplinary Science (2%), International Studies (2%), and Undeclared (11%). B) Percent of Neuroscience majors selecting various Learning Communities. NEURO = Neuroscience: *Mind, Body, Community*. OTHER = *Organic Chemistry of the Cell* (13%), *The Practice of Medicine and You* (13%), all other learning communities (45%).

While it is true that most students who enroll in the Neuroscience LC are Neuroscience majors, it is not the case that most Neuroscience majors take the Neuroscience LC. It is the single most popular LC for Neuroscience majors, being selected by 29% of the Neuroscience majors, but 71% of the Neuroscience majors opt to take a different LC entirely (Figure 2B). For example, a popular LC for Neuroscience majors who plan to apply to medical school is *Organic Chemistry of the Cell* taken by 13% of the Neuroscience majors. Another 13% of Neuroscience majors planning to enter allied health programs after graduation opt to take *The Practice of Medicine and You*. In the final analysis, 45% of Neuroscience majors decide to take an LC that is offered through the humanities departments. The decision to choose a Learning Community unrelated to one's major may be due to the emphasis placed on a liberal arts education at Stonehill College, the availability of various LCs that involve national or international travel, or the draw of an LC that matches one of the student's other interests.

We looked at retention in the Neuroscience major by comparing the rosters of the Neuroscience LC from 2009-2012 with the rosters of the required senior Neuroscience Capstone course from 2011-2013. This serves as a proxy

for those whom we expect to graduate with a Neuroscience degree. Of the 31 students who were Neuroscience majors at the time of the Neuroscience LC, 48% went on to take the Capstone; 23% are currently juniors and are not yet eligible to enroll in the Capstone; 23% switched out of the Neuroscience major some time after taking the Neuroscience LC; and 6% withdrew from the college (Figure 3A).

We also looked at retention in non-Neuroscience majors. Of the 26 students who were not Neuroscience majors at the time of the Neuroscience LC, 42% of students did not change majors; 38% later changed their majors to Psychology; 15% later changed their majors to Neuroscience; and 4% later changed their major to Political Science (Figure 3B). It is important to acknowledge, however, that the move into or out of any major did not necessarily follow the immediate completion of the Neuroscience LC, thus we cannot claim the LC itself was a deciding factor in the decision to change.

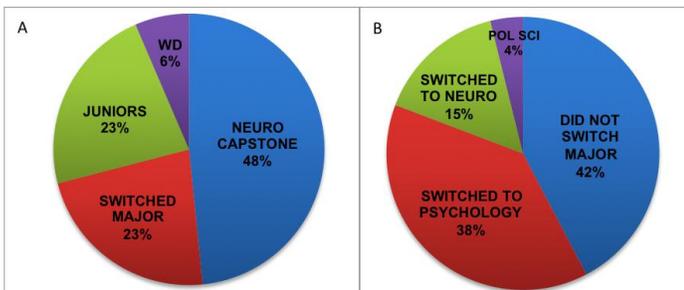


Figure 3. A) Retention and attrition of Neuroscience majors from 2009-2012 after completing the Neuroscience LC. 48% ($n = 15$) of Neuroscience majors who complete the Neuroscience LC have taken the Neuroscience Capstone in the senior year. 23% ($n = 7$) of Neuroscience majors who took the Neuroscience LC are currently juniors and have yet to take the Neuroscience Capstone. 23% ($n = 7$) of Neuroscience majors who took the Neuroscience LC switched their majors (Psychology $n = 2$, Communications $n = 1$, Criminology $n = 1$, Healthcare Administration $n = 1$, Sociology $n = 1$). 6% ($n = 2$) of Neuroscience majors who took the Neuroscience LC withdrew (WD) from the school. B) Of undeclared or non-majors who completed this LC ($n = 26$), 42% did not change majors ($n = 11$), 38% ($n = 10$) changed their majors to Psychology (including double majors), 15% ($n = 4$) changed their majors to Neuroscience, and 4% ($n = 1$) changed their major to Political Science.

Strikingly, when we looked at all non-Neuroscience majors who completed this LC but who later declared or changed their majors after taking this LC, we see a substantial number switching into Psychology. Specifically, 38% of all students who declared majors or changed their major after taking this LC, declared or changed their major to Psychology, a closely related major (Figure 3B).

