Interdisciplinary Bachelor of Science Degree in Neuroscience
University of Nevada, Reno
2016 Program Review

Self-Study Report

Prepared by Michael A. Webster and Grant Mastick (Co-Directors)

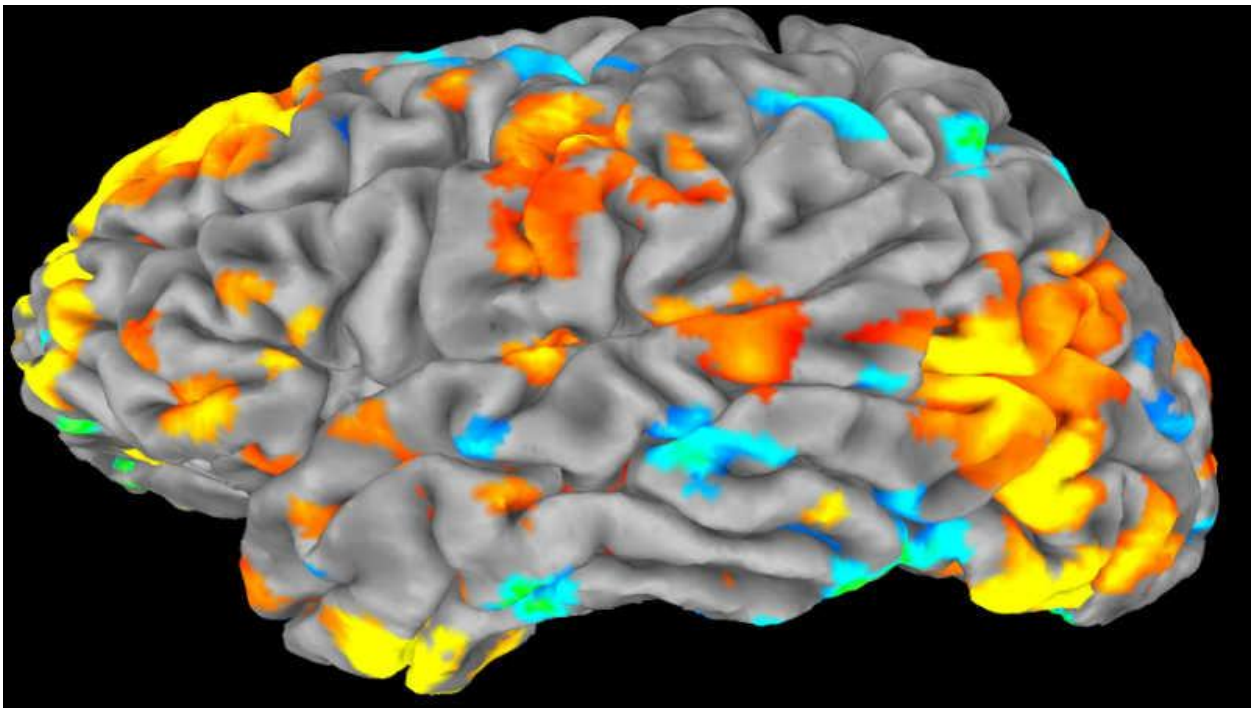

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Table of Contents

Self-Study Report

Appendices

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(Submitted March 14, 2016)

Overview

The Bachelor of Science degree in Neuroscience was initiated in 2008 as a training program offered jointly through the Departments of Psychology and Biology, and was the first interdisciplinary degree at UNR to span two colleges (Liberal Arts and Science). It is served by a core of roughly 19 teaching faculty in the two departments along with a wide range of affiliated faculty with neuroscience interests, who hold appointments throughout the campus and the School of Medicine. The degree is designed to provide students comprehensive training in the foundations of modern neuroscience, from the cellular to systems level; a solid foundation in general science, psychology, and biology; as well as general core knowledge and skills consistent with a broad university education. The degree also exposes students to a variety of research experiences and draws on a wide range of research resources including core facilities supported by center grants for neuroscience. A major aim of the degree program is to equip students with the knowledge and skills that will prepare them to successfully pursue graduate studies or careers in a variety of basic and applied disciplines in neuroscience-related fields, from cognitive and biological sciences to biotechnology and medicine.

History

The concept of an undergraduate neuroscience degree program at UNR was initiated by M Webster and developed by faculty in Psychology and Biology who considered their own work to be closely aligned with the discipline. Psychology had faculty in cognitive neuroscience while Biology was building strengths in cellular and molecular and developmental neuroscience, and course offerings in both departments were already providing substantial content in brain sciences. The goal of the program was to leverage these strengths as well as bring faculty with shared interests together to tailor a training program focused on basic principles of neuroscience, spanning levels from genetics to behavior. A survey of other universities at the time showed that undergraduate neuroscience degrees were already common at many US institutions (numbering roughly 200 today), ranging from research-intensive universities (e.g. NYU, Duke, UCLA) to undergraduate liberal arts colleges (e.g. Oberlin, Vassar, Wellesley). Moreover in schools that offered the degree it was often among the most popular majors. This suggested that there is high demand for graduates with the degree for advanced graduate programs or in industry, and consistent with this, the last decade has seen a strong priority on neuroscience research by funding agencies (e.g. NIH and NSF), special federal initiatives (e.g. the recent Brain Initiative), and industry (e.g. pharmaceutical, biomedical, and “smart” technologies). The proposal for the degree was developed based on extensive planning and discussions led by M Webster in Psychology and G Mastick in Biology. Outside consultations

were provided by J Movshon (Director of Neuroscience, NYU) and B Olshausen (Director of Redwood Center for Theoretical Neuroscience, UC Berkeley).

The degree was approved and formally launched in Fall, 2008. The curriculum was designed to draw roughly equally from courses in Psychology and Biology, and thus the major fell largely within these departments which are housed in the College of Liberal Arts (CLA) and College of Science (COS) respectively. As such neuroscience was the first interdisciplinary undergraduate degree at UNR to span two colleges. To maintain connections to both departments it was decided to appoint both M Webster and G Mastick as co-directors of the program.

