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July 22, 2015

MEMORANDUM

TO: State Board of Regents

FROM: David L. Buhler

SUBJECT: Utah State University – Doctor of Philosophy in Neuroscience

Issue

Utah State University (USU) requests approval to offer a Doctor of Philosophy (Ph.D.) in Neuroscience effective August 31, 2015. The institutional Board of Trustees approved the degree on May 1, 2015.

Background

USU's proposed interdisciplinary Ph.D. in Neuroscience would be administratively based in the Department of Psychology in the Emma Eccles Jones College of Education and Human Services, but would utilize courses and faculty from multiple departments: Psychology; Biology; Communicative Disorders and Deaf Education; Health, Physical Education, and Recreation; Mathematics and Statistics; Biological Engineering; and Family, Consumer, and Human Development. The proposed degree would be comprised of 64 total credits: 43 required, 9 elective, and 12 in one of three focus areas (Transitional Neuroscience, Educational Neuroscience, or Lifespan Neuroscience). A vast majority of the courses needed for the proposed Ph.D. in Neuroscience are already offered at USU under existing programs.

Neuroscience is a rapidly-growing field, and Ph.D. graduates are in demand to fill an increasing number of research, teaching, and clinical positions in universities, hospitals, and rehabilitation centers. Labor market information in the USU proposal points to hundreds of available, high-wage positions in neuroscience. The proposed USU Ph.D. program would focus primarily on applied clinical neuroscience in response to the need for neuroscientists with expertise in applying basic neuroscience discoveries to clinical, behavioral, and educational topics and questions.

The proposed USU Ph.D. program was developed in consultation with the director of the interdepartmental PhD program in neuroscience at the University of Utah. The two institutions view the respective Ph.D. programs as complementary, with the University of Utah focusing on basic neurophysiology and Utah State focusing on translating basic discoveries in neuroscience into clinical knowledge. The number of annual applicants for the University of Utah's Ph.D. in Neuroscience far outpaces the number of available slots in the program, so a new Ph.D. in Neuroscience at USU would provide additional opportunities, as well as a different focus.

Policy Issues

The proposed degree has been developed and reviewed in accordance with processes established by Utah State University and the Board of Regents. The USHE Chief Academic Officers, with input from appropriate faculty at their institutions, are supportive of USU's request to offer a Doctor of Philosophy in Neuroscience. There are no additional policy issues relative to approval of this program.

Commissioner's Recommendation

The Commissioner recommends the Regents approve the request by Utah State University to offer a Doctor of Philosophy in Neuroscience.

_____
David L. Buhler
Commissioner of Higher Education

DLB/GVB
Attachment

Program Description
Utah State University
Doctor of Philosophy in Neuroscience

Section I: The Request

Utah State University (USU) requests approval to offer a Doctor of Philosophy (PhD) in Neuroscience effective August 31, 2015. The institutional Board of Trustees approved the degree on May 1, 2015.

Section II: Program Description

Complete Program Description

The primary goal of the proposed doctoral program in neuroscience is to provide students with a strong educational and research foundation in cellular, cognitive, and behavioral neuroscience. Students will apply critical concepts in neuroscience to understanding normal and disordered processes of sensation, movement, cognition, language, and communication across the lifespan. This goal will be accomplished through a core set of neuroscience courses, advanced electives, and laboratory experiences. Students in the neuroscience doctoral program are expected to align themselves with a focus area: Translational Neuroscience, Educational Neuroscience, or Lifespan Neuroscience. The program will produce experts in experimental and applied research across a variety of academic disciplines.

Purpose of Degree

The proposed Neuroscience PhD program at Utah State University will be strongly interdisciplinary, involving faculty in Psychology; Biology; Communicative Disorders and Deaf Education; Health, Physical Education, and Recreation; Mathematics and Statistics; Electrical and Computer Engineering; and Family, Consumer, and Human Development. The Neuroscience PhD program will serve to connect faculty and students who are currently engaged in neuroscience research related to sensation, information processing, memory, decision-making, language development, cognitive development, motor development, and aging, as well as applied clinical neuroscience related to neurodevelopmental, neurogenic, and neurocognitive disorders.

Students in the interdisciplinary Neuroscience PhD Program will learn the theoretical, conceptual, and methodological issues involved in neuroscience research within one of three focus areas: Translational Neuroscience, Educational Neuroscience, or Lifespan Neuroscience.

- The Translational Neuroscience focus area emphasizes understanding the signal transduction pathways underlying neurophysiological function in normal and disease states at the molecular, cellular, tissue, system, and organism levels. Students will understand trans-disease processes related to core brain functions that are required for appropriate behavioral regulation, attention, memory, and decision-making. Translational research experiences will combine approaches in genetics, biophysics, electrophysiology, functional imaging, and behavioral analyses in order to explore the mechanisms underlying normal and aberrant neuronal function in a variety of systems across the lifespan. Students will explore the use of animal models as a means for examining underlying causes of neurodevelopmental and neuropsychological disorders starting at the genetic level, working up through fundamental brain functioning, and then observing how these processes

are impacted by individual experience throughout the lifespan. Students in this focus area will also understand neurocognitive and neurophysical abnormalities that are the source of a wide range of human disorders, including depression, schizophrenia, autism, attention deficit disorder, anxiety, drug addiction, communication disorders, and others.

