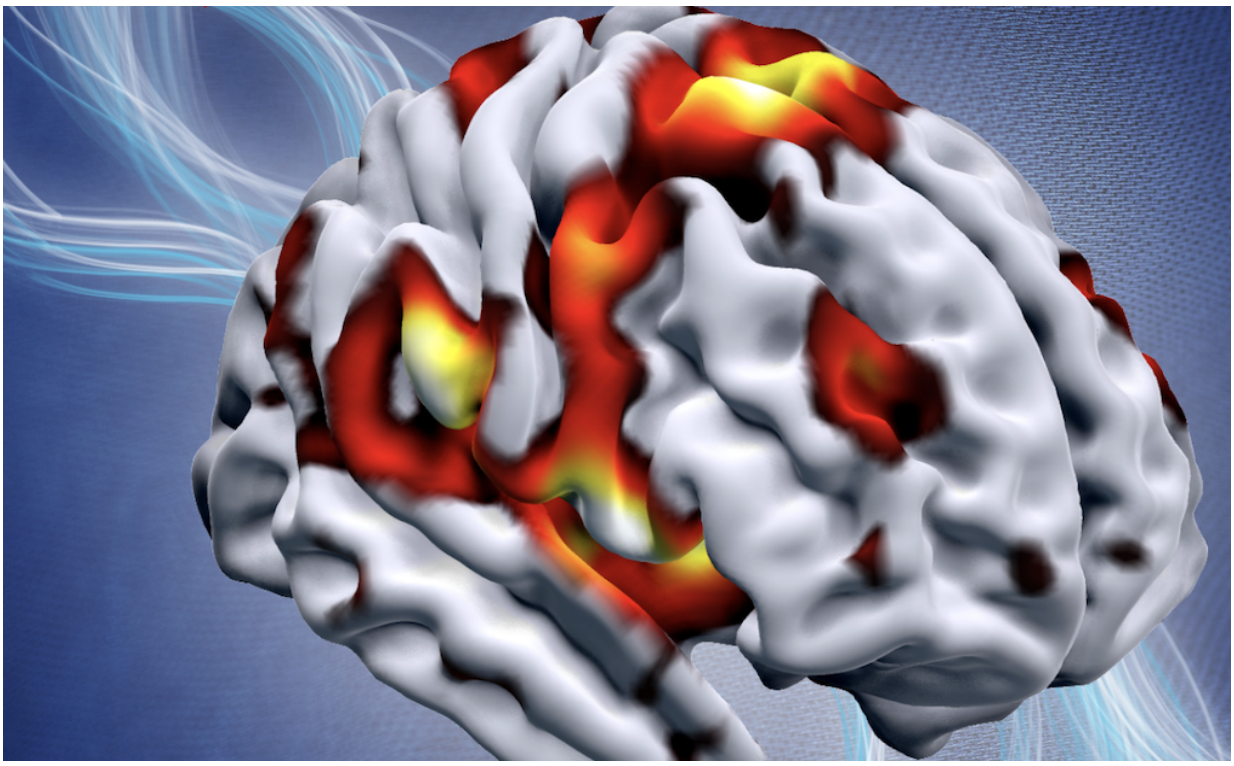
Student Handbook:

Neuroimaging Methods Certificate

2022-2023



Cognitive Science Graduate Interdisciplinary Program
University of Arizona

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Introduction: The Graduate Interdisciplinary Degree Program (GIDP) Neuroimaging Research Methods Certificate offered by the Cognitive Science GIDP

Classes taken to earn the 12-credit Neuroimaging Methods Certificate will provide graduate students with training in neuroimaging - experimental design, acquisition, processing and analysis of functional and structural brain images. The certificate classes provide training in MRI pulse sequences, best practices in data preprocessing, quality control, artifact removal, statistical modeling, analysis, and visualization and interpretation of results. The students who complete the certificate will have training in state-of-the-art tools to design and implement neuroimaging experiments. Students will be better prepared for the job market in biomedical research and industry. For potential employers, the certificate indicates that the students have the necessary skills to understand, process, and analyze data from neuroimaging experiments.