The degree was started without adding any new courses or faculty, and thus was assembled based on courses already offered by both departments. This was a practical limitation because faculty were already committed to full teaching loads. However, in 2013 with the hire of new faculty it was possible to add two new courses specifically for the degree. BIOL/PSY 105 was added as an introductory survey course designed to provide an overview of the major as well as highlight the neuroscience research programs of faculty at UNR. BIOL/PSY 479 was implemented as a team-taught laboratory methods course specifically for upper division students in the major. These two newly developed courses were given dual listings between BIOL and PSY because there is not yet an NSC prefix associated with any courses, and were designed to be taught by faculty from either department. More recently a number of additional new courses have also been developed with a focus toward the degree. These included BIOL 476/676: Clocks, Rhythm, and Disease and BIOL 477/677: Genes, Brain, and Behavior. Other courses (e.g. BIOL 403/603: Genomics and Bioinformatics) are currently in the pipeline to be added to the major, with still other courses (e.g. Cognitive Neuroscience and a Capstone) under development. In 2014, Ilya Vilinsky (Director of the Neuroscience Major at U Cincinnati) was invited to visit UNR to provide an evaluation of the new BIOL/PSY 479 lab course as well as the overall degree program. The evaluation is provided in Appendix 4. In 2015, courses in the major were also evaluated to align them with the core objectives of UNR's new Silver Core Curriculum, which will be implemented in Fall, 2016.

As documented below, growth in the major has been explosive. The proposal projected an enrollment of 50 students by the 5th year, but the number of majors instead grew to 220 in that time, and there are currently 368 declared neuroscience majors. This rapid growth placed a number of strains on the resources for both teaching and advising, as well as for providing students access to research or direct learning opportunities. Each of these issues is detailed below. The mechanics of administering the program across the two departments and colleges also raised a number of challenges. To try to address these, a meeting was held in 2013 that included the co-directors, chairs of Psychology and Biology, and representatives of both colleges. The meeting was led by J Cline (Vice Provost, Undergraduate Education). This meeting resulted in a memo of understanding between the colleges and departments for jointly running the program (Appendix 3). The degree program was also included under a newly formed academic unit representing interdisciplinary programs, which is under the administration of

Provost Cline. M Webster and G Mastick were reappointed as co-directors at this time. CLA and COS continued to provide the faculty and advising for the program and each receive full FTE's for the students. The program has since operated under this structure.

Broader context of neuroscience at UNR

Over the last several years UNR has launched a number of initiatives that have resulted in rapid growth in both research and training programs in the neurosciences. These initiatives have brought many new resources and faculty as well as educational and outreach activities. They thus provide an important broader context for evaluating the educational opportunities afforded by the Neuroscience BS program. The following lists a number of these initiatives and programs.

1. Program Grants. As an IDEA state, Nevada is eligible for substantial NIH funding targeting research and infrastructure development. These include COBRE (Center of Biomedical Research Excellence) center grants, which provide ~$10 million in funding for 5 years (renewable for up to 15 years), including R01-level funding for junior faculty project leaders and funding for research cores. UNR currently has 2 COBRE's in their first phase, both with a focus on neuroscience. The COBRE for Cell Biology (PI C von Bartheld) was awarded in 2011 and funds research project leaders in the School of Medicine (SOM) and Biology, with a primary focus on cellular and molecular neuroscience. The COBRE for Integrative Neuroscience (PI M Webster) was awarded in 2012 and supports faculty in Psychology, Biology, and Biomedical Engineering, including projects on cognitive and cellular neuroscience. A new COBRE for Epigenetics in Development and Disease (PI W Yan) is currently under review and will include further projects and cores impacting neuroscience. UNR also has a longstanding INBRE (IDEA Network of Biomedical Research Excellence) grant (PI J Kenyon), which has just been awarded a renewal, and supports statewide infrastructure and education, including pilot grants for junior faculty and research cores. In addition, the COBRE for Smooth Muscle Plasticity (PI K Sanders) is currently in Phase III and has focused on research and cores related to the enteric nervous system. Finally a new COBRE for Neurodegenerative Diseases (PI J Cummings) was recently awarded to the Cleveland Clinic/RUVO Center in Las Vegas in partnership with UNLV, with plans to develop shared activities with the UNR COBREs. In sum, these IDEA grants have allowed an enormous infusion of funding and research in labs of faculty directly involved in the Neuroscience BS degree, and have helped UNR recruit or propel a large number of early-career neuroscience faculty. Although these research programs do not directly support the undergraduate degree program, the degree benefits from increased numbers of research-active faculty, and many increased opportunities for undergraduate research.

2. Research Infrastructure. A second important component of the IDEA funding is the development of research core facilities. The specific cores and equipment are listed in Appendix 2. The COBRE for Integrative Neuroscience currently supports cores dedicated to neuroimaging, molecular imaging, and access to special populations (e.g. TBI) for research. The neuroimaging core provides the equipment, access, support, and training for 2 high-density EEG systems and

fNIRS (housed in Psychology) and confocal microscopy (housed in Biology). In 2014, the core initiated a partnership with the nearby imaging center at Renown Health to purchase a head coil and display to allow for fMRI studies using their 3T MRI scanner. These neuroimaging systems are now all in widespread use by both faculty and students. The newly established molecular imaging core (also part of the Neuroscience COBRE) provides equipment and training for imaging biomolecules including DNA, RNA, proteins and dyes as well as centralized facilities for media preparation for model organisms. The Cell Biology COBRE includes cores for electron microscopy, cell metabolism analysis, confocal imaging, transgenics, and tissue culture, with plans to implement an optogenetics core in Phase II. Other IDEA-funded cores include fluorescence-activated cell sorting / flow cytometry and single cell molecular expression (Smooth Muscle Plasticity COBRE) and core facilities for bioinformatics, proteomics, genomics, cytometry and in vivo imaging (INBRE). Thus there has been enormous growth and modernization in the neuroscience facilities and consequent research at UNR, directly impacting a large number of undergraduates involved in research. One important impact on the neuroscience curriculum has been an enriched research infrastructure that contributes to students' directed learning courses as well as experimental modules in the BIOL/PSY 479 lab course.

3. Neuroscience Graduate Program. In Fall, 2015 the university formally launched a new interdisciplinary MS/PhD Graduate Program in Integrative Neuroscience. The program is co-directed by M Webster, G Mastick, and J Kenyon, and thus includes the two co-directors of the BS program. A total of 4 new Graduate Teaching Assistant (GTA) lines have been allocated to the program, with the stipulation that the support is for teaching assistantships for courses contributing to the undergraduate Neuroscience degree. This increased TA support contributes to key Neuroscience courses, including BIOL 315: Cell Biology, BIOL 475: Neurobiology, BIOL 395: Cell Biology and Genetics Lab, PSY 405: Perception and PSY 427: Computer Applications. Fifty faculty are affiliate members of the graduate program, with representation from most colleges and SOM. These faculty – who have self-identified as researchers within the neurosciences – are listed in Appendix 5. The degree program began with an initial cohort of 8 graduate students, a number of whom received their BS degrees in Neuroscience at UNR. In February 2016, an NSF NRT was also submitted (PI G Mastick) to fund a training program within the degree in the area of neuroplasticity. The graduate program fills an important missing gap in the neuroscience education programs at UNR, and plans are being developed to integrate the program with the undergraduate degree. The BS degree program is likely to be an important pipeline for the graduate program, which will in turn provide an important avenue for advanced training for students in the Neuroscience major.