- The Educational Neuroscience focus area is designed to apply the principles of behavioral, cognitive, and biological neuroscience to core problems in education related to cognition, socialization, learning, and/or teaching. Students will explore the anatomical and functional neurological mechanisms that contribute to cognition, language, and literacy development, as well as the relationships between neural activation patterns and children's performance on cognitive, linguistic, communicative, and literacy tasks. This focus area is also designed to help students understand the neurophysiological, neurobiological, and environmental contributions to sensory disorders, intellectual disabilities, communication disorders, learning disabilities, autism spectrum disorders, and motor disorders in children. Students will learn how to combine behavioral experimentation methods with neuroimaging methods (Near Infrared Spectroscopy, EEG, eye-tracking, and pupilometry) to examine processes involved in accessing, manipulating, storing, retrieving, and classifying information and associated changes in activation patterns across micro- and macro-brain structures during information processing tasks. New advances in translational research and research on the principles of neuroplasticity will lead to greater understanding of the best ways to promote brain changes through language, literacy, and STEM education. Research on educational neuroscience should lead to innovative perspectives on the integration of basic research and educational practices and to the development of sound education policies.
- The Lifespan Neuroscience focus area will emphasize the study of changes in central and peripheral nervous system structures from infancy to late adulthood with corresponding effects on behavior in domains such as cognition, language, and emotion. This focus area includes the neuroscience of movement and how the motor system interacts with sensory, perception, and cognitive systems. Normative changes in attention, memory, executive functions, and other cognitive processes will be juxtaposed with pathological conditions. Areas of study include normal aging, language and communication disorders, movement variability, movement timing/sequences, motor planning, motor learning, and functional recovery in populations with disorders and disabilities, such as aphasia, apraxia, Alzheimer's disease, and other dementias. Students may focus on neuropsychological assessment of speech, language, and cognitive-communicative functions; variability across different linguistic populations; and language treatment following stroke, traumatic brain injury, neurosurgery, and degenerative disorders. Coursework and research experiences may examine the role of genes, environmental factors, and gene-environment interactions in normal aging, disease-free survival and longevity, as well as examining factors that increase risk for depression and disease states that occur in late-life. In addition to foundational courses in neuroscience, seminars will be offered that are specific to each specialty area.

In their courses, students will develop an appreciation of the cognitive factors that influence patterns of brain activation in human and animal models, and they will learn about the effects of disease on brain anatomy and integrity. In their lab rotations, students will gain hands-on experience with data acquisition, data processing, statistical analysis, and visualization techniques related to research on brain structures and functions before, during, and after neurorehabilitation. Upon completion of the program, students will be prepared to design and conduct state-of-the-art neuroscience research that employs a variety of neuroimaging methods and that contributes to the solution of educational, medical, social, and vocational problems.

Institutional Readiness

Current administrative structures that support graduate programs, including supports from the Office of Research and Graduate Studies, as well as college and departmental infrastructures that are already in place, will be used to support this program. No new supports or organizational structures are needed. This neuroscience program will be an interdisciplinary program, but will be administratively housed in the Psychology department. The staff resources (e.g., Graduate Program Coordinator) already in place will be used to support this program. This proposed program will have minimal impact on the delivery of undergraduate courses. Some of the courses currently being taught, that will be part of this program, are open to advanced undergraduate students, but this slight increase in offerings for undergraduates will be the only impact on undergraduate programs.

Program Faculty

The numbers in the below table reflect faculty across the seven departments involved in the program. Because this program is interdisciplinary, only program faculty (and not all faculty in the seven participating departments) are reflected in this table.

Program Faculty Category	Faculty Headcount – Prior to Program Implementation*	Faculty Additions to Support Program	Faculty Headcount at Full Program Implementation*
With Doctoral Degrees (Including MFA and other terminal degrees, as specified by the institution)			
Full-time Tenured	12	0	12
Full-time Non-Tenured	7	0	7
Part-time Tenured	0	0	0
Part-time Non-Tenured	0	0	0
With Master's Degrees			
Full-time Tenured	0	0	0
Full-time Non-Tenured	0	0	0
Part-time Tenured	0	0	0
Part-time Non-Tenured	0	0	0
With Bachelor's Degrees			
Full-time Tenured	0	0	0
Full-time Non-Tenured	0	0	0
Part-time Tenured	0	0	0
Part-time Non-Tenured	0	0	0
Other			
Full-time Tenured	0	0	0
Full-time Non-Tenured	0	0	0
Part-time Tenured	0	0	0
Part-time Non-Tenured	0	0	0
Total Headcount Faculty			
Full-time Tenured	12	0	12
Full-time Non-Tenured	7	0	7

Part-time Tenured	0	0	0
Part-time Non-Tenured	0	0	0
Total Program Faculty FTE *(As reported in the most recent A-1/S-11 Institutional Cost Study for "prior to program implementation" and using the A-1/S-11 Cost Study Definition for the projected "at full program implementation.")*	19	0	19

*These numbers reflect faculty across the seven participating departments. Only faculty who will be involved in the proposed Neuroscience PhD program are included.

