UC SANTA BARBARA Crossroads

PHASE 2 REPORT
2017 - 2020

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Executive Summary

Crossroads is a year-long, multi-faceted interdisciplinary research experience for UC Santa Barbara doctoral students, which also encompasses the undergraduate classroom through curriculum development and closely mentored teaching. The program takes its name from the multiple intersections involved: of disciplines; of research and teaching; and of faculty members, graduate students, and undergraduates.

This report focuses on Phase 2 of Crossroads, which covers the years 2017-2020. During this time, Crossroads was funded in part by a grant from the National Science Foundation Innovations in Graduate Education (IGE) program, which paid for a full-time academic coordinator, a formal evaluation, and travel for graduate students to give presentations at scholarly meetings. The graduate division provided funding for graduate student fellowships (one quarter per fellow), the Divisional Deans contributed one TAship for each fellow, and the Office of Research provided $1000 per fellow for research expenses. Instructional Development contributed to the project by enrolling all fellows in Grad 210 (College and University Teaching—From Theory to Practice), which was co-taught jointly by Lisa Berry (instructional development) and Joshua Kuntzman (Crossroads Academic Coordinator).

Five projects were funded in this period: The California Grizzly Project, Green Chemistry, Unconscious Memory, Visualizing Environmental Models, and Spatial Navigation. They involved faculty and graduate students from the Bren School, Chemistry & Biochemistry, Chemical Engineering, Computer Science, Education, English, History, Molecular, Cellular and Marine Biology, and Psychological & Brain Sciences. Note that due to the NSF funding, all projects in this phase had a STEM focus. Although the graduate division was open to proposals from other divisions, none were received.

An important innovation in this phase of Crossroads was the development of interactive activities to facilitate groups in developing understanding of each other's disciplines and coordinating their project goals. These were well received, especially by project leaders who worked with the academic coordinator to adapt the exercises to the context of their own projects. All fellows were required to take Grad 210, which included modules created specifically for the Crossroads fellows on interdisciplinary pedagogy. The students found this course to be very valuable, but were sometimes challenged by the amount of work required while also participating in other aspects of the projects. The graduate division funding was reduced from two quarters to one quarter of fellowship in Phase 2, and several participants commented that they would have appreciated an additional fellowship quarter (as was given in Phase 1 of Crossroads). About half of participants used the travel funding – others planned to do so but were unable to travel due to COVID-19.

The projects were all successful and led to novel research presentation, papers and grant proposals (including a proposal for a Science and Technology Center). The teaching contributions included interventions in a large GE course (Environmental Studies), the development of a new GE course on Unconscious Memory, the development of videos to bring interdisciplinary perspectives to large GE courses in Chemistry and Psychology, and the use of data visualizations of environmental data in an undergraduate Computer Science course and a Master's level course in the Bren School.

This is a very successful program in general, and continuation of the program is recommended if budget permits. This report makes several recommendations for improving the program in the future, including suggestions for different funding models and institutionalization of program elements. Specifically it makes recommendations regarding advertising the program on campus, development of proposals, funding levels, selecting students to participate in the program, facilitating interdisciplinary collaboration, project time length, pedagogical training and teaching experience.

Introduction

This report provides an overview of the key conceptual elements and goals of the UCSB Crossroads program, with an emphasis on Phase 2 (2017-2020). It explains how these elements have been translated into a program structure, how they were implemented, and provides recommendations for future program development.

Context and Purpose of Crossroads

Most of the problems facing human society are complex and will only be solved when people with different types of expertise collaborate. Although university faculty are often involved in interdisciplinary collaboration, most PhD students are still trained in single departments and have little opportunity to learn about working in interdisciplinary teams. In addition, there are few interdisciplinary courses for undergraduates, so that they do not get exposed to the power of interdisciplinary problem-solving. Fewer interdisciplinary undergraduate courses also means that there are few opportunities for graduate students to teach in interdisciplinary settings, even though one of the best ways to learn about the complexity of interdisciplinary work is to teach about it. As a result, graduate students do not have many opportunities to learn how to communicate interdisciplinary research, either in classes or to the general public.

The Crossroads program addresses these gaps in graduate student development. However, interdisciplinary collaboration is also challenging work. True interdisciplinary collaboration requires an understanding and integration of core disciplinary knowledge, approaches and methods, which requires time and effort to acquire and synthesize. For these reasons, the design of the Crossroads program incorporates several key concepts:

- the experience should be interdisciplinary (working in an integrated way at the intersection of disciplines, not multidisciplinary or transdisciplinary)
- there should be collaboration (requiring collaboration moves interdisciplinary from theoretical to application, surfacing issues and deepening knowledge and skills)
- there should be a research-to-teaching application (teaching about interdisciplinary topics forces graduate students to more deeply understand the disciplines and topics by thinking about curriculum and explaining their materials to a non-expert audience)

Goals and Outcomes of Crossroads

The Crossroads program focuses on the following goals and outcomes:

- foster graduate interdisciplinary research collaboration knowledge and skill development
- foster graduate disciplinary and interdisciplinary teaching development
- foster graduate student and faculty interactions across disciplines

- foster a UCSB culture of supporting interdisciplinary efforts
- serve as a model for other interdisciplinary graduate student (academic and professional) development experiences on and off campus
- impact undergraduate education

Crossroads and the Role of Interdisciplinary Graduate Development at UCSB

Like many universities, UC Santa Barbara provides a patchwork of opportunities for graduate students to do interdisciplinary research. Some faculty engage in interdisciplinary scholarship, and their students may be able to participate in such endeavors. Additional opportunities aimed specifically at graduate students are potentially available via integrative traineeship programs (such as NSF-NRT) and through Interdisciplinary Doctoral Emphases (certificate programs that augment the student's departmental degree). Furthermore, a few graduate programs are interdisciplinary by design. However, these opportunities are topic-oriented and unevenly distributed across campus, such that, in a 2012 survey, many doctoral students reported that they had inadequate opportunities to do interdisciplinary work. Furthermore, traineeship programs, emphases, and doctoral programs all require substantial investments of faculty and administrative time to establish, such that new opportunities are created infrequently. The UCSB Crossroads program provides an opportunity for training and mentorship in interdisciplinary research and teaching that has included a variety of projects covering a broad range disciplines across the campus.

Design of Crossroads

UC Santa Barbara's Crossroads Program enables faculty members and doctoral students to collaborate on a year-long interdisciplinary research projects through the auspices of a team-taught graduate seminar. The interdisciplinary research is then translated into the undergraduate classroom (or, for appropriate fields, the professional Master's classroom). The central goal of the Crossroads Program is to enhance both graduate and undergraduate learning through the infusion of interdisciplinary research into the curriculum. The program takes its name from the multiple intersections involved: of disciplines; of research and teaching; and of faculty members, graduate students, and undergraduates.