4. Neurology Department. As part of the growing partnership with Renown Health, SOM also recently launched a new Department of Neurology, which became active in 2015. The faculty are drawn from clinicians at Renown's Institute for Neuroscience. The Neurology group has potential to offer clinically relevant internships which will be of interest to undergraduates, as well as guest lectures on neurology topics to enrich the undergraduate courses.

5. Faculty growth and strategic cluster hires. These programs have seen concomitant growth in new positions for neuroscience faculty. For example, the Cognitive and Brain Sciences Program in Psychology (CBS) has increased from 6 tenure-track lines when the BS was started to currently 8 lines, while Biology has hired several new neuroscience faculty since the start of the major (now totaling 8 molecular neurobiologists, and 8 ecologists who study aspects of animal behavior). New hires in departments such as Physiology have recruited neuroscience faculty as part of the Cell Biology COBRE, while departments including Mathematics and Computer Science have also brought in faculty with research and teaching interests in neuroscience. Last year the university requested proposals for cluster hires to develop UNR's strength in targeted strategic areas. A cluster of 8 new faculty over the next 3 years was approved for neuroscience. In the current year this includes two new cognitive neuroscience hires in Psychology (a spousal hire for L Strother and a search that is currently at the offer stage), and two searches in Biology targeting neurobiology and optogenetics (also at the offer stage for both positions).

6. Activities and outreach. In 2008 a local chapter of the Society for Neuroscience was established by C von Bartheld. The chapter hosts a number of activities including an annual conference with invited speakers and student posters. Recent speakers have included Nobel Laureate T Sudhof (Stanford), J Neitz (U Washington), and S Luck (UC Davis). The Neuroscience COBRE also hosts a regular NeuroLecture seminar series that brings roughly 1 speaker per month and has included leading researchers such as K Deisseroth (Stanford) and J Gallant (UC Berkeley). In 2014 a UNR chapter of the national neuroscience honor society Nu Rho Psi was founded. The initial induction included a keynote lecture by M Goodale (U Western Ontario) and the coming induction is planning to host R Shapley (NYU). There is also an active student-led organization entitled Nevada Neuro Society that is involved in a number of activities including organizing a regional SFN Brain Bee competition for northern Nevada. These different programs have been heavily involved in recruiting undergraduate Neuroscience majors to undertake community and outreach activities including activities and talks as part of Brain Awareness Week. Through these events students in the neuroscience major have access to a wide range of activities and exposure to top researchers in the field.

Organizational Structure

As an interdisciplinary program, there are no faculty with FTE's directly linked to the neuroscience program, and faculty instead participate from their home departments. Consequently the faculty membership of the program is somewhat amorphous, but can be roughly divided into 4 tiers. The first involves individuals formally appointed for administering the program. This includes the two co-directors (M Webster and G Mastick). Both have served as directors since the inception of the program and were reappointed in 2013. The memo of understanding for the degree states that directors will serve renewable 3-year terms, and thus their current terms are nearing an end. As described above, a co-directorship was implemented to ensure that the program had equal input and representation from the two main participating departments. The co-directors carry out an increasing service role for the program, including annual program assessment, ensuring that departments contribute balanced resources to

curriculum development and advising, gaining approval for courses for the new Silver Core university core program, and recruiting efforts by the colleges. The program also has an appointed curriculum committee, which reviews new courses and curricular issues. This committee consists of the co-directors and a representative from Psychology (J Hutsler) and Biology (T Kidd). The curriculum committee also receives input from the academic advisors for students to the program.

The second tier of faculty constitute individuals who teach courses directly within the discipline. These include required courses for the degree such as Neurobiology (BIOL 475) and Physiological Psychology (PSY 403). These faculty are almost all housed in either psychology or biology, and are also members of the new graduate program in neuroscience. Typically these individuals are included in general discussions and planning for the program. The CV's of these faculty are included in Appendix 6. A third tier is faculty from both departments that provide the foundation courses for the major, such as introductory psychology, cellular and molecular biology, or statistics. These are often taught by researchers from other fields, they are not typically involved in the program, and their courses are not explicitly tailored for neuroscience content. The final tier to be noted is the wide umbrella of faculty who conduct neuroscience-related research. As noted 50 faculty are part of the Integrative Neuroscience graduate program, and there are many additional faculty with relevant research interests spread throughout the campus. These include many faculty at SOM who by the nature of their appointments are not involved in undergraduate teaching. However, these faculty nevertheless often contribute to the program by providing research experience for students in the major, or promoting activities such as neuroscience chapters or seminars related to the major. They are thus an important factor in shaping the larger culture of neuroscience education on the campus.

Psychology and Biology fall under different colleges, and thus the degree program is jointly administered under both CLA and COS. Students receive their degree from both colleges, and both colleges receive full FTE's for each student in the major. As an interdisciplinary degree, the degree is also directly under the administration of the Vice Provost for Undergraduate Education (J Cline). This was formalized as part of the memo of understanding between the colleges.

There is currently no specific support for administering the program and no operating budget, and all resources for mounting it are therefore borne by the participating departments and colleges, and by individual faculty. It should be emphasized that this burden comes on top of two departments that already mount two of the largest undergraduate majors at UNR. The co-directors do not receive a stipend or course release, though a course release for M Webster has been provided by the Chair of Psychology for Fall, 2016. The program has also operated without classified staff support. However, Psychology has been approved for a new administrative assistant 2 position that will begin in the summer of 2016 and who will assist with both the Neuroscience undergraduate program and the Cognitive and Brain Sciences graduate program. Until recently teaching assistantships supporting the program have come from the two departments. However, the new Neuroscience graduate program has an allocation of 4 TA lines

that require assisting with courses that contribute to the undergraduate degree. Finally, substantial funds for securing the equipment and supplies for mounting the Neuroscience Lab course were provided by an Instructional Enhancement Grant awarded to Neuroscience faculty. Resources for advising are described below.

Curriculum

As noted, the curriculum for the Neuroscience degree is almost entirely mounted from existing courses. There is currently no dedicated neuroscience prefix for courses, and all courses instead have the prefix and cross-listings to their home departments. The curriculum was originally designed for 128 credits and then revised to 120 credits in 2012 to align with the university's broad goal to shorten degree requirements to allow faster time to completion.