No new lines are required for this program as existing faculty can cover program needs. However, additional faculty lines would strengthen the program in terms of diversity of course offerings and lab experiences. Opportunities for targeted hires in the neuroscience area will be explored over time.

Staff

Existing staff will be utilized to provide support to the neuroscience program. Although interdisciplinary, the program will be housed in the Psychology department, where the current staff can provide support for admissions, student tracking, etc. As with all doctoral-level program advising, advising duties will be carried by individual faculty mentors, as well as the program steering committee, which will be comprised of all faculty involved in the Neuroscience PhD program.

Library and Information Resources

No additional library resources will be needed to support this program. Key journals in the neuroscience area (e.g., *Cognitive Neuroscience*, *Journal of Neuroscience*, *Annals of Neurology*, *Neuropathology*, *Neuroscience Research*, *Neurobiology of Learning and Memory*, *Current Topics in Behavioral Neurosciences*, *Neuroscience and Biobehavioral Reviews*, *Trends in Neurosciences and Annals of Neurology*, *Nature Neuroscience*) are available digitally at USU's library.

Admission Requirements

Prospective students will submit the standard graduate school application through the School of Graduate Studies. Admissions criteria will be consistent with graduate school requirements, including a 3.0 (or higher) GPA for the last 60 credits and GRE scores for the verbal and quantitative areas at the 40th percentile or above. Students will also submit a statement of interest / letter of intent that should address their fit with the program in terms of research interests that are consistent with current faculty in the program.

Student Advisement

Students will be assigned a faculty advisor at the time they are admitted to the program. This faculty member will remain the student's primary advisor through the student's time in the program. Each student's progress in the program will be reviewed annually by all program faculty in a student review meeting. Students will receive written feedback on their progress following this meeting. The feedback will address progress in the areas of: research skills and progress; progress toward completion of the program; didactic course work; assistantship performance; other accomplishments and/or concerns.

Justification for Graduation Standards and Number of Credits

Students entering the program with a bachelor's degree will be required to earn a minimum of 64 credits for graduation. Students entering with a master's degree must earn a minimum of 44 credits. This credit requirement is consistent with other doctoral programs in the sciences at USU and with neuroscience programs across the nation in which the majority of the teaching occurs in the laboratory rather than the classroom. Students will complete 20 hours of core neuroscience courses, 11 hours of statistics and research design, 9 hours of general electives, 12 hours of advanced electives in one of three focus areas, a minimum of 2 lab rotations, qualifying exams, and 12 hours of dissertation credits, for a total of 64 credits post bachelor's. The total credit requirement is similar to Boston University and the University of Utah. This credit requirement exceeds that of many doctoral programs in the neurosciences, including the University of Colorado at Boulder, Georgetown University, and the University of Montana. The proposed program requires fewer credits than Colorado State University, the University of Wyoming, and the University of Idaho, primarily because in the proposed program students earn fewer graduate credits for their lab experiences and will be required to take fewer dissertation credits.

External Review and Accreditation

There are currently no agencies or associations that accredit programs such as this one. No external consultants were involved in the development of the proposed program.

Projected Program Enrollment and Graduates; Projected Faculty/Students

Data Category	Current – Prior to New Program Implementation*	PROJ YR 1	PROJ YR 2	PROJ YR 3	PROJ YR 4	PROJ YR 5
Data for Proposed Program						
Number of Graduates in Proposed Program	X	0	0	0	0	3
Total # of Declared Majors in Proposed Program	X	3	6	9	12	15
Program Data						
Total Program Faculty FTE *(as reported in Faculty table above)*	19	19	19	19	19	19
Total Program Student FTE *(Based on Fall Third Week)*	N/A	3	6	9	12	15
Student FTE per Faculty FTE** *(ratio of Total Program Faculty FTE and Total Program Student FTE above)*	N/A	0.16	0.32	0.47	0.63	0.79
Program accreditation-required ratio of Student FTE/Faculty FTE, if applicable: (Provide ratio here:_____N/A_____)						

*Because this program is new and across different departments, data prior to program implementation cannot be calculated. Projected data reflect student numbers only in this program. It is acknowledged that

faculty within this program will also be working with other undergraduate and graduate students outside this program.

** Because a given full-time faculty member's workload will not be devoted 100% to the PhD in Neuroscience, the student-to-faculty FTE ratio for the program will be far more favorable than is represented in the table above.

Consistent with lab-based graduate programs, entering classes for this program will be small, especially in initial years. It is anticipated 3-4 new students will enroll each fall. Students entering with bachelor's degrees should be able to complete all requirements for the PhD within 5 years.

Expansion of Existing Program

This program is a new interdisciplinary PhD program and not an expansion or extension of an existing program.

Section III: Need

Program Need

Neuroscience is one of the fastest-growing areas of research around the world, resulting in an increased demand for doctoral-level graduates to fill research and teaching positions. As reported by the Society for Neuroscience in the 2011 survey of graduate programs, only 2% of neuroscience program graduates were not employed after graduation, and all of those who were employed were in a neuroscience field. Neuroscience research covers a broad spectrum, including biophysics, molecular and cellular neurobiology, neuronal development, neuronal degeneration, integrative neuroscience, brain imaging, and neurological and neurodevelopmental disorders. As a result, the scope of neuroscience and the demand for neuroscience education have grown exponentially. As reported by the Society for Neuroscience in its 2011 survey, applicant numbers per neuroscience program averaged 88 (with programs admitting less than a quarter of these students), a significant increase from the average of approximately 22 in 1986.