Each Crossroads group project involves three (or more) faculty members from at least two departments. Each project receives support for three to five doctoral students from diverse disciplines as Crossroads Fellows, including one quarter of fellowship support and one quarter of support as a Teaching Assistant (leading sections in a large class) or Teaching Associate (serving as the instructor of record in a standalone course). Funding for the fellowship quarter is provided by the Dean of the Graduate Division and funding for the teaching provided by the Dean of the participating academic college or division. Crossroads group projects are proposed by faculty and

selected for funding based on a campus competition; students are selected for participation in the program by the faculty leaders of each group project.

History of UCSB Crossroads and Phase 1

UCSB Crossroads was originally conceived in 2012 by the Dean of the Graduate Division, Carol Genetti, who developed the program in collaboration with Associate Dean Bruce Kendall. The original design consisted of teams of 3 or more faculty and 3-5 graduate students across 2 or more disciplines, who participated in interdisciplinary seminars across three quarters. Graduate Fellows were funded for two quarters and received teaching assistant or associate funding for the third quarter. Funding was also available upon request for research or instructional development.

Phase 1 of the program ran from 2013-2016. During these years, 6 Crossroads projects were funded. The funded projects included:

1. *The Politics of Language and Race in Learning Contexts (SKILLS)*. Faculty: Mary Bucholtz, Dolores Inez Casillas & Jin Sook Lee. Departments: Linguistics, Chicana/o Studies, Education (2013)

2. *Framing Effects in Individual and Collective Action on Environmental Politics and Policy (PEPP)*. Faculty: Sarah Anderson, Heejung Kim, Matt Potosky & David Sherman. Departments: Bren School, Psychological & Brain Sciences (2013)

3. *Climate Justice Futures*. Kum Kum Bhavnani, John Foran & Janet Walker. Departments: Sociology, Film and Media Studies (2014)

4. *Materials, Mechanics and Medicine (M3)*. Faculty Samir Mitragotri, Otger Campas & Adele Doyle. Departments: Chemical Engineering, Mechanical Engineering, Neuroscience Research Institute (2014)

5. *Religion, Experience and Mind (REM)*. Faculty: Ann Taves, Tamsin German, & Ray Paloutzian. Departments: Religious Studies, Psychological & Brain Sciences, Westmont College. (2014)

6. *Conflict and Accommodation in the Global Borderlands (Borderlands)*. Faculty: Stuart Tyson Smith, Beth dePalma Digeser, James F. Brooks, Mary Hancock, Greg Wilson Departments: History, Anthropology (2015)

A report was issued in the final year of Phase 1, summarizing the key outcomes, successes and challenges for the six projects. The analysis of Phase 1 projects found that the Crossroads graduate seminars were well-attended, that graduate students were almost universally positive about their experiences, that the projects yielded a variety of research papers, conference presentations, grant submissions and other projects, and that new courses had been generated.

The report also made four recommendations around support for facilitating interdisciplinary project development, a shift in the types of courses associated with the teaching phase, a decrease in the number of fellowship quarters, and requiring Crossroads fellows to take a newly developed pedagogy course (see below).

Transition Year to Phase 2

2016-2017 marked an interim planning year to move from Phase 1 to Phase 2. During the discussion of changes to Phase 2, Crossroads project leaders Bruce Kendall (PI), Carol Genetti (Co-PI) and Steve Gaines (Co-PI) sought and received an $500,000 NRT – Innovations in Graduate Education (IGE) grant from the National Science Foundation to provide support for the desired changes. Mary Hegarty took over as PI of the grant when Bruce Kendall left Graduate Division in 2018.

Phase 2

Phase 2 of the program ran from 2017-2020. Several key changes marked the shift from Phase 1 to Phase 2 of the project in response to the lessons learned during Phase 1. These changes included:

a. More engagement with faculty proposal writing: In order to facilitate the development of projects, a preproposal was required and a FAQ page was added to the Crossroads website to provide additional detail.

b. Reduced fellowship support per student. In order to support more fellows, fellowship support for graduate student fellows was reduced from 2 quarters to 1 quarter.

c. Formalized training in interdisciplinary project work. Based on analysis of reports and feedback from Phase 1, it was clear that projects could benefit from more support around the challenges of developing interdisciplinary projects and teams, particularly within the one-year project framework. With NSF funding, Phase 2 incorporated a full-time project coordinator to develop approaches and materials to facilitate the interdisciplinary dynamics as they unfolded over the length of the projects.

d. Requirement of GRAD 210. (College and University Teaching—From Theory to Practice)

While all the projects included informal pedagogical support for graduate student fellows, there was no standardized pedagogical training built into the program in Phase 1. In Phase 2, the Crossroads Program leveraged the opportunity presented by the newly developed GRAD 210 pedagogy course. Crossroads fellows were required to take this course, which included units on interdisciplinary teaching and incorporating research into the undergraduate classroom.

e. *Types of courses for teaching component*. In order to broaden the impact on undergraduate learning and expand the opportunities for teaching assistantship opportunities, the teaching component was shifted to focus on incorporating interdisciplinary learning into larger undergraduate classrooms or professional Master's classes. The Call for Proposals was revised to request that proposals define which undergraduate courses might be taught as part of the Crossroads project and to encourage that any new courses developed with Crossroads funding be appropriate as general education courses.

f. Addition of graduate fellow conference funding. The Office of Research continued to provide up to $1,000 per student in the project for research development. In addition, the NSF grant provided up to $700 per students for conference travel to present on Crossroads-related research.

g. Assessment expanded to include outside evaluation. With support from and as a requirement of the NSF grant, Crossroads incorporated an evaluation component, which was completed by Ellie Sciaky at CSEP (Center for Science and Engineering Partnerships). Assessment had previously included written reports from each project, which were continued in Phase 2. The evaluation component added focus groups of faculty and pre and post-surveys and focus groups of graduate fellows.

h. Advisory Board. An Advisory Board was added to give additional input on the UCSB Crossroads program. The Board Members consisted of:

- Linda Adler-Kassner, CITRAL Faculty Director and Associate Dean of Undergraduate Education
- Lisa Berry, Instructional Consultant, Instructional Development
- Lisa Leombruni, Environmental Communication Program Director & Lecturer, Bren School for Environmental Science and Management
- Matthew Potoski, Professor, Bren School for Environmental Science and Management
- Ronald E. Rice, Professor, Department of Communication
- Susannah Scott, Distinguished Professor, Mellichamp Chair Sustainable Catalytic Processing, Department of Chemistry and Biochemistry

Phase 2 Projects Funded

From 2017-2020, five Crossroads projects were funded. These included:

a. *California Grizzly Study Group*. Peter Alagona (History, Environmental Studies), Sarah Anderson (Political Scientist, Bren School of Environmental Science & Management), Bruce Kendall (Ecologist, Bren School) (2017)

b. *Green Chemistry*. Mahdi Abu-Omar (Chemical Engineering), Sangwon Suh (Industrial ecologist, Bren School), Susannah Scott (Chemistry, Chemical Engineering) and affiliated faculty member Wendy Meiring (Probability and Statistics) (2017)

c. *Visualizing Environmental Models (VEM)*. Christina (Naomi) Tague (Ecohydrologist, Bren School), James Frew (Ecohydrologist Information scientist, Bren School), Tobias Hollerer (Computer Science), John O'Donovan (Computer Science) (2018)

d. *Unconscious Memory*. Sowon Park (English), Michael Gazzaniga (Psychological & Brain Sciences), Ken Kosik (Molecular, Cellular, & Developmental Biology), Matthew Turk (Computer Science) (2019)

e. *Spatial Navigation, Sex Differences and Aging: From Cells to Society*. Elizabeth Chrastil (Geography), Steven Gaulin (Anthropology), Mary Hegarty (Psychological & Brain Sciences (PBS)), Emily Jacobs (PBS) (2019)

Phase 2 Outcomes

Specific Project Outcomes. A brief summary of Crossroads Projects and their products (as of Fall 2020) is included here. The full set of products is listed in the Appendix.