Successful use of neuroimaging requires familiarity with MRI scanning sequences, neuroanatomy, relevant experimental design considerations, and considerable computational skill, especially as related to selecting and running appropriate processing software and interpreting those results. Currently, researchers with an interest in applying neuroimaging techniques to their discipline must expend considerable effort, outside of their area of study, to acquire the appropriate skills, and they may have to do so without formal guidance. ***This certificate program provides a clear path to developing neuroimaging skills which often fall outside of the student's main area of study.***

The course of study to earn the Certificate in Neuroimaging Methods will provide a programmatic state-of-the-art education *in the practical skills necessary to conduct a neuroimaging project using open science research practices. It guarantees a student has a well-defined and rigorous set of relevant experiences and training. This contrasts with saying "I worked in a neuroimaging lab for 2 years" which guarantees very little about the nature of the student's training.*

The set of certificate courses reduces replication of effort*: Students get standard training so that each lab doesn't have to begin from scratch/cover everything. Although each lab will train students on their own procedures, they can begin by knowing the students have some basic computational skills, and relevant background in theory, statistics, and experimental design.*

The certificate ensures practical hands-on experience*: The coursework includes substantial hands-on experience using relevant software. This hands-on experience is crucial to providing students with the necessary skills for processing and analysis of neuroimaging data, but it requires small classes and individualized attention which is not reliably available in other coursework.*

Improved Job Opportunities*:*

A certificate in neuroimaging might impact employability in many disciplines where the brain and cognition are legitimate topics of study: Neuroimaging is a useful tool for understanding the structure and function of both human and nonhuman brains, including neuroanatomy, development, aging, disease processes, mental health, the impact of interventions (e.g., pharmacological, surgical, noninvasive), and the functional organization of cognitive processes involved in language, perception, thought, social cognition, learning and memory (etc.).

Reliable job-related data on certificates are not generally available. Nevertheless, Coursera reports that 50% of learners started a new career after completing their brief neuroimaging course. Ziprecruiter.com lists much higher average salaries for Functional Neuroimaging jobs ($121,430) than for jobs classified as "Psychology" ($55,447) or "Psychology research" ($62,430).

- *Many **Postdoctoral positions** in neuroscience/psychology/cognitive science require students to be proficient in data preprocessing and analysis, coding, programming, and scripting.*
    - *Other fields, such as linguistics and sociology, increasingly incorporate neuroimaging into their research.*

- ***Industry Jobs**: Biomedical companies hire candidates with neuroimaging data analysis and preprocessing skills: e.g.,*
    - *Electrogeodesic: EGI*
    - *MAG STIM*
    - *NeuroCon*
    - *Brain Vision*
    - *Neuroscan*

Skill sets. A unique aspect of our program is that the courses offered will provide theoretical foundations and hands-on experience with neuroimaging. The certificate will provide a consistent state-of-the-art, hands-on education in the practical skills necessary to conduct a neuroimaging project, including familiarity with current best practices, MRI scanning sequences, neuroanatomy, experimental design, processing software, and interpretation of results.

The course sequence has been carefully designed so that the students are guided through the relevant background and practical experiences to the mastery of neuroimaging experiment design and analysis. In addition, each student will have an opportunity to specialize in the neuroimaging technique of their choice by working with a faculty mentor on a capstone project. Practical skill sets that students will have an opportunity to exercise and acquire include:

- Design of fMRI/EEG experiments
- Issues related to working with human participants and special populations
- IRB application for fMRI research
- Hands-on experience in fMRI data acquisition
- Data organization and conversion to the BIDS standard
- Working with High-Performance Computing Resources (HPC) to increase efficiency

- Data preprocessing and preparation, including methods of artifact correction
- Statistical modeling and analysis
- Visualization of results
- Writing and presenting neuroimaging results

The Neuroimaging certificate is supported by diverse faculty from different departments but administered through the Cognitive Science department.