In a recent paper that appeared in *Nature Neuroscience*, Paul Howard-Jones (2014) pointed out that there are numerous disconnects between current findings in neuroscience and educational beliefs and practices. Howard-Jones recognized a need for increased communication between educators and neuroscientists and called for a new field of inquiry that is dedicated to bridging the gaps between education and neuroscience in order to inform our understanding of teaching and learning. Neuroscience has much to offer educational attitudes and approaches, and this proposed program is poised to be at the forefront of this exciting new movement.

There is a strong student demand for neuroscience doctoral programs. Within the intermountain region, there are PhD neuroscience programs at the University of Colorado-Denver, the University of Colorado-Boulder, Colorado State University, the University of Montana, the University of Idaho, the University of Wyoming, and the University of Utah. Student demand and the desire to provide programs that students are interested in make neuroscience programs common in research universities like USU. However, none of the existing programs in the intermountain region are housed in a College of Education and Human Services with a focus on making neuroscience discoveries relevant to educators and human services

professionals. The three foci in the proposed program, bridging basic and applied neuroscience across the lifespan, are unique to this proposed program.

As one of Utah's two state-supported research universities, Utah State University has focused on hiring strong faculty who conduct cutting-edge research. The proposed PhD in Neuroscience, in addition to adding research strength to the University with a new PhD, will also complement and strengthen current University programs in the Emma Eccles Jones College of Education and Human Services and the College of Science. Faculty and students across departments in these colleges are already collaborating on research in the area of neuroscience. The PhD in Neuroscience will bring these faculty and students together into one program, increasing opportunities for cross-disciplinary learning and collaboration.

Labor Market Demand

In November 2014, Indeed.com listed 598 neuroscience jobs that were available in the US. The Society for Neuroscience listed 341 available jobs in neuroscience. These were largely tenure-track openings in university departments of medicine, biology, bioengineering, neuroscience, or psychology, but they are also in private industry and research institutes. According to Indeed.com, 205 openings in neuroscience pay between $80,000 and $99,000; 128 openings pay between $100,000 and $119,000; and 97 openings pay $120,000 or above. The Neuroscience PhD graduation rate at the University of Utah is approximately 75%. Between 2006 and 2012, 51% of their graduates went on to postdoctoral positions or other post graduate school studies, 18% went into Law or Medicine, 10% went into academia as faculty, 8% entered academia as research associates, 3% went into industry, and 3% took non-science positions.

The proposed PhD in Neuroscience will respond to the growing need for neuroscientists, especially those with expertise in applying basic neuroscience discoveries to clinical, behavioral, and educational topics and questions. Given the current job market demand, as well as the placement rates from the University of Utah's program, it is expected that graduates of USU's program will be well-positioned to move into postdoctoral and other professional positions.

Student Demand

Utah lags other states in the region with regard to providing student access to neuroscience education. For example, the state of Colorado has 97,687 students in 14 universities (http://highered.colorado.gov/Data/Reports.aspx) with three Neuroscience PhD programs in the state (the University of Colorado-Denver, the University of Colorado-Boulder, and Colorado State University). In Utah, there are 92,882 students in the six public universities that compose the Utah System of Higher Education, but there is only one Neuroscience PhD program (the University of Utah). That program only admits 12 students per year out the more than 200 applicants. Clearly, students in Colorado have much more access to neuroscience education than students in Utah, and the demand for a neuroscience education in Utah cannot be met by the University of Utah alone.

The labs of faculty participating in this proposed neuroscience program contain undergraduate and graduate students who are interested in obtaining knowledge and research skills in neuroscience. There is a need for a doctoral degree that will enable these students to receive research and academic experiences that focus on molecular, cognitive, behavioral, or educational neuroscience. More students wanting a PhD degree in neuroscience will be able to stay in Utah rather than go out of state. This change will help to keep more talented students in Utah for their doctoral degrees.

Similar Programs

There is an interdepartmental graduate program in neuroscience at the University of Utah. Neuroscience faculty are housed in the departments of Ophthalmology/Visual Science, Neurobiology and Anatomy, Bioengineering, Biology, Pharmacy, Physiology, Pediatrics, Psychiatry, Neurology, and Psychology. Students complete a basic neuroscience program core curriculum that includes Frontiers in Neuroscience, Cellular and Molecular Neuroscience, Systems Neuroscience, Neuroanatomy for Biomedical Scientists, Neurophysiology Laboratory, Molecular Biology Laboratory, Neuroscience Rotations, and Developmental Neurobiology. Neuroscience PhD students are required to take a quantitative science/statistics course, an ethics course, a grant writing course, three graded elective graduate-level courses, and 3 credit hours of ungraded, departmental journal club courses beyond the core curriculum. The faculty and students are divided into five areas of research: Developmental Neuroscience, Molecular Neuroscience, Neurobiology of Disease, Brain and Behavior, and Cellular Neuroscience.