California Grizzly Study Group

The CG Project brought together faculty and graduate students with backgrounds in history, education, ecology, and political science to understand what would need to be known to successfully reintroduce grizzly bears to California, after being extirpated from the state in 1924. This project used the example of the grizzly bear to highlight the kinds of knowledge and tools needed to understand reintroduction, as well as the social and natural system requirements for successful reintroductions. From identifying what grizzly bears ate in California prior to extirpation to mapping suitable habitat to evaluating public opinion on reintroduction to developing curriculum plans, this project's research illustrated the difficulty of reintroducing a species with a large extinction gap (characterized by deviations in the natural and social conditions needed for successful reintroduction) and provided insight into the tools academics and managers can use to gather information and formulate potential scenarios for reintroducing such species. The graduate students then brought these research experiences and their expanded cross-disciplinary perspectives into their classroom lessons and discussions with undergraduates in a large-enrollment introductory environmental studies course.

Products: 2 publications, 5 talks/conference presentations, 4 grants submitted (3 funded)

Green Chemistry

The Green Chemistry project brought together faculty and graduate students from chemistry, chemical engineering, and environmental science to explore the materials, methods, and environmental impacts associated with recycling/processing strategies such as carbon capture,

reverse osmosis, plastics recycling and rare-earth metals separation. They conducted literature reviews on these processes, then created video-lectures and live presentations to demonstrate for Chemistry undergraduates the real-world situations wherein fundamental knowledge of chemical processes can be used to analyze and address pressing environmental issues. These videos were used in conjunction with guest lectures by the graduate students in General Chemistry classes. The project's members then continued to explore literature on plastics degradation in natural environments, which will lead to a critical review of literature and original laboratory research on degradation of marine plastics under ultraviolet light and NSF STC proposal for The Center for Advancing Sustainability via Action on Plastics (ASAP).

Products: 1 publication, 1 NSF Science and Technology Center (STC) proposal submitted, finalist status

Visualizing Environmental Models

The Visualizing Environmental Models (VEM) project leveraged UCSB's strengths in environmental modeling, human-computer interface design, uncertainty quantification, and science-communication. The vision of the VEM team was to radically transform environmental models, though advances in human-computer interface design, uncertainty quantification, and science-communication. A key outcome of the Crossroads project was the development of new research proposals that will continue to evolve the ideas that emerged through the year-long seminar. Along with much cross disciplinary learning, two project ideas emerged – one seeks to transform coarse grained output from a forest ecosystem carbon cycling model into visually familiar forest structures, using high resolution remote sensing data and machine learning. A second project developed a statistical emulator version of an ecohydrologic model. This emulator radically expanded feasible applications to a much larger study domains and scenario possibilities. A working version of this emulator was completed for Mission Creek, a chaparral dominated watershed near Santa Barbara, and Sagehen Creek, a snow dominated watershed in the California Sierra. A research paper on the emulator is forthcoming and results were integrated into two NSF proposals.

Products: 2 presentations, 2 proposals submitted for funding

Unconscious Memory

The Unconscious Memory project brought together faculty and graduate students from English, Neuroscience and Computer Science to explore the intersection of research on human memory within neuroscience with humanities-based study of the unconscious mind in literature and connections with artificial intelligence in computer science. The goals were to further define this interdisciplinary landscape, identify new avenues of research and revise and develop undergraduate and graduate courses around these intersections. The group's efforts resulted in a productive graduate seminar, a number of conference presentations on the intersections of literature, unconscious memory and neuroscience, a new undergraduate GE course and a revised

interdisciplinary course connected to literature and the mind, a new undergraduate reading group and several productive undergraduate mentorship opportunities.

Products: 2 joint conference presentations, 5 individual conference presentations, 1 individual publication, 2 manuscripts in progress

Spatial Navigation, Sex Differences and Aging: From Cells to Society

The Spatial Navigation project brought together faculty and graduate students from Psychological & Brain Sciences, Geography, Anthropology, and English to study spatial navigation from these traditionally distinct but inherently overlapping academic disciplines. Students and faculty from the departments delved into existing literature on sex differences in navigation and spatial cognition, the effects of menopause on the brain and behavior, sex differences in navigation in both animals and human societies, and the neuroscience of aging. The Crossroads fellows developed a broad understanding of spatial navigation that will form the basis of their doctoral research and developed a set of pedagogical videos exploring spatial navigation from different disciplinary perspectives. The project helped launch a highly interdisciplinary research program that has resulted in an in-press manuscript, two grant proposals (one funded), and several ongoing research projects.

Products: 1 publication, 3 conference presentations, 1 grant submitted

General Program Outcomes

Interdisciplinary Training Development

One of the key goals of the Academic Coordinator position was to help Crossroads project groups navigate challenges in the process of interdisciplinary collaboration and to shorten the time needed to work efficiently.

In the first year of Phase 2, the Academic Coordinator (Joshua Kuntzman) conducted a focused literature review on interdisciplinary research (and other topics) and analyzed the Phase 1 reports to identify the tasks and challenges that faculty and students experienced in the process. Based on the analysis and preliminary testing during 2016-2017, he developed a three-stage developmental model that Crossroads project groups pass through when moving from initial inception to final deliverables (see Figure 1), recognizing that not all groups pass through the stages in the same way and at the same time point. The stages identified were coordination, integration and dissemination. The Academic Coordinator developed and refined a set of activities to facilitate the needs and challenges for each of the three phases as follows:

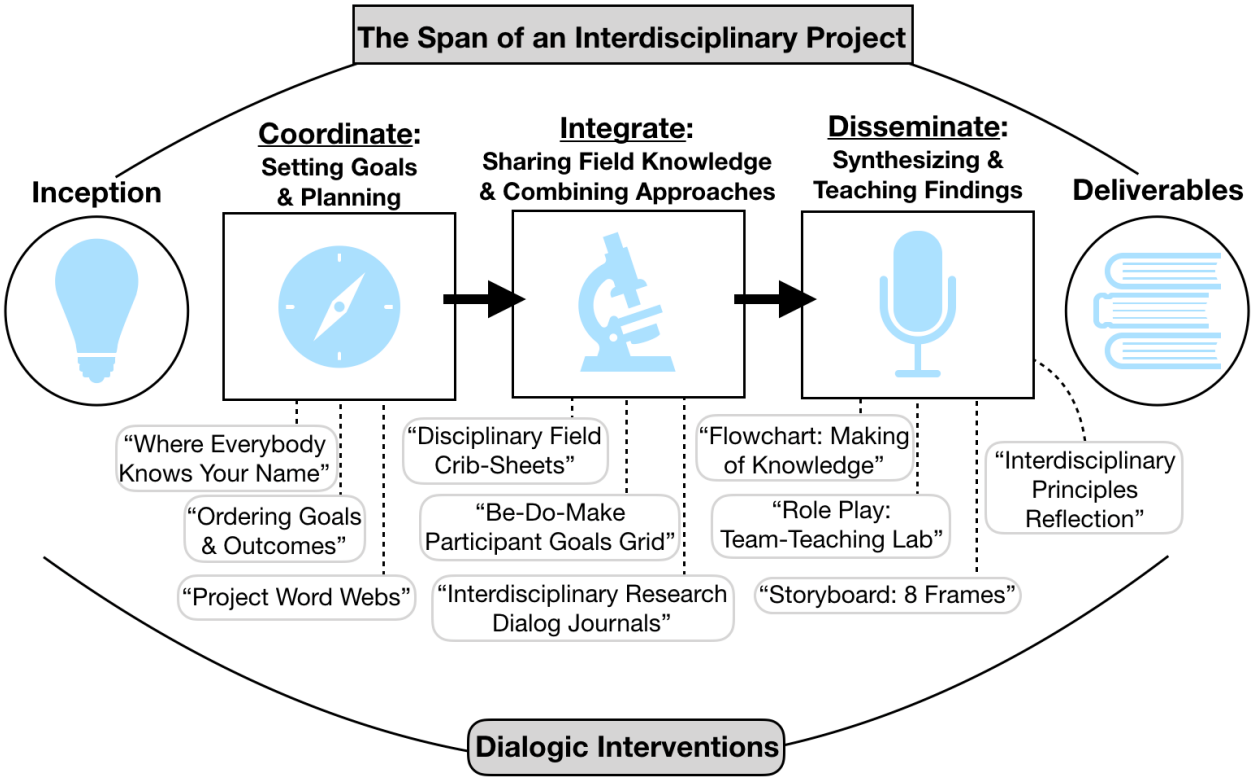

Figure 1. Stages in the development of a Crossroads project.

During the **Coordination** phase, the faculty leaders focus on setting goals for the group and planning the seminar structure to reach those goals. Activities during this phase focus on helping faculty surface and discuss their diverse interests and then go through a process to prioritize goals and outcomes. These activities generally took place before the start of the first seminar.

During the **Integration** phase, faculty and graduate student fellows work to share their disciplinary perspectives and combine approaches. Activities during this phase focus on helping the group navigate disciplinary differences in terminology and methods to come to a shared understanding on what concepts and approaches are most central to the project and then to define the roles and tasks for each group member. These activities typically coincided with the first seminar. However, graduate fellows were also encouraged to keep a structured research dialog journal and held discussions about the journals with the Academic Coordinator.

During the **Dissemination** phase, graduate student fellows focus on synthesizing their disciplinary and interdisciplinary knowledge and learning to communicate this knowledge to others and to undergraduates through teaching. Activities included reflection, discussion and charting to condense information and role playing to practice how to communicate the information to a group of novices. These activities typically coincided with the GRAD 210 class. However, fellows also

kept a structured interdisciplinary reflections journal during their teaching quarter and held discussions about the journals with the Academic Coordinator.

Crossroads' interventions for facilitating interdisciplinary collaboration and teaching have been refined, organized, communicated in papers and handouts, and offered to various groups across campus. These interventions have now been tested with a variety of projects, providing examples of how such activities can be adapted to meet specific research aims and to fit different classroom environments.

Grad 210 Engagement

At the beginning of Phase 2, a new graduate course, GRAD 210 (College and University Teaching—From Theory to Practice), was developed and implemented independently of Crossroads, but which the Crossroads Fellows were required to take. It was designed to be useful for all graduate students, but the Crossroads Academic Coordinator and other course planners thought carefully about how to construct a course that would give Crossroads graduate fellows, in particular, supportive concepts, resources, and experiences for their future teaching and professional academic development. To that end, the course designers focused particularly on bringing in conversations about threshold concepts and metacognition, research, and disciplinarity, to help the fellows to expand their students' understandings of knowledge-making within and among diverse fields. This is a modular course, and the Academic Coordinator organized separate bi-weekly sections and activities for the Crossroads fellows, making sure that ideas of interdisciplinary research were explored, challenged, tested, and understood, using these fellows' direct experiences as a resource and tool for learning.

In connecting GRAD 210 to the Crossroads experience, graduate student fellows were provided with ample support, not only in their working relationships with faculty in the project, but also as part of a larger cohort of graduate TAs in the pedagogy course, and as a dedicated group together in their bi-weekly meetings with the Crossroads project coordinator. They were given professional guidance in their research questions and methods, teaching scholarship and strategies with peers across disciplines, and supported in creating their own resources of experience and reflection, and applying those resources to refine their educational approaches and classroom strategies.

Overall, graduate student fellows enrolled in Grad 210 concluded that this course's value for graduate teachers comes from its use of practical examples, its modeling of techniques by the instructors, and its focus on developing methods awareness, concrete skills, and fluency with instructional technologies through hands-on practice, peer/instructor feedback, and personalized group discussions. Students' feedback will be used to continue improving this educational resource at the university.

Dissemination of the Crossroads Model

In order to provide information to the campus and outside institutions interested in the UCSB Crossroads program, a website was developed during Phase 1. The website included key information about the program, descriptions of past and current projects and the call for proposals. During Phase 2, this website was updated to include answers to frequently asked questions about proposal development and advice from prior Crossroads faculty on leading successful projects.

The Graduate Division and the College of Letters and Sciences Division of Humanities and Fine Arts co-sponsored a visit by Mary Robson of the University of Durham to present 2 workshops on January 31, 2019 entitled "The Future of Interdisciplinary Education at UCSB" and "Beyond Disciplines: Mapping the Knowledge."

Conference papers were developed for AERA 2019 and 2020, but were ultimately not successful. Two draft manuscripts were completed and are in the process of being archived or submitted to journals

Crossroads PIs and Co-PIs gave 3 conference presentations, as follows.

> Kendall, B.E., and C. Genetti (2017). *Lessons from UCSB Crossroads: Facilitating interdisciplinary approaches to research and undergraduate teaching*. 59th Annual Meeting of the Western Association of Graduate Schools. Seattle, WA.
>
> Carol Genetti featured the Crossroads project in a "Dean's Dialog" entitled "*Interdisciplinary Graduate Education: Different Models, Different Funding Streams*" at the annual meeting of the Council of Graduate Schools in San Diego (July 2019). Co-led with Marjorie Zatz (University of California, Merced), and with Phillip Trella (University of Virginia).
>
> Hegarty, M., Kuntzman, J. Genetti, C., Gaines, S. & Kendall, B. (2020, January). *Interdisciplinary Graduate Education: Facilitating research and Teaching Across Disciplines.* NSF IGE Program PI Meeting. Washington, DC.