Despite the fact that the LC has existed for only three years and the number of students who have taken this LC is still small, we suggest that the clinical and hands-on experiences of this LC tend to help some students steer away from more biological-based approaches to Neuroscience and helps students to target their interests in a more human-centered direction.

Since, as previously mentioned, the LC experience may

not be the deciding factor for students switching into or out of the Neuroscience major, it is worth considering other factors that may contribute to attrition from the Neuroscience major after taking the Neuroscience LC. Most students take the Neuroscience LC in fall of their sophomore year, at a time when many students still have substantial core coursework to complete for the neuroscience degree. For example, we require four semesters of Chemistry, a Research Methodology course, and encourage those who plan to pursue a graduate degree to complete Calculus I and II in addition to Physics I and II. Few of these courses are completed by the fall of the sophomore year. Thus, an interest in Neuroscience might draw students to the LC, but further research into the requirements of the major might lead some to decide on a different course of study. Based on this reasoning, we suggest that the exposure students receive in the Neuroscience LC to some psychological principles draws some students to a related field that does not require Chemistry, Calculus, or Physics.

COURSE EVALUATION

As part of our on-going efforts to improve the Neuroscience LC, on the last day of class the students are asked to fill out course evaluations. Four important questions were asked:

- 1) Name one strength describing how Dr. Dawson's class, Prof. Goyette's class and the HOPE House experience seemed integrated. Comments we received included:
 - "It was very interesting because we could take what we learned in Dr. Dawson's class and really apply to what we experienced at the HOPE House."
 - "All three worked very well together. We can learn about disorders in Dawson's class, how the brain works in Goyette's class, and then see first-hand at the HOPE House."
 - "The academics in both classes make it possible to understand the material because you can clearly relate the material learned to the children seen at the HOPE House."
- 2) Name one weakness suggesting disintegration between Dr. Dawson's class, Prof. Goyette's class and the HOPE House experience. Comments included:
 - "I struggled with the biological aspects as a psychology major at times, but it was usually manageable."
 - "I did not think that there was much disintegration. In Goyette's class a lot of the biology was covered which was helpful to understand how the diseases that were discussed in Dawson's class were caused and treated, and this can be seen in the children at the HOPE House."
- 3) Please give a specific example of an assignment, project, presentation, or activity that asked you to synthesize ideas from the different courses or perspectives within the LC. Comments included:
 - "Volunteering at the HOPE House gave me the

opportunity to critically think and apply what I have learned in each of the classes.”

- “We had to write an essay on something we learned in class and [relate] it to our trips to the HOPE House.”
- 4) At Stonehill, LCs are typically a second-year requirement. Given the choice of placing LCs in the first year, second year, or third year of college, which would you prefer? Why? Comments included:
- “I think second year is a good year. I think it really helped me decide that neuroscience was what I wanted to study!”
 - “Second year as it helped me to declare my major in neuroscience. Wasn’t sure before what I wanted to do.”

In the assessment surveys we found that the most negative comments from students regarding the Neuroscience LC seemed to come entirely from students who struggled with the heavy biological emphasis in the *Brain and Behavior* course. However, based on the largely positive feedback we received from students, we believe that the Neuroscience LC resulted in greater motivation to learn class material as well as a better overall understanding of the concepts. Some students from this LC even continued their work as a summer volunteer or as an Independent Study with the goal of designing activities aimed at promoting social interaction among children with neurodevelopmental disabilities. A number of our Neuroscience alumni who completed this LC matriculated in doctoral programs and other graduate programs, some with an emphasis on special education and early learning. Other alumni secured employment as special education teachers after graduating from Stonehill. Other Neuroscience alumni went on to pursue graduate studies in Neuroscience with an emphasis on basic research (Figure 4).

For our ongoing assessment purposes, we plan to conduct interviews when the course is complete rather than questionnaires so that we may have students expand on their thought processes. This will enable us to obtain even more constructive feedback from those students who completed the LC. One important additional question we plan to add to our survey will pertain to choice of major. We would like to determine if the Neuroscience LC experience helps students decide on or change majors. If the student is changing his or her major, it will be interesting to see if the trend toward choosing Psychology remains strong.