Program Oversight Committee & Faculty:

- Program Coordinator: Dianne Patterson, Ph.D.
    - Cognitive Science GIDP faculty member; Research Innovations and Impact (RII) Neuroimaging Staff Scientist, dkp@arizona.edu
- Program Director Mary Peterson, Ph.D.
    - Professor and Director of the Cognitive Science Program; Professor, Department of Psychology; Professor, Evelyn F. McKnight Brain Institute; Director of the Visual Perception and Cognition laboratory; Chair, Cognitive Science GIDP, mapeters@arizona.edu
- Admissions Contact: Aneta Kielar, Ph.D.
    - Assistant Professor, Speech, Language, and Hearing Sciences Department; Director of the Language and Neuroimaging Research Laboratory; Cognitive Science GIDP faculty member; BIO5 faculty member, akielar@arizona.edu

Additional Faculty:

Additional faculty have declared their interest in providing elective coursework and mentoring of individual students

- John Allen, Psychology
- Lee Ryan, Psychology
- Ying Hui Chou, Psychology
- Jamie Edgin, Psychology
- Mary Frances O'Connor, Psychology
- Nan Kuei Chen, Biomedical Engineering
- Ted Trouard, BIomedical Engineering
- Russ Witte, BIomedical Engineering
- Srini Vedantham, BIomedical Engineering
- Luca Caucii, BIomedical Engineering
- William Killgore, Psychiatry
- Barbara Cone, Speech, Language and Hearing Sciences

Resources & Facilities

The Neuroimaging Research Methods Certificate appreciates access to the MRI research scanner provided through RII and approved by the Faculty Research Advisory Committee

Funding

A scholarship fund of 14% of the fee income will be set aside for eligible students. The application procedure will be posted once fees are approved.
Additional requirements for financial aid eligibility apply to international applicants. Please see the following page for more information: https://grad.arizona.edu/funding/ga/english-speaking-proficiency-evaluation.

Policies

Student Appeals

Our faculty and staff are committed to our students and their success. We encourage you to raise issues and concerns with your academic advisor or other faculty. The University of Arizona ensures that student grievances are heard and appropriately addressed. The policy on grievance procedures can be found at the following website: http://grad.arizona.edu/academics/policies/academic-policies/grievance-policy.

Advising

By the beginning of the second semester in residence the student must choose an advisor from among the available faculty associated with the GIDP certificate in Neuroimaging Methods (see Faculty above). Until the student has chosen an advisor, the chair of the GIDP Committee, or another GIDP faculty member designated by the GIDP Chair, will serve as the student's temporary advisor.

Graduate College

The University of Arizona Graduate College is the best resource to access and review policies and procedures. Students may access Graduate College policies, contacts, information about resources, deadlines, and other useful information: https://grad.arizona.edu/.

Professional Development, Health, Wellness and Safety, Childcare and Family Friendly Information and Resources. Resources for all the above categories can be found here: https://grad.arizona.edu/new-and-current-students

UArizona Catalog

The UA Arizona Catalog is a comprehensive resource for information related to academic programs and policies: https://catalog.arizona.edu/

Academic Integrity

All students at the University of Arizona are responsible for reviewing, knowing and practicing the Code of Academic Integrity. Honesty in all class work and ethical conduct in all labs and clinical assignments is expected. This principle is furthered by the Student Code of Conduct and disciplinary procedures established by ABOR Policies 5-308 through 5-404 (see chapter 5), all provisions of which apply to all University of Arizona students. This Code of Academic Integrity (hereinafter "this Code") is intended to fulfill the requirement imposed by ABOR Policy 5-403.A.4 and otherwise to supplement the Student Code of Conduct as permitted by ABOR Policy 5-308.C.1.

Students are strongly encouraged to review the code here:
https://deanofstudents.arizona.edu/policies/code-academic-integrity

Responsible Conduct of Research

Students are required to review the responsible conduct of research documentation and complete the appropriate forms within UAccess Student (GradPath):
https://research.arizona.edu/compliance/RLSS

Important Note: The student is responsible for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of their degree.

It is the responsibility of students to familiarize themselves with the general campus-wide requirements and information on the transfer of graduate credit from other institutions, off-campus graduate study, scholastic standards, forms that the student must submit to the Graduate College, and the time limit for the completion of requirements for graduate degrees.

Degree Program Requirements

The Graduate Certificate in Neuroimaging research methods requires students to complete 12 units of coursework.