The main difference between the program at the University of Utah and the proposed program at Utah State University is that the curriculum and research experiences at the University of Utah are focused primarily on basic cellular and molecular neuroscience. The program at USU will focus primarily on applied clinical neuroscience. USU faculty and students are studying such issues as how the human nervous system learns and executes motor skills, how people with Parkinson's Disease plan and execute sequential actions, how neural processing differs among children who are developing typically and children with developmental language disorders, and how neural activation changes in response to memory or language training.

The state of Utah already has one neuroscience program that focuses on basic neurophysiology. There is a need for another program that focuses on translating basic discoveries in neuroscience into clinical knowledge of human development, education, aging, and neurodevelopmental and neurogenic disorders.

Collaboration with and Impact on Other USHE Institutions

On September 29, 2014, Dr. Ron Gillam from USU met with Dr. Richard Dorsky, the head of the interdisciplinary neuroscience program at the University of Utah. Dr. Dorsky and Dr. Gillam discussed the neuroscience program at the University of Utah and the planned program at Utah State University. Dr. Dorsky noted that the two programs would have a different focus. He said there is a strong need for another neuroscience doctoral program in the state, noting there are many more students who apply for the doctoral program in neuroscience at the University of Utah than they can accept. In addition, there are students who are primarily interested in translational or clinical neuroscience who decide to leave the state for other programs. Dr. Dorsky indicated that a cohort of doctoral students at Utah State University who focus on different aspects of neuroscience would increase the participation of students in the intermountain chapter of the Society for Neuroscience. The program at USU would provide collaborative opportunities for students and it would increase the number of potential postdoctoral applicants. Dr. Dorsky did not believe that the addition of a neuroscience program at USU would have any negative impacts on the program at the University of Utah.

Dr. Gillam is currently collaborating on neuroimaging research with Dr. Richard Wiggins, director of Imaging Informatics and Medical Administrator for the Picture Archiving Communication System at the University of Utah. They are working on a project that compares fMRI imaging and fNIRS imaging during memory and attention tasks.

Benefits

The proposed program will benefit the institution by adding to the doctoral program offerings. Given that USU is focused on increasing graduate enrollments, specifically doctoral enrollments, this program will benefit USU. In addition, the focus on interdisciplinary training will benefit programs at USU that are engaged in similar research and training. In terms of benefits to USHE and the state, as noted in the section above, there is a need for additional neuroscience programs in the state to better meet the needs of students interested in studying neuroscience, and especially the more applied aspects of neuroscience.

Consistency with Institutional Mission

This proposed program is consistent with USU's mission to be a premier university with a focus on graduate (as well as undergraduate) education. USU's graduate education goals and objectives include a strengthening of graduate education, which this program will address. In addition, the goals of discovery and promotion of excellence and research and scholarship are consistent with this program's focus on producing strong researchers in the neuroscience area. The doctoral program in neuroscience will serve the public need for increased information about neuroscience.

Section IV: Program and Student Assessment

Program Assessment

The overall goal of this program is to produce neuroscience PhD graduates who will be successful in research and academic settings post-graduation. Data on placement rates of students will be an important metric of success. While in the program, students will be expected to meet certain standards (as described below). Outcomes on these standards will also be used to judge program success.

Expected Standards of Performance

All students will complete a group of core neuroscience courses, as specified below, as well as a variety of specialty courses in their focus area. In addition to coursework, students are also required to engage in applied learning experiences and to produce finished products illustrating their understanding and capability to apply key concepts and skills. These experiences must include involvement in research above and beyond the required Second Year Project and Dissertation project. Students must also complete a series of Professional Milestones, including presenting research at a professional meeting, writing and submitting a grant, and publishing a paper.

Students entering with a baccalaureate degree are expected to complete a Second Year Project within two years and the PhD within five years. Students entering with a master's degree are expected to complete the requirements for the PhD within four years. These students would be expected to take the required courses and electives in the PhD program or have equivalent courses in their MS program. Neuroscience faculty will evaluate the student's MS program to determine which courses will be required to complete the PhD.

All students are required to pass a comprehensive exam before advancement to candidacy for the PhD degree. Students entering with a baccalaureate must pass the comprehensive exam prior to the beginning of their fourth academic year in the program. Students entering with a master's degree must complete the

comprehensive exam prior to the beginning of their second academic year in the program.

Section V: Finance

Department Budget

No additional funding is being requested for this program. Current budget figures below are for the Psychology department only as this is where the program will be housed.

Three-Year Budget Projection							
Departmental Data	Current Departmental Budget – Prior to New Program Implementation	Departmental Budget					
		Year 1		Year 2		Year 3	
		Addition to Budget	Total Budget	Addition to Budget	Total Budget	Addition to Budget	Total Budget
Personnel Expense							
Salaries and Wages	$2,022,789		$2,022,789		$2,022,789		$2,022,789
Benefits	$869,799		$869,799		$869,799		$869,799
Total Personnel Expense	$2,892,588		$2,892,588		$2,892,588		$2,892,588
Non-Personnel Expense							
Travel							
Capital							
Library							
Current Expense	$72,982		$72,982		$72,982		$72,982
Total Non-Personnel Expense	$72,982		$72,982		$72,982		$72,982
Total Expense *(Personnel + Current)*	$2,965,570		$2,965,570		$2,965,570		$2,965,570
Departmental Funding							
Appropriated Fund	$2,965,570		$2,965,570		$2,965,570		$2,965,570
Other:							
Special Legislative Appropriation							
Grants and Contracts							
Special Fees /							