DISCUSSION

Today, traditional classroom instruction is being supplemented with experiential learning for a variety of reasons. The Neuroscience LC at Stonehill College is an example of a course that gives students real-world experience. First, students are invested in learning when given opportunities to apply classroom content to personal experiences (Boylan, 2004). Second, students are able to expand their learning horizons and critical thinking skills

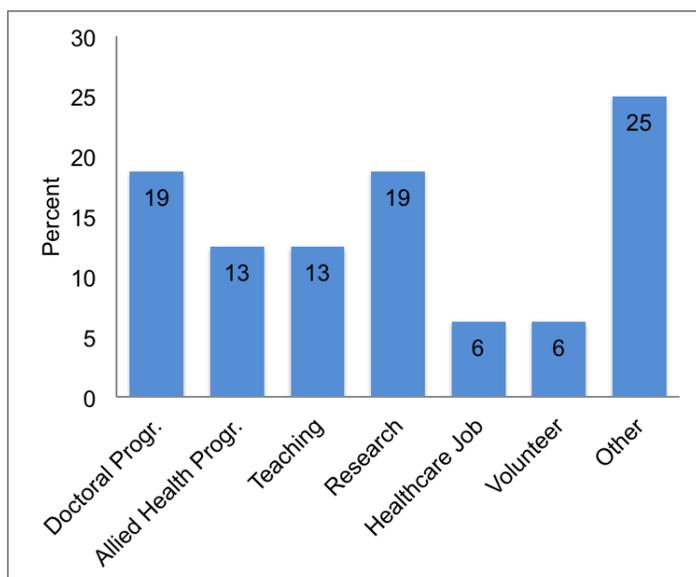


Figure 4. Neuroscience LC graduate outcomes (2009-2013). Neuroscience graduates who took the Neuroscience LC enter a variety of graduate programs and professions. Doctoral programs include MD, PhD, and DO. Allied Health programs include NP, PT, PA, and BSN. Teaching includes employment as a special education teacher. Other includes consulting, business, administration, and no response.

beyond what is possible in the classroom or in a laboratory course (Simons et al., 2011). Third, we found that students are able to explore a field in enough depth so they can make an informed decision as to what major or career path to pursue.

From a pedagogical perspective, the Neuroscience LC is designed to help students organize information by making connections at multiple levels: molecular, anatomical, cognitive, and behavioral. Doing so promotes deeper and more enduring understanding (Leamson, 1999; National Research Council [NRC], 2000). This LC aims to incorporate “best practices” based on empirical work that suggests students learn best by beginning with a concept and then exploring that concept through several distinct lines of active inquiry (Felder, 1995; Felder and Brent, 1996; Huba and Freed, 2000; NRC, 2000; Handelsman et al., 2004; Knight and Wood, 2005; Lawson, 2006).

In *Brain and Behavior* students begin to understand the brain starting at the chemical and molecular level of organization. In *The Neurological Basis of Behavior* students approach Neuroscience from a more clinical perspective, by incorporating advanced anatomical and systems level understanding of brain function. In the weekend visits to the HOPE House students observe children with specific developmental deficits first-hand. Thus, *Brain and Behavior* and *The Neurological Basis of Behavior* provide a foundation of knowledge, while the community service component provides students with “socially responsive knowledge” and real-world experience. Students in this learning community participate in “knowledge integration” (Linn et al., 2006) in the same way scientists make connections among diverse yet interrelated information. Thus, students who complete this LC not only

develop a broader understanding of Neuroscience, they also gain the contemporary perspective that to properly answer scientific questions, knowledge must be incorporated from several lines of evidence.