The specific degree requirements and recommended schedule, as recently aligned with the Silver Core Curriculum, are given in Appendix 1. Required course work includes completing the university-wide core curriculum and a range of general courses providing foundational knowledge in math and statistics, and science including general chemistry and physics. Students also complete a set of core requirements in biology and psychology that include general and experimental psychology, and cellular and molecular biology, organismal biology, cell biology and genetics. These then culminate in upper division courses in neurobiology and physiological psychology. As part of the core curriculum students must also complete two integrative "capstone" courses designed to synthesize their skills and knowledge. There is not yet a capstone course specific to Neuroscience, and many students take the "Evolution" course in Biology to fulfill one of the two required capstones.

As noted previously, a number of new courses have been added specifically for the Neuroscience program. These include new broad-content courses (e.g. BIOL/PSY 105 and 479) as well as greater options for specialized electives (e.g. BIOL 476/676: Clocks, Rhythm, and Disease and BIOL 477/677: Genes, Brain, and Behavior). BIOL/PSY 105: Introduction to Neuroscience is required for the major but open to non-majors. This survey course is designed primarily for freshmen, and provides an overview of the field as well as an introduction to the different faculty and labs at UNR. The 105 course provides an important opportunity for students to get a "real" neuroscience course early on, while their schedule is otherwise filled with preparatory or introductory courses in chemistry, physics, math, etc. The course has a single instructor of record that is currently alternating between Biology and Psychology faculty. However, it typically includes weekly guest lectures from many of the Neuroscience faculty. BIOL/PSY 479: Techniques in Neuroscience Laboratory was introduced to provide a formal lab course for the major. Course enrollment is limited to 20 students based in part on available lab equipment, and the course is currently offered once per year. This is a team-taught course coordinated by A Altick, in which different faculty run labs ranging from single unit recording to EEG. The course provides one option for meeting the directed learning / independent study requirement for the degree, which aims to give students hands-on research experience. Other courses that satisfy this requirement are research courses in Biology or Psychology that provide credit for working in a faculty lab, the senior thesis options in Biology or Psychology, and the

honors thesis for students in the Honors Program. The focus of the required Experimental Psychology course (PSY 301) is also on methods and experimental design, and provides exposure to core experiments and techniques in cognitive science along with student-initiated research projects. This course culminates with a poster session in which students present their projects.

The degree requirements are complemented by a set of electives within the major. Students must complete 6 courses, 3 from a cluster of biology electives and 3 from a cluster of psychology electives. The biology cluster includes courses such as developmental biology, animal behavior, and anatomy and physiology, while the psychology cluster exposes students to topics ranging from cognitive science and perception to neuropsychology. Two philosophy courses (Philosophy of Cognitive Science and Philosophy of Mind) are included within the psychology cluster. This cluster also provides a course on computer applications (PSY 427), which currently involves an introduction to Matlab programming for cognitive science experiments. The cluster electives also provide an option for taking direct learning (research experience) credits.

The final set of courses are general electives. While not required for the major, premedical students are also advised to complete two semesters of organic chemistry to meet the entrance requirements for medical school. The degree is popular with premed students, and is one of only 6 majors participating in UNR's BS-MD Accelerated Program, which admits high-achieving high-school seniors directly into medical school, attending UNR for 3 years and then entering SOM in their 4^{th} year.

To align with the major requirements for COS, the neuroscience degree does not require that students complete a minor, though many students choose to complete a minor or a second major. Biology opted not to allow a minor with Neuroscience because of the high degree of course overlap. To address student requests, Psychology allows a minor to obtain training in clinical areas of psychology, such as abnormal psychology or personality. These courses do not count toward the psychology electives for the Neuroscience major.

Advising

Like the curriculum, advising for the major is provided jointly by Biology and Psychology. In 2012 COS and Biology requested handling all advising for the first two years. One argument for this is that the biology courses follow a much more linear and prerequisite-dependent sequence than psychology courses, so that scheduling is more critical to fulfill the biology requirement. COS has also included Neuroscience as part of its SCI 110 (First Year Experience) course, and this coming year will include Neuroscience as part of the Science Fit Bootcamp (a week long orientation designed to better prepare incoming freshmen for their future courses). Inclusion in these programs has posed some issues discussed below under challenges. For upper division students, an agreement was reached to split advising alphabetically, with COS taking students with last names starting with the first half of the alphabet and CLA the second. Neuroscience students also have access to a professional academic advisor who can provide

advice on professional graduate schools including medical school. The advisors in Psychology also provide a series of workshops (preparing for graduate school, careers in psychology, networking, direct learning information, navigating academic requirements in MyNevada) which are open to both psychology and neuroscience majors.

There are large disparities in the resources available for advising. Biology has a team of advisors who are non-tenure track faculty in the department, and a lecturer and advisor specifically for Neuroscience is being recruited. Psychology has so far relied on a 20 hr graduate assistant line funded by CLA to help with the neuroscience advising. This position is not permanent and must be re-requested from the college each year. As of this year Psychology will also have two faculty advisors (G. DeBernardis and a newly offered hire). The Psychology advisor has been very helpful with Neuroscience advising, but the role for Neuroscience for these two advising faculty has not yet been defined. It should also be noted again that for both Psychology and Biology this advising is in addition to the enormous advising burden that the departments take on for their own majors.

Student Profile

As described previously, the neuroscience degree has been marked by continuous and rapid growth in majors since its inception. This is illustrated in Table 1, which show the number of majors by year. Enrollment numbers for Psychology and Biology, the two home departments, are included for comparison. The initial cohort of 11 students in the inaugural semester has expanded to 368 active majors as of Fall, 2015. Over the same time period majors in Psychology increased from 576 to 947 and in Biology from 709 to 1045, in part reflecting the general growth in undergraduate enrollment at the university. Part of the early growth in Neuroscience included current students transferring from Psychology or Biology (as well as other majors) into the program. However, from 2012, when the program included 4th year students who entered after the start of the major, enrollment in Neuroscience continued to increase by 62% to reach its Fall 2015 levels, compared to 23% growth for Psychology and 8.5% for Biology.

Enrollment growth	F'08	F'09	F'10	F'11	F'12	F'13	F'14	F'15
NSC	***11***	***82***	***114***	***175***	***227***	***296***	***317***	***368***
% change		***645%***	***39%***	***53.5%***	***29.7%***	***30.4%***	***7.1%***	***16.1%***
PSY	576	565	615	580	770	855	977	947
% change		-1.9%	8.8%	-5.7%	32.8%	11%	14.2%	-3.1%
BIO		709	765	903	963	1025	1002	1045
% change			7.9%	18%	6.6%	6.4%	-2.2%	4.3%

Table 1. Number of Neuroscience majors by year, compared to the enrollment in the majors of the home departments of Psychology and Biology.