Differential Tuition							
Total Revenue	$2,965,570		$2,965,570		$2,965,570		$2,965,570
Difference							
Revenue-Expense	$0		$0		$0		$0
Departmental Instructional Cost / Student Credit Hour* *(as reported in institutional Cost Study for "current" and using the same Cost Study Definition for "projected")*	$228		$228		$228		$228

** Projected Instructional Cost/Student Credit Hour data contained in this chart are to be used in the Third-Year Follow-Up Report and Cyclical Reviews required by R411.*

Funding Sources

The Neuroscience PhD program will utilize existing faculty and courses at USU. No additional funding is required for this program.

Reallocation

No reallocation of funds will be needed to support this program.

Impact on Existing Budgets

Budgets in other programs will not be impacted. Many of the classes taught in this program are already being offered in existing programs, and there is capacity for additional students. Although faculty engaged in the neuroscience program may have additional advisees, this load will be spread out over multiple faculty members, with little or no implications for budgets. Several additional courses will be added for this program, but these courses will be incorporated into teaching loads of existing faculty.

Section VI: Program Curriculum

All Program Courses (with New Courses in Bold)

Note that a variety of elective courses across departments are listed. These are examples of courses that could be taken. It is not expected that a large number of students will take any one of these listed classes.

Course Prefix and Number	Title	Credit Hours
Required Courses	BIOL 6100: Neurobiology or PSY 6200: Fundamentals of Neuroscience I	3
	PSY 6210: Fundamentals of Neuroscience II	3
	PSY 7110: Cognitive Neuroscience	3
	PSY 7830: Mechanisms of Neuropsychiatric Diseases	3
	PSYC 7090: Program Seminar	8: 1 per semester
	PSY / EDUC 6570: Introduction to Educational and Psychological Research or STAT5200: Design of Experiments	3
	PSY / EDUC 6600: Research Design and Analysis 1 or STAT 5710: Intro to Probability	3
	PSY / EDUC 7610: Measurement, Design and Analysis 2 or STAT 5720: Intro to Mathematical Statistics	3
	USU 6900: Research Integrity	2
	PSY 7970/FCHD 7970/PEP 7970/BIOL 7970 (or other 7970): Dissertation	12
	Sub-Total	43
Elective Courses		
(9 credits from the following)	PSY 7900/COMD 6900/PEP 7900/: Independent Study	Var
	PSY 7910/COMD 7910/PEP 7910/FCHD 7060/ BIOL 6910: Independent/Advanced Research	Var
	PSY 7140: Methods in Neuroscience	3
	BIOL 5210: Cell Biology	3
	FCHD 7033: Research Methods 3: Dyadic and Longitudinal Data Analysis	3
	PSY 7670: Literature Reviews in Education and Psychology	3
	PSY 7700/PEP 7070: Grant Writing	
	PSY 7780: Multivariate Statistical Analysis I	3
	PSY 7790: Multivariate Statistical Analysis II	3
	STAT 5100: Linear Regression	3
	STAT 6100: Advanced Regression	3
	Sub-Total	9
Focus area options		

Course Prefix and Number	Title	Credit Hours
Translational Neuroscience		
(12 credits from the following)	PSY 7100: Biological Basis of Behavior	3
	COMD 7420: Electrophysiology	3
	PSY 6670: Neuropsychopharmacology	3
	PSY 6680: Neuroeconomics	3
	PSY 7820: Neuropsychology: Principles and Assessment	3
	SPED 7820: Research Instrumentation in Neuroimaging	3
	PSY 6650: Theories of Learning	3
	PSY 7740: Behavioral Pharmacology	3
Educational Neuroscience		3
(12 credits from the following)	PSY 6530: Developmental Psychology	3
	FCHD 7520: Development in Childhood	3
	PSY 6650: Theories of Learning	3
	PSY 6600: Cognition and Instruction	3
	PSY 7110: Advanced Theories of Cognitive Psychology	3
	PSY 7820: Neuropsychology: Principles and Assessment	3
	SPED 7820: Multidisciplinary Seminar on Language and Literacy	3
	SPED 7820: Research Instrumentation in Neuroimaging	3
Lifespan Neuroscience		
(12 credits from the following)	FCHD 7920: Aging Mind – Aging Brain	
	PSY 7270: Lifespan Psychopathology	3
	PSY 7820: Neuropsychology: Principles and Assessment	3
	COMD 6130: Neural Bases of Cognition and Motor Speech Disorders	3
	COMD 6120: Adult Language Disorders	3
	COMD 6140: Dysphagia	3
	PEP 6850: Neural Aspects of Rehabilitation I and II	3
	PEP 6860: Motor Development	3
	PEP 6840: Fundamentals of Motor Behavior	3
	PEP 7870: Advanced Motor Behavior Seminar	3
	PEP 7820: Variability and Dynamical Systems	3
	Sub-Total	12
	Total Number of Credits	64