According to Gardner (1993), a true understanding of any subject requires students to take foundational knowledge and apply that knowledge to new situations “for which that knowledge is appropriate.” This is one of the key problem solving learning outcomes of the Neuroscience LC. Furthermore, Boylan (2004) believes that students tend to pursue knowledge and a deeper understanding of the material if they have direct and immediate ways to apply new information. This is particularly important in a field such as Neuroscience that is at the interface of scientific inquiry and social responsibility. This conclusion is corroborated by studies showing that students enhance their learning in the classroom by concurrently participating in service learning (Eyler and Giles, 1999; Simons et al., 2011). Our observations lead us to believe that students in the Neuroscience LC progress through Kolb’s learning cycle, which involves concrete experience, reflective observation, and abstract conceptualization (Kolb, 1984). According to Kolb, students who participate in all aspects of this learning cycle learn better and attribute greater meaning to their learning (Kolb, from Bringle and Duffy, 2006) than students who only focus on one or two components of the learning cycle such as memorizing specialized vocabulary or procedures (Boylan, 2004). The design of this LC fosters involvement in all aspects of Kolb’s cycle, thereby affording students maximum opportunity for learning Neuroscience.

Besides gaining a deeper understanding of Neuroscience, students who complete this LC learn the importance of Neuroscience in everyday life. One critical learning outcome of this LC that was highlighted in several responses and journals is to understand the importance of studying Neuroscience not only from a scientific and biological viewpoint, but just as importantly, from a humanistic point of view. For example, one student wrote

“...After completing this LC I now have a greater respect and understanding of what parents of developmentally disabled children go through...”

Based on comments such as this, we will continue to assess in our interviews and questionnaires whether this LC promotes advocacy for Neuroscience research.

Finally, one unexpected, but equally important outcome, was that this LC helped a number of students decide on majors and career paths that are best for them. For example, at some time after taking this LC, a few students switched into the Neuroscience major while a several others switched out of the Neuroscience major. We believe that this LC helped students select paths that are right for them by providing an opportunity to explore Neuroscience in depth and in a hands-on way. One student who was particularly thankful for the experience of this LC wrote in her journal that she

“Thought she wanted to be a behavioral therapist before

this LC, but after experiencing how difficult and emotionally draining it can be... decided to pursue an alternative career path.”

For some students the decision to pursue an alternative path meant leaving the Neuroscience major; for other students it meant honing in on a related career path. This is supported by the fact that a significant number of non-Neuroscience students who took this LC declared Psychology as their major at some point after taking this LC. It is unclear whether the post-LC declaration of a Psychology major is due to a positive clinical experience in this LC. Alternatively, the switch to Psychology may also be due to the heavy Biology and Chemistry emphasis along with Psychology requirements in the Neuroscience curriculum that discourages some students from pursuing the Neuroscience degree. We feel that any attrition that may have occurred as a result of taking this LC is not necessarily a bad thing since all students made informed decisions about their choice of major. Clearly, meaningful, real-world experience allowed each student to decide on a career path that is best for him or her. Going forward, we plan to add further questions to our course evaluations that pertain to major selection and career choice.

Higher learning institutions continue to see increasing enrollments in Neuroscience (Ramos et al., 2011) and based on our assessment, the Neuroscience Program at Stonehill College appears to follow the national trend. Because we find that most students who take this Neuroscience LC continue in the Neuroscience major and go on to take the Neuroscience Capstone course, we believe the LC promotes considerable interest in the field of Neuroscience, but provides an opportunity to reflect on choice of major early in the college career. Furthermore, since many of our Neuroscience graduates matriculate into graduate programs in Neuroscience-related fields such as medicine, research, counseling, and education, we believe exposure to the clinical aspects of the field contributes to their breadth of knowledge regarding the opportunities available to those with a Neuroscience degree. Thus, in the final analysis, despite high enrollment numbers and finite resources, we are able to provide an in-depth learning experience in Neuroscience through this Learning Community. In addition, we are able to provide real-world experiences that enable students to make confident, informed decisions about their career paths going forward.

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Received July, 02, 2013; revised September 05, 2013; accepted September 12, 2013.

We thank neurologists Dr. David Dawson and Dr. Adam Cohen for their lectures in *The Neurological Basis of Behavior*. We also thank Paula Kavolius, Amy Mirabito, and Kristen DeSisto of the Yawkey House of Possibilities for facilitating our collaboration. We also thank the students of LC 282A for feedback on this course. Thank you to Veronica Dunn for the registrar data and to Corey Dolgon, the Director of Community-Based Learning.

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