The Academic Coordinator gave a three-minute "lightning talk" summarizing the Crossroads program's findings and benefits for UCSB's interdisciplinary Center for Spatial Studies.

Outcomes from Formal Evaluation of Projects

The final project reports and evaluation reports were analyzed for project outcomes. These reports are available from Graduate Division by request.

Positive Impacts on Faculty and Graduate Student Development and Productivity

Overall, review of final reports and assessments showed that both the faculty and graduate students found participation in their Crossroads Project activities to be a productive experience.

The evaluation reports from the Grizzly Group and Green Chemistry demonstrated a positive impact. The fellows provided important insights about how the Crossroads model of interdisciplinary research and teaching benefitted them as students and educators. Common themes across the two projects included the important leadership role that faculty play (thinking through theoretical details, organizing group activities, dividing tasks, and setting timelines) and the empowering collaborative role that graduate students play (doing much of the hands-on research and analysis, bringing that information into the group's collective knowledge-base, and co-planning/writing the group's final products). The fellows in both groups expressed their appreciation for specific activities—the Grizzly Fellows emphasizing the value of reflective journals, the Green Chemistry Fellows emphasizing the usefulness of preparatory role-play—as methods that have helped them to have more intentional, explicit interdisciplinary dialogs with students in smaller classroom settings and to prepare more engaging, relevant, and useful presentations for larger lectures.

The evaluations reports from the Visualizing Environmental Models, Unconscious Memory and Spatial Navigation projects also demonstrated a positive impact on faculty and fellows. Faculty on all three projects reported that graduate student fellows demonstrated an increased understanding of different disciplines and the ability to explain and work across disciplines. Faculty members felt that they learned more about interdisciplinary communication and collaboration as well. Faculty members and graduate students all successfully engaged in interdisciplinary research and other products, although this took different forms across projects. Graduate students on all three projects were pleased with the pedagogical skills and products they developed. Students on all three projects served as TAs for courses related to one of the project disciplines. On the Unconscious Memory project, students had an additional opportunity to mentor undergraduate students through the FRAP program (a program for engaging undergraduate students in research). On the Spatial Navigation project, students developed a series of educational videos as part of their experience.

Faculty leading Crossroads projects felt that these projects allowed them to strengthen knowledge, skills and connections necessary for strong interdisciplinary collaboration. Faculty used Crossroads to build collaborations with the goal of working together on larger collaborative projects on their topics. Crossroads provided the push needed to solidify specific partnerships. It also provided the time needed to get to know each other and to find common ground for a mutually beneficial project. Faculty felt that the full-year participation was important to build the depth of connections and understanding necessary to develop a strong interdisciplinary collaborative research team. Without this structure, they felt it would have been more difficult to carve out the time needed to do this work because of the many demands on their time.

Institutionalization

Crossroads has played an important role in building institutional infrastructure to support interdisciplinary initiatives in graduate education. One element has been the deepened connections

between the Academic Deans and the Graduate Division to financially partner around interdisciplinary graduate research and teaching efforts. Another element is that Crossroads facilitated the development of Grad 210, which will continue to be offered to graduate students. Other elements which have the potential to be strengthened further in the future include connections of Graduate Division with the Center for Innovative Teaching Research and Learning (CITRAL), which has partnered with the Graduate Division to incorporate workshops around interdisciplinary communication and collaboration and offer those to the wider campus community. Connections could also be strengthened with the Office of Research, which provided seed funding for interdisciplinary research programs. For example, the Office of Research could help some Crossroads participants find funding for continuing the collaboration beyond the length of the Crossroads project.

Lessons Learned from Crossroads/Infrastructure and Concepts Applied to MRCI

The Crossroads project has been a successful model for collaborative interdisciplinary research to enhance graduate student development on campus. In April 2020, Graduate Dean Carol Genetti proposed and sought joint funding for an interdisciplinary graduate student research initiative, the Multidisciplinary Research on COVID-19 and its Impacts (MRCI) initiative. The funding model used several elements borrowed from the Crossroads project, including partnerships with the Office of Research and the Academic Deans to provide funding for the project. The MRCI project provided competitive summer mini-grants to graduate students, with a funding cycle from June 22 to September 22, 2020. These grants were available to graduate students to work individually or in collaborative teams in a multidisciplinary setting. A total of 44 projects and 55 students were funded (6 were collaborative team proposals). The student research projects focused on understanding the impact of COVID-19 from a variety of disciplinary lenses. Students funded by the MRCI project participated in a learning community over the summer, with activities designed by Crossroads to help students better understand each other's projects and disciplines and to find common ground. These included both asynchronous activities, such as reflections, and synchronous activities, including several of the workshops initially designed for the Crossroads project.

Recommendations Regarding Program Design

Overall Recommendation: It is clear that the Crossroads program has been very successful and that faculty and especially graduate students have benefitted greatly from participating in the program, so the overall recommendation is that **the program should be continued, providing funding is available.** The following sections outline possible improvements in the program, moving forward, including options for different program components and funding models.

Each element of the UCSB Crossroads program has both strengths and challenges. Some of the challenges may reflect intrinsic tensions in the design of interdisciplinary experiences and the

limitations of budgets. However, many of the challenges have or could be addressed through development and facilitation, innovative campus partnerships, and flexibility in implementation of specific projects.

Advertising the Program on Campus: During Phase 1 and Phase 2, Crossroads leaders worked with Graduate Division Strategic Communication to develop and maintain a project website, to distribute and publicize the annual Call for Proposals, and to develop press releases for articles in *The Current*. During Phase 2, there were also several events aimed at sharing project information with the campus or across projects. At the beginning of Phase 2, a campus workshop for faculty highlighted lessons learned from Phase 1 and opportunities for Phase 2. During Phase 2, the academic coordinator and PIs also made presentations to graduate emphasis leaders and faculty funded by the Interdisciplinary Humanities Center and met with several faculty members with an interest in the program. However, in Phase 2, there were fewer applicants for projects than in Phase 1, possibly because of the reduced funding for graduate students (see below).

Recommendations:

- In future phases, the Graduate Division might partner more closely with the Office of Research and other interdisciplinary centers (e.g. CNSI) to identify faculty interested in developing or continuing collaborative research projects with a graduate student development component.
- For future phases, the Graduate Division might also seek ways to advertise the program directly to graduate students, via GSRC events, such as the Lunch and Learn series. These could be timed to coincide with the Call for Proposals.

Project Proposals

One recommendation made during Phase 1 was to increase the guidance to project applicants. During Phase 2, additional support was provided through more detail on the Crossroads website, and a pre-proposal was required, which allowed for more feedback during the proposal process. Phase 2 also changed from an annual call to more of a rolling deadline, with an informal deadline for proposals each quarter. A consequence was that it was easy for faculty to put off applying and in some cases, initial enquiries never materialized as proposals. Some faculty also found the proposal process onerous, especially the need to specify both a research project and an intervention in a large undergraduate class in advance. They expressed an interest in having access to previous examples of teaching interventions for guidance.