Program Schedule - Example

Year 1

Fall Semester – 7 credits

- BIOL 6100 Neurobiology or PSY 6200 Fundamentals of Neuroscience I – 3
- PSY / EDUC 6570 Introduction to Educational and Psychological Research or STAT 5200 Design of Experiments – 3
- Neuroscience Program Seminar – 1
- Lab Rotation #1

Spring Semester – 7 credits

- PSY 6210 Fundamentals of Neuroscience II – 3
- PSY / EDUC 6600 Research Design and Analysis 1 or STAT 5710: Introduction to Probability – 3
- Neuroscience Program Seminar – 1
- Lab Rotation #1

Year 2

Fall Semester – 7 credits

- PSY 7110 Cognitive Neuroscience – 3
- PSY / EDUC 7610 Research Design and Analysis 2 or STAT 5100 Linear Regression – 3
- Neuroscience Program Seminar – 1
- Lab Rotation #2

Spring Semester – 6 credits

- PSY 7830 Mechanisms of Neuropsychiatric Diseases – 3
- General Elective – 2
- Neuroscience Program Seminar – 1
- Lab Rotation #2

Year 3

Fall Semester – 6 credits

- Research Integrity – 2
- Emphasis Area Advanced Elective - 3
- Neuroscience Program Seminar – 1

Spring Semester – 7 credits

- General Elective – 3
- Emphasis Area Advanced Elective – 3
- Neuroscience Program Seminar - 1

Year 4

Fall Semester – 6 credits

- General Elective – 2
- Emphasis Area Advanced Elective – 3
- Neuroscience Program Seminar – 1

Spring Semester – 6 credits

- Emphasis Area Advanced Elective - 3
- General Elective – 2
- Neuroscience Program Seminar – 1

Year 5

Fall Semester – 6 credits

- Dissertation

Spring Semester – 6 credits

- Dissertation

Section VII: Faculty

Psychology

Tim Shahan, PhD – Dr. Shahan's research focuses on fundamental behavioral processes with an emphasis on quantitative theoretical models of conditioning, learning, and behavioral regulation. His research examines how processing of information about rewards and reward-related cues contributes to decision-making, attention, and the persistence goal-directed behavior. Translation of insights from this basic research to problems of human health (e.g., drug addiction, developmental disabilities, mental illness) is a core feature of Dr. Shahan's research program.

Catalin Buhusi, PhD – Dr. Catalin Buhusi uses rodent models to manipulate, visualize, and examine the involvement of the dopaminergic system in normal and abnormal behavior. Current work includes behavioral studies, pharmacological manipulations, and multiple electrode recordings in behaving mice and rats. Computational models are used to integrate the growing body of data relative to the role of the

dopamine system in learning, memory, and attention. Research is relevant to psychopathology ranging from Intellectual Disabilities, to Schizophrenia, Parkinson's disease, and Huntington's disease.

Mona Buhusi, PhD – Dr. Mona Buhusi's research aims at (a) understanding how neuronal connectivity relates to normal and abnormal behavior and neuropsychopathology (from neurodevelopmental disorders such as autism and schizophrenia to age-related cognitive and motor deficits), (b) identifying molecules and mechanisms involved in the formation of specific neuronal circuits, and (c) identifying mechanisms of synapse formation, plasticity or maintenance.

JoAnn Tschanz, PhD – Dr. Tschanz's research interests involve the study of severe cognitive deficits in the elderly. For the past 12 years, she has examined genetic and environmental factors that appear to influence the risk of developing severe cognitive impairments such as dementia of the Alzheimer's type. Recently, Dr. Tschanz has studied diverse topics of aging, such as the cognitive correlates of late-life depression, the influence of cardiovascular and cerebrovascular disease on memory and other cognitive abilities, the role of various medications in reducing the risk for Alzheimer's disease, neuroimaging correlates of cognitive impairment, behavioral disturbances in dementia, and the influence of family history of Alzheimer's disease and other genetic factors on an individual's cognitive performance.

Kerry Jordan, PhD – Dr. Jordan directs the Multisensory Cognition Lab. Using various behavioral paradigms and a mobile EEG setup, research in the lab melds cognitive neuroscience, developmental psychology, and education approaches to investigate the brain's representation of number through multiple senses (e.g., vision, audition) in both adults and children. Dr. Jordan researches both what typically developing children know about mathematics behaviorally and also how they process this information in the brain. By mapping early neural processing of mathematics in children, Dr. Jordan and her collaborators ultimately aim to help identify atypical learners who may benefit from early intervention.

Communication Disorders and Deaf Education

Ron Gillam, PhD – Dr. Gillam directs the Language, Education, and Auditory Processing (LEAP) Brain Imaging Lab in the Emma Eccles Jones Early Childhood Education and Research Center. He conducts research on neural processing in children with developmental language disorders, autism, phonological disorders, and academic disorders. His research team uses functional Near Infrared Spectroscopy (NIRS) to assess the extent and variability of neural processing as children engage in information processing, language comprehension, and language production tasks.

Lisa Milman, PhD – Dr. Milman conducts translational research in the area of adult language neuro-rehabilitation. Her research explores how basic theories and discoveries from the fields of neuroscience, psychology, and linguistics can be used to develop innovative assessment and interventions that improve communication and quality of life for individuals affected by aphasia and other neurogenic communication disorders.

Sandra Laing Gillam, PhD – Dr. Laing Gillam conducts research on neural processing in children and adults with neurodevelopmental, speech and language, and phonological processing disorders. She specializes in the development and analysis of tasks that compare the behavioral and neuroimaging data obtained from Near Infrared Spectroscopy (NIRS).

Stephanie Borrie, PhD – Dr. Borrie is the director of the Human Interaction Lab. In this lab she explores how speech disorders arising from neurological origins (e.g., dysarthria) interfere with the mechanisms that underpin speech production, perception, and interpersonal coordination. Her work emphasizes the role of rhythm in communication and draws from a breadth of disciplines, including speech science, neuroscience, cognitive science, psychology, sociolinguistics, and tools from the field of engineering.

Kim Corbin-Lewis, PhD – Dr. Corbin-Lewis specializes in the applied science of dysphagia (swallowing disorders) diagnosis and management using a physiology-based model. She focuses on quantitative and qualitative methods of fluoroscopic imaging interpretation of swallow with the goal of improving clinical decision-making. She teaches undergraduate and graduate courses in speech science, dysphagia, and disorders of voice.

Health, Physical Education, and Recreation (Pathokinesiology Specialization)

Eadric Bressel, PhD – Dr. Bressel's research examines neuromechanical adaptations to therapeutic exercise in healthy and special populations. He has specific interest spine stabilization exercises, determinants of balance, and rehabilitation of chronic conditions such as osteoarthritis using an aquatic environment.

Breanna Studenka, PhD – Dr. Studenka specializes in pathokinesiology. She conducts research on how humans plan for and control movements that occur in sequence, including rhythmic timing, planning of grasping for object manipulation and joint-action, and continuous sensory-motor coupling. Her current research includes movement timing related to visual control and stuttering, the role of social/contextual factors on characteristics of movement variability, and potential therapeutic interventions for persons with movement disorders specifically related to control of sequential, timed movement (Parkinson's disease).

Sydney Schaefer, PhD – Dr. Schaefer's research focuses on how the human nervous system learns and executes motor skills, and relearns existing ones during motor recovery following neural damage. Dr. Schaefer and her team use noninvasive, behavioral techniques to study the control and learning of functional upper extremity movements, such as reaching, grasping, and object manipulation, as well as balance and posture. Findings from this research provide much-needed evidence for neurorehabilitation in geriatric populations with a number of movement disorders.

Family, Consumer, and Human Development

Beth Fauth, PhD – Dr. Fauth conducts research on Alzheimer's disease and other dementias; stress processes for caregivers of older adults; and the physical, cognitive, and psychosocial components of late life disability. She teaches undergraduate and graduate courses in aging, including the cognitive and neural changes associated with normative and non-normative aging (e.g., dementia and mild cognitive impairment).

Maria Norton, PhD – Dr. Norton's research program focuses on geriatric mental health and the psychosocial factors that affect risk for depression and dementia in late-life, including lifestyle choices, stressful life events, social support networks, personality, religiosity, and the extent to which these factors might alter genetic influences. Her current work examines psychosocial stressors across the entire lifespan (e.g., family member deaths, poverty, divorce, teen or unwed pregnancy, widowhood, premature offspring birth) and their association with late-life cognitive health, and the moderating effects of depression and

genes. Dr. Norton is also engaged in the development and testing of evidence-based lifestyle behavioral interventions with a multi-disciplinary team (health educator, neuropsychologist, sports educator, nutritionist, therapist, human developmentalist, and gerontologist) to encourage and support middle-aged persons in making and sustaining healthy lifestyle changes towards the goal of lowering risk for Alzheimer's disease.

Biology

Tim Gilbertson, PhD – The main goal of Dr. Gilbertson's research is to understand how information is processed by the nervous system. To accomplish this broad objective, he has focused on investigating the processing of taste stimuli by the peripheral gustatory system. He investigates the mechanisms the body uses to recognize nutrients and how this process is regulated by nutritional need. Current research focuses on the way nutrients, including fats, carbohydrates, and minerals, are detected by chemosensory cells in the oral cavity and in several nutrient-sensitive, post-ingestive organs. The research in his laboratory spans from genes through behavior with expertise in molecular biology, proteomics, electrophysiology, imaging, biochemistry, and analysis of behavior.

Brett Adams, PhD – Dr. Adams' research concerns the molecular underpinnings of cell signaling processes. Currently, his laboratory investigates signaling by two small GTPases, Dexras1 and Rhes.

Biological Engineering

Anhong Zhou, PhD – Dr. Zhou is the principal investigator of the Molecular and Cellular Sensing and Imaging Research Laboratory (MCSIRL) in the Department of Biological Engineering. Laboratory research is mainly focused on the integration of state-of-the-art instrumentation methods and new chemo/bio-sensing technologies for biomolecular surface engineering applications.

Mathematics and Statistics

Guifang Fu, PhD – Dr. Fu conducts research on statistical genetics, statistical shape analysis, statistical neural analysis, functional data analysis, and high-dimensional big data modeling. She develops advanced statistical models to analyze data with different background applications such as whole genome association studies, morphological data, Near Infrared Spectroscopy data, and EEG data.