One consequence of this growth is that Neuroscience is now among the more popular majors on campus. For example, Table 2 compares the number of students in the different majors within CLA or COS. By Fall 2015, neuroscience was the 4th largest out of the 15 majors in CLA and ranked 2nd largest out of 9 majors in COS, and made up roughly 8% and 16% of the total number of students supported by CLA and COS respectively. This also represents a very large fraction of students in the home departments. Neuroscience students comprise 28% of the total undergraduates under the umbrella of psychology, while students in the research specialization track of the psychology degree make up 18%. Similarly, Neuroscience students make up roughly a quarter (26%) of the combined pool of Neuroscience and Biology majors.

CLA Enrollment	F'13	S'14	F'14	S'15	F'15	% of CLA
All CLA majors	3768	3954	4353	4008	4468	100
Psychology	855	875	977	845	948	21.2
Criminal Justice	733	736	839	734	862	19.3
Political Science	389	414	459	453	516	11.5
Neuroscience	***296***	***294***	***317***	***313***	***368***	***8.2***
English	294	314	331	310	317	7.1
Art	225	233	245	230	238	5.3
Communication	149	180	214	191	229	5.1
World Lang and Lit	206	221	219	226	199	4.5
Music	165	171	183	164	194	4.3
Anthropology	136	159	146	144	162	3.6
History	118	126	154	137	153	3.4
Sociology	70	81	118	118	128	2.9
Theatre and Dance	64	70	66	59	64	1.4
Philosophy	60	70	74	65	69	1.5
Gender, Race, Ident	8	10	11	19	21	0.5

COS Enrollment	F'13	S'14	F'14	S'15	F'15	% of COS
All COS majors	2019	1970	2181	2056	2372	100
Biology	1025	966	1002	897	1045	44.1
Neuroscience	***296***	***294***	***317***	***313***	***368***	***15.5***
Geological Sciences	163	157	171	172	193	8.1
Molec Micro Immun	9	34	98	120	186	7.8
Chemistry	125	113	147	137	158	6.7
Mathematics	130	140	148	141	149	6.3
Physics	105	107	124	128	127	5.4
Mining Eng	119	116	129	104	101	4.3
Geography	47	43	45	44	45	1.6

Table 2. Enrollment by year in the different degree programs offered under CLA or COS.

Table 3 provides additional data on the majors, again compared to the home departments. By Fall 2015, 62 students had received their degrees from the neuroscience program, with an average time to degree of 4.8 years, and an average year-to-year retention rate of 89%. These students graduated with an average GPA of 3.40. These numbers compare favorably with students who earned their degrees in psychology or biology.

	08-09	09-10	10-11	11-12	12-13	13-14	14-15	avg
NSC								
total majors	***11***	***72***	***114***	***167***	***220***	***281***	***291***	
degrees granted	***2***	***9***	***9***	***29***	***31***	***59***	***62***	
time to degree	***5.0***	***4.8***	***5.9***	***3.8***	***4.6***	***4.8***	***4.5***	***4.8***
graduating GPA	***3.25***	***3.53***	***3.40***	***3.54***	***3.32***	***3.32***	***3.27***	***3.40***
2nd-3rd year retention		***100%***	***100%***	***78%***	***82%***	***90%***	***85%***	***89%***
PSY								
total majors	575	564	614	765	753	826	819	
degrees granted	95	146	96	139	158	161	218	
time to degree	6.1	4.9	5.4	5.3	5.2	5.0	4.7	5.2
graduating GPA	3.30	3.24	3.28	3.20	3.29	3.19	3.24	3.20
2nd-3rd year retention	79%	84%	89%	82%	80%	85%	82%	80%
BIO								
total majors		709	765	903	963	1025	1002	
degrees granted								
time to degree	4.96	4.94	5.02	5.14	5.07	4.85	4.79	4.97
graduating GPA	2.82	2.92	2.8	3.13	3.23	3.21	3.22	3.05
2nd-3rd year retention	80.3%	82.8%	83.4%	80.1%	84.0%	82.0%	87.3%	83%

Table 3. Vital statistics for Neuroscience majors compared to Psychology and Biology majors.

One indication of the quality of the Neuroscience students is that they are disproportionately represented in UNR's Honors Program. This program selectively admits students with high academic credentials and provides an enriched academic experience including a wide range of extracurricular activities, regular courses for honors credit (which involves completing additional individually-tailored assignments for the courses) and a senior honors thesis, supervised by a faculty mentor and concluded with an oral defense and often poster presentation at the honors conference. Table 4 shows that the number of Neuroscience students currently active in the Honors Program rivals the numbers for Biology and Psychology, even though the total number of majors is much lower, such that the percentage of

Neuroscience honors students is roughly 3 times as high. Note also that Neuroscience students make up a significant fraction of the total number of students in the Honors Program.

	honors majors	total majors	% of majors in honors	% of all honors majors
NSC	***41***	***368***	***11.1%***	***7.6%***
PSY	31	947	3.3%	5.8%
BIO	51	1045	4.9%	9.5%

Table 4. Number of Neuroscience, Psychology, and Biology majors enrolled in the Honors Program.

A second gauge of student quality is with regards to the standards set for membership in Nu Rho Psi, the national honors society for neuroscience. Eligibility requires a minimum GPA of 3.2 overall and 3.5 within the major, and at least 3 semesters of college courses with a minimum of 3 courses in the major. Currently 162 of the 368 neuroscience majors, or 44%, meet these inclusion criteria. For comparison, membership in the Psychology Honors Society Psi Chi has a substantially more lenient GPA requirement (3.0 overall and in the major), for which 330 of the 947 Psychology majors are eligible, a rate of 35%.

The Neuroscience program also fares well with regard to diversity in the program. The gender and ethnicity of students is provided in Table 5, again compared to benchmarks from Psychology and Biology. Relative to UNR or the state of Nevada as a whole, all three of the programs have a very high representation of female students, and Neuroscience is similar to Biology in attracting a large percentage of students identifying as Asian. All three programs also have a higher representation of the UNR population of Black and Hispanic students.

	enrollment				**% of total**						
	NSC	**PSY**	**BIOL**		**NSC**	**PSY**	**BIOL**		**UNR undergrad**		**NV state**
Total	336	830	1,045								
Male	111	227	432		33.0	27.3	41.3		47.4		50.3
Female	225	603	613		67.0	72.7	58.7		52.6		49.7
Amer Indian	2	4	8		0.6	0.5	0.8		0.7		1.6
Asian	54	32	150		16.1	3.9	14.4		7.2		8.3
Black	16	37	48		4.8	4.5	4.6		3.7		9.1
Hispanic	80	203	233		23.8	24.5	22.3		18.9		27.8
Pac Islander	1	2	8		0.3	0.2	0.8		0.6		0.7
Multi-Ethnic	26	47	71		7.7	5.7	6.8		6.2		4.0
White	152	486	504		45.2	58.6	48.2		60.5		51.5
Unknown	2	11	14		0.6	1.3	1.3		1.1		
Non-res Alien	3	8	9		0.9	1.0	0.9		1.1		

Table 5. 2015 Enrollment in NSC, PSY or BIO by gender and ethnicity/race. Comparison numbers are included for all UNR undergradautes and for the state population (2014 census). Total enrollments differ from the previous tables because of the time points queried.