Recommendations:

- Return to the practice of having an annual call for proposals and a single deadline each year.

- Consider incorporating graduate students into the proposal-writing process, which would be a good professional development opportunity, give them more ownership of the project, and alleviate some of the burden of faculty in proposal preparation.
- Include examples of previous teaching interventions in the materials and training for future phases of Crossroads.

Funding Project Participation

During Phase 1, graduate student fellows were funded for 2 quarters. This was reduced to 1 quarter in Phase 2, in part to allow for the funding of more projects and also because several graduate students had willingly participated in Phase 2 without funding. Phase 2 project participants expressed a preference for 2 quarters of fellowship funding. Another element noted by participants was that faculty time was not covered by the project, but the amount of time needed for project development and graduate student advising was substantial.

Recommendations:

- Provide two quarters of funding for students, which, depending on budget, might necessitate running only one Crossroads program per year. An alternative is to provide summer funding, which is less costly because fees and tuition do not have to be covered in summer.
- Consider partnering with Academic Deans to provide some level of compensation for faculty involved in Crossroads projects.

Supplemental Funding for Projects

During Phase 1, the Office of Research provided $1000 per student for project research funding, for speakers, or other activities. In addition, Instructional Development provided $1,000 per project for instructional support for teaching expenses. During Phase 2, the Office of Research continued to provide the same amount for project research funding and the NSF NRT-IGE grant provided up to $700 per student to present project research at conferences (about half of the students used this funding; some others planned to use it but were unable to travel due to COVID-19). In Phase 2, Instructional Development's contribution was the teaching of Grad 210.

Projects spent their funding in various ways, including several successful speaker events. A few Phase 2 project groups expressed initial confusion over how to request and use the funds, but were eventually able to get the information needed.

Recommendations:

- Continue support for research funding, if budget allows.
- Communicate the process for requesting research funding more clearly.

- To replace the NSF support for travel, remind students of the availability of travel funds through the academic senate and remind PIs that research funding can be spent on student travel.

Choosing Students who were a good fit for the Project

In general, the students who were chosen for Crossroads fellowship funding were a good fit for the project. When asked to comment on the selection process, Phase 2 faculty generally recommended choosing students in the middle of their doctoral programs, but noted that this criterion could be flexible for the right student. Faculty used a variety of strategies to select fellows, including an application process and hand-selection. Some of the criteria used in the selection process included relevance of the topic to their research, stage in the program, and openness to interdisciplinary scholarship. One key criterion was eligibility to serve as a TA for the undergraduate classes associated with the project disciplines. Some students commented that they were not aware of all the program components, or the time commitment, before they applied/or were chosen to participate.

Recommendations:

- Have a formal application process, which makes the program elements, time commitment, and criteria for selection clear to potential students
- Give preference to students in the middle years of their program, but weigh this preference against other criteria, such as their interest in research, teaching and interdisciplinarity. Students should not be selected based on their need for funding alone.
- Consider broadening teaching experience options to a greater number of eligible students.

Facilitating Interdisciplinary Collaboration

A major recommendation during Phase 1 was to provide assistance to projects in moving through the interdisciplinary research and teaching process. Project faculty often did not hold a realistic expectation for just how much work that leading an interdisciplinary project would take, nor did they necessarily have the training to readily navigate the interdisciplinary dimensions of the project planning and communication process.

In Phase 2, the NSF NRT-IGE funded a full-time coordinator (Josh Kuntzman) to address these challenges through facilitation and training. He analyzed the literature and Phase 1 data to develop a model of the interdisciplinary coordinator process and developed and tested a set of facilitation exercises to assist the project teams in navigating planning their projects, and the challenges of interdisciplinary communication and collaboration. Some of these exercises were implemented in the context of the GRAD 210 class to help students develop their pedagogical skills in communicating disciplinary and interdisciplinary concepts. Project participants found the facilitated activities helpful, especially if the project faculty worked directly with Dr. Kuntzman to adapt the activities to the specific needs of the project. Dr. Kuntzman is still on campus, in a

different role (as assessment coordinator for Budget & Planning) and is still engaged in teaching Grad 210.

Recommendations:

- In future phases, Crossroads might partner with CITRAL or other entities to provide such facilitation.
- Document the facilitation activities on the Crossroads website, so that they can be adapted by future project leaders.
- Provide model syllabi for the seminar, with suggested dates for the facilitation activities, which, again, can be adapted by future project leaders.
- Crossroads fellows should continue to be required or at least encouraged to take Grad 210, and modules on interdisciplinary pedagogy should continue to be offered in this class.

Project participants expressed appreciation of the willingness of project staff to answer questions and help them navigate departmental challenges in teaching seminars and TA training across departments.

Sufficient Project Time/Project Time Length

A continuing challenge in Phase 2 was fitting the research project into the year allotted for the project, given the time needed to get up to speed on the project disciplines and negotiating the interdisciplinary collaboration topic. There were also issues with timing of when undergraduate courses were offered, and some of the projects were allowed to extend beyond one year for this reason. Some projects recommended additional time, although this comes with a cost of additional (uncompensated) faculty time. Other projects proposed beginning with an existing dataset, rather than collecting new data, which facilitated research development. Because each project and research process is different, there is not a standardized approach to addressing this issue.

Recommendations:

- Allow projects to extend beyond one year, with the understanding that this will not entail additional funding.
- Require a timeline in new proposals that specifies when different project components will be addressed and how that relates to when students will be funded.

Pedagogical Development

The fellows generally found the GRAD 210 experience and coordinator-facilitated activities helpful and appreciated the mentorship and feedback from faculty and the project coordinator.

However, they were sometimes overwhelmed by the amount of work required, especially during the quarter when they were taking GRAD 210.

Recommendations:

- Continue to require or at least recommend GRAD 210, but give students the option of taking this course for 2, 3, or 4 credits and scale the assignment workload accordingly.
- Make Crossroads faculty aware of the syllabus and requirements of GRAD 210 so that they do not overload students while they are taking this course.

Teaching experience options

Graduate fellows had mixed experiences with the teaching component. During Phase 1, graduate fellows had the opportunity to design and teach small focused classes, which they found valuable. However, this approach was not cost-effective for the Deans and had a smaller impact on undergraduate education. During Phase 2, graduate fellows were matched with TA positions in larger undergraduate classes. For some graduate fellows, the experience worked well and they were able to incorporate interdisciplinary lectures and assignments into the class. In other cases, the undergraduate class material had little flexibility, so graduate fellows had fewer opportunities. Fellows on two different projects created instructional videos on interdisciplinary topics related the project research. Under one project, fellows had the opportunity to serve as a teaching associate for a summer class, and several students had the opportunity to mentor Faculty Research Assistance Program (FRAP) undergraduate students.