Certificate level (graduate certificate or post-master's certificate)	Graduate Certificate
Minimum total units required	12
Total transfer units that may apply to the certificate.	6

Note: no more than 6 units of transfer credit may apply to a graduate certificate.	
Pre-admissions expectations (i.e. academic training to be completed prior to admission)	Involvement in a neuroimaging lab is encouraged but not required.
Graduate non-degree status units permitted? (Yes/No). If yes, list how many. ***Note: per policy, 6 units maximum may be used.***	6 units may be used towards the certificate
Certificate requirements. List all certificate requirements including core and electives.. Courses listed must include course prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department. ***Note: No less than 50% of the course work applied to a certificate must be taken for a regular letter grade.***	Students will be required to be certified in **MRI safety**. The training is provided through the University of Arizona D2L course site and includes an in-person component. Required coursework: COG 505 (3) Neuroimaging Theory, Methods and Applications (New) COG 510 (3) Computing for Neuroimagers (New) COGS 512 (3) Experience in Neuroimaging Study Design and Analysis (New), (COGS699/SLHS699, or PSY699 can be substituted with permission) Electives: Complete 3 units from the options below: BME 516 (3) Biomedical Imaging BME 639 (3) Magnetic Resonance Imaging COGS 500 (3) Computing for the Research Lab BME 599, SLHS 699 or PSY 699 (3): Can be taken to undertake specialized analysis not covered in the required

	coursework. Can substitute for COGS 512 PSY 501A (3) Principles of Psychophysiology PSY 502 (3) Principles of Neuroanatomy PSY 516 (3) Analyzing Neural Time-series Data PSY 528 (3) Cognitive Neuroscience SLHS 588C (3) Electrophysiology of Auditory Perception and Cognition
Research methods, data analysis, and methodology requirements. (Yes/No). If yes, provide description.	Yes. Basic knowledge of neuroanatomy and brain function is recommended.
Internship, practicum, applied course requirements (Yes/No). If yes, provide description.	No
Is substitution of required or elective courses permitted at advisor's discretion? (Yes/No). If yes, provide description *Note: standard substitution allowance is up to 25% of the total required units without Graduate College approval.*	Yes, students may substitute 3 units with program advisor approval
May units earned for the certificate be applied to affiliated graduate programs (from section II)? (Yes/No). If yes, list how many.	Yes (12 units)
Additional requirements (provide description)	Students must complete MRI safety training

Time to Degree

It is expected that students can complete the program in three semesters

Satisfactory Academic Progress

What is satisfactory progress? The absolute minimum criteria for satisfactory progress include:

- Maintain a grade point average of no less than 3.00 in all certificate course work. GPA is calculated at the end of each semester.
- No final grades below a "B" in core courses.
- Students may not carry more than two "incompletes" at any time.
- Satisfactory progress must be made toward completion of the degree and this should be documented in the annual review process with the faculty and advisor/program coordinator through Grad Path.

What happens when students are deemed to be not making satisfactory progress?

An evaluation of "not making Satisfactory Academic Progress" is grounds for the removal of funding from the program and may be grounds for removal from the program. Students judged to have academic difficulties (e.g., poor grades, failing or at risk of failing to satisfy program requirements) will receive written notice from the Program Committee with specific suggestions as to how these problems might be remedied and the date by which such actions must be taken. This notification will be copied to the Graduate College. The Graduate College has established guidelines, which departments must follow in order to dismiss graduate students from their programs. Students should familiarize themselves with the steps in the process so they will know their rights, responsibilities, and remedies should such a situation develop. Students who fail to remediate by the deadlines specified may be dismissed from the program.

Annual Review

Certificate students should meet with their advisor annually to review their progress and plan of study.

Transfer Credits

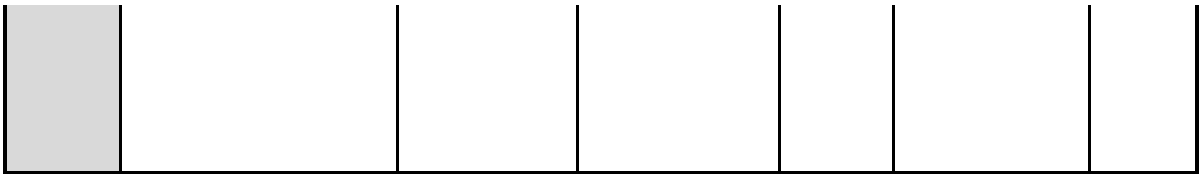
Students can transfer up to 6 units of coursework into the graduate certificate program subject to approval by a core faculty member. Students are responsible for completing the plan of study, and transfer credit documentation, and must obtain permission from the Chair, faculty advisor, or program coordinator prior to completing the first semester of the program.

Incomplete Policy

Students earning a grade of Incomplete, "I" for a course should submit a completed Report of Incomplete Grade form (https://registrar.arizona.edu/faculty-staff-resources/grading/grading-policies/incomplete) to the Graduate Advisor/Coordinator for inclusion in their academic record: http://registrar.arizona.edu/gradepolicy/incomplete.htm. Incomplete grades should be completed in a timely manner and are submitted at the discretion of the course Instructor.

Plan of Study (Template)

Unofficial plan of study template: Neuroimaging Methods Certificate						
Courses Required for Degree		**Completed Coursework: Enter Term**			**Planned Term of Completion**	**Notes**
	Major Courses	**Transferred**	**Transfer Forms Completed?***	**Taken at UA**		
COGS 505	Neuroimaging Theory, Methods, and Applications	N/a	N/a			
COGS 510	Computing for Neuroimagers	N/a	N/a			
COGS 512	Experience in Neuroimaging Study Design and Analysis	N/a	N/a			
	Elective/Selective Courses**					
COGS 500	Computing for the Research Lab					



An Excel file of this template will be available from the Graduate Program Coordinator.

Learning Outcomes

Learning Outcome #1: Students will gain theoretical and analytical skills in neuroimaging data preprocessing, artifact correction, quality assessment, model specification, statistical analysis, and image visualization.
Concepts: Students will apply data preprocessing and analysis to the neuroimaging data
Competencies: Students will demonstrate the ability to preprocess neuroimaging data, perform artifact correction and quality assessment, specify statistical model, performs statistical analysis, and visualize results
Learning Outcome #2: Students will design neuroimaging experiments, prepare, and present research proposals implementing neuroimaging techniques.
Concepts: Students will learn to design experiments and write and present research proposals
Competencies: Students will demonstrate the ability to design experiments and write and present research proposals implementing neuroimaging techniques.
Learning Outcome #3: Students will learn to leverage emerging neuroimaging standards (e.g., BIDS), containerization and large compute resources (e.g., HPC) to improve reproducibility and efficiency in processing.
Concepts: Students will apply neuroimaging standards to improve data processing and analysis
Competencies: Students will demonstrate the ability to use BIDS containers and HPC resources to preprocess data in a reproducible and efficient way

Current Courses

Course prefix and number	Units	Title	Pre-requisites
BME 516	3	Biomedical imaging	None, Not listed
BME 639	3	Magnetic Resonance Imaging	Basic MRI knowledge at the level of BME 516 or BME 638 is recommended but not required. Basic computer programming in a language suitable for image analysis and signal processing (e.g. Matlab, Python, Julia, C, or C++) is recommended.
COGS 500	3	Computing for the Research Lab	None
COGS 505	3	Neuroimaging Theory, Methods, and Applications	COGS 500 or equivalent experience with Unix, Matlab, etc.
COGS 510	3	Computing for Neuroimagers	COGS 505
COGS 512	3	Experience in Neuroimaging Study Design and Analysis	COGS 505 and 510 *An independent study could be substituted for 512 with permission
PSY 501A	3	Principles of Psychophysiology	None, Not listed
PSY 502	3	Principles of Neuroanatomy	None, Not listed
PSY 516	3	Analyzing Neural Time-series Data	None, Not listed
PSY 528	3	Cognitive Neuroscience	PSY 290A or PSY 290B or instructor's permission

SLHS 588C	3	Electrophysiology of Auditory Perception and Cognition	None, Not listed
Independent Study: BME 599, PSY 699, SLHS 699	1-3	Independent Study	COGS 505 and 510 (or equivalents)