Faculty Profile

The program depends on a core of faculty within Psychology and Biology whose teaching and research encompasses a range of areas within the broad discipline of neuroscience. In Psychology, these faculty are part of the Cognitive and Brain Sciences Graduate Program. In Biology, many are part of the graduate programs in Cellular and Molecular Biology and Cellular and Molecular Pharmacology and Physiology. All are also part of the Integrative Neuroscience Graduate Program, which as noted includes a much wider range of faculty spread across the campus and SOM. Here we focus on the core faculty, who include a broad mix of early and mid-career faculty with diverse research interests. A list and brief description of the core faculty is given in Table 6.

Within the CBS program a dominant (but not exclusive) research theme is vision science, with faculty engaged in research spanning optics to conscious awareness. This includes expertise in human and comparative color vision, form and motion perception, object recognition, reading, visual working memory, short- and long-term neural plasticity and multisensory processing. All of the labs combine human behavioral studies with neuroimaging techniques. The latter include adaptive optics, fMRI, EEG, fNIRS, and tDCS. The research in CBS also encompasses anatomical and morphological studies of the neural correlates of autism spectrum disorder. Biology includes strong expertise in neural development and the molecular and genetic dissection of neural circuits and behavior. The labs work with a number of model organisms including Drosophila, C. elegans, and mice, and explore questions ranging from factors controlling axon guidance to circadian rhythms and sensory coding.

UNR has been able to recruit faculty with very strong training in neuroscience. These include faculty coming from high-profile labs in institutions such as Berkeley, Washington, Michigan, Dartmouth, Yale, and Princeton. As a group, the researchers contributing to the Neuroscience major are also well funded. For example, both of the program co-directors have active R01's, and both direct or co-direct one of the COBRE grants (Webster, Integrative Neuroscience; Mastick, Cell Biology). Many of the faculty are also funded as project leaders on the COBRE grants. These include Berryhill, Caplovitz, Miura, and Zhang (Neuroscience) and Kidd and Berninsone (Cell Biology). Many of the early-career faculty have also had great success in securing their own extramural funding. This includes recent NSF awards to Kidd and Van der Linden, as well as a variety of NIH R03/R15/R21 awards to Berryhill and Caplovitz, Van der Linden, and Kidd. Jiang was recruited to UNR a year ago and came with a prestigious K99/R00 Pathway to Independence award; and Snow, who is in her 3rd year at UNR, recently learned that she has been awarded an R01. Through these various funding mechanisms the program faculty thus have very strong lab-specific and shared resources for their research. Recent hires have also benefited from increasingly competitive start-up packages provided by the university.

As a group the Neuroscience faculty has also been highly productive in terms of publications. The nature of research and thus the rate of publication varies widely across disciplines, and thus summary numbers are not diagnostic. However, as detailed in the faculty CV's in Appendix 6, the faculty frequently publish in high-impact journals including Science, Nature, Nature

Name	Rank	hire year	Doctorate / Postdoc	Gender	Ethnicity	Research
Psychology (CLA)						
Webster, Michael	Professor	1994	Berkeley / Cambridge	M	Caucasian	Color, form, and face perception; sensory adaptation
Crognale, Michael	Professor	1998	UC Santa Barbara / Berkeley & Washington	M	Caucasian	Human and comparative color vision; human factors; visual development
Hutsler, Jeff	Assoc Prof	2001	UC Davis / Dartmouth	M	Caucasian	Neural correlates of autism spectrum disorder
Berryhill, Marian	Asst Prof	2009	Dartmouth / Temple	F	Caucasian	Attention and working memory; memory in normal and special populations
Caplovitz, Gideon	Asst Prof	2010	Dartmouth / Princeton	M	Caucasian	Form and motion perception Visual illusions
Snow, Jacqueline	Asst Prof	2013	U Melbourne / Birmingham and Western Ontario	F	Caucasian	Object recognition; neuropsychology
Jiang, Fang	Asst Prof	2015	UT Dallas / U Louvain & Washington	F	Asian	Neural plasticity and cross-modal interactions; sensory deficits
Strother, Lars	Asst Prof	2016	U Virginia / CMU & West Ontario	M	Caucasian	Cognitive and neural mechanisms of form perception and reading
Biology (COS)						
Mastick, Grant	Professor	1998	CMU / Michigan	M	Caucasian	Neural development and axon guidance
Peacock, Mary	Assoc Prof	1998	AZ State / UNR	F	Caucasian	Conservation genetics
Kidd, Thomas	Assoc Prof	2003	Oxford / Berkeley	M	Caucasian	Neural development, axon guidance, DSCAM
Berninsone, Patricia	Assoc Prof	2006	U Buenos Aires / U Mass & Boston	F	Hispanic	Glycosylation in cellular signaling
Van der Linden, Alex	Assoc Prof	2009	Utrecht / Brandeis	M	Caucasian	Neural sensing of temperature; circadian clocks
Altick, Amy	Lecturer	2012	UNR	F	Caucasian	Learning and memory; strabismus
Leonard, Anne	Asst Prof	2013	UC Davis / Arizona & U Mass	F	Caucasian	Plant-pollinator interactions; multisensory cues
Mathew, Dennis	Asst Prof	2014	U Mass / Yale	M	Asian	Neural basis of olfactory coding
Miura, Pedro	Asst Prof	2014	Ottawa / Sloan-Kettering	M	Hispanic	Post-transcriptional regulation and non-coding RNA
Zhang, Yong	Asst Prof	2014	Shanghai / U Mass	M	Asian	Neural and genetic mechanisms circadian clocks
Physiology (SOM)						
Renden, Robert	Asst Prof	2013	Utah / OHSU & Heidelberg	M	Caucasian	Synaptic transmission

Table 6. Core Neuroscience teaching faculty.

Neuroscience, PLoS ONE, Current Biology, Cell, J Neuroscience, J Cognitive Neuroscience, Proceedings of the Royal Society, and Annual Reviews. A number of these publications have also had high impact as indicated by citations.