Recommendations:

- Look for ways to expand the types of teaching experiences available so that students have more options and ability to integrate their interdisciplinary knowledge into their teaching experience.
- Reach out to faculty who teach large GE classes to promote Crossroads as a mechanism for developing more interdisciplinary content into their classes.
- Provide more opportunities for graduate students to mentor undergraduates participating in FRAP or URCA (which also provide modest research budgets).

Assessment of outcomes

During Phase 1, project faculty produced a written report of the project activities, products and outcomes, which were very helpful in writing reports. During Phase 2, project faculty produced a shortened report of project activities, products and outcomes; however, it sometimes took several requests before these were submitted. In addition, the NSF grant funded formal project evaluations for each project, consisting of faculty focus-group interviews, fellow pre- and post- focus group interviews, and a fellow pre-post survey of expectations, experiences and outcomes. Faculty encouraged Crossroads staff to take a coordinated approach to collecting data.

Recommendations:

- For future phases, make the reporting requirements clear to faculty at the proposal stage.
- Continue to streamline the reporting requirements so that they do not overburden faculty or students.
- Continue to use the assessment and evaluation instruments, which were developed in Phase 2, but refine them to include only the most useful questions, to streamline the assessment process.
- One option for gaining assistance with the assessment process is to partner with the Center for Evaluation and Assessment to pay a graduate student stipend to assist with fellow data collection and analysis.

Sharing of Information Across Projects

During the final year of Phase 2, a lunch was held for all Phase 2 participants to share what they did and what they learned. This was very successful and **is recommended for future iterations of Crossroads.**

Crossroads for the Future

Participation in the Crossroads program has had a positive impact on both students and faculty. Crossroads collaborations have led to a number of publications, conference presentations and grant proposals, as well as avenues for future research and collaboration. Crossroads participants also felt that the experience helped them develop interdisciplinary navigation, teaching and communication skills and develop new collaborations. Looking toward the future of Crossroads, one of the main questions going forward are **sustainability** and **scalability**.

Sustainability at one project with 5 graduate students per year

For the first four years (Phase 1), Crossroads operated without grant funding. Future phases of Crossroads do not have identified grant funding if the program continues. However, Crossroads may be sustainable even with the new elements developed during Phase 2, such as the facilitation of interdisciplinary collaboration and teaching and expanded assessment instruments. First, the existing non-grant-funded activities could continue:

- continued funding of graduate fellowships by the Graduate Division (1 or 2 quarters)
- continued partnering with the Office of Research to provide limited research funding
- continued partnering with Academic Divisions to identify TA or other teaching opportunities

- continued student enrollment in GRAD 210

Some of the strategies that might be used to expand the potential project pool and continue the facilitation of interdisciplinary coordination include:

- delivering project training and facilitation of interdisciplinary work in partnership with CITRAL or other entities (the past Academic Coordinator is still on campus and interested in continuing this work)
- partnering with the Center for Evaluation and Assessment in GGSE to facilitate the documentation project activities and assist with evaluation of program

The current fellowship cost for five fellows per year is about $75,000 for one quarter funded or $150,000 for two quarters funded. As long as GRAD 210 is viewed as a campus priority, and instructors for it are provided, then there is no additional cost for Crossroads Fellows to take it. Other ongoing expenses would include research funds (Office of Research), part-time support for the facilitation, and any support needed by the Center for Evaluation and Assessment.

Scalability issues:

Most of the costs described above would scale linearly with the number of projects. An alternative would be to fund more students for shorter periods, as described above for MRCI. Crossroads is currently formulated as an in-depth, yearlong experience where students develop deep learning of interdisciplinary teamwork through multiple seminars focusing on interdisciplinary scholarship, carrying out a full research project and completing a teaching experience. Students engaged in shorter experiences would likely not realize the full scale of these experiences. However, programs that focus on either the research component, or the teaching component, rather than both, could be very valuable. A current Crossroads initiative, involving a collaboration between the Graduate Division and the College of Creative studies focuses on an interdisciplinary teaching project but does not require a research project, and therefore can be accomplished in a shorter time and with less funding.

Appendix A: Products from Phase 2 projects

California Grizzly Group

Publications

Hiroyasu, Elizabeth H. T., Christopher P. Miljanich, and Sarah E. Anderson. 2019. "Drivers of Support: The Case of Species Reintroductions with an Ill-Informed Public." *Human Dimensions of Wildlife* 24(5): 401–17.

Forbes, E. S., Alagona P.S., Adams AJ, Anderson, S.E., Brown KC, Colby, J., Cooper, S.D., Denny, S.M., Hiroyasu, E. H. T., Heilmayr, R., Kendall, B. E., Martin, J., Hardesty-Moore, M., Mychajiw, A.M., Tyrrell, B.P., Tyrell, B.P., Welch, Z. 2020. Analogies for a No-Analog World: Tackling Uncertainties in Reintroduction Planning. *Trends in Ecology & Evolution*, in press. DOI: 10.1016/j.tree.2020.04.005.

Talks

Alagona, Peter, and Zoe Welch, "Bear Essential: The Past, Present, and Potential Future of Grizzlies in California," Pathways international wildlife conference, Estes Park, CO. 19-22 September 2017

Anderson, Sarah E., Elizabeth H.T. Hiroyasu, and Christopher Miljanich. 2017. Rewilding California: How values, knowledge, and salience shape wildlife management. Pathways Conference. Estes Park, CO.

Anderson, Sarah E., Elizabeth H.T. Hiroyasu, and Christopher Miljanich. 2018. Bear in Mind: Assessing knowledge and attitudes toward Grizzly bear reintroduction in California. Bren School of Environmental Science and Management, University of California Santa Barbara. Santa Barbara, CA.

Brown, KC. 2018. Pickled Pupfish and Bear Bones: Uncovering Histories of Survival and Extinction in the Modern American West. La Brea Tar Pits & Museum Seminar Series.

Mychajliw AM, Campbell BT, Lindsey EL. 2018. Extinction, extirpation, and (re)introduction of bears. Western Association of Vertebrate Paleontology.

*Alagona has given around a dozen additional public talks about the grizzly project.

Grants (funded, submitted, and not funded):

Alagona, Peter S. (with PIs from The Netherlands, UK, Brazil, Tanzania, and Finland). "Towards Convival Conservation: Governing Human-Wildlife Interactions in the Anthropocene." Belmont Forum—NORFACE. Approved to receive ~$1,454,140. (The National Science Foundation will contribute the U.S. tranche of approximately $250k.) Grant will support two years of a postdoctoral fellow to conduct social science fieldwork related to the grizzly project.

Alagona, Peter S. “Bear Essential?: The Ethics of Reintroducing Lost Species.” Institute for Social, Behavioral, and Economic Research C-RIG. Received $7,709. Grant will fund a workshop with colleagues from CU, Boulder, to develop the environmental ethics portion of the grizzly project.

Brown, Kevin C., Peter S. Alagona, and Robert Heilmayr. 2018. "BearMap: A Historical Atlas of the California Grizzly," Institute for the Study of Ecological and Evolutionary Climate Impacts, University of California. Received $4900. Grant will support (1) graduate student researcher to complete develop historical sources for interactive map of California grizzly interactions and (2) consultation with design firm on approaches for producing interactive map.