A further important aspect of the Neuroscience degree is that it draws on many early career faculty, 12 of whom have been hired since the beginning of the program. These hires have come from replacement hires as well as growth within both departments in positions that have specifically targeted neuroscience. As noted above, the growth of neuroscience positions is currently rapidly expanding with the approved strategic cluster of 8 new neuroscience faculty over the next 3 years. Four of these positions are expected to be filled by Fall, 2016 with searches currently concluding in both Psychology and Biology. The program is thus poised to experience substantial growth in new faculty and research resources.

Strengths

As the self-study report documents, the Neuroscience degree has far exceeded its original expectations and has achieved a high degree of success. Students, faculty, and administration are enthusiastic about the program, and the major continues to attract growing numbers of high-caliber students. Moreover the program has both contributed to and benefited from the collective growth of neuroscience initiatives in research and education across the campus. The Neuroscience degree now ranks very high in terms of the number of majors in the different programs at UNR, and is now larger than many departments on campus. Thus we believe the degree program is very healthy and poised to flourish even further. The following list summarizes some of the key strengths of the program:

1. The degree has filled an important gap in the educational programs offered by the university and prepares students for advanced studies or career options in a field that is itself rapidly growing and in high demand.

2. The major is a very popular degree option for students, reflected in continually expanding enrollment numbers.

3. The degree attracts very high quality students including large numbers of honors students and premedical students.

4. The curriculum is taught by a large pool of strong research faculty with active extramurally-funded labs who are strongly committed to the program.

5. The degree is well-aligned with strategic hiring priorities at UNR, with a growing base of new neuroscience faculty flowing from recent hires and approved future hires.

6. The degree has broken ground as a model for interdisciplinary undergraduate programs that span across colleges, and along with the other neuroscience research and degree

programs, has gained high visibility within the state-wide university system, highlighted by presentations to the state Board of Regents in Spring, 2012 and 2015.

7. The interdisciplinary curriculum encompasses and integrates core areas of neuroscience.

8. Substantial research infrastructure is in place to provide students access to a wide range of techniques at the forefront of the field, and frequent seminar and chapter activities bring leading researchers to campus and provide opportunities for outreach.

9. There is strong future potential to grow synergistically with the newly established Neuroscience graduate program.

Challenges

Despite these marked successes, there are a number of challenges and shortfalls which limit the full potential of the program. Some of these are probably inherent to any interdisciplinary program, while others are specific to the program as it is currently implemented. The following lists a number of these challenges:

1. Curriculum. As a program built largely out of existing courses borrowed from other majors, the curriculum for the degree does not ideally fulfill the sequence and content that would likely be developed were the degree designed from scratch. There is little coordination between the content offered by different classes across Psychology and Biology, and thus both redundancies and gaps in information sometimes occur. For example, students have noted that they are introduced to concepts such as membrane potentials multiple times. In other cases important foundational material may be missed. For example, some faculty have noted a need for a basic course focused on functional neuroanatomy, while others have asked for a greater emphasis on computational neuroscience and computer programming skills. Some of this is unavoidable because the same classes and faculty must also serve a diverse cohort of students beyond those in the Neuroscience program.

2. Program identity. Related to the preceding issue, in an early survey of students, a number responded that they felt the degree was not really its own major but rather a collection of psychology and biology courses. A common complaint is, “When do I get to take Neuroscience courses?” The addition of new courses targeting the major (e.g. Introduction to Neuroscience, the Neuroscience Techniques Lab, and Genes, Brain and Behavior) have helped form a cluster of classes with a clear neuroscience theme. However, there is a need to further develop offerings specifically tied to degree. One clear deficiency is the lack of a dedicated capstone course for the major. This has been recognized and some faculty are currently developing proposals for a new capstone. Yet more generally, there is a need to find ways to position Neuroscience as a free-standing program that is not perceived merely as an area of emphasis within Psychology and Biology.

3. Research experience. Access to research experience remains an important bottleneck in the program. It was originally envisioned that majors could count on working directly with a faculty mentor in their lab as part of their research credits. However as enrollment exploded this became infeasible. The Neuroscience Techniques Lab course was designed to help address this problem and provide formal hands-on experience, but the number of students that can enroll in this course is restricted. Other methods options, such as Cell Biology Lab (Bio 395) again must serve a diverse cohort of students. Thus ensuring that students in the major have adequate hands-on experience remains problematic. Many students do have very rich research experiences. For example, there are many in Psychology labs actively involved in projects utilizing behavioral assessments, fMRI or EEG, and many in Biology working with molecular techniques in model organisms. Moreover, Neuroscience students in the Honors Program must complete a senior honors thesis as part of the program. The question is how best to make such opportunities available to all students. It should be noted that this is also a more general problem for the home departments. For example, Psychology recently abandoned the requirement for directed learning because it was not possible to accommodate all majors, nor was it evident that all students would benefit from this experience. To address this they switched to a model in which the requirement was retained only for students in the research specialization (graduate school preparation) track.

4. Student engagement. UNR is experiencing a rapid growth of neuroscience research and activities across a wide swath of areas. However, there is currently not an explicit strategy for leveraging these activities to enhance the major. For example, student attendance at neuroscience seminars is often low, and there is not yet a mechanism in place to bridge the undergraduate and graduate programs. A further sign of the lack of engagement is that only a small percentage of the many students who are eligible for Nu Rho Psi membership take advantage of the opportunity.

5. Interdisciplinary issues. The co-administration of the degree across two departments and colleges has led to a number of organizational challenges. As noted, these have been addressed in a series of meetings but remain to be fully resolved. Concerns include issues of parity and ownership and shared governance of the program. On the one hand, Biology and COS have made some unilateral decisions for the major without input from the program directors, Psychology, or CLA. For example, there was a lack of prior consultation in the decision to include Neuroscience as part of the COS Science 110: First Year Experience course or the upcoming Science Fit Bootcamp for incoming freshmen. Both are credit courses and thus impact the curriculum for the major. This has led to some concerns over control of the program, and about how students identify with the program. For example, a worry is that the early and disproportionate exposure to Biology leads students to identify more strongly with COS. For the graduation ceremony, Neuroscience students can choose to walk with either the COS or CLA classes, and a large majority choose COS. On the other hand, there are tangible signs that as a department, Biology has more fully embraced the major, something that can be seen from how the Neuroscience degree is portrayed on the two department web sites, and Biology faculty are actively encouraged to develop new neuroscience courses. The former Psychology Chair and CLA Dean were also both demonstrably guarded in their letters of support

for the recent proposal for the Neuroscience Graduate Program, with their support contingent on the provision that no additional department resources be diverted to Neuroscience. These administrators have now stepped down. The new Psychology Chair (M Crognale) is an active member and strong advocate of both the undergraduate and graduate Neuroscience programs, and a search for a new permanent Dean for CLA is currently in progress. It is important that the new CLA leadership recognize the importance of supporting the Neuroscience degree.

6. Neuroscience as a discipline. A related issue is that the field of neuroscience does not fit as naturally into the range of disciplines encompassed by liberal arts. Neuroscience is arguably a science that has close intellectual ties with the natural sciences. Some students have noted that they did not choose the major because of (unfounded) concerns that it was offered as a liberal arts degree. The fact that both the undergraduate and graduate degree programs (along with the COBRE for Integrative Neuroscience) are housed within CLA stems from the fact that it was cognitive neuroscience faculty in Psychology who initiated these programs. Several years ago (and before the advent of the Neuroscience degree), when the previous College of Arts and Sciences was split to form CLA and COS, the Psychology department argued unsuccessfully to be aligned with science. Psychology faculty members engaged in neuroscience also have resource needs more aligned to COS in terms of start-up and space. The university and CLA have been fully supportive in this regard, but it nevertheless means that Neuroscience is a conspicuous outlier within CLA. Moreover, the split between the colleges introduces some large disparities between the expectations for program faculty. For example, Psychology faculty members contributing to the degree have a teaching charge of 4 courses per year compared to 2 courses for their counterparts in Biology.

Future Plans and Recommendations

Moving forward, we propose meeting these challenges and further augmenting the program through the following recommendations.

1.Curriculum. The curriculum should be revised to better coordinate the content across the courses and to add new courses to fill gaps in the major. Foremost among these is adding a dedicated capstone course for the major. As noted, the proposal for a capstone is currently being developed. A second priority is solving the research experience opportunities through the major, potentially including developing more formal lab courses or offering them more frequently, and developing a course on experimental design specifically for the major. These changes are now more feasible to implement with the recent and future recruitment of many new faculty in the discipline. Another area to refine the curriculum will be to have the curriculum committee review the content of courses to identify potential areas of redundancy (to potentially reduce unnecessary repetition of material), and to identify gaps in knowledge or skills that students are currently missing (possibly leading to new content in existing courses, or adding new courses). The current curriculum could also be improved by adding a stronger emphasis on computational neuroscience and more formal training in programming or bioinformatics. Finally, the program should strategize on how to expand its impact and accessibility through the development of online and summer courses for the major.

2. NSC prefix. A separate prefix for courses contributing to the major will help students and departments to better define the major as a distinct program for students. There are already a number of courses contributing to the major that are appropriate for an NSC designation, including those with neuroscience already in the course title (e.g. BIOL/PSY 105: Introduction to Neuroscience, BIOL 475 Neurobiology, BIOL/PSY 479 Techniques in Neuroscience Laboratory, BIOL 477 Genes, Brains, and Behavior). Courses for independent-study or research-experience credits should also be created or amended to include an NSC designation.

3. Teaching assistants. Almost all of the Neuroscience courses serve multiple majors with very high enrollments, or involve lab-based content with high instructional support needs. TA support is thus critical but remains in very short supply for both Neuroscience and the home departments. As noted 4 new GTA lines were allocated as part of the Neuroscience Graduate Program, and help fill a critical need both for mounting the undergraduate major and for recruiting and supporting students in the graduate program. However the current deficiencies in graduate student support continue to place heavy restrictions on the quality and growth of both programs. We hope that the university will continue to build the support for TA lines designated specifically to the Neuroscience programs. This graduate student support is also critical for supporting the new faculty lines approved for Neuroscience.

4. Dedicated advisors and staff. As noted there are very few resources specifically allocated to the program and thus a heavy burden is placed on the home departments. The approved addition of a new administrative assistant in Psychology will help enormously to better coordinate and run the program, but there is also a need for permanent advisors dedicated specifically to the program. Biology is currently interviewing candidates for a new Neuroscience Lecturer/Advisor position, with the department to make this choice in March 2016. The roles for this position include teaching neuroscience and supporting Biology courses, and approximately 50% effort to advising the Biology share of the junior and senior Neuroscience majors. A complementary position should be explored for Psychology.

5. Student Engagement. Mechanisms and activities should be developed to more fully engage the undergraduate majors with the many other neuroscience programs on campus. The graduate program has already begun discussions of how to bridge with the undergraduate degree including a potential mentoring program or workshops that would pair the graduate students with groups of undergraduates. The COBRE for Integrative Neuroscience is also planning to fund a graduate RA line to facilitate bridging research and outreach activities with the undergraduate majors.

6. Faculty Engagement. While enthusiasm for the program is high among many faculty, direct participation is still limited primarily to faculty in Psychology and Biology. Thus the program currently fails to tap into the deep pool of expertise in other departments, which include many faculty participating in the graduate program. Strategies should be explored and implemented to widen the range of faculty who contribute to the degree through courses or research experiences. For example, developing a greater emphasis on computational neuroscience

would benefit from recruiting current and future faculty in Mathematics and Computer Science who are already engaged in neuroscience research.

7. Neuroscience Institute. With a very large and successful undergraduate program, a new doctoral program, very high levels of research funding including COBRE center grants, and a rapidly growing infusion of high-caliber junior faculty through recent hires and approved future hires, it is a propitious time to consider developing an autonomous center to further synergize and leverage the full potential of these closely connected initiatives. One possible model would be to create a stand-alone Department of Neuroscience which would bring the programs together under a single home and better align both students and faculty with common interests. An alternative model would be to create a semi-autonomous Institute for Neuroscience, again with the aim of establishing greater visibility and self-determination for the discipline. We believe these models could help solve many of the hurdles inherent in an interdisciplinary program without its own home, and that they could be implemented in a way that would increase the effectiveness and impact of all of the neuroscience initiatives on campus while continuing to serve the best interests of COS and CLA, including helping to relieve Psychology and Biology of the high resource burden they have undertaken to maintain the Neuroscience programs. A Neuroscience Department or Institute would offer many advantages including:

1. More focused and integrated development and alignment of the curriculum

2. A stronger and more seamless integration among the undergraduate and graduate programs and with the research centers

3. Better long term strategic planning for faculty hiring, development of research strengths and core facilities

4. Increased visibility of degree and research programs to draw higher quality undergraduate and graduate students, and for recruiting new faculty and research staff

5. Better positioning UNR to be competitive for programmatic research and training grants, and to provide a stronger institutional environment for supporting individual faculty grants

6. Better opportunities for fundraising, including for endowed chairs, and for raising the priority of a new research building centered on Neuroscience