Brown, Kevin C. 2017. "Bear Bones: Habitat, Diet, and the Historical Range of California's Bears," Harvey L. Karp Discovery Award, University of California, Santa Barbara. Not funded.

Green Chemistry

Ali Chamas, Hyunjin Moon, Jiajia Zheng, Yang Qiu, Tarnuma Tabassum, Jun Hee Jang, Mahdi Abu-Omar, Susannah L. Scott, and Sangwon Suh (2020). Degradation Rates of Plastics in the Environment. ACS Sustainable Chem. Eng. 2020, 8, 9, 3494–3511

Crossroads project faculty Mahdi Abu-Omar, Sangwon Suh and Susannah Scott have joined forces with researchers at UC Davis, UC Riverside, USC, UIUC, WUSTL and Missouri S&T and taken a leadership role to submit an NSF STC proposal for The Center for Advancing Sustainability via Action on Plastics (ASAP). This center would advance the science, technology, and policy needed to create value from used plastics in environmentally and socially responsible ways, accelerating the transition to a circular plastic economy, and allowing the world to continue to benefit from plastics, while preventing widespread contamination of the natural environment.

UCSB is the lead institution, and the Crossroads team is the leadership team for the project (Director, Co-director, and Research Director). The Crossroads team competed in the on-campus competition for the privilege of submitting an STC preproposal on behalf of UCSB. Our preproposal was selected in peer review at NSF and invited to submit a full proposal. We submitted the full proposal in January 2020 and are waiting to hear if we are invited for the next step of the process

Visualizing Environmental Models

Burke, W., & Tague, N. (2019, December). Multiscale Routing–Integrating the Tree-scale Effects of Disturbance into a Watershed Ecohydrologic Model. In *American Geophysical Union* (*AGU) Fall Meeting San Francisco, 2019*. AGU.

Torres, R., Tague, N., Miller, D., Alonzo, M. & McFadden, J.P. (2019, December). Estimating urban tree recovery after drought using an eco-hydrologic model parameterized by remote sensing data, *American Geophysical Union* (*AGU) Fall Meeting San Francisco, 2019*. AGU

Proposals

Tague (Bren), Meiring (Stats) (2019) Opening the Black Box of Earth System Models to Enhance Usefulness, Credibility and Reliability, Submitted to National Science Foundation – Geoinformatics, Spring 2020 (failed but encouraging comments, resubmit next year)

Stevenson (Bren), Tague (Bren), Meiring (Stats), Moritz (Bren), Improving understanding of post-fire vegetation dynamics and risk of wildfire reoccurrence in Earth System Models using a hierarchical model approach). Submitted to Department of Energy, Spring 2020. (in review)

Unconscious Memory

Conference Presentations

Gross, Madeleine Gross and Daniel Martini, "The Cognitive Affordance of Lettrisme: The Importance of Schizotypal Personality Type", Cognitive Futures in the Arts and the Humanities, University of Mainz, June 22, 2019.

Mackey, I. "Digital Doubles: Borges and Chatbots with Anthropomorphic Memory." Paper presented at 33rd Annual Meeting of the Society for Literature, Science, and the Arts, Irvine, California, November 2019

Pettersson Peeker, Aili - "Moving Past the Narrative Self: Metaphors of Memory in Beckett and and Neuroscience" at Memory and Movement," 6th Annual Graduate Center for Literary Research Interdisciplinary Conference, University of California, Santa Barbara, May 4, 2019

Petterson Peeker, Aili, "Under Construction: False Memories and Conditional Identities in Light in August," Faulkner and Yoknapatawpha Conference, Oxford, MS, July 2019

Pettersson Peeker, Aili - "Moving Past the Narrative Self: Metaphors of Memory in Beckett and Neuroscience" SLSA 2019: 33rd Annual Meeting of the Society for Literature, Science, and the Arts, University of California, Irvine, November 2019

Pettersson Peeker Aili**, "**Under Construction: A Cognitive Approach to False Memories and Conditional Identities in William Faulkner's *Light in August*," Modern Language Association Annual Convention, Seattle, WA, in January 2020

Pettersson Peeker, Aili, Global Barn Burning: Empathy Across Cultures and Media, University of California, Santa Barbara, The International Society for the Study of Narrative's Annual Conference in New Orleans, LA, March 2020.

Papers Published

Petterson Peeker, Aili (2019, Fall) Seeing Memory: Using Digital Yoknapatawpha to Teach Cognitive Literary Studies, Teaching Faulkner Newsletter, The Center for Faulkner Studies at Southeast Missouri State University.

Papers in Progress

Petterson Peeker, Aili - Planning to submit a revised version of the paper given in Irvine as an article for publication.

Martini, Daniel – Working on replicating and publishing a version of the work presented in June 2019 at the Cognitive Futures conference.

Spatial Navigation

Yu, S*, Boone[1], A. P. He*, C. Davis, R. C. Hegarty, M, Chrastil, E, & Jacobs, E. G. (in press), Age-related changes in spatial navigation are evident by midlife and differ by sex. *Psychological Science.*

Cheng, Y*., Ling, S., Stern, C. E., Huang, A., Chrastil, E.R. (2020, October) Travel Direction as a Fundamental Component of Human Navigation, Talk presented at Interdisciplinary Navigation Symposium (iNAV), remote.

Yu, S*., Boone, A.P., He, C*., Davis, R.C., Hegarty, M., Chrastil, E.R., & Jacobs, E.G. (2020, October) Sex Differences and Age-Related Changes in Spatial Navigation. Talk presented at Interdisciplinary Navigation (iNAV) Symposium, remote.

He, C.*, Boone, A. P., & Hegarty, M. (2020, October). Ability to Navigate by Novel Efficient Paths with Imprecise Spatial Knowledge. Talk presented at Interdisciplinary Navigation (iNAV) Symposium, remote.

* Crossroads fellow

In addition, PIs Jacobs, Chrastil and Hegarty submitted an NIH grant to study spatial navigation across the menopause transition.

Graduate Division/UCSB Crossroads Program

Presentations

Kendall, B.E., and C. Genetti (2017). Lessons from UCSB Crossroads: Facilitating interdisciplinary approaches to research and undergraduate teaching. 59th Annual Meeting of the Western Association of Graduate Schools. Seattle, WA.

Carol Genetti (Co-PI, Dean of the Graduate Division) featured the Crossroads project in a "Dean's Dialog" entitled "Interdisciplinary Graduate Education: Different Models, Different Funding Streams" at the annual meeting of the Council of Graduate Schools in San Diego (July 2019). She co-led this session with Marjorie Zatz (Dean of the Graduate Division, University of California, Merced) who also featured an NRT-IGE project and with Phillip Trella (Associate Vice Chancellor, University of Virginia).

Hegarty, M., Kuntzman, J. Genetti, C., Gaines, S. & Kendall, B. (2020, January). Interdisciplinary graduate education: Facilitating research and teaching across disciplines. NSF IGE Program PI Meeting. Washington